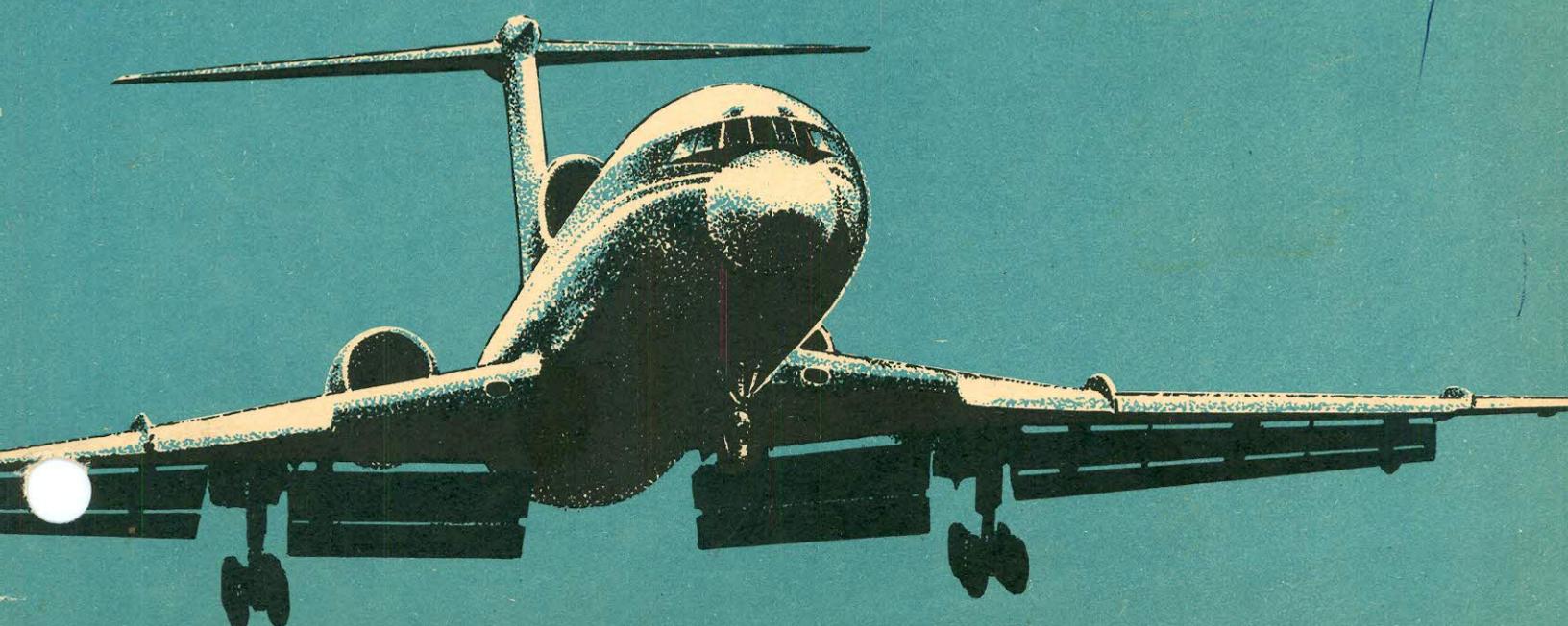


Ty-154M

FLIGHT MANUAL

Book 2



GENERAL CONTENTS

Section 8. OPERATION OF AIRCRAFT SYSTEMS	8.1. Engine and Its Systems 8.2. Auxiliary Power Unit (APU) 8.3. Fuel System 8.4. Hydraulic System 8.5. Not Installed in Airplane 8.6. Electrical Power Supply 8.7. Aircraft Control 8.8. AECY-154-2 Automatic Flight Control System 8.9. Landing Gear 8.10. Wing High-Lift Devices 8.11. Air Conditioning 8.12. Air Pressure Control 8.13. Oxygen System 8.14. Ice Protection System and Windshield Wipers 8.15. Fire Protection System 8.16. Flight-Navigation System 8.17. Flight Instruments 8.18. ATC Equipment 8.19. Communication Equipment 8.20. Lights 8.21. Not Provided for in Airplane 8.22. Mode Recording 8.23. Emergency Equipment 8.24. Warning/Indicating
Section 9. APPENDICES	9.1. Fueling Instructions 9.2. Reference Data

—oo—

Apr 24/84

GENERAL CONTENTS
Pages 1/2

Ty-154M

Section 8

OPERATION OF AIRCRAFT SYSTEMS



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Contents

TABLE OF CONTENTS

<u>Title</u>	<u>Page</u>
8.1. ENGINE AND ITS SYSTEMS	8.1.1
8.1.1. Operational Limitations	8.1.1
8.1.2. Normal Procedures	8.1.4
8.1.3. Troubles	8.1.23
8.1.4. Д-30КУ-154 Engine	8.1.29
8.1.4.1. Brief Description	8.1.29
8.1.4.2. Thrust Reversal System	8.1.30
8.1.4.3. Starting	8.1.31
8.1.4.4. Fuel System	8.1.32
8.1.4.5. Oil System	8.1.32
8.2. AUXILIARY POWER UNIT (APU)	8.2.1
8.2.1. Operational Limitations	8.2.1
8.2.2. Normal Procedures	8.2.5
8.2.3. Troubles	8.2.9
8.2.4. Brief Description	8.2.11
8.3. FUEL SYSTEM	8.3.1
8.3.1. Operational Limitations	8.3.1
8.3.2. Normal Procedures	8.3.2
8.3.3. Troubles	8.3.10
8.3.4. Brief Description	8.3.18
8.3.4.1. Main Engines Fuel Supply System	8.3.18
8.3.4.2. APU Fuel Supply System	8.3.19
8.3.4.3. Fueling System	8.3.20
8.3.4.4. Fuel Tank Vent System	8.3.20
8.3.4.5. Automatic Fuel Control System	8.3.20
8.3.4.6. Fuel Flowmeter System	8.3.23
8.3.4.7. Fuel Temperature Measurement System	8.3.23
8.3.4.8. Emergency Cut-off of Three Generators	8.3.24

(cont'd)

Apr 24/84

<u>Title</u>	<u>Page</u>
8.4. HYDRAULIC SYSTEM	8.4.1
8.4.1. Operational Limitations	8.4.1
8.4.2. Normal Procedures	8.4.2
8.4.3. Troubles	8.4.12
8.4.4. Brief Description	8.4.22
8.6. ELECTRICAL POWER SUPPLY	8.6.1
8.6.1. Operational Limitations	8.6.1
8.6.2. Normal Procedures	8.6.3
8.6.3. Troubles	8.6.19
8.6.4. Brief Description	8.6.23
8.6.4.1. Three-Phase, 200/115 VAC, 400 Hz Primary Generation System	8.6.23
8.6.4.2. Three-Phase, 36 VAC, 400 Hz Secondary Generation System	8.6.25
8.6.4.3. 27-VDC Secondary Generation System	8.6.26
8.7. AIRCRAFT CONTROL	8.7.1
8.7.1. Operational Limitations	8.7.1
8.7.2. Normal Procedures	8.7.1
8.7.3. Troubles	8.7.6
8.7.4. Brief Description	8.7.10
8.7.4.0. General	8.7.10
8.7.4.1. Elevator Control	8.7.10
8.7.4.2. Rudder Control	8.7.11
8.7.4.3. Aileron Control	8.7.12
8.7.4.4. Middle Spoiler Control	8.7.13
8.7.4.5. Inner Spoiler Control	8.7.14
8.8. AECY-154-2 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)	8.8.1
8.8.1. Operational Limitations	8.8.1
8.8.2. Normal Procedures	8.8.4
8.8.3. Troubles	8.8.38
8.8.4. Brief Description	8.8.51
8.8.4.1. AFCS Specifications	8.8.51
8.8.4.2. AFCS Control and Monitoring Instruments	8.8.52

(cont'd)

Apr 24/84

<u>Title</u>	<u>Page</u>
8.9. LANDING GEAR	8.9.1
8.9.1. Operational Limitations	8.9.1
8.9.2. Normal Procedures	8.9.2
8.9.3. Troubles	8.9.10
8.9.4. Brief Description	8.9.16
8.9.4.1. Landing Gear	8.9.16
8.9.4.2. Wheel Braking System	8.9.18
8.10. WING HIGH-LIFT DEVICES	8.10.1
8.10.1. Operational Limitations	8.10.1
8.10.2. Normal Procedures	8.10.3
8.10.3. Troubles	8.10.6
8.10.3.1. Troubles in Flap Control System	8.10.6
8.10.3.2. Troubles in Horizontal Stabilizer Control System	8.10.8
8.10.3.3. Troubles in Slat Control System	8.10.10
8.10.4. Brief Description	8.10.11
8.10.4.1. Flap Control	8.10.11
8.10.4.2. Slat Control	8.10.12
8.10.4.3. Horizontal Stabilizer Control	8.10.14
8.11. AIR CONDITIONING	8.11.1
8.11.1. Operational Limitations	8.11.1
8.11.2. Normal Procedures	8.11.2
8.11.3. Troubles	8.11.11
8.11.4. Brief Description	8.11.13
8.12. AIR PRESSURE CONTROL SYSTEM	8.12.1
8.12.1. Operational Limitations	8.12.1
8.12.2. Normal Procedures	8.12.2
8.12.3. Troubles	8.12.6
8.12.4. Brief Description	8.12.8
8.13. OXYGEN SYSTEM	8.13.1
8.13.1. Operational Limitations	8.13.1
8.13.2. Normal Procedures	8.13.2

(cont'd)

Apr 24/84

<u>Title</u>	<u>Page</u>
8.13.3. Troubles	8.13.9
8.13.4. Brief Description	8.13.10
8.13.4.1. Crew Oxygen Equipment	8.13.10
8.13.4.2. Portable Oxygen Equipment	8.13.11
8.14. ICE PROTECTION SYSTEM AND WINDSHIELD WIPERS	8.14.1
8.14.1. Operational Limitations	8.14.1
8.14.2. Normal Procedures	8.14.3
8.14.3. Troubles	8.14.9
8.14.4. Brief Description	8.14.12
8.14.4.1. Engine Anti-icers	8.14.12
8.14.4.2. Wing and Horizontal Stabilizer Anti-icer	8.14.13
8.14.4.3. Slats Heater	8.14.13
8.14.4.4. Flight Compartment Windshield Heater	8.14.14
8.14.4.5. Pitot Tube Heater	8.14.14
8.15. FIRE PROTECTION SYSTEM	8.15.1
8.15.1. Operational Limitations	8.15.1
8.15.2. Normal Procedures	8.15.1
8.15.3. Troubles	8.15.3
8.15.4. Brief Description	8.15.4
8.16. FLIGHT-NAVIGATION SYSTEM	8.16.1
8.16.1. HBV-E3 Navigation Computer System	8.16.1
8.16.1.1. Operational Limitations	8.16.1
8.16.1.2. Normal Procedures	8.16.2
8.16.1.3. Troubles	8.16.10
8.16.1.4. Brief Description	8.16.11
8.16.3. TKC-II2 Compass System with Additional Magnetic Channel	8.16.16
8.16.3.1. Operational Limitations	8.16.16
8.16.3.2. Normal Procedures	8.16.17
8.16.3.3. Troubles	8.16.27
8.16.3.4. Brief Description	8.16.30

(cont'd)

Apr 24/84

<u>Title</u>	<u>Page</u>
8.16.4. ДИСС-013 Doppler Sensor System	8.16.33
8.16.4.1. Operational Limitations	8.16.33
8.16.4.2. Normal Procedures	8.16.34
8.16.4.3. Troubles	8.16.36
8.16.4.4. Brief Description	8.16.37
8.16.5. КМ-13 Magnetic Compass	8.16.40
8.16.5.1. Operational Limitations	8.16.40
8.16.5.2. Normal Procedures	8.16.40
8.16.5.3. Troubles	8.16.40
8.16.5.4. Brief Description	8.16.40
8.17. FLIGHT INSTRUMENTS	8.17.1
8.17.1. Airspeed Indicators, Machmeters, Altimeters, Rate-of-Climb Indicators. Pitot Static System	8.17.1
8.17.1.1. Operational Limitations	8.17.1
8.17.1.2. Normal Procedures	8.17.2
8.17.1.3. Troubles	8.17.5
8.17.1.4. Brief Description	8.17.7
8.17.2. PB-5M Radio Altimeter	8.17.10
8.17.2.1. Operational Limitations	8.17.10
8.17.2.2. Normal Procedures	8.17.10
8.17.2.3. Troubles	8.17.13
8.17.2.4. Brief Description	8.17.14
8.17.3. АЯЧН-12ВРМ Angle-of-Attack and Acceleration Warning System	8.17.17
8.17.3.1. Operational Limitations	8.17.17
8.17.3.2. Normal Procedures	8.17.17
8.17.3.3. Troubles	8.17.19
8.17.3.4. Brief Description	8.17.19
8.17.4. APK-15M Automatic Direction Finder (ADF)	8.17.22
8.17.4.1. Operational Limitations	8.17.22
8.17.4.2. Normal Procedures	8.17.22
8.17.4.3. Troubles	8.17.23
8.17.4.4. Brief Description	8.17.24

(cont'd)

Apr 24/84

8. CONTENTS
Page 5

<u>Title</u>	<u>Page</u>
8.17.5. KVPC-MII VOR/ILS Navigation System	8.17.26
8.17.5.1. Operational Limitations	8.17.26
8.17.5.2. Normal Procedures	8.17.26
8.17.5.3. Troubles	8.17.31
8.17.5.4. Brief Description	8.17.32
8.17.6. СД-75 Distance Measuring Equipment (DME)	8.17.35
8.17.6.1. Operational Limitations	8.17.35
8.17.6.2. Normal Procedures	8.17.35
8.17.6.3. Troubles	8.17.37
8.17.6.4. Brief Description	8.17.38
8.17.7. ТР03А-І54М Weather Radar System	8.17.40
8.17.7.1. Operational Limitations	8.17.40
8.17.7.2. Normal Procedures	8.17.41
8.17.7.3. Troubles	8.17.46
8.17.7.4. Brief Description	8.17.47
8.17.8. Ground Proximity Warning System (GPWS)	8.17.51
8.17.8.1. Operational Limitations	8.17.51
8.17.8.2. Normal Procedures	8.17.51
8.17.8.3. Troubles	8.17.53
8.17.8.4. Brief Description	8.17.53
8.17.9. Attitude Display and Monitoring System (СИКПИ)	8.17.57
8.17.9.1. Operational Limitations	8.17.57
8.17.9.2. Normal Procedures	8.17.57
8.17.9.3. Troubles	8.17.63
8.17.9.4. Brief Description	8.17.70
8.17.10. OMEGA/VLF Navigation System with АБСУ-І54-2 AFCS Interface	8.17.76
8.17.10.1. Operational Limitations	8.17.76
8.17.10.2. Normal Procedures	8.17.77
8.17.10.3. Troubles	8.17.96
8.17.10.4. Brief Description	8.17.97

(cont'd)

Apr 24/84



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Contents

<u>Title</u>	<u>Page</u>
8.17.11. CBC-IIH-I5-4E Air Data Computer System	8.17.104
8.17.11.1. Operational Limitations	8.17.104
8.17.11.2. Normal Procedures	8.17.105
8.17.11.3. Troubles	8.17.107
8.17.11.4. Brief Description	8.17.107
8.18. ATC EQUIPMENT	8.18.1
8.18.1. CO-70 Radar Transponder	8.18.1
8.18.1.1. Operational Limitations	8.18.1
8.18.1.2. Normal Procedures	8.18.1
8.18.1.3. Troubles	8.18.3
8.18.1.4. Brief Description	8.18.4
8.19. COMMUNICATION EQUIPMENT	8.19.1
8.19.1. CLV-7 Interphone System	8.19.1
8.19.1.1. Operational Limitations	8.19.1
8.19.1.2. Normal Procedures	8.19.1
8.19.1.3. Troubles	8.19.2
8.19.1.4. Brief Description	8.19.3
8.19.2. Audio System	8.19.6
8.19.2.1. Operational Limitations	8.19.6
8.19.2.2. Normal Procedures	8.19.6
8.19.2.3. Brief Description	8.19.10
8.19.3. Voice Recording Equipment	8.19.12
8.19.3.1. Operational Limitations	8.19.12
8.19.3.2. Normal Procedures	8.19.12
8.19.3.3. Troubles	8.19.13
8.19.3.4. Brief Description	8.19.13
8.19.4. BAKJAH Radio	8.19.15
8.19.4.1. Operational Limitations	8.19.15
8.19.4.2. Normal Procedures	8.19.15
8.19.4.3. Troubles	8.19.16
8.19.4.4. Brief Description	8.19.16

(cont'd)

Jul 29/85

8. CONTENTS
Page 7

<u>Title</u>	<u>Page</u>
8.19.5. MKPOH HF Radio Set	8.19.17
8.19.5.1. Operational Limitations	8.19.17
8.19.5.2. Normal Procedures	8.19.18
8.19.5.3. Troubles	8.19.20
8.19.5.4. Brief Description	8.19.20
8.19.6. TCM-A-18 Headset	8.19.23
8.19.6.1. Operational Limitations	8.19.23
8.19.6.2. Normal Procedures	8.19.23
8.19.6.3. Troubles	8.19.23
8.19.6.4. Brief Description	8.19.23
8.19.7. Portable Megaphone (5 HGM-I)	8.19.25
8.19.7.1. Operational Limitations	8.19.25
8.19.7.2. Normal Procedures	8.19.25
8.19.7.3. Troubles	8.19.25
8.19.7.4. Brief Description	8.19.25
8.20. LIGHTS	8.20.1
8.20.1. Operational Limitations	8.20.1
8.20.2. Normal Procedures	8.20.1
8.20.3. Troubles	8.20.4
8.20.4. Brief Description	8.20.5
8.20.4.1. External Lights	8.20.5
8.20.4.2. Interior Lighting	8.20.6
8.20.4.3. Emergency Lights	8.20.7
8.20.4.4. Light Signs	8.20.7
8.20.4.5. Illumination of Compartments	8.20.8
8.22. MODE RECORDING	8.22.1
8.22.1. Operational Limitations	8.22.1
8.22.2. Normal Procedures	8.22.1
8.22.3. Troubles	8.22.3
8.22.4. Brief Description	8.22.3

(cont'd)

Apr 24/84



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Contents

<u>Title</u>	<u>Page</u>
8.23. EMERGENCY EQUIPMENT	8.23.1
8.23.1. Arrangement Diagram	8.23.1
8.23.2. Emergency Exits	8.23.1
8.23.3. Emergency Evacuation Equipment	8.23.1
8.23.3.1. TH-2 Inflatable Evacuation Slide with OCY-5 Bottle	8.23.1
8.23.3.2. Fabric Chute	8.23.2
8.23.3.3. Escape Ropes	8.23.2
8.23.4. Ditching Survival Equipment	8.23.11
8.23.4.1. Life Vests	8.23.11
8.23.4.2. Life Rafts	8.23.11
8.23.5. Other Emergency Equipment	8.23.13
8.23.5.1. Crash Axes	8.23.13
8.23.5.2. Guard Bands	8.23.13
8.23.5.3. Lanterns	8.23.13
8.24. WARNING/INDICATING	8.24.1
8.24.1. Fire	8.24.1
8.24.2. Cabin Depressurization	8.24.2
8.24.3. Approaching and Reaching Operation Limits	8.24.2
8.24.4. Dangerous Failure of Systems and Equipment	8.24.5
8.24.5. Airplane is Not Ready for Takeoff	8.24.8
8.24.6. Landing Gear is Not Extended before Landing	8.24.11
8.24.7. Other Warnings	8.24.11
8.25. WATER SUPPLY AND WASTE DISPOSAL SYSTEM	8.25.1
8.25.1. Operational Limitations	8.25.1
8.25.2. Normal Procedures	8.25.2
8.25.3. Troubles	8.25.4
8.25.4. Brief Description	8.25.5
8.25.4.1. Water Supply System	8.25.5
8.25.4.2. Waste Disposal System	8.25.5

Ty-154M

8.1. ENGINE AND ITS SYSTEMS

8.1. ENGINE AND ITS SYSTEMS

8.1.1. Operational Limitations

Characteristic	Unit of measure	Minimum	Normal	Maximum
(1) LP compressor rotor speed (n_{LP})	%	-	-	95
(2) HP compressor rotor speed (n_{HP})	%	-	-	98.5
(3) Exhaust gas temperature	°C			
Engine starting		-	-	550
Take-off conditions		-	-	640 at outside temperature 30°C
(4) Fuel pressure at fuel control unit inlet	kgf/cm ²	1.8	-	2.9
(5) Fuel pressure at fuel nozzle inlets	kgf/cm ²	-	-	65
(6) Oil pressure at engine inlet	kgf/cm ²	2.5	-	-
Idle conditions	kgf/cm ²	3.5	-	4.5
(7) Oil temperature at engine inlet	°C	-30	-	+90 for 10 minutes
(8) Engine vibration	%	-	-	65
(9) Time of engine continuous operation under takeoff conditions	min	-	-	5 up to H=3 km (up to 15 in special cases independent of altitude)
(10) Time of engine continuous operation under other conditions	min	-	-	Not limited
(11) Time required to gain idle r/min	s	-	-	80 (on the ground) 120 (in flight) 7000
(12) Permissible altitude for in-flight engine starting	m	-	-	

(cont'd)

Characteristic	Unit of measure	Minimum	Normal	Maximum
(13) HP compressor rotor speed in wind-milling in case of in-flight engine starting				
At altitudes less than 4000 m	%	11	-	-
At altitudes of 4000 to 7000 m	%	14	-	-
(14) Air pressure at starter inlet during engine starting	kgf/cm ²	3.23	-	4.54 (Ref. Fig. 8.1.8)
(15) Time of engine continuous operation under reverse thrust conditions	min	-	-	1
(16) Blowoff valve closing speed n_2 _{max.} at engine acceleration	%	77.5	-	80 (Ref. Fig. 8.1.4)
(17) Blowoff valve opening speed n_2 _{max.} at deceleration	%	76.5 (73.5 at abrupt deceleration)	-	80
(18) Speed n_2 _{max.} at which IGVs setting starts changing from angle of -33° to angle of 0° (IGV 33° light annunciator extinguishes) as engine power increases	%	73	-	75.5 (77.5 at acceleration)
(19) Speed n_2 _{max.} at which IGVs set at angle of 0° (IGV 0° light annunciator extinguishes) as engine power increases	%	88.5	-	91.5 (93 at acceleration)
(20) Speed n_2 _{max.} at which IGVs setting starts changing from angle of 0° to angle of -33° (IGV 0° light annunciator illuminates) as engine power decreases	%	86.5 (85.5 at acceleration)	-	91.5
(21) Speed n_2 _{max.} at which IGVs set at angle of -33° (IGV 33° light annunciator illuminates) as engine power decreases	%	71 (70 at acceleration)	-	75.5

(cont'd)

Characteristic	Unit of measure	Minimum	Normal	Maximum
(22) Speed n_2 at which air bleed selector valve is switched over from stage XI to stage VI as engine power increases	%	78.5	-	81
(23) Speed n_2 at which air bleed selector valve is switched over from stage VI to stage XI as engine power decreases	%	77.5 (70.5 at abrupt deceleration)	-	81
(24) Set engine power conditions and monitor them by engine HP compressor rotor rotational speed, (%), in compliance with Tables 8.1.1 and 8.1.2				

Table 8.1.1

Ground Engine Power Conditions ($P_{out} = 760 \text{ mm Hg}$, $t_{out} = 15^\circ\text{C}$, $H = 0$)

Power condition	Rotor rotational speed, %		Exhaust gas temperature, $^\circ\text{C}$
	LP compressor	HP compressor	
Take-off	85.0 to 88.0	94.5 to 96.0	595, max.
Maximum-continuous	82.0 to 85.0	93.0 to 95.0	575 (585 in winter), max.
0.9 maximum-continuous	78.5 to 81.5	91.5 to 93.5	545 (for reference)
0.7 maximum-continuous	71.0 to 74.0	87.5 to 90.0	505 (for reference)
0.6 maximum-continuous	67.0 to 70.0	85.5 to 88.0	485 (for reference)
0.42 maximum-continuous (minimum flight idle during approach)	57.5 to 60.5	81.0 to 83.5	445 (for reference)
Idle	30	59.5 to 61.5	465 (for reference)

(cont'd)

Table 8.1.2

Altitude Engine Power Conditions ($H = 11$ km, $M = 0.8$ at SA)

Power condition	Rotor rotational speed, %		Exhaust gas temperature, °C
	LP compressor	HP compressor	
Take-off	93.5 to 95.0	95.5 to 97.5	585, max.
Maximum-continuous	88.0 to 90.5	93.0 to 95.0	540 (550 in winter), max.
0.9 maximum-continuous	85.5 to 88.0	91.5 to 93.5	510, max.
0.7 maximum-continuous	79.5 to 82.5	87.5 to 90.0	470 (for reference)
0.6 maximum-continuous	76.0 to 79.0	85.5 to 88.0	440 (for reference)
0.42 maximum-continuous (minimum flight idle during approach)	68.0 to 70.5	81.0 to 83.5	380 (for reference)
Idle	63.0	78.0	365 (for reference)

8.1.2. Normal Procedures

CONDITION (PROCEDURE)	REQUIRED ACTION
(1) In situ external inspection of airplane	<p>Receive ground personnel report on airplane preparation for flight.</p> <p>Make sure that ground fire extinguishing means are available in the vicinity of airplane.</p> <p>Make sure there are no fuel and oil leaks in engine nacelles.</p>
(2) In situ internal inspection	Make sure (by light annunciators) that door locks, latches, doors and access panels are closed.
(3) Prior to engine starting	<p>External power supply voltage - Check</p> <p>External power source to a/c electrical system - Connect</p> <p>DC and AC circuit voltage - Check</p> <p>Power supply to engine starting system and engine instruments - Check</p> <p>Communication with ground signaller - Reliable</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Ground personnel ready for engine starting</p> <p>Parking brake</p> <p>Hydraulic system and emergency braking system pressure</p> <p>Pressure below 150 kgf/cm²</p> <p>After charging</p> <p>Oil gauge indicator pointers are in green scale part (21 to 27 l of oil in oil tank)</p> <p><u>NOTE:</u> After engine starting, setting of oil gauge indicator pointers at red-green scale portion is allowed.</p> <p>Ground maintenance personnel within at least 10 m off air intakes and 50 m off exhaust nozzle in the reactive jet zone</p> <p>Generator switches</p> <p>LAMP TEST (КОНТРОЛЬ ЛАМП) button</p>
	<p>- Receive report</p> <p>- Apply</p> <p>- Check</p> <p>- Charge up to 210 kgf/cm² by switching on pump unit of second hydraulic system with subsequent connection of second hydraulic system to first hydraulic system</p> <p>- Disconnect hydraulic system No. 2 from hydraulic system No. 1, switch on pump unit of hydraulic system No. 2</p> <p>- Check</p> <p>- OFF</p> <p>- Press</p> <p>Make sure that all indicating lights and light annunciators are serviceable</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Engine operating conditions (warning/indicating)</p> <p>By successively setting vibration switch to positions ENG 1 (1 ДВ), ENG 2 (2 ДВ), ENG 3 (3 ДВ) and pressing TEST (КОНТРОЛЬ) button</p> <p>Smooth movement of throttle control - Check lever from position IDLE (МАЛЫЙ ГАЗ) to position TAKE-OFF (ВЗЛЕТ)</p> <p>Smooth movement of HP fuel shutoff valve lever from HP FUEL VALVE CLOSED (СТОП-КРАН ЗАКРЫТ) to OPEN (ОТКРЫТ) position and backward, and reliable locking of the lever in the OPEN position</p> <p>Smooth movement of thrust reverser control lever</p>
	<p>Command to connect air starter - Give</p> <p>Report from ground maintenance personnel on readiness for start - Receive</p> <p>Air pressure in starting line - Check</p> <p>"Off engine" command - Issue</p> <p>Switch POWER (ПИТАНИЕ) of fire extinguishing system - ON</p> <p>FUEL QTY IND (ТОПЛИВОМЕР) switch - ON</p> <p>SERVICE TANK 1 (ПАСХОДНЫЙ БАК I) pump switches - ON</p>
(4) Engine starting from air starter	

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
PROPORTIONER (АВТОМАТ ТОПЛИВА) switch	- ON
FLOWMETER (ПАСХОДОМЕР) switch	- ON
AUTO - MAN (АВТОМАТ - РУЧНОЕ) selector switch	- Set to AUTO (АВТОМАТ) position
SHUTOFF VALVES (ПЕРЕКРЫВНЫЕ КРАНЫ) switch	- Set to OPEN (ОТКРЫТО) position
ENGINE START ON GROUND (ЗАПУСК ДВИГАТ НА ЗЕМЛЕ) panel cover	- Open
MASTER SWITCH (ГЛАВНЫЙ ВЫКЛ)	- ON
START - CRANK (ЗАПУСК - ХОЛОД ПРОКРУТ) switch	- Set to START (ЗАПУСК) position
ENGINE SELECT 1, 2, 3 (ВЫБОР ДВИГАТ 1, 2, 3) selector switch	- Set to number of required engine
Throttle control lever	- IDLE
HP fuel shutoff valve lever	- Set to HP FUEL VALVE OPEN (СТОП-КРАН ОТКРЫТ) position
Thrust reverser control lever	- In lower position, fixed
Start the engine:	
START (ЗАПУСК) button	- Press
Stop-watch	- Start
<u>CAUTION:</u> 1. DURING ENGINE STARTING NEVER ATTEMPT TO ADJUST FUEL CONSUMPTION MANUALLY BY CHANGING POSITION OF THROTTLE CONTROL LEVER.	
2. NEVER ATTEMPT TO BLEED AIR FOR AIRPLANE NEEDS FROM THE ENGINE UNDER START, EXCEPT FOR AIR BLEED FOR HEATING THE IGVs, ENGINE INLET CONE AND INLET DUCT AIR INTAKE AT OUTSIDE AIR TEMPERATURE OF +5 °C AND BELOW.	

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Time required for normal engine starting (from moment the START (ЗАПУСК) button is depressed and up to the moment idle rpm are gained) is 35 to 80 s.</p> <p><u>NOTE:</u> It is allowed to make five engine starts that follow one after another without an interval. In this case it is recommended to perform every next start only after the engine rotor has come to complete standstill.</p> <p>Carry out successive five starts after a 30-min interval. Start the other two engines.</p> <p>After starting the engines check oil level in the oil tanks. Not more than 6 l of oil are allowed to flow from the oil tank into the engine. In this case the oil gauge indicator pointer may be set at the red-green scale portion.</p>
(5) After engine starting	<p>MASTER SWITCH - OFF</p> <p>START - CRANK (ЗАПУСК - ХОЛОДН ПРОКРУТ) switch - Set to neutral position</p> <p>ENGINE SELECT (ВЫБОР ДВИГАТАЛ) selector switch - Set to neutral position</p> <p>ENGINE START ON GROUND (ЗАПУСК ДВИГАТАЛ НА ЗЕМЛЕ) panel cover - Close</p>
(6) Engine heating and test-running	<p>Ambient air temperature and pressure - Determine</p> <p>Engine parameters under IDLE conditions - Check</p> <p>AC generator - ON</p> <p>Engine test-running according to full or reduced test-run chart (Ref. Figs 8.1.5, 8.1.6) - Carry out</p> <p><u>CAUTION:</u> IT IS ALLOWED TO SWITCH OFF THE GENERATOR OF A RUNNING ENGINE DURING ENGINE PARAMETER MEASUREMENTS.</p> <p>0.7 maximum-continuous power - Gain smoothly</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>HP compressor rotor speeds when IGVs start moving off angle -33° and when air blowoff valve starts closing</p> <p>Moments of IGV movement and air blowoff valve closing by extinguishing of IGV -33° (BHA -33°) and BLOWOFF VLVS (КЛАПАНЫ ПЕРЕПУСК) light annunciators</p> <p>At least one minute at 0.7 maximum-continuous power</p> <p>HP compressor rotor speed and exhaust gas temperature</p> <p>Engine inlet oil pressure</p> <p>Operation of BIPT-44 all-condition exhaust gas temperature control</p> <p>0.6 maximum-continuous power</p> <p>Cover of TEMP CONT GROUND ADJUST (НАЗЕМНАЯ НАСТРОЙКА PT) switch panel</p> <p>BIPT-44 function selector switch to ENGINES 1, 2, 3 position</p> <p>Throttle control lever to take-off power setting</p> <p>At BIPT-44 ADJUSTMENT (НАСТРОЙКА BIPT-44) setting for 20 to 30 s</p> <p>Exhaust gas temperature</p> <p>0.6 maximum-continuous power</p> <p>BIPT-44 function selector switch to IN FLIGHT OFF (ВЫКЛ В ВОЗДУХЕ) position</p> <p>Cover of TEMP CONT GROUND ADJUST switch panel</p> <p>Engine to maximum-continuous power</p> <p>- Check</p> <p>- Determine</p> <p>- Operate</p> <p>- Check</p> <p>- Check</p> <p>- Rev up engine</p> <p>- Open</p> <p>- Set in succession</p> <p>- Move gradually</p> <p>- Operate</p> <p>- Check</p> <p>- Decelerate</p> <p>- Set</p> <p>- Accelerate gradually</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>HP compressor rotor speed at the moment of IGVs setting at angle of 0°</p> <p>- Check</p> <p>Setting moment by extinguishing of IGV 0° (BHA 0°) light annunciator</p> <p>- Determine</p> <p>One minute at maximum-continuous power</p> <p>- Operate</p> <p>HP compressor rotor speed and exhaust gas temperature</p> <p>- Check</p> <p>Engine casing vibration not to exceed 65 %</p> <p>- Check</p> <p>Generator current frequency to be 400 ± 4 Hz</p> <p>- Check</p> <p>Engine to take-off power</p> <p>- Accelerate</p> <p>10 to 15 s at take-off power</p> <p>- Operate</p> <p>HP compressor rotor speed and exhaust gas temperature</p> <p>- Check</p> <p>LP compressor rotor speed</p> <p>- Check</p> <p>Engine casing vibration to be not in excess of 65 %</p> <p>- Check</p> <p>AC generator current frequency to be 400 ± 4 Hz</p> <p>- Check</p> <p>Engine to idle power</p> <p>- Decelerate gradually</p> <p>HP compressor rotor speed at moments of IGVs moving off angle of 0°, air blowoff valve opening and IGVs setting to angle of -33° (Ref. Fig. 8.1.3)</p> <p>- Check</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Moments of IGVs moving off angle of - Determine 0°, air blowoff valve opening, IGVs setting to angle of -33° by illumination of light annunciators IGV 0° (BHA 0°), BLOWOFF VLVS (КЛАПАНЫ НЕРЕГУЛЯРНЫХ), and IGV 33° (BHA -33°)</p> <p>Two minutes at idle power - Operate</p> <p>Oil pressure to be at least 2.5 kgf/cm² - Check</p> <p>HP compressor rotor speed and exhaust gas temperature - Check</p> <p>During engine test-run according to reduced test-run chart (Ref. Fig. 8.1.6) - Switch off engine</p> <p>During engine test-run according to full test-run chart (Ref. Fig. 8.1.5):</p> <p>Engine acceleration - Check</p> <p>Throttle control lever from IDLE (МАЛЫЙ ГАЗ) position to takeoff power setting in 1 to 2 s - Move</p> <p>Simultaneously with throttle control lever movement onset, stopwatch - Start</p> <p>Time of acceleration from idle to take-off power (7 to 10 s) - Record</p> <p>Count acceleration time off the beginning of throttle control lever movement up to HP compressor rotor speed 1.0 % below take-off rotational speed for particular atmospheric conditions is attained.</p> <p>After engine gains takeoff rpm - Operate for 8 to 10 s</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>HP compressor rotor speed and exhaust gas temperature - Check</p> <p>Throttle control lever to IDLE (МАЛЫЙ ГАЗ) position in 1 to 2 s - Move</p> <p><u>NOTES:</u> 1. With engine power increasing from idle to take-off rating and AC generator load of at least 5 kVA, current frequency increase up to 430 Hz is permissible. Time of generator operation at a current frequency of above 420 Hz is 3.5 s maximum.</p> <p>2. With engine decelerating from take-off to idle power conditions, current frequency drop down to 370 Hz is allowed. Time of generator operation at frequency below 380 Hz is 2 s maximum.</p>
	<p>One minute at idle power - Operate</p> <p>Oil pressure to be at least 2.5 kgf/cm² - Check</p>
	<p>Thrust reverser operation - Check</p> <p>Thrust reverser control lever from forward thrust position to thrust reverser engagement setting in 1 to 2 s - Move</p>
	<p>See to it that thrust reverser doors are turned to reverse thrust position and RVSR DOORS (CTBOPKM PEEPCA) light annunciator illuminates.</p>
	<p>8 to 10 s at minimum reverse thrust - Operate</p> <p>Thrust reverser control lever to forward thrust position in 1 to 2 s - Move</p>
	<p>See to it that thrust reverser doors turn to forward thrust position and RVSR DOORS (CTBOPKM PEEPCA) light annunciator extinguishes.</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
<p><u>NOTE:</u> When thrust reverser doors are being turned to forward thrust position, RVSR LOCK (3AMOK PEBEPCA) light annunciator gets illuminated for short period of time.</p> <p>Two minutes at idle power</p> <p>Oil pressure to be at least 2.5 kgf/cm²</p> <p>HP compressor rotor speed and exhaust gas temperature</p> <p>Engine</p> <p><u>NOTE:</u> If the airplane parking conditions offer no possibility to check operation of the thrust reverser on a running engine, it is allowed to perform the check on a non-operating engine immediately after it has been switched off.</p> <p>To this end:</p> <p>Thrust reverser control lever to thrust reverser engagement setting</p> <p>See to it that thrust reverser doors will turn to reverse thrust position in not more than two seconds, and RVSR DOORS (CTBOPKM PEBEPCA) light annunciator illuminates.</p> <p>Thrust reverser control lever to forward thrust position</p> <p>See to it that thrust reverser doors are turned to forward thrust position, and RVSR DOORS (CTBOPKM PEBEPCA) light annunciator extinguishes.</p> <p>As thrust reverser doors are being moved to their forward thrust position, RVSR LOCK (3AMOK PEBEPCA) light annunciator illuminates for short period of time.</p> <p>The hydraulic accumulator capacity is designed for a single-time thrust reverser test cycle.</p>	<p>- Operate</p> <p>- Check</p> <p>- Check</p> <p>- Switch off</p> <p>- Move</p> <p>- Move</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
(7) Engine starting from APU	<p>APU</p> <p>Air bleed valve for engine starting - Open</p> <p>Air bleed valve for airplane anti-icing system - Close</p> <p>Air pressure in engine starting line - Check</p> <p>Engine</p> <p>- Start</p>
(8) Engine starting from operating engine	<p>Recommended HP compressor rotor speed (n_{HP}) of operating engine</p> <p>Air bleed valve of operating engine - Open</p> <p>Engine</p> <p>- Start</p>
(9) Cranking	<p>MASTER SWITCH</p> <p>START (ЗАПУСК) - CRANK (ХОЛОДН ПРОКРУТ) selector switch - To CRANK (ХОЛОДН ПРОКРУТ) position</p> <p>ENGINE SELECT (ВЫБОР ДВИГАТАЛ) selector switch - To position corresponding to number of engine under start</p> <p>Throttle control lever - To IDLE (МАЛЫЙ ГАЗ) position</p> <p>HP fuel shutoff valve lever - To HP FUEL VALVE OPEN (СТОП-КРАН ОТКРЫТ) position</p> <p>APU</p> <p>AIR BLEED (ОТЕОП ВОЗДУХА) selector switch on APU panel - Press up, hold for 7 to 8 s</p> <p>ENGINE START ON GROUND (ЗАПУСК ДВИГАТЕЛЯ НА ЗЕМЛЕ) button - Depress for 1 to 2 s</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
(10) Engine shutdown	<p>(a) Normal conditions</p> <p>Throttle control lever - To IDLE (МАЛЫЙ ГАЗ) position. Run for 2 min</p> <p>Generator switch - Switch off constant-speed drive</p> <p>HP fuel shutoff valve lever - To HP FUEL VALVE CLOSED (СТОП-КРАН ЗАКРЫТ) position</p> <p>Smooth rotation of LP and HP compressor rotors - Check</p> <p>Rotor run-down time from HP compressor rotor speed $N_2 = 9\%$ - Measure. At least 80 s for LP compressor rotor. At least 60 s for HP compressor rotor</p>
	<p>(b) Emergency conditions</p> <p>Engine may be stopped from any power setting without cooling at idle setting</p> <p>Throttle control lever - To IDLE (МАЛЫЙ ГАЗ) position</p> <p>HP fuel shutoff valve lever - To HP FUEL VALVE CLOSED position</p> <p><u>CAUTION:</u> DO NOT ATTEMPT TO STOP THE ENGINE BY CLOSING FUEL SHUTOFF VALVE FOR FEAR OF DAMAGE TO ENGINE AUTOMATIC FUEL SYSTEM UNITS DUE TO OPERATION WITHOUT FUEL SUPPLY.</p>
(11) After engine have been stopped	<p>Fuel shutoff valve - Close</p> <p>SERVICE TANK 1 (РАСХОДНЫЙ БАК I) pump switches - To OFF (ВЫКЛЮЧЕНО) position</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>All switches that have been switched - To OFF position ON for starting and testing the engines</p> <p>Engine - Inspect. Make sure there are no fuel and oil leaks</p> <p>Engine inlet duct, IGVs and accessible compressor blades - Inspect</p> <p>Exhaust nozzle and thrust reverser doors - Inspect</p> <p>After engine inspection blank off engine inlet duct, and after engine shutdown and cooling (at the lapse of 12 to 15 min) blank off exhaust nozzle.</p>
(12) In-flight engine shutdown	<p>Throttle control lever - IDLE (МАЛЫЙ ГАЗ). Run for at least 1 min</p> <p>Generator and air bleed for airplane needs - OFF</p> <p>HP fuel shutoff valve lever - To HP FUEL VALVE CLOSED (СТОП-КРАН ЗАКРЫТ) position</p> <p>Fuel shutoff valve (of stopped engine) - To CLOSED (ЗАКРЫТ) position</p> <p>When stopping a faulty engine at any stage of continued take-off, exert every care in throttling this engine for fear of retarding the throttle control lever of the engine that is in good condition. Perform engine emergency shutdown by retarding throttle control lever from any power setting to the IDLE (МАЛЫЙ ГАЗ) position and moving subsequently the HP fuel shutoff valve lever to HP FUEL VALVE CLOSED position.</p>
(13) In-flight engine	<p><u>CAUTION:</u> 1. DO NOT PERFORM IN-FLIGHT START OF THE ENGINE THAT HAS BEEN SHUT DOWN BY CLOSING THE FUEL FIRE SHUT-OFF VALVE.</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>2. WHEN FLYING UNDER ICING CONDITIONS WITH STOPPED ENGINE, IN-FLIGHT ENGINE STARTING IS FORBIDDEN.</p> <p>Perform in-flight engine starting during windmilling at HP compressor rotor speed of not below 11 % at altitudes up to 4000 m and not below 14 % at altitudes above 4000 m.</p>
Fuel fire shutoff valve	- Open
AC generator from a/c electrical system	- Disconnect
Throttle control lever	- IDLE (МАЛЫЙ ГАЗ)
Engine HP fuel shutoff valve lever	- HP FUEL VALVE CLOSED (ЗАКРЫТ)
FLT RESTART (ЗАПУСК В ВОЗДУХЕ) button	- Press
Simultaneously stop-watch	- Start
5 to 8 s after button depression, HP fuel shutoff valve lever	- Set to HP FUEL VALVE OPEN (СТОП-КРАН ОТКРЫТ)
Engine shall automatically accelerate up to idle power conditions in 120 s, maximum.	
Fuel pressure rise and fuel mixture ignition in combustion chamber by rise in exhaust gas temperature	- Check visually
After engine has gained idle rpm	- Run at this condition at least for 1 min
<u>NOTE:</u> With throttle control lever at IDLE (МАЛЫЙ ГАЗ) stop, HP compressor rotor speed is the more the higher flight altitude.	
<u>CAUTION:</u> EXHAUST GAS TEMPERATURE RISE UP TO 550 °C DURING ENGINE STARTING IS ALLOWED FOR NOT LONGER THAN 4 S.	
AC generator	- Switch ON

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Engine to required power</p> <p>In case of unsuccessful engine start and to interrupt starting</p> <ul style="list-style-type: none"> - Accelerate - Move HP fuel shutoff valve lever to HP FUEL VALVE CLOSED (CTOH-KPAH 3AKPH) position and blow through at windmilling for at least 30 s
(14) Peculiarities of engine operation at negative temperatures	<p>Prior to engine starting, LP compressor rotor rotation by hand</p> <p>If rotor does not rotate</p> <p><u>CAUTION:</u> DO NOT START ENGINE IN CASE OF ICE AND SNOW ON INLET DUCT PARTS. REMOVE ICE BY HEATING. MECHANICAL ICE REMOVAL IS FORBIDDEN.</p> <p>At temperature of +5 °C and below and at high air humidity (rain, snow-frost, snow, etc.), prior to engine starting, engine anti-icing system</p> <p>Prior to engine starting, if airplane stay exceeded 2 h at air temperature of -30 °C and below, fuel control unit, auto start control unit and acceleration control unit, IGVs with vanes through which oil passes, fuel and oil coolers, oil tank, front and rear accessory gear boxes, sensing unit, air starter by airfield engine heater (with air temperature not above 80 °C)</p> <p><u>CAUTION:</u> DO NOT OPERATE THE ENGINE UNDER ICING CONDITIONS WITH THE ENGINE ANTI-ICING SYSTEM SWITCHED OFF.</p>
(15) Taxiing	<p>After engine starting</p> <ul style="list-style-type: none"> - Warm up

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>For which purpose:</p> <p>Two minutes at idle and one minute at 0.7 maximum-continuous power - Operate</p> <p>Engines (during taxiing or at holding point) - Warm up</p> <p>If airplane is to take off immediately after engine start, accelerate engine to take-off power condition (provided the above heating has been made) not earlier than five minutes after depression of START (BALYCK) button.</p> <p>Taxiing is allowed at any power rating, beginning from idle and higher.</p> <p>It is not recommended to operate the engine at HP compressor rotor speeds at which the blowoff valves are opened and closed.</p> <p>Prior to take-off, with engines operating at take-off power, HP compressor rotor speed and exhaust gas temperature correspond to values determined from chart (Ref. Fig. 8.1.2) versus atmospheric conditions - Verify</p> <p>Oil inlet pressure is within 3.5 to 4.5 kgf/cm² - Verify</p> <p>With engines operating at take-off power, light annunciators on engine monitoring panel - Remain dead</p> <p><u>CAUTION:</u> 1. MOVE THE THROTTLE CONTROL LEVER ON THE GROUND AND IN FLIGHT GRADUALLY, WITHOUT JERKS, NOT APPLYING TOO GREAT FORCE.</p> <p>2. TO PREVENT INADVERTENT MOVEMENT OF THE THROTTLE CONTROL LEVERS ON THE GROUND AND IN FLIGHT, BRAKE THEM WITH THE AID OF HAND BRAKE.</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
(16) Take-off and climb	<p>Time of engine continuous operation - Not to exceed 5 min at take-off power</p> <p><u>NOTE:</u> In special cases, the time of engine continuous operation at take-off power may be increased, if required, up to 15 min.</p> <p>Take-off power condition - Use up to altitude of 3 km</p> <p><u>NOTE:</u> At altitudes above 3 km, use take-off power in special cases only.</p> <p>After take-off and climb to safe altitude maximum-continuous or lower engine power condition - Set</p> <p>At ambient air temperature on the ground of +15 °C and higher, throttle control lever to position providing for HP compressor rotor speed at maximum-continuous engine power - Set</p> <p>Automatic maintaining of rotor speed at 93 to 95 % as flight altitude increases - Monitor</p> <p>At ambient air temperature on the ground of below +15 °C, HP compressor rotor speed by 1.5 % less than take-off actual speed to ensure maximum-continuous power - Set</p> <p>As flight altitude increases, rotor speed approximately by 2 % per every 1000 m - Increase, if required</p> <p>In all cases, rotor speed shall not exceed maximum-continuous power speed.</p>

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Engine and Its Systems

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>With air bleed for aircraft requirements switched ON at take-off, maximum-continuous and cruise power conditions, exhaust gas temperature will increase up to temperature restricted by BIPT-44 system, after which it will be kept at a constant level, while engine rotor speed may decrease somewhat.</p> <p>The decrease in rotor speed depends on the amount of air tapped from the engine.</p> <p>Maximum permissible exhaust gas temperature at take-off and maximum-continuous power conditions is restricted by BIPT-44 system depending on atmospheric air temperature and on specified exhaust gas temperature value for corresponding power condition (Ref. Tables 8.1.1 and 8.1.2).</p> <p>At all other engine power conditions, exhaust gas temperature shall not exceed temperature value specified for maximum-continuous power condition.</p> <p><u>CAUTION: ENGINE OPERATION AT TAKE-OFF POWER AND EXHAUST GAS TEMPERATURE EXCEEDING MAXIMUM PERMISSIBLE VALUE (REF. TABLE 8.1.1) IS FORBIDDEN.</u></p> <p>It is allowed, when required, to operate at exhaust gas temperatures exceeding the maximum permissible value for maximum-continuous power and at HP compressor rotor speeds exceeding the speed of maximum-continuous power condition. The time of operation under such conditions shall not exceed five minutes and shall be recorded as time of operation at take-off power.</p> <p>When air is tapped from the engine operating under cruise conditions, it is allowed to accelerate the engine up to exhaust gas temperature equal to maximum permissible temperature for maximum-continuous power, specified in Table 8.1.2. See to it that HP compressor rotor speed does not exceed maximum-continuous condition speed. Consider engine operation under such conditions as operation at maximum-continuous power.</p>
(17) Horizontal flight	Horizontal flight is allowed at any condition of engine operation.

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
In flight at atmospheric air temperature below +5 °C, in conditions of possible icing, at entry into clouds or fog, and also in case of IGV ICING (ОБЛЕДЕНИЕ ВНА) light illumination, anti-icing system of air intake, inlet duct, IGVs and engine inlet nose cone	- Switch ON - Observe

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Engine and Its Systems

8.1.3. Troubles

TROUBLE	CORRECTIVE ACTION	
(1) Troubles that require immediate interruption of engine starting:	HP fuel shutoff valve lever	- To HP FUEL VALVE CLOSED (СТОП-КРАН ЗАКРЫТ)
Slow increase in HP compressor rotor speed and abrupt increase in exhaust gas temperature or exhaust gas temperature of 550 °C.	DISCONT (ПРЕКРАЩЕНИЕ ЗАПУСКА) button	- Depress
Constant HP compressor rotor speed (speed hold-up).		
Oil pressure less than 2.5 kgf/cm ² at HP compressor rotor speed of more than 21 %.		
Illumination of CHIPS IN OIL (СТРУМ-КА В МАСЛЕ) light annunciator.		
Illumination of STARTER OVERSPEED (ОПАЧНЫЕ ОБОРОТЫ СТАРТЕРА) light annunciator.		
Inadvertent setting of thrust reverser doors to reverse thrust position and illumination of RVSR DOORS (СТВОРКИ РЕВЕРСА) light annunciator.		

(cont'd)

TROUBLE	CORRECTIVE ACTION
Inadvertent opening of thrust reverse door lock and illumination of RVSR LOCK (ЗАМОК РЕВЕРСА) light annunciator.	
Turning of IGVs from -33° position and extinguishing of IGV 33° (BHA -33°) light annunciator.	
Blow-off valves failed to open and BLOWOFF VLVS (КЛАПА-НЫ ПЕРЕЛУЧКА) light annunciator does not illuminate at HP compressor rotor speed exceeding 14 %.	
Illumination of ABNORM VIBRATION (ОПАСНАЯ ВИБРАЦИЯ) light annunciator.	
Engine start time exceeds 80 s.	
Other troubles in operation of engine and its accessories revealed during start.	
Inadvertent airplane movement.	
Failure of engine instruments.	

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Engine and Its Systems

TROUBLE	CORRECTIVE ACTION	
Fire in nacelle of engine under start.		
(2) Troubles that require engine shutdown after it has been started:	Throttle control lever HP fuel shutoff valve lever	- IDLE - HP FUEL VALVE CLOSED (СТОЙ-КРАН ЗАКРЫТ)
Abrupt inlet oil pressure drop to below permissible limit.		
Jet flame or intensive sparking from exhaust nozzle.		
Icing of inlet duct.		
Fire.		
Abnormal engine noise.		
Failure of HP compressor stages V and VI blowoff valves to open at rotor speed below lower limit speed for particular outside air temperature.		
(3) Troubles that require deceleration or shutdown of engine:		
Illumination of HI VIBR (ВИБРАЦИЯ ВЕЛИКА) and ABNORM VIBRATION (ОПАСНАЯ ВИБРАЦИЯ) light annunciations	Vibration indicator switch to pickup sending high vibration signals Vibration speed value	- Set - Determine

(cont'd)

TROUBLE	CORRECTIVE ACTION
	<p>At vibration speed of 65 % and less, if engine rotor speed, exhaust gas temperature, oil pressure and temperature do not change and are within specified limits, further engine operation is allowed.</p>
	<p>At vibration speed higher than 65 %, HP compressor rotor speed by 1.5 to 2.5 % with throttle control lever</p> <ul style="list-style-type: none"> - Reduce till light annunciators extinguish
	<p>Engine operation at newly established power condition. See to it that engine parameters are within specified limits.</p> <ul style="list-style-type: none"> - Continue
	<p>If engine deceleration does not reduce vibration speed or vibration speed increased up to 90 % and ABNORM VIBRATION (ОПАСНАЯ ВИБРАЦИЯ) light annunciator illuminates</p> <ul style="list-style-type: none"> - Immediately shutdown engine
ILLUMINATION OF CHIPS IN OIL (СТРУЖКА В МАСЛЕ) LIGHT ANNUNCIATOR	<p>Illumination of light annunciator prior to take-off</p> <ul style="list-style-type: none"> - Do not perform takeoff, find out cause <p>Illumination of light annunciator at take-off, engine after climbing to safe altitude</p> <ul style="list-style-type: none"> - Switch OFF <p>Illumination of light annunciator in flight with all engines operating, engine from which signal is received</p> <ul style="list-style-type: none"> - Switch OFF <p>Illumination of light annunciator in flight with two engines operating, engine from which signal is received</p> <ul style="list-style-type: none"> - Decelerate to 0.7 maximum-continuous power <p>Flying to nearest airfield</p> <ul style="list-style-type: none"> - Continue

(cont'd)

TROUBLE	CORRECTIVE ACTION
	Vibration level, oil pressure and temperature of this engine - Check
Illumination of OIL LEVEL (YPOBEHЬ MACJA) light annunciator	Engine to 0.7 maximum-continuous power - Decelerate Tank oil level by oil gauge indicator - Check At take-off, after climbing to safe altitude - Decelerate
	If oil level dropped to zero or exceeded 34 l, and oil pressure and temperature are beyond the specified limits, engine - Switch OFF
Illumination of FUEL PRES (P TOLJIMBA) light annunciator	Fuel control unit inlet pressure by reading indicator - Check In case of excessive pressure, continue engine operation without limitations.
	If light annunciator illumination is accompanied by drop in HP compressor rotor speed, engine - Switch OFF
	At take-off after climbing to safe altitude, engine - Switch OFF
Illumination of OIL PRES (P MACJA) light annunciator	If light annunciator illumination is accompanied by drop in engine inlet oil pressure to below 2.5 kgf/cm ² , engine - Switch OFF
	After climbing to safe altitude at take-off, engine - Switch OFF
Illumination of FLTR CLOG (QMLBTP 3ACOPEH) light annunciator	With light annunciator illumination, - Continue flight without limitations

(cont'd)

TROUBLE	CORRECTIVE ACTION
<p>Simultaneous illumination of light annunciators IGV 0°, IGV 33°, BLOWOFF VLVS (КЛАПАНЫ ПЕРЕДНИХ КАНАЛІВ) at HP compressor rotor speed exceeding value at which IGVs start turning from angle of 0°</p>	<p>Engine to HP compressor rotor speed of $N_2 = 80\%$</p> <p>Engine vibration level, exhaust gas temperature and absence of chips in oil</p> <ul style="list-style-type: none"> - Decelerate - Monitor
<p>Illumination of RVSR DOORS LOCK (CTBOPKM PEBEPCA) at thrust reverser control lever position corresponding to forward thrust</p>	<p>If thrust reverser doors are in forward thrust position</p> <p>If thrust reverser doors are turned to reverse thrust position</p> <ul style="list-style-type: none"> - Continue engine operation - Immediately switch OFF engine
<p>Illumination of RVSR DOORS (CTBOPKM PEBEPCA) light annunciator with thrust reverser control lever in position corresponding to forward thrust</p>	<p>Engine</p> <p>At light annunciator illumination during take-off after climbing to safe altitude, if thrust reverser doors are in forward thrust position</p> <p>In case of inadvertent turning of thrust reverser doors to reverse thrust position at take-off</p> <ul style="list-style-type: none"> - Switch OFF - Switch OFF engine - Immediately switch OFF engine

(cont'd)

8.1.4. Д-30KV-154 Engine

8.1.4.1. Brief Description

The TU-154M airplane is powered by the Д-30KV-154 turbine two-rotor by-pass exhaust mixing engines.

The engine static thrust under Standard Atmosphere conditions at takeoff power is 10,500 kgf \pm 1 %, at maximum-continuous power - 9500 kgf -2 %, with respective specific fuel consumption of 0.498 and 0.492 $\frac{\text{kg fuel}}{\text{kgf thrust}\cdot\text{h}}$.

The engine compressor is of two-rotor axial type, with the first supersonic stage of the low pressure (LP) compressor.

The LP compressor rotor has three stages, while the HP compressor rotor has eleven stages.

The engine HP compressor V and VI stage air bleed into the by-pass duct and inlet guide vanes setting control are provided to ensure the compressor stable operation at a speed below the operational r.p.m.

The combustion chamber is of an annular type with twelve flame tubes.

The engine turbine is of an axial jet type with the following number of stages:

HP turbine (HP compressor rotor) - 2 stages

LP turbine (LP compressor rotor) - 4 stages.

The engine is equipped with the system for air bleed to feed the airframe and power plant ice protection system and to pressurize the pressure cabin.

Two side engines (No. 1 and No. 3) are fitted with thrust reversers.

The engine power setting is controlled via the throttle control levers located on the center pedestal and on the flight engineer's control panel. Forces required to move the throttle control levers do not exceed 3 kgf on the center pedestal and 4 kgf on the flight engineer's control panel.

The throttle control levers at the flight engineer's station are provided with a lock to prevent inadvertent displacement of the levers.

With the lock control lever moved forward the throttle control levers become locked, and unlocked if the lock lever is moved backward.

With the engine autothrottle operating and the throttle control levers locked in the second or third detent the UNLOCK THROTTLE (ПАСТОН СЕКТОПА) amber light annunciators become illuminated on the flight engineer's control panel and the auto-throttle is switched off. To switch the autothrottle on again, unlock the throttle control levers.

(cont'd)

The throttle levers are fitted with collapsible knobs with built-in limit switches used to switch off the autothrottle when a force of 2 to 3 kgf is applied to the knobs.

The engines are shutdown by means of the HP fuel shutoff valve levers mounted on the flight engineer's control panel.

The HP fuel shutoff valve levers can be set to two positions: forward - FUEL ON (СТОП-КРАН ОТКРЫТ), and rear - OFF (ЗАКРЫТ). In the ON (ОТКРЫТ) position the levers are latched. The HP fuel shutoff valve lever knobs are fitted with red lights which illuminate when the engine nacelle fire extinguishing system is activated with the ABNORM VIBRATION (ОПАСНАЯ ВИБРАЦИЯ) light annunciator comes on which will minimize the risk to shutdown a sound engine.

8.1.4.2. Thrust Reversal System

The thrust reversers and pertaining control components are mounted on the engine and are used to reverse the engine thrust.

The thrust reverser is used for reversing the engine exhaust direction to reduce the airplane landing run and for emergency braking within the accelerate-stop distance.

The reverse thrust is obtained by directing the exhaust efflux forward in the direction of the airplane motion.

The exhaust efflux deflection is accomplished by opening the thrust reverser doors.

The thrust reverser doors can be set to the FORWARD THRUST (ПРЯМАЯ ТЯГА) or REVERSE THRUST (ОБРАТНАЯ ТЯГА) position.

The thrust reverser doors are set to either the FORWARD THRUST or REVERSE THRUST position by two power cylinders. The operating rods of the cylinders are linked to the lever mechanism of the hydraulic system operating the thrust reverser.

The engine thrust can be reversed from the center pedestal by the pilots only who operate for the purpose the thrust reverser control levers mounted on the ENG 1 and ENG 3 throttle control levers.

The thrust reverser control levers are locked in the down off position. To unlock the thrust reverser control lever it is necessary to press the lever knob.

To reverse the thrust it is necessary to unlock the thrust reverser control lever and move it up fully. The reverse thrust power is dependent on the amount of the thrust reverser control lever upward setting similar to that of the throttle control lever used to control the forward thrust.

(cont'd)

Before selecting the reverse thrust, move the throttle control lever to the IDLE (МАЛЫЙ ГАЗ) position.

The thrust reverser operation is monitored by referring the following light annunciators:

RVSR LOCK (ЗАМОК РЕВЕРСА) amber light,

RVSR DOORS (СТВОРКИ РЕВЕРСА) green light,

located on the flight engineer's control panel and the 1, 3 RVSR DOORS (СТВОРКИ РЕВЕРСА 1, 3) green light annunciator located on the center instrument panel.

The RVSR DOORS (СТВОРКИ РЕВЕРСА) light annunciators illuminate when the thrust reverser doors are set open (reverse thrust position), and the RVSR LOCK (ЗАМОК РЕВЕРСА) light annunciator momentarily illuminates and extinguishes when the thrust reverser is being set to ON and OFF. The RVSR LOCK (ЗАМОК РЕВЕРСА) light annunciator illuminates continuously if the reverser lock is released inadvertently.

8.1.4.3. Starting

The engine starting system provides for:

Starting the engine on the ground

Engine cranking

Engine false starting

Engine automatic flight-restart

Engine manual flight-restart (if auto start system failed)

Engine start discontinuation

The engine is started automatically by a starter driven by compressed air. The air pressure is indicated on the pressure indicator.

The engines can be started in turn in any sequence. Selection of any engine to start is accomplished via the 1, 2, 3 ENG SELECT (ВЫБОР ДВ 1, 2, 3) selector switch.

The engine starting controls are located on the engine start control panel:

MASTER SWITCH (ГЛАВНЫЙ ВЫКЛЮЧ) switch

Engine selector switch (engines 1, 2, 3)

START - CRANK (ЗАПУСК - ХОЛОДН ПРОКРУТ) selector switch

START (ЗАПУСК) button

START DISCONT (ПРЕКРАЩЕНИЕ ЗАПУСКА) button

Three AUTOSTART ON 1, 2, 3 (АПД РАБОТАЕТ 1, 2, 3) green light annunciators

Three ENG 1, ENG 2, ENG 3 FLT RESTART (1 ДВ, 2 ДВ, 3 ДВ ЗАПУСК В ВОЗДУХЕ) buttons

Air pressure indicator

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Engine and Its Systems

8.1.4.4. Fuel System

The fuel system provides for feeding the fuel to the engines, controlling the fuel flow depending on the engine power setting, and operating the engine control accessories.

The fuel system is subdivided into the low pressure fuel system, high pressure fuel system, and drainage system. The drainage system incorporates a front drain tank and pipes connecting the accessory cavities to the tank.

The service tank fuel is delivered by the tank boost pump via the pipes to the engine-mounted back-up (LP) pump. Then the fuel flows via pipes through the fuel flow metering unit, fuel-to-oil cooler (used to cool oil) and screen fine filters (located in fuel-to-oil cooler) to the fuel control unit.

The FCU outlet high pressure fuel is delivered via pipes to the ring-type primary and main fuel manifolds distributing the fuel via 24 pipes to 12 fuel nozzles.

The fuel system operation is monitored with reference to two pressure indicators:

HP fuel before fuel nozzle inlets (indicated by three-pointer engine gauge unit).

Fuel control unit inlet fuel pressure.

Fuel system operation is monitored by illumination of the following red light annunciators:

FUEL PRES (ПТОЛІМВА) annunciator coming on when the fuel control unit inlet fuel pressure drops to $1.6 \pm 0.3 \text{ kgf/cm}^2$.

FLTR CLOG (ФИЛЬТР ЗАКОПЕН) annunciator illuminating when the low pressure fuel filter is clogged (a pressure differential across filter reaches 0.4 kgf/cm^2).

8.1.4.5. Oil System

Each engine is provided with an independent oil system ensuring oil circulation through the oil tank and fuel-to-oil cooler. The system is vented to atmosphere via the centrifugal breather mounted on the engine casing.

The fuel-to-oil cooler is incorporated in the low pressure oil and fuel system. MK-8II and MC-8II oils and the mixtures thereof taken in any proportion are used for lubricating the engines.

It is allowed to use foreign-made oils indicated in the table as substitutes of the Soviet-made oils.

Soviet-made oils, Grade, State Standard	Foreign-made oils		
	Grade	Specification	Company, country of origin
MK-8II	Aeroshell	Mil-L-6081	Shell
FOCT 6457-66	Turbine Oil-2	Grade 1010	
MC-8II	Aeroshell	DERD 2490	Shell
OCT 38 01163-78	Turbine Oil-3 АВИА-8А		Romania

(cont'd)

NOTES: 1. Aeroshell Turbine Oil-2 and Aeroshell Turbine Oil-3 may be used as substitutes of MK-8II and MC-8II oils with the following limitations on the engine operating time accounted for:

- operation of the engine on Aeroshell Turbine Oil-2 shall not exceed 30 per cent of the engine service life (specified in the Engine Log Book);
- operation of the engine on Aeroshell Turbine Oil-3 shall not exceed 50 per cent of the engine service life (specified in the Log Book).

Further operation of the engine shall be accomplished on MK-8II or MC-8II oil without limitations of the engine operating time within the.

2. It is allowed to mix Soviet-made mineral oils with foreign-made mineral oils taken in any proportion, which is specified in the table. When mixing up the Soviet-made mineral oils with foreign-made mineral oils (MK-8II and MC-8II with Aeroshell Turbine Oil-2 and Aeroshell Turbine Oil-3), the engine operating time limitation is established to be the same as for the foreign-made mineral oil used in the mixture, independent of its percentage.

(cont'd)

The oil system operation is monitored at the flight engineer's station with reference to the following annunciators and indicators:

OIL PRES (П МАСЛЯ) red light annunciator illuminating when oil pressure drops to 2.2 ± 0.45 kgf/cm².

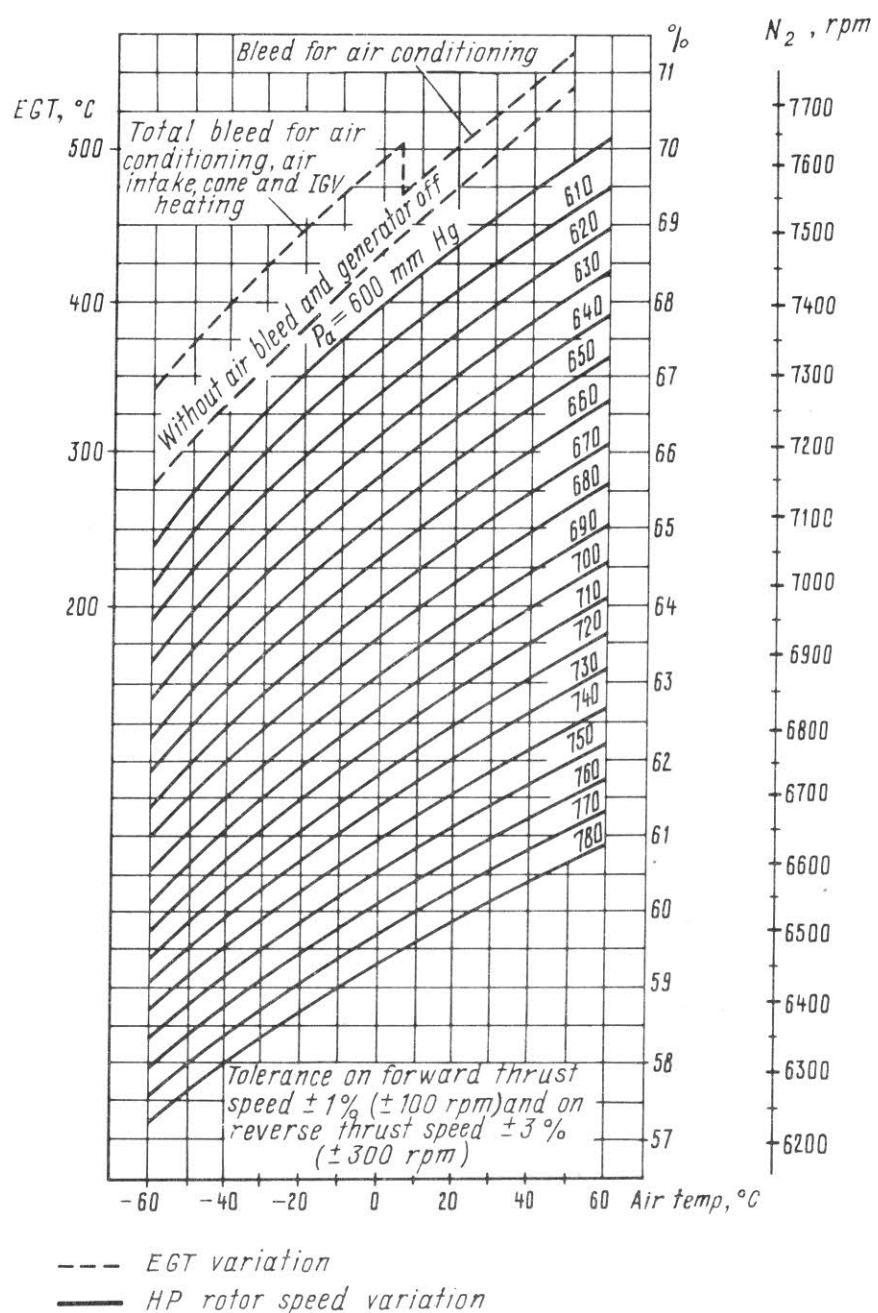
CHIPS IN OIL (СТРУЖКА В МАСЛЕ) red light annunciator illuminating when metal chips appear in the oil.

OIL LEVEL (УРОВЕНЬ МАСЛА) red light annunciator illuminating when the tank oil level drops to 8 ± 1 liters or rises up to 34 ± 1 liters.

ENG 1, ENG 2, ENG 3 (1 ДВ, 2 ДВ, 3 ДВ) oil quantity indicators showing the oil quantity in the oil tanks.

Three-pointer engine gauge units indicating the oil pressure and temperature (Ref. Fig. 9.2.2.10).

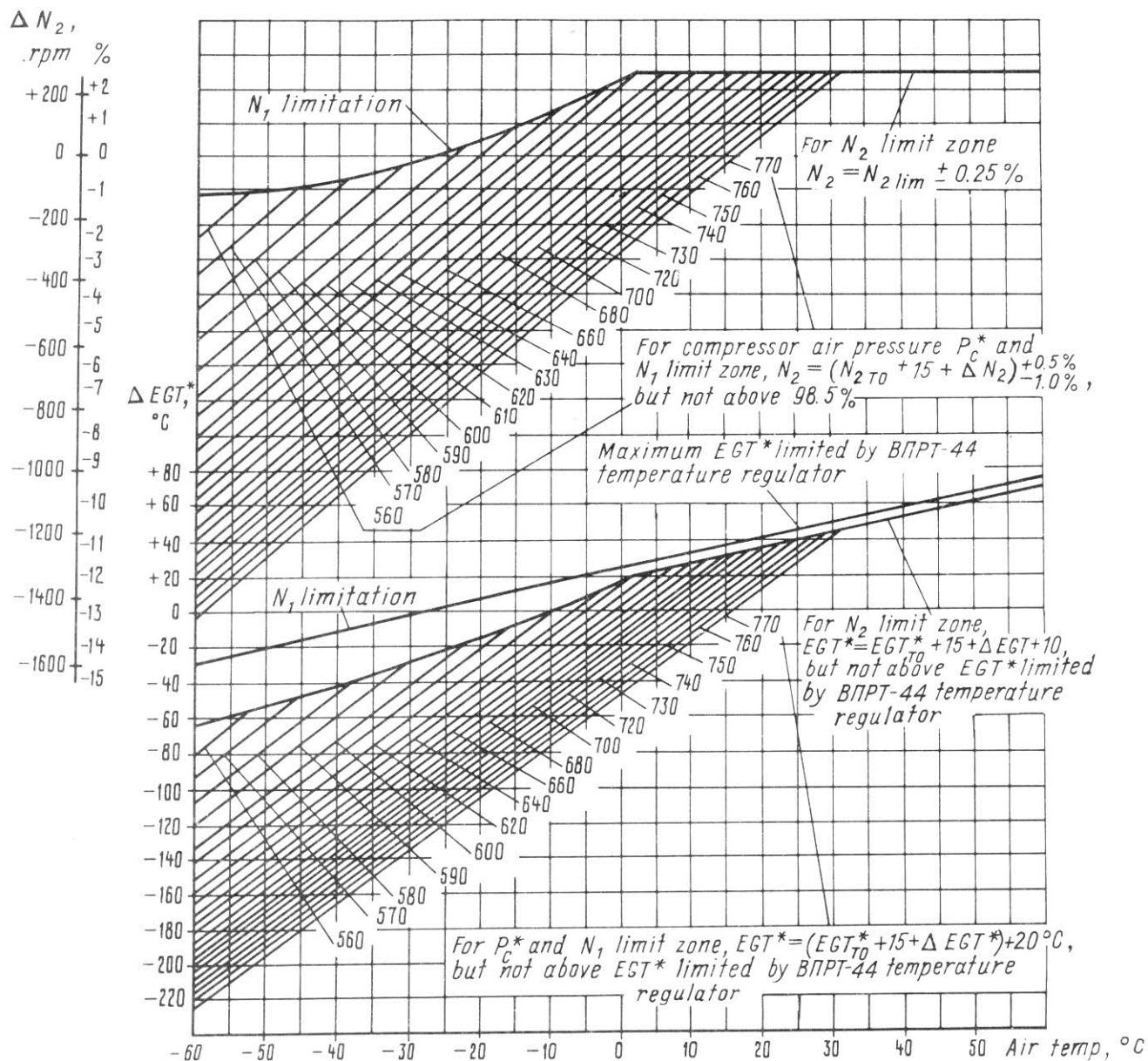
(cont'd)



Change of Exhaust Gas Temperature and HP Compressor
Rotor Speed at Idle Power Versus
Atmospheric Conditions with Engine Operating on Ground

Figure 8.1.1

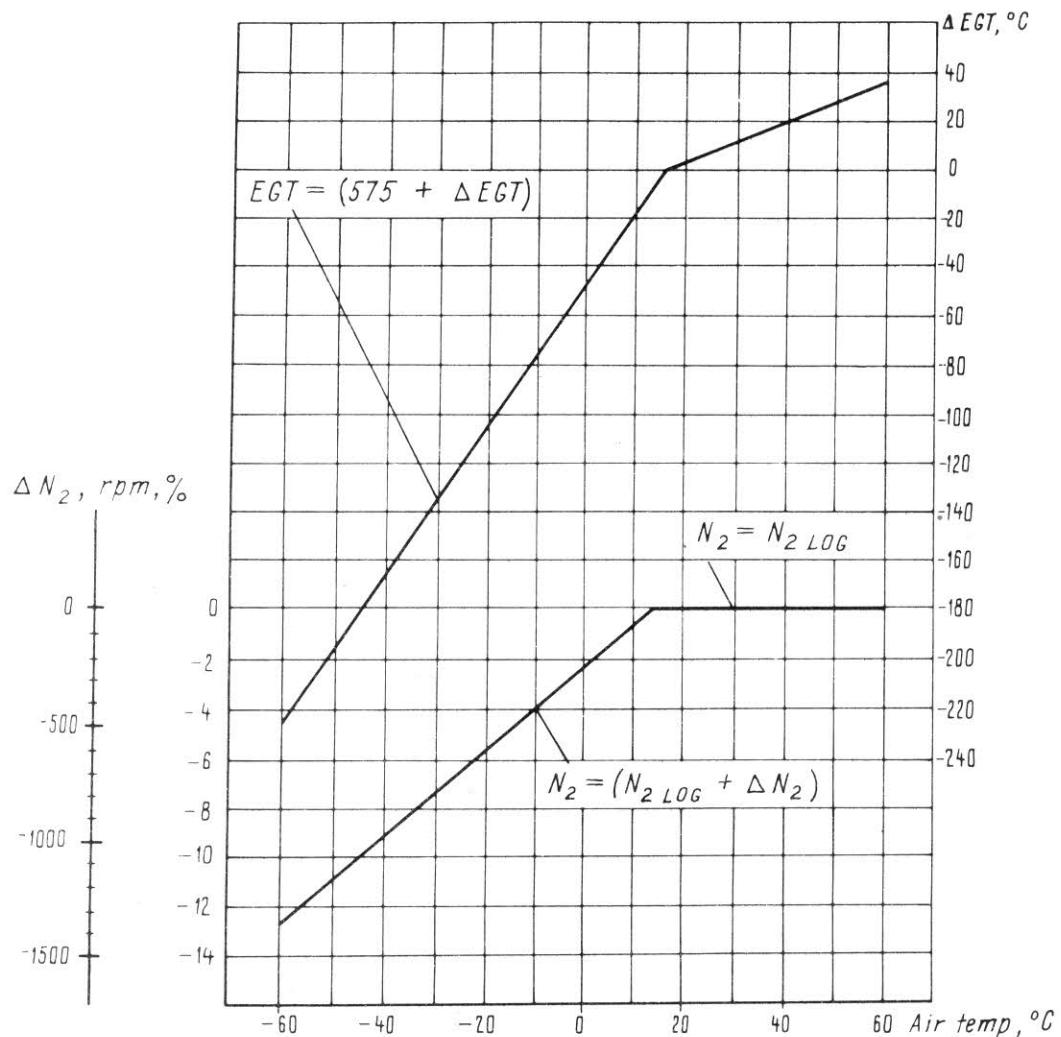
(cont'd)



Change of HP Compressor Rotor Speed and Exhaust Gas Temperature at Takeoff Power Versus Atmospheric Conditions with Engine Operating on Ground

Figure 8.1.2

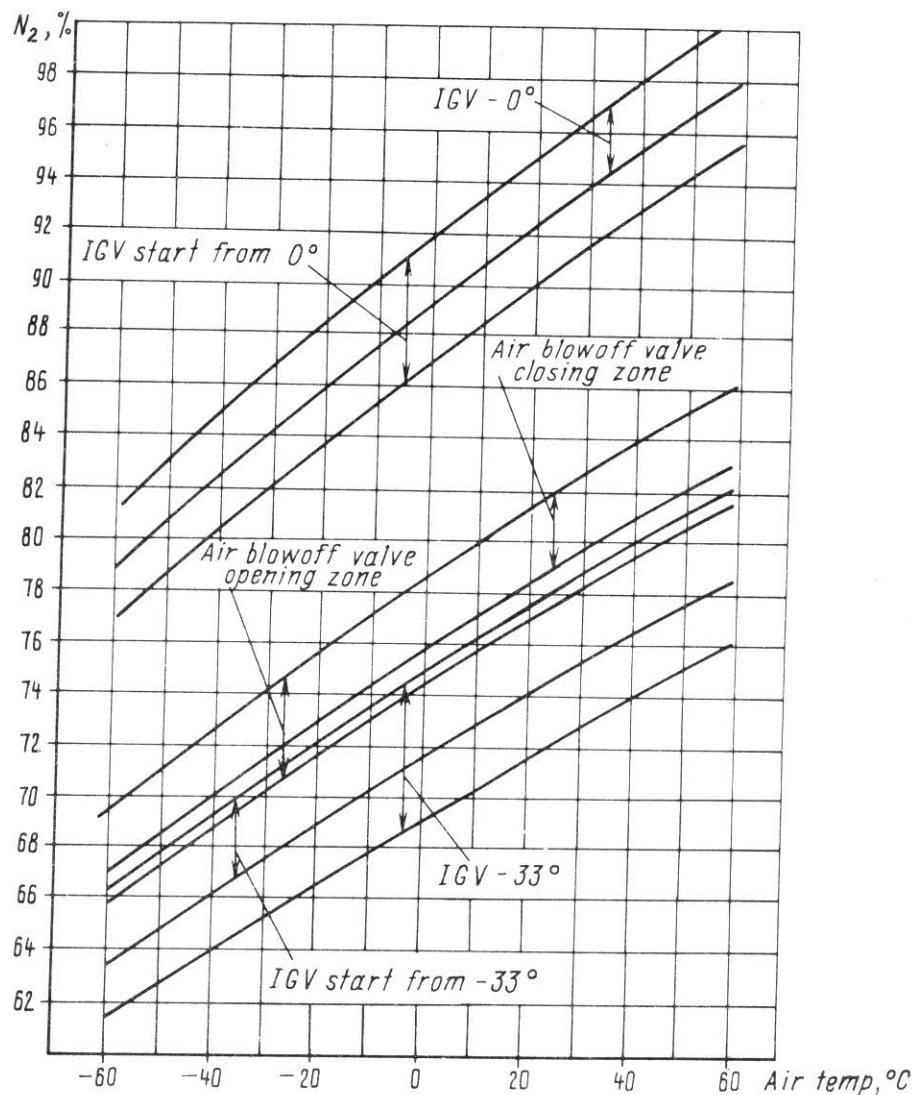
(cont'd)



Change of HP Compressor Rotor Speed and Exhaust Gas Temperature
at Maximum-Continuous and Cruising Powers Versus Ambient
Air Temperature with Engine Operating on Ground

Figure 8.1.3

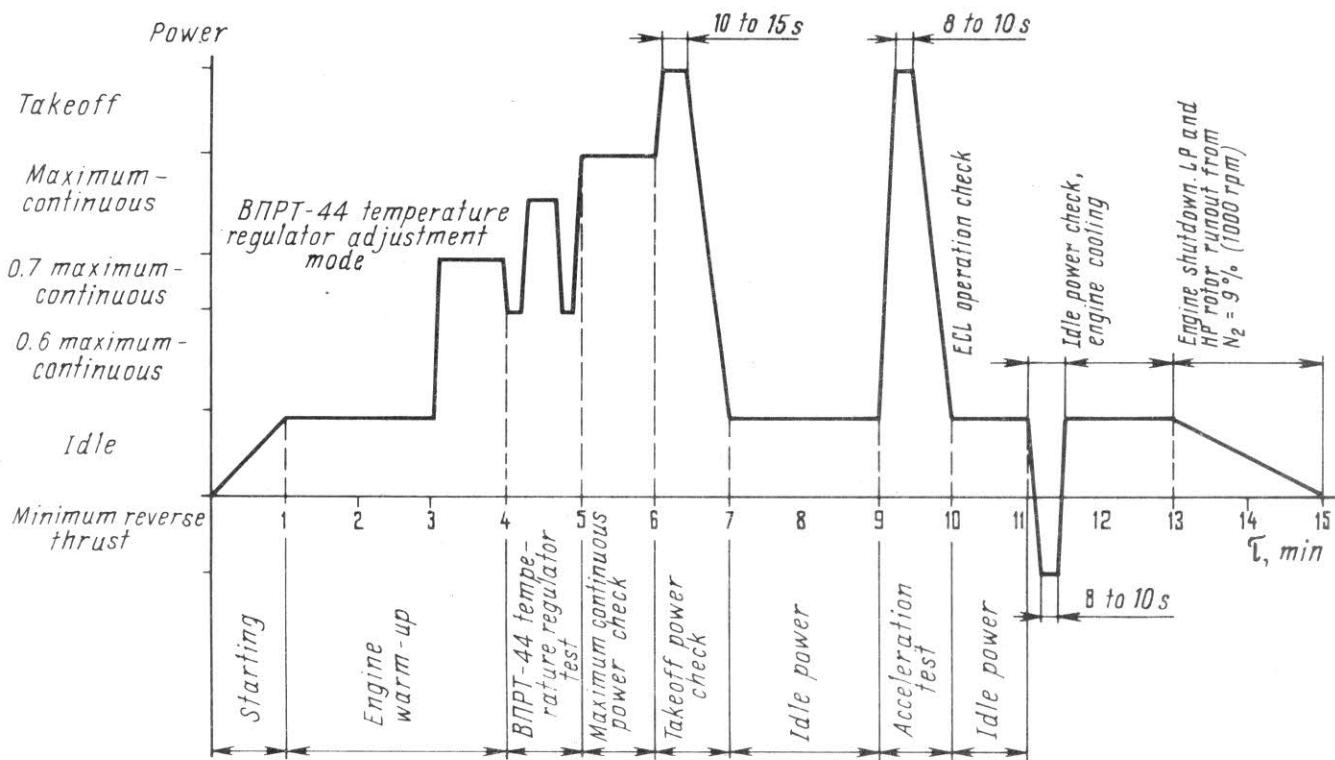
(cont'd)



Change of HP Compressor Rotor Speed, at Air Blowoff Valve Closing and Opening, and IGVs Starting to Move and Setting in -33° and 0° Positions, Versus Ambient Air Temperature, at Smooth Increase/Decrease of Engine Power

Figure 8.1.4

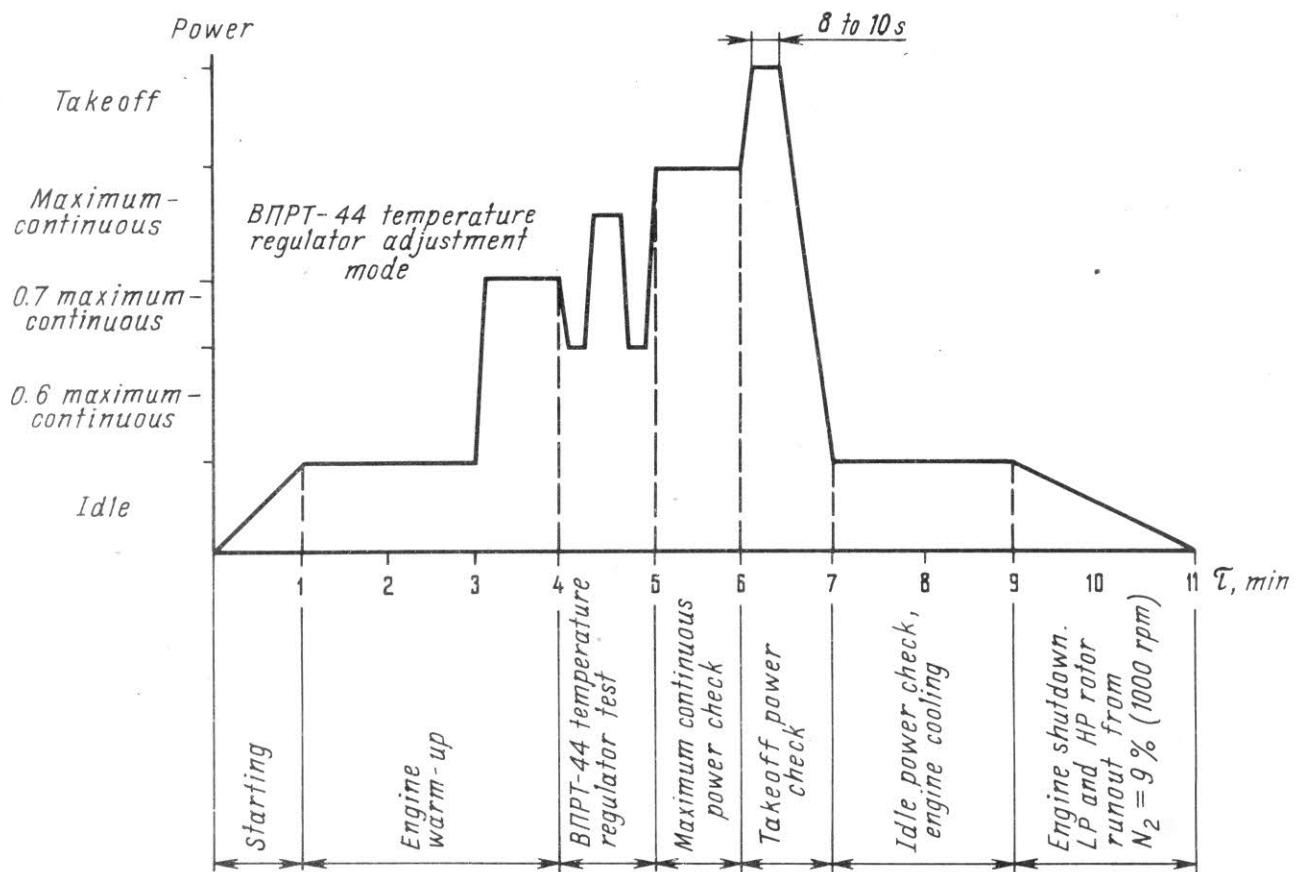
(cont'd)



Engine Ground-Test Chart (Full Cycle)

Figure 8.1.5

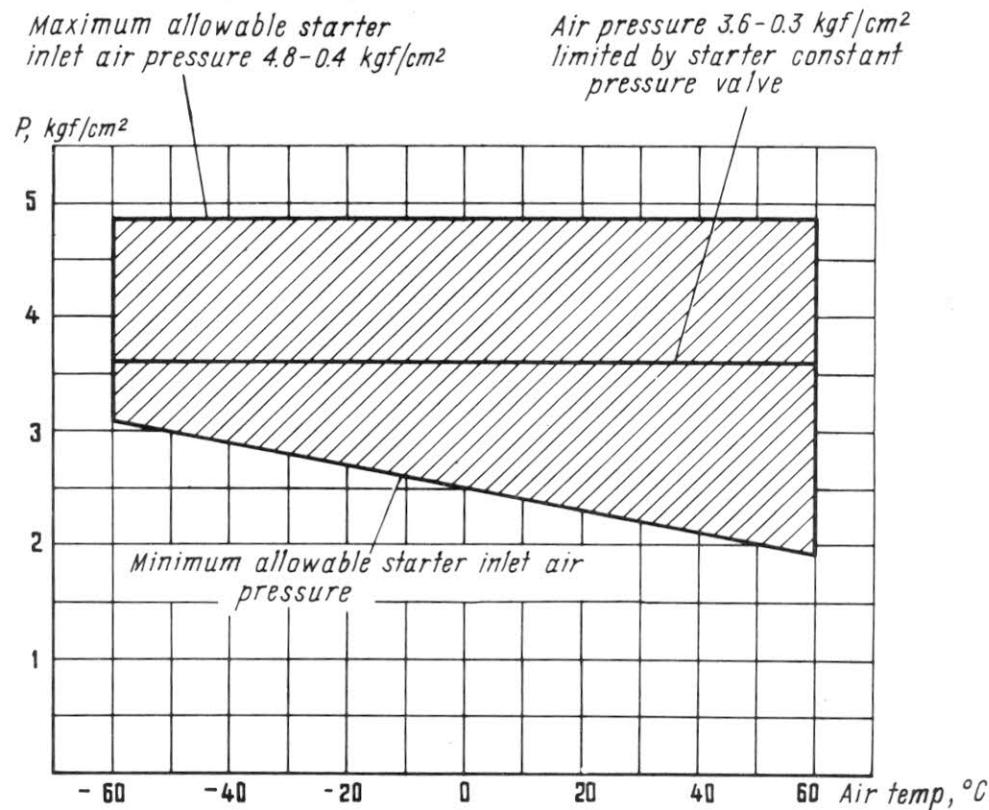
(cont'd)



Engine Ground-Test Chart (Abridged Cycle)

Figure 8.1.6

(cont'd)



Air Starter Inlet Air Pressure When Starting Engine

Figure 8.1.8

Ty-154M

8.2. AUXILIARY POWER UNIT (APU)

8.2. AUXILIARY POWER UNIT (APU)

8.2.1. Operational Limitations

Characteristic	Unit of measure	Minimum	Normal	Maximum
(1) Preparation for engine start on the ground and in flight:				
A/C electrical system DC voltage prior to start	V	In compliance with 8.6.1	-	-
Oil tank temperature	°C	-25	-	-
<u>CAUTION: STARTING AT OIL TEMPERATURE BELOW MINUS 25 °C IS FORBIDDEN.</u>				
Quantity of oil in oil tank		LO OIL LEVEL (MACJIA MAJO) light annun- ciator shall not be illu- minated		
<u>CAUTION: TAKE OFF WITH "LO OIL LEVEL" (MACJIA MAJO) LIGHT ANNUNCIATOR ILLUMINATED IS FORBIDDEN.</u>				
Time of descent to APU start altitude since transition of A/C electrical system to storage battery supply	min	-	-	8
(2) Start on the ground and in flight:				
Exhaust gas temperature:				
On the ground	°C	-	-	680
In flight	°C	-	-	Till automatic stop, but not more than 700
Rotor speed:				
On the ground	%	-	-	103 with subsequent drop to 99+1 in not more than 3 s

(cont'd)

Characteristic	Unit of measure	Minimum	Normal	Maximum
In flight	%	-	-	Till automatic shutdown, but not higher than 108
Time required to gain idle speed (till NORMAL SPEED (ВЫХОД НА РЕЖИМ) light annunciator becomes illuminated)	s	32	-	37
Starting altitude	m	-	-	3000
Airplane speed during APU start	km/h	400	-	525
Number of successive starts on the ground from external power source		-	-	7
Interval between first five starts	min	1	-	-
Interval after 5th start	min	15	-	-
Interval after 6th start	min	1	-	-
Interval after 7th start	min	Starter-generator cooling down to ambient temperature		
Number of successive starts on the ground from storage batteries		-	-	3
Interval between starts	min	3	-	-
<u>CAUTION: TAKE OFF WITH STORAGE BATTERIES DISCHARGED BY MORE THAN THREE STARTS OR CRANKINGS IS FORBIDDEN.</u>				
Number of successive starts in flight		-	-	1
<u>WARNING: 1. REPEATED IN-FLIGHT START FROM STORAGE BATTERIES IS FORBIDDEN.</u>				
<u>2. POST-LANDING START IS ALLOWED ONLY AFTER REVERSE THRUST IS SWITCHED OFF, EXCEPT FOR IN-FLIGHT USE OF APU BECAUSE OF EMERGENCY DISENGAGEMENT OR SUCCESSIVE FAILURE OF THREE GENERATORS OF MAIN AIRPLANE ENGINES.</u>				
(3) Idle condition on the ground and in flight:				
Exhaust gas temperature	°C	-	-	460

(cont'd)

Characteristic	Unit of measure	Minimum	Normal	Maximum
Rotor speed	%	98	-	100
Time of warm-up at idle speed till load connection	min	1	-	-
<u>NOTE:</u> In flight, under complicated or emergency conditions, it is allowed to connect loads immediately after NORMAL SPEED (ВЫХОД НА РЕЖИМ) light annunciator illuminates.				
(4) Load conditions on the ground and in flight:				
Flight altitude	m	-	-	9000
Flight speed	km/h	-	-	575
Exhaust gas temperature	°C	-	-	550
Rotor speed:	%			
On the ground and in flight at altitudes up to 3000 m		97	-	101
In flight at altitudes higher than 3000 m		-	-	103.5
<u>NOTE:</u> At load connection or sharp variation, permissible speed deviation is 3 % maximum, provided steady speed shall be recovered in not more than 3 s.				
Time of continuous operation	h	-	-	5
Oil temperature in oil tank	°C	-	-	115
AC generator loading current on the ground with simultaneous air bleed for main engine starting or into air conditioning system and in-flight generator loading current	A	In compliance with 8.6.1		
<u>CAUTION:</u> AIR BLEED FOR SIMULTANEOUS MAIN ENGINES STARTING AND FOR AIR CONDITIONING IS FORBIDDEN.				
Time of APU idle operation after load is removed	min	1	-	-

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Auxiliary Power Unit (APU)

Characteristic	Unit of measure	Minimum	Normal	Maximum
(5) Cranking				
Rotor speed	%	19	-	23
Cranking cycle	s	-	-	32
(6) APU shutdown				
Time of rotor run-down from speed of 30 % to 10 %	s	14	-	-

(cont'd)

8.2.2. Normal Procedures

CONDITION (PROCEDURE)	REQUIRED ACTION
(1) Prior to starting on the ground	<p>Interphone system to communicate with ground signaller - ON</p> <p>All circuit breakers relating to start - Check for ON</p> <p>External power supply or storage batteries - Switch ON as instructed in 8.6.2</p> <p>External power supply or storage battery voltage - Check according to 8.6.2</p> <p>Fire extinguishing system - Check and switch ON as instructed in 8.15</p> <p>ANNUNC LAMP TEST (КОНТРОЛЬ ЛАМП ТАБЛО) button - Press and release</p> <p>With button depressed make sure that light annunciators are - OK</p> <p>START-OFF (ЗАЛУЧК-ВЫКЛ) selector switch - Select to START (ЗАЛУЧК)</p> <p>Illumination of light annunciators INTAKE OPEN (СТВОПКИ ОТКРЫТЫ), READY TO START (ГТОВ К ЗАЛУЧКУ) - Check</p> <p>Light annunciators LO OIL LEVEL (МАСЯ МАЛО) and TCH CONV FAIL (ИТА-6М НЕИСПРАВ)</p> <p>Oil temperature - Check according to 8.2.1 (1)</p> <p>START - CRANK (ЗАЛУЧК - ХОД ПРОКР) selector switch - Select to START (ЗАЛУЧК)</p> <p>Illumination of light annunciator FUEL PRES (П ТОЛЮМБА) - Check</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
(2) APU ground start	<p>START (ЗАПУСК) button</p> <p>- Press button and keep it depressed for 2 to 3 s, starting stop-watch at the same time</p> <p>Monitor APU starting process with reference to instruments, light annunciators and stop-watch. Annunciator NORMAL SPEED (ВЫХОД НА РЕЖИМ) should light up at rotational speed 90%. If engine start is accompanied by a surge of turbine outlet gas temperature over 570°C, light annunciator NORMAL SPEED (ВЫХОД НА РЕЖИМ) may illuminate with delay of up to 10 s after engine gains idle rpm.</p>
(3) APU in-flight start	<p>Flight conditions with regard to altitude and IAS</p> <p>- Check and adjust</p> <p>Oil temperature</p> <p>- Check</p> <p>A/C electrical system DC voltage, when supplied from storage batteries or rectifier</p> <p>- Check according to 8.6.1</p> <p>START - OFF (ЗАПУСК - ВЫКЛ) selector switch</p> <p>- Select to START (ЗАПУСК)</p> <p>Illumination of light annunciators INTAKE OPEN (СТВОРОКИ ОТКРЫТЫ), READY TO START (ГОТОВ К ЗАПУСКУ)</p> <p>- Check</p> <p>Annunciators LO OIL LEVEL (МАСЛА МАЛО) and TCH CONV FAIL (ИТА-6М - НЕИСПРАВ)</p> <p>Must not illuminate</p> <p>START - CRANK (ЗАПУСК - ХОД ПРОКР) selector switch</p> <p>- Select to START</p> <p>Light annunciator FUEL PRES (P ТОПЛИВА) illuminates</p> <p>- Check</p> <p>START (ЗАПУСК) button</p> <p>- Press and keep button depressed for 2 to 3 s,</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	starting stop-watch at the same time
	APU starting process with reference to instruments, light annunciators and stop-watch
	Light annunciator NORMAL SPEED (ВЫХОД НА РЕЖИМ) should light up at rotational speed 90% after exhaust gas temperature reduces below 570°C.
(4) Switching ON (OFF) of AC electrical power collection on the ground and in flight	In compliance with 8.6.2.
(5) Engagement of air bleed on the ground	AIR BLEED - CLOSE (ОТБОР ВОЗДУХА - ЗАКРЫТЬ) selector switch - Select to AIR BLEED (ОТБОР ВОЗДУХА) for 7 to 8 s
	Extinguishing of light annunciator READY TO START (ГОТОВ К ЗАПУСКУ) - Check
	Air conditioning or main engines starting system - Switch on as instructed in 8.1.2 or 8.11.2
(6) Disengagement of air bleed system on the ground	Air conditioning system - Switch off according to 8.11.2
	AIR BLEED - CLOSE (ОТБОР ВОЗДУХА - ЗАКРЫТЬ) selector switch - Set to CLOSE (ЗАКРЫТЬ) till illumination of light annunciator READY TO START (ГОТОВ К ЗАПУСКУ)
(7) Engagement (disengagement) of various power consumers	Engagement (disengagement) of air bleed in line with switching ON (or OFF) of AC electrical power may be carried out in any succession
(8) Monitoring of engine operation under various power conditions	Monitor engines operation visually with reference to instruments and light annunciators.

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	With engine running at steady-state operating conditions on the ground, periodic check of its operating parameters (every 10 to 15 minutes) is allowable.
(9) Engine shutdown on the ground	<p>Air bleed and electrical power consumers</p> <p>- Turn off</p> <p>Under engine idle power for at least 1 minute</p> <p>- Operate</p> <p>SHUTDOWN (СТОП) button</p> <p>- Press and keep depressed for 2 to 3 s</p> <p>Engine rotor run-down time</p> <p>- Measure</p> <p>START - CRANK (ЗАПУСК - ХОД ПРОКР) selector switch</p> <p>- Select to CRANK (ХОД ПРОКР)</p> <p>Extinguishing of light annunciator FUEL PRES (Р ТОПЛИВА)</p> <p>- Check</p> <p>START - OFF (ЗАПУСК - ВЫКЛ) selector switch after engine rotor comes to complete standstill</p> <p>- Select to OFF</p> <p>INTAKE OPEN (СТВОРОКИ ОТКРЫТЫ) light annunciator</p> <p>- Check for extinguishing</p>
(10) Cranking	<p>Prepare engine for starting</p> <p>- Perform in accordance with 8.2.1 (1)</p> <p>START - CRANK (ЗАПУСК - ХОД ПРОКР) selector switch</p> <p>- Select to CRANK (ХОД ПРОКР)</p> <p>START (ЗАПУСК) button</p> <p>- Press and keep it depressed for 2 to 3 s, having started stop-watch at the same time</p> <p>Cranking time</p> <p>- Check</p> <p>Cranking speed</p> <p>- Check</p>

(cont'd)

8.2.3. Troubles

TROUBLE	CORRECTIVE ACTION	
(1) In starting:		
Starting time exceeds permissible time (on the ground)	SHUTDOWN (CTOII) button	- Press
Fuel fails to ignite	SHUTDOWN (CTOII) button	- Press
Exhaust gas temperature is equal to or exceeds 550°C at rotor speed up to 40%	SHUTDOWN (CTOII) button	- Press
Exhaust gas temperature is equal to or exceeds 680°C at rotor speed over 40%	SHUTDOWN (CTOII) button	- Press
Failure to gain 45% rpm within 32 s	SHUTDOWN (CTOII) button	- Press
(2) Starting, idling and power loading on APU:		
Engine surge	SHUTDOWN (CTOII) button	- Press
Fire in APU compartment	SHUTDOWN (CTOII) button	- Press
Automatic shutdown accompanied by illumination of light annunciators LIMIT TEMP (ПРЕДЕЛЬН ТЕМПЕРАТ), MAX RPM (ПРЕДЕЛЬН ОБОРОТЫ), or OIL PRES (Р МАСЛА)	SHUTDOWN (CTOII) button	- Press

(cont'd)

TROUBLE	CORRECTIVE ACTION	
Illumination of light annunciator TCH CONV FAIL (ПТА-6А НЕИЧИПАБ):		
On the ground	SHUTDOWN (CTOII) button	- Press
Under critical or emergency conditions in flight	Take good care that vital operating parameters are not exceeded.	
Illumination of light annunciator LO OIL LEVEL (МАСЛЯ МАЛО)		
On the ground	Operation for not over than 2 hours is allowed	
Under critical or emergency conditions in flight	Operation till automatic shutdown is allowable.	
Exhaust gas temperature exceeds permissible limit:		
On the ground	SHUTDOWN (CTOII) button	- Press
Under critical or emergency conditions in flight	Operation till automatic shutdown is allowable, if exhaust gas temperature does not exceed 570°C. As temperature rises to 570°C press SHUTDOWN (CTOII) button.	
Rotor speed exceeds permissible limits:		
On the ground	SHUTDOWN (CTOII) button	- Press
Under critical or emergency conditions in flight	Operation till automatic shutdown is allowed with rotor rpm not exceeding 108%. As rotational speed rises to 108% press SHUTDOWN (CTOII) button. After engine is shutdown, do not restart it, until the cause of trouble is revealed and eliminated.	

(cont'd)

8.2.4. Brief Description

- (1) The auxiliary power unit (APU) is arranged in the aft non-pressurized part of the fuselage, being intended to fulfil the following functions:

Ensure pneumatic starting of the main engines on the ground.

Supply compressed air into the air conditioning system.

Provide AC electric power supply into the aircraft electrical system on the ground and, if need arises, in flight.

The auxiliary power unit consists of a gas turbine engine and systems designed for attachment of the engine, for intake of atmospheric air and delivery it to the compressor, for discharge of exhaust gas outboard, for starting and operation of the engine under service conditions.

The gas turbine engine is of a single rotor type with air bleed from the compressor. Mounted on the engine reduction gear are a starter-generator operating in the starter mode only and an AC generator.

- (2) The starting system is designed to effect automatic starting, cranking and false start of the APU. It comprises the following principal elements:

Starter-generator.

Igniters with ignition plugs.

APU start control panel.

Starter-generator control panel.

Ignition unit.

- (3) The oil system is of the self-contained, circulating, pressure-feed type providing lubrication of the fan, reduction gear, lubrication and cooling of the engine bearings. It comprises the following components:

Oil tank.

Oil pump.

Air-cooled oil cooler.

Centrifugal breather.

The oil grades used in the APU oil system are identical with those specified for use in the main engine oil system. The oil system provides for the automatic single-point filling of the oil tank with oil.

- (4) The fuel system is designed to ensure automatic supply of fuel in the combustion chamber according to a preset law of fuel flow rate change in the course of starting and under steady-state operating conditions as well as to automatically

(cont'd)

maintain constant actual rpm of the rotor with a preset accuracy under all operating conditions.

The fuel system comprises the following basic elements:

Fuel filter.

Fuel control unit.

Starting and main fuel control solenoid valves.

The APU fuel system makes use of the same fuels the main engines do.

- (5) The engine air bleed and compressor blow-off control system provides for surge-less operation of the compressor under all operating conditions of the engine, for air bleed control and limitation. The system comprises the following elements:

Air bleed regulator.

Air bleed system.

The check/measuring equipment and controls of the APU are arranged on the APU start control panel of the flight engineer's control panel (Fig. 9.2.2.15) and comprise the following elements:

START - OFF (ЗАПУСК - ВЫКЛ) selector switch, catering for opening and closing the air intake shutters and exhaust system shutters as well as for starting system fuel control.

START - CRANK (ЗАПУСК - ХОД ПРОКР) selector switch used to switch on (off) the fuel booster pump and to open (close) the fuel shut-off valve.

AIR BLEED - CLOSE (ОТБОР ВОЗДУХА - ЗАКРЫТ) selector switch intended to open (close) the air bleed regulator shutters.

START (ЗАПУСК) button whose function is to supply electric power to the APU start control panel.

SHUTDOWN (СТОП) button used to deenergize the APU start control panel.

ANNUNC LAMP TEST (КОНТРОЛЬ ЛАМП ТАБЛО) button used to check annunciator lamps for condition.

Engine rotor speed indicator.

Exhaust gas temperature gage.

Engine inlet oil temperature indicator.

(cont'd)

Light annunciators INTAKE OPEN (СТВОРКИ ОТКРЫТЫ), OIL PRES (P MACJA), READY TO START (ГТОВ К ЗАПУСКУ), NORMAL SPEED (ВЫХОД НА РЕЖИМ), START APU (ЗАПУСТИ БСУ) (illuminates on the ground as soon as the LG wheels blower is on), LO OIL LEVEL (МАСЛА МАЛО), OIL PRES (P MACJA), LIMIT TEMP (ПРЕДЕЛ ТЕМПЕРАТ), MAX RPM (ПРЕДЕЛ ОБОРОТЫ), TCH CONV FAIL (ПТА-6М НЕИСПРАВ).

In the course of engine start and operation under normal service conditions all its operating parameters are monitored by special follow-up systems enabling an automatic shutdown of the engine under the following critical conditions:

At exhaust gas temperature within $700 \pm 8^{\circ}\text{C}$ in the course of starting and at $570 \pm 8^{\circ}\text{C}$ after idle speed rating is gained, which is accompanied by illumination of light annunciator LIMIT TEMP (ПРЕДЕЛ ТЕМПЕРАТ).

At engine rotor speed within $105^{+3}_{-1}\%$ in line with illumination of the MAX RPM (ПРЕДЕЛ ОБОРОТЫ) light annunciator.

If oil pressure rises to $3.2 \pm 0.4 \text{ kgf/cm}^2$ at rotor speed amounting to or exceeding 90%, which is accompanied also by illumination of the OIL PRES (P MACJA) light annunciator.

Besides, the engine is automatically shut down, the air intake and exhaust pipe shutters close, the fuel booster pump is switched off and the fuel shut-off valve closes simultaneously in response to a signal obtained from the fire extinguishing system (the FIRE (ПОЖАР) warning annunciator and APU switch-light become illuminated).

The engine is cranked with the aim of purging out fuel from the combustion chamber and cooling the engine. Cranking is accomplished in the following cases:

After unsuccessful start.

After "false" start.

In case of post-shutdown burning of fuel or oil in the engine (detected visually by smoke issuing from the exhaust pipe).

1 to 3 minutes before engine restart, if the engine exhaust gas temperature is still equal to or exceeds 70°C .

Ty-154M

8.3. FUEL SYSTEM

8.3. FUEL SYSTEM

8.3.1. Operational Limitations

Characteristic	Unit of measure	Minimum	Normal	Maximum
(1) Unusable fuel: In case of constrained switching-off of three generators If three generators fail in succession	kg	-	-	700
(2) Fuel level maintained in service tank automatically or manually	kg	3150	-	3300
(3) Fuel reserve at which light annunciators illuminate	kg	2500	-	3300

(cont'd)

8.3.2. Normal Procedures

CONDITION (PROCEDURE)	REQUIRED ACTION
(1) External visual inspection of airplane	<p>Make sure that:</p> <p>Engine cowlings - No evidence of fuel or oil leaks</p> <p>In places where fuel tanks, fuel system units and pipelines are located - No leaks</p> <p>Vent and drain holes - Clean</p> <p>Switches on refueling control panel - OFF</p> <p>Access doors of pressure refuel couplings and refueling control panel - Closed</p> <p>Fuel system drains - Fuel sediment is drained</p> <p><u>CAUTION: CHECK AMOUNT OF FUEL IN TANK No. 4 FOR COMPLIANCE WITH PAYLOAD.</u></p> <p>Fuel tank filler caps (if over-wing fueling has been performed) - Closing</p> <p>Shutters of fuel overflow spill valves - Closed</p>
(2) Internal checks	PROPORTIONER (ПРИНУД ВКЛ ПОРЦ) switch - OFF and closed with cap switch
(3) Before engine start	<p>FUEL FR TANK No. 1 (РАСХОД ИЗ БАКА № 1) and 2500 KG FUEL RESERVE (ОЧТАТОК ТОПЛИВА 2500) annunciators proper condition - Check and adjust maximum light intensity</p> <p>Condition of standby fuel transfer system valves - Check</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>To this aim:</p> <p>FUEL TO TANK 1 STBY TRANSF VLVS - Select to OPEN (ОТКРЫТО) (КРАНЫ РЕЗЕРВНОЙ ПЕРЕКАЧКИ В БАК № I) selector switch</p> <p>Two amber light annunciators - ON LEFT (ЛЕВ) and RIGHT (ИПАВ)</p> <p>FUEL TO TANK 1 STBY TRANSF VLVS - Select to CLOSED (КРАНЫ РЕЗЕРВНОЙ ПЕРЕКАЧКИ В БАК № I) selector switch (ЗАКРЫТО) and cap</p> <p>Amber light annunciators LEFT - Go out (ЛЕВ) and RIGHT (ИПАВ)</p>
	<p>FUEL QTY IND (ТОПЛИВОМЕР) switch - Set to ON</p> <p>Buttons Z (H) and M (P) on fuel - Press in turn quantity indicator</p> <p><u>CAUTION: NEVER PRESS Z AND M BUTTONS SIMULTANEOUSLY.</u></p> <p>Fuel quantity indicator pointers - Be certain should travel to scale zero and maximum points accordingly</p> <p>After buttons are released, the fuel quantity indicator pointers should return to initial position.</p> <p>Amount of fuel in tanks for compliance with flight assignment with reference to fuel quantity indicators - Check</p>
	<p>FUEL MNGM (ABT PACX) switch - Set to ON</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>As a consequence, red light annunciator FUEL MNGM INOP (AP НЕ РАБ) must go out and respective amber light annunciators TANK USAGE (ПОРЯДОК РАСХОДА) should come on, depending on amount of fuel in each tank.</p> <p>AUTO - MAN (АВТОМАТ - РУЧНОЕ) - Select to AUTO selector switch</p> <p>As a result, the following three versions of operation of light annunciators, depending on the amount of fuel in tanks, may occur:</p> <p>If amber light annunciator TANK USAGE, TANKS 2 (ПОРЯДОК РАСХОДА, БАКИ № 2) illuminates, fuel transfer pumps of tanks No. 2 should start operating, which is indicated by illumination of tank No. 2 pumps operation light annunciators (green).</p> <p>If amber light annunciators TANK USAGE, TANKS 2 and TANKS 3 (ПОРЯДОК РАСХОДА, БАКИ № 2 И БАКИ № 3) illuminate, fuel transfer pumps of tanks No. 2 and tanks No. 3 or of tanks No. 3 only should start running, which is indicated by illumination of green light annunciators catering for indication of operating condition of the fuel transfer pumps of the respective fuel tanks.</p> <p>In case amber light annunciators TANK USAGE, TANKS 2, TANKS 3 and TANK 4 (ПОРЯДОК РАСХОДА, БАКИ № 2, БАКИ № 3 И БАК № 4) illuminate, fuel transfer pumps of tank No. 4 should start operating, which is indicated by illumination of green light annunciators catering for indication of operating condition.</p> <p>EQUALIZER (АВТОМАТ ВЫРАВНИВАНИЯ) - ON switch</p> <p>Refer to respective green light annunciator to make sure - Equalizer is serviceable</p> <p>FLOWMETER (РАСХОДОМЕР) switch - Set to ON</p>

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Fuel System

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Be certain that:</p> <p>FG (CT) (fuel grade) selector switch on FLOWMETER (ПАСХОДОМЕР) indicator</p> <p>- Set according to fuel grade in tanks</p> <p>FLOWMETER (ПАСХОДОМЕР) indicator pointer</p> <p>- Set according to T (C) (total) pointer reading of fuel quantity indicator</p> <p>SHUTOFF VALVES 1, 2, 3 (НЕПРОКЛЮЧАЮЩИЕ КРЫВИЕ КРАНЫ 1, 2, 3) switches</p> <p>- Set to OPEN (ОТКРЫТО) in turn</p> <p>Illumination of respective green light annunciators is indicative of open position of the valves.</p> <p>SERVICE TANK 1 (ПАСХОДНЫЙ БАК № 1) switches 1, 2, 3 4</p> <p>- Turn on one by one</p> <p>Illumination of respective green light annunciators is indicative of pump operation (pump operates if light annunciator is ON).</p> <p>AUTO - MAN (АВТОМАТ - РУЧНОЕ) selector switch</p> <p>- Select to MAN</p> <p>Turn on switches TANK 2, TANK 3 (LEFT and RIGHT), TANK 4 (БАК 2, БАК 3 (ЛЕВ И ПРАВ), БАК 4) in turn</p> <p>- Illumination of green light annunciators is indicative of pumps operation</p> <p>Green light annunciator illuminates</p> <p>- Pump is running (with fuel amount in the tank)</p> <p><u>NOTE:</u> When checking fuel transfer pumps for operation, refer to applicable fuel quantity indicators to observe amount of fuel in tanks No. 1 and No. 2, which should not change.</p> <p>Any increase of fuel quantity in tanks is indicative of the fact that:</p> <p style="padding-left: 20px;">fuel-to-tank 1 standby transfer valves are closed or proportioner valves are faulty.</p>

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Fuel System

CONDITION (PROCEDURE)	REQUIRED ACTION
	AUTO - MAN (АВТОМАТ - РУЧНОЕ) selector switch - Select to AUTO Check APU fuel pump for operation, for which purpose do the following: START (ЗАПУСК) switch (on APU start control panel) - Set to ON START - CRANK (ЗАПУСК - ХОЛ ПРОБК) selector switch - Apply to START (ЗАПУСК) Illumination of green light annunciator FUEL PRES (Р ТОЛЖВА) on APU start control panel is indicative of pump serviceability.
(4) After starting the engines	TANK USAGE (ПОРЯДОК РАСХОДА) and fuel pump operation light annunciations - Come on according to sequence of fuel usage from tanks
(5) At lineup	Carry out checks according to Item (4) of this Sub-Section.
(6) Fuel handling in flight	<p>CAUTION: 1. DURING ALL STAGES OF FLIGHT (CLIMB, LEVEL CRUISE FLIGHT, DESCENT, INITIAL AND FINAL APPROACH) IT IS THE DUTY OF THE FLIGHT ENGINEER EVERY 15 MINUTES OF FLIGHT TO ESTIMATE FUEL SYSTEM SERVICEABILITY, INFORM THE CREW ON FUEL SYSTEM OPERATING CONDITIONS, FUEL QUANTITY IN SERVICE TANK AND ON FUNCTIONING OF FUEL BOOSTER AND TRANSFER PUMPS. INFORM THE PILOT ON DETECTED MALFUNCTIONS OF FUEL SYSTEM AT ONCE.</p> <p>2. IF BEFORE TAKEOFF THE TANKS ARE FILLED WITH 25 T OF FUEL, MAXIMUM, THEN, DURING CLIMB THE PUMPS OF TANKS No. 3 MAY BE SWITCHED ON AS SOON AS THE AMOUNT OF FUEL IN TANKS No. 2 IS ABOUT 3000 KG.</p> <p>WARNING: KEEP "FUEL MNGM" (АВТ РАСХ) AND "SERVICE TANK 1" (ПАРХОДНЫЙ БАК № 1) SWITCHES 1, 2, 3, 4 TURNED ON THROUGHOUT THE FLIGHT.</p> <p>Fuel quantity in tanks with reference to fuel quantity and flowmeter indicators - Check fuel contents regularly</p> <p>Uneven consumption of fuel from symmetrical tanks No. 2 and No. 3 - Turn on equalizer</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>This must be followed by illumination of respective green light annunciator (Ref. 8.3.4.5(b)).</p> <p>If JET-A fuel is used in the airplane tanks, be careful not to allow its temperature to be below minus 35°C. To preclude formation of ice needles in fuel JET-A or its blends with JET-A fuel exceeding 20% total amount of fuel, do the following:</p> <ul style="list-style-type: none"> (a) Plan the flight route and select altitude of flight, proceeding from anticipated weather conditions so as to avoid flying in zones with ambient air temperatures below minus 55°C which corresponds to air stagnation temperature minus 35°C as read off the outside air temperature indicators located on the pilot's and flight engineer's instrument panels. (b) The flight engineer should periodically monitor outside air stagnation temperature and temperature of fuel in tanks. (c) The flight engineer should inform the pilot, if fuel temperature in tanks drops to 35°C below zero. The pilot should take measures to increase the fuel temperature by reducing the flight altitude or changing the route of flight, which must be agreed to with the air traffic control service; a clearance must be obtained for the change in flight. (d) In case of inadvertent reduction of air stagnation temperature to 35°C subzero, increase the flying speed to exclude further reduction of fuel temperature. (e) After fuel is consumed from tanks No. 3, in which fuel temperature sensors are installed, and fuel usage from tank No. 4 commences, adhere to the instructions outlined above in Item (d). (f) To effect automatic control of fuel pumps, make sure that: <ul style="list-style-type: none"> SERVICE TANK 1 (РАСХОДНЫЙ) - Are ON BAK № 1) switches 1, 2, 3, 4 Fuel transfer pump switches - Are ON TANK 2, TANK 3 (LEFT and

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>RIGHT), TANK 4 (БАК № 2, БАК № 3 (ЛЕВ И ПРАВ), БАК № 4)</p> <p><u>NOTE:</u> To perform flying with no fuel consumed from tank No. 4, do not switch on tank No. 4 pumps switch; change over to manual control of fuel pumps after tanks No. 2 are emptied of fuel.</p> <p>AUTO - MAN (АВТОМАТ - РУЧНОЕ) - Select to MAN selector switch</p> <p>Operation of fuel pumps and functioning of equalizer with reference to respective green light annunciators and in accordance with a preset fuel usage schedule - Monitor</p> <p>(g) Change over to manual control of fuel pumps in the following cases:</p> <p>In case of failure of fuel management control system (to ensure required C.G. position).</p> <p>At low fuel remainder (when tanks Nos 2, 3 and 4 are empty and fuel consumption from tank No. 1 begins).</p> <p>In case of early cutting-off of fuel pumps in tank No. 4 (about 600 kg of fuel remains in tank No. 4).</p> <p>In case of premature cutting-off of fuel pumps in tanks Nos 2 and 3 (too little fuel remains in these tanks), when fuel consumption from tank No. 4 or tank No. 1 (if fuel tank No. 4 is empty) begins.</p> <p>After manual balancing the amounts of fuel in tanks Nos 2 and 3 (manual equalization of fuel quantities in identical right and left tanks), if fuel pumps in these tanks fail to operate upon selection of automatic control mode.</p> <p>AUTO - MAN (АВТОМАТ - РУЧНОЕ) - Select to MAN selector switch</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>TANK 2, TANK 3 (LEFT, RIGHT), - Turn on and off in accordance with fuel management schedule TANK 4 (БАК № 2, БАК № 3 (ЛЕВ, ПРАВ), БАК № 4) switches</p> <p>Determine the amount of fuel in tanks by referring to the readings of the respective fuel quantity indicators. Warning of fuel still available in the tank is indicated by the applicable fuel pump operation light annunciator remaining on.</p> <p>(h) When amber light annunciator FUEL FR TANK No. 1 (ПАСХОД ИЗ БАКА № 1) illuminates:</p> <p>Fuel quantity with reference to fuel quantity and flow-meter indicators - Check</p> <p>AUTO - MAN (АВТОМАТ - РУЧНОЕ) - Select to MAN selector switch</p> <p>TANK 2, TANK 3, (LEFT, RIGHT) - Turn on (БАК № 2, БАК № 3 (ЛЕВ, ПРАВ) switches)</p> <p>After relevant green light annunciators go out switches TANK 2, TANK 3 (LEFT, RIGHT) (БАК № 2, БАК № 3 (ЛЕВ, ПРАВ))</p> <p>Landing on nearest airfield - Commit</p>

(cont'd)

8.3.3. Troubles

TROUBLE	CORRECTIVE ACTION	
(1) Green light annunciator of one (two) booster pumps of service tank is (are) dead Pump SERVICE TANK 1 (ПАСХОДНЫЙ БАК № I) switches 1, 2, 3, 4 are ON	Light annunciators With light annunciators in proper condition, switchés of inoperative pumps Observe ammeter (starting current) of suspected pump Faulty pump Engine operating parameters Flight	- Test for condition - Turn OFF and ON - Check current - Turn OFF - Check - Continue
(2) Fadeout of green light annunciator of one fuel transfer pump in tank No. 2 (or two, one in each tank No. 2) with fuel available in tank (tanks)	Light annunciator Fuel transfer with reference to fuel quantity indicator Flight	- Test for condition - Check - Continue
(3) Fadeout of green light annunciators of both fuel transfer pumps in one of tanks No. 2 with fuel available in tank. Pumps are not switched off by equalizer	Light annunciators Refer to fuel quantity indicator, to make sure that fuel is not transferred from tank. With light annunciators in proper condition, have AUTO - MAN (ABTO-MAT - РУЧНОЕ) selector switch Pump switches TANK 2 (LEFT and RIGHT) (БАК № 2 (ЛЕВ и ПРАВ)) <u>NOTE:</u> To determine quantity of fuel available for further flight, subtract fuel quantity in tanks No. 2 from total quantity of fuel remainder.	- Test for condition - Set to MAN (РУЧНОЕ) - OFF - Continue
(4) Fadeout of green light annunciator of one	Light annunciators	- Test for condition

(cont'd)

TROUBLE	CORRECTIVE ACTION
(two) transfer pumps in each tank No. 3 with fuel available in tanks	Fuel transfer with reference to fuel quantity indicator Flight - Check fuel quantity indicator - Continue
(5) Fadeout of green light annunciations of three fuel pumps in one tank No. 3 with fuel available in tank and fuel pumps not switched off by equalizer	Lights annunciations Refer to fuel quantity indicator, to make sure that fuel is not transferred from tank. With light annunciations in proper condition and fuel not transferred from tank, have AUTO - MAN (ABTO-MAT - РУЧНОЕ) selector switch - Test for condition
Pump switches labelled TANK 3 (LEFT and RIGHT) are ON	With light annunciations in proper condition and fuel not transferred from tank, have AUTO - MAN (ABTO-MAT - РУЧНОЕ) selector switch Pump switches TANK 3 LEFT and RIGHT (BAK № 3 ЛЕВ и ПРАВ) - Turn OFF - Perform
	<u>NOTES:</u> 1. To determine fuel reserve available for further flight, subtract fuel quantity in tanks No. 3 from total quantity of fuel remainder. 2. In case fuel reserve is insufficient to accomplish flight mission, it is allowable to transfer more fuel from tanks No. 3 till the fuel quantity difference between identical tanks No. 3 is not over 1000 kg, afterwards switch off pump switches TANK 3 (BAK № 3).
(6) Fadeout of green light annunciator of one pump installed in tank No. 4 with fuel still available in tank	Light annunciations Fuel transfer with reference to fuel quantity indicator Flight - Test for condition - Check fuel quantity indicator - Continue
(7) Fadeout of green light annunciations of two pumps of tank No. 4 with fuel still available in tank and amber	Light annunciations In the event of faulty light annunciations - Test for condition - Continue flight

(cont'd)

TROUBLE	CORRECTIVE ACTION
light annunciator TANK USAGE, TANK 4 (ПОРЯДОК РАСХОДА, БАК № 4) illuminates	Refer to fuel quantity indicator, to make sure that fuel is not transferred from tank. With light annunciators in proper condition, have AUTO - MAN (АВТОМАТ - РУЧНОЕ) selector switch
Pump switch TANK 4 (БАК № 4) is ON	Switches of fuel transfer pumps of all tanks Pump switch TANK 4 (БАК № 4) Landing to nearest airfield
	- Turn ON - OFF - Perform
(8) With main fuel transfer system pumps controlled automatically, fuel level in service tank rises. Fuel quantity in tanks No. 2 increases	This trouble is indicative of failure of proportioner in open position. Fuel level in service tank cannot rise excessively due to fuel overflow pipes interconnecting tank No. 1 and tanks No. 2 Fuel transfer with reference to fuel quantity indicator Flight
	- Check - Continue
(9) With main fuel transfer system pumps controlled manually, fuel level in service tank rises and fuel quantity in tanks No. 2 increases	This trouble is indicative of failure of proportioner in open position. Fuel from overfilled tank No. 2 Fuel quantities in alternate tanks No. 2 and No. 3 and fuel management schedule Fuel transfer pump switches TANK 2 (БАК № 2) and TANK 3 (LEFT and RIGHT) (БАК № 3 (ЛЕВ и ПРАВ)) Fuel from service tank to level corresponding to 3150 kg
	- Consume - Comply - Turn OFF - Consume

(cont'd)

TROUBLE	CORRECTIVE ACTION
	<p>Pump switches TANK 2 (БАК № 2) and TANK 3 (LEFT and RIGHT) (БАК № 3) (ЛЕВ и ПРАВ)</p> <p>Let proportioner close fuel transfer lines.</p> <p>In case overfilling of service tank persists, above described corrective actions</p>
(10) Fuel level in service tank drops below 3150 kg. Fuel transfer pump operation light annunciators are alive, fuel transfer pumps function properly	<p>This trouble is indicative of failure of proportioner in closed position.</p> <p>PROPORTIONER (ПРИНУД ВКЛ ПОРН) switch</p> <p>As soon as fuel level in service tank rises to normal, have PROPORTIONER switch</p> <p>Fuel level in service tank within 3300 to 3150 kg</p> <p>PROPORTIONER switch periodically</p> <p>In case proportioner fails to be cut in by PROPORTIONER switch, fuel quantity in service tank within 3150 and 3300 kg should be</p>
	<p>- Turn ON</p> <p>- Repeat</p> <p>- Turn OFF</p> <p>- Maintain</p> <p>- ON and OFF</p> <p>- Maintained by periodically setting FUEL TO TANK 1 STBY TRANSF VLVS (КРАН РЕЗЕРВНОЙ ПЕРЕКАЧКИ В БАК №1) switch in OPEN (OTKРЫТО) and CLOSED (ЗАКРЫТО)</p>
(11) Fuel level in service tank drops to 2500 kg fuel reserve. Red light annunciator 2500 KG FUEL RESERVE (OCTATOR TOПИМБА 2500) and red annunciator 2500 KG FUEL RSV are alight, loud-	<p>Proceed as specified in Item (10).</p> <p>Remove aural signal by setting 2500 KG FUEL RSV AURAL SYGN (OCTATOR TOПИ 2500 ЗВУК СИГН) switch to</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
speaker sounds continuously. Green light annunciators of fuel transfer pumps illuminate, the fuel transfer pumps operate	
(12) Fuel flow rate of one of engines rises (or drops) abruptly	Engine featuring excessive (reduced) fuel flow rate - Identify Malfunctioning engine - Shut down Fuel shut-off valve of this engine - Close Two-engine flight - Continue
(13) Amber light annunciator FLTR CLOG (ФИЛЬТР ЗАСОПЕХ) of one power plant illuminates	Flight to next scheduled airport of landing, monitoring engine operation with reference to other engine instruments After landing find out the cause of operation of the signalling system. Filters of all engines - Inspect and clean
(14) Amber light annunciators FLTR CLOG (ФИЛЬТР ЗАСОПЕХ) of two (three) power plants illuminate	Landing to nearest airfield - Perform After landing find out the cause of operation of the signalling system. Filters of all engines - Inspect and clean
(15) Outside air stagnation temperature indicators mounted on pilot's and flight engineer's instrument panels do not respond to air temperature change	Continue flight on any grade of fuel. If fuel JET-A or its blends are used in airplane tanks, proceed with flying, observing the instructions given in 8.3.2 (6).

(cont'd)

TROUBLE	CORRECTIVE ACTION
(16) Fuel temperature indicator relating to one of tanks No. 3 fails to respond to fuel temperature change	Fuel temperature in that tank - Determine with reference to temperature indicator of identical counterpart tank
(17) One of two pointers of fuel quantity indicator of tanks No. 2 is held at left or right limiter	This trouble is indicative of partial failure of fuel quantity indicator of tank No. 2. Consumption of fuel from tank No. 2, whose fuel quantity indicator is faulty, with reference to pointer of fuel quantity indicator of similar tank Tank empty condition with reference to tank pumps operation green light annunciators extinguishing - Determine
(18) Both pointers of fuel quantity indicator of tanks No. 2 are thrust against left or right limiter	This trouble is indicative of failure of fuel quantity indicator of tanks No. 2. Commencement of fuel consumption from this tank by illumination of amber light annunciator TANK USAGE, TANKS 2 (ПОРЯДОК РАСХОДА, БАКИ № 2) End of fuel consumption from this tank by extinguishing of tank No. 2 pumps operation green light annunciators - Monitor
(19) One of two pointers of fuel quantity indicator of tanks No. 3 is held motionless at left or right limiter	This trouble is indicative of partial failure of fuel quantity indicator of tank No. 3. Consumption of fuel from tank No. 3, whose fuel quantity indicator is faulty, with reference to pointer of fuel quantity indicator of identical tank - Monitor

(cont'd)

TROUBLE	CORRECTIVE ACTION
	<p>Tank empty condition with reference to tank No. 3 pumps operation green light annunciators extinguishing and to TANK USAGE, TANK 4 (ПОРЯДОК РАСХОДА, БАК № 4) amber light annunciator illumination, or by the beginning of fuel consumption from tank No. 1</p> <p>Commencement of fuel consumption from tanks No. 3 should be determined by illumination of amber light annunciator TANK USAGE, TANKS 3 (ПОРЯДОК РАСХОДА, БАКИ № 3)</p>
(20) Both pointers of fuel quantity indicator of tanks No. 3 are thrust against left or right limiter	<p>This trouble is indicative of failure of fuel quantity indicator of tanks No. 3.</p> <p>Commencement of fuel consumption from these tanks by illumination of amber light annunciator TANK USAGE, TANKS 3 (ПОРЯДОК РАСХОДА, БАКИ № 3)</p> <p>Tank empty condition with reference to tank No. 3 pumps operation green light annunciators extinguishing and to TANK USAGE, TANK 4 (ПОРЯДОК РАСХОДА, БАК № 4) amber light annunciator illumination</p>
(21) Pointer of fuel quantity indicator of service tank No. 1 is held motionless at left or right limiter	<p>This trouble is indicative of failure of fuel quantity indicator of tank No. 1.</p> <p>Fuel remainder in service tank with reference to tank No. 1 pump operation green light annunciator alive and to 2500 KG FUEL RESERVE (ОЧТАТОК ТОПЛИВА 2500) red light annunciator illumination</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
(22) Pointer T (C) of total fuel quantity indicator is held motionless at left or right limiter	This trouble is indicative of failure of total fuel quantity indicator. Fuel remainder in tanks with reference to FLOWMETER (РАСХОДОМЕР) indicator - Determine
(23) Quantity of fuel in identical tanks differs by (800±200) kg, pumps operation green light annunciators of tank with smaller amount of fuel illuminate, four amber light annunciators EQUALIZATION (ВЫРАВНИВАНИЕ) illuminate, green light annunciator EQUALIZER (АВТОМАТ ВЫРАВНИВАНИЯ) is dead	Equalizer - Turn OFF AUTO - MAN (АВТОМАТ - РУЧНОЕ) selector switch Equalization of fuel quantities in tanks - Set to MAN (РУЧНОЕ) EQUALIZER (АВТОМАТ ВЫРАВНИВАНИЯ) switch - Turn ON AUTO - MAN (АВТОМАТ - РУЧНОЕ) selector switch - Set to AUTO (АВТОМАТ)
(24) Red light annunciator FUEL MNGM INOP (AP НЕ РАБ) becomes illuminated, amber light annunciators TANK USAGE (ПОРЯДОК РАСХОДА) extinguish, fuel level in tank No. 1 drops to below 3150 kg	This trouble is indicative of failure of entire automatic fuel management control system. AUTO - MAN (АВТОМАТ - РУЧНОЕ) selector switch Pump switches of tanks Nos 2, 3 and 4 in compliance with preset fuel management schedule - Turn OFF and ON

(cont'd)

8.3.4. Brief Description

The fuel system is intended to continuously supply fuel to the engines, meeting the engine demands under all operating conditions and maintaining the C.G. position within the tolerable limits.

The entire fuel system is subdivided into the following systems:

Main engines fuel supply system

APU fuel supply system

Fueling system

Fuel tank vent system

Automatic fuel control system

Fuel flowmeter system

Fuel temperature measurement system pertaining to tanks No. 3

8.3.4.1. Main Engines Fuel Supply System

The system provided for fuel supply to the engines from service tank No. 1 under any operating conditions of the engines with the aid of four booster pumps.

- (1) The total quantity of fuel amounting to 39,750 kg (at a fuel specific gravity of $\gamma = 0.8 \text{ g/cm}^3$) is stored in six integral tanks of the following holding capacities:

One service tank No. 1 arranged in the wing center section and holding 3300 kg of fuel.

Two counterpart tanks No. 2 arranged in the wing center section and holding 9500 kg of fuel each.

Two counterpart tanks No. 3 arranged in the outer wing panels and capable of containing 5425 kg of fuel each.

One tank No. 4 arranged in the wing center section with a holding capacity of 6600 kg (it is used also as a container for ballast fuel).

From the five integral tanks the fuel is transferred via four main lines and a fuel proportioner into service tank No. 1 in accordance with a preset fuel management schedule.

(cont'd)

From the service tank the fuel is fed by four fuel feed pumps through the system of separate pipelines via the fuel shut-off valve and flow rate metering unit to the booster pump mounted on each engine. The fuel feed pumps are driven by 200 VAC electrical motors. Besides, a stand-by pump driven by a DC electrical motor is also mounted in the service tank to supply fuel to the main engines with the 200 VAC electrical system deenergized.

- (2) The automatic fuel control system ensures the following sequence of fuel consumption from the tanks.

Fuel is transferred into service tank No. 1 according to the following schedule:

From tanks No. 2 (left and right) till 3700 ± 250 kg of fuel remain in each of them.

From tanks No. 2 and No. 3 (left and right) until tanks No. 2 are empty (with 1725 ± 250 kg of fuel still remaining in each of tanks No. 3).

From tanks No. 3 (left and right) till they are empty.

From tank No. 4 till runout.

Fuel is used from the service tank.

- (3) Warning of fuel reserve of 3300 kg and critical fuel reserve of 2500 kg in the tanks is indicated by the FUEL FR TANK No. 1 (ПАСХОД ИЗ БАКА № 1) and 2500 KG FUEL RESERVE (ОЧТАТОК 2500) light annunciators.

(a) After extinguishing of green annunciators indicating operation of all fuel transfer pumps of tanks Nos 2, 3 and 4 the amber light annunciator FUEL FR TANK No. 1 (ПАСХОД ИЗ БАКА № 1) will be illuminated on the engine instrument panel.

(b) As the quantity of fuel remaining in the service tank is 2500 kg a red light annunciator 2500 KG FUEL RESERVE (ОЧТАТОК ТОПЛИВА 2500) flashes up on the engine instrument panel of the flight engineer's control panel, red light annunciator 2500 KG FUEL RESERVE (ОЧТАТОК ТОПЛИВА 2500) flashes up on the pilot's instrument panel and the loudspeaker sounds intermittently.

8.3.4.2. APU Fuel Supply System

Fuel for the auxiliary power unit is delivered by a pump driven by a DC electrical motor via a fuel shut-off valve along the pipeline.

(cont'd)

8.3.4.3. Fueling System

The airplane fueling system is intended for filling the airplane tanks with fuel from a refueler or an airfield fuel servicing unit. Fueling the airplane is effected through the single-point pressure fueling system of the airplane. The pressure refuel couplings are located in the leading edge section of the right wing panel. The system fueling valves are closed automatically by the pressure fueling automatic control unit. As an exception and in the event of failure of the single-point pressure fueling system, fueling of the tanks may be accomplished also through the overwing filler necks of the integral tanks. Airplane fueling is carried out in compliance with a preset fueling priority schedule.

8.3.4.4. Fuel Tank Vent System

The fuel tank vent system is of an open type. It provides for communication of each tank air space with the atmosphere through two vent outlets located on the fuselage bottom skin at frame No. 36.

8.3.4.5. Automatic Fuel Control System

The automatic fuel control system provides for:

Measurement of fuel amount in each tank.

Measurement of total quantity of fuel in the airplane.

Automatic or manual fuel transfer in compliance with a preset fuel management schedule (Ref. 8.3.4.1 (2)).

Uniform consumption of fuel from counterpart tanks No. 2 and No. 3.

Delivery of a 3300 kg fuel reserve signal (FUEL FR TANK No. 1 (ПАСХОД ИЗ БАКА № I)).

Delivery of a 2500 kg fuel reserve signal to warn that 2500 kg of fuel remain in the service tank.

The automatic fuel control system comprises:

Fuel management and indicating system.

Light annunciator FUEL FR TANK No. 1.

2500-kg fuel reserve pressure switch and warning unit.

(cont'd)

(1) Fuel Management and Indicating System

The fuel management and indicating system consists of a fuel quantity gage, equalizer, automatic fuel management control unit and a pressure fueling automatic control unit.

- (a) The fuel quantity gage is put into action prior to starting the engines with the help of FUEL QTY IND (ТОЛЛИВОМЕР) switch located on the fuel control panel of the flight engineer's control panel and remains cut in throughout the flight period.

The fuel quantities in the airplane tanks are measured by the fuel quantity indicators TANK 1 (БАК № 1) AND TOTAL (СУММА), TANKS 2 (БАК № 2), TANKS 3 (БАК № 3), TANK 4 (БАК № 4) and located on the fuel control panel at the flight engineer's station and by the total fuel quantity indicator installed on the co-pilot's instrument panel.

In case the readings of the fuel quantity gage indicators are doubtful, test the fuel quantity gage for condition by pressing buttons Z (H) and M (P) (Ref. 8.3.2 (4)).

The fuel quantity gage receives electrical power from the 115/200 VAC junction box through the АЗФИК-2 circuit breaker and 27 VDC from the right CB panel through two АЗСИК-2 circuit breakers FUEL QTY IND LEFT, RIGHT (ТОЛЛИВОМЕР ЛЕВ, ПРАВ).

- (b) The function of the fuel equalizer is to ensure uniform consumption of fuel from counterpart tanks Nos 2 and 3 arranged in the right and left wing panels, respectively. The fuel equalizer is put into action by the EQUALIZER (АВТОМАТ ВЫРАВНИВАНИЯ) switch, which is accompanied by the illumination of the respective green light annunciator.

The fuel equalizer functions only in case the fuel management control system is engaged.

The fuel equalizer operates when the difference between the quantities of fuel in counterpart tanks No.2 is (350 ± 150) kg and that in identical tanks No.3 is within (300 ± 100) kg, in which case the fuel equalizer stops the fuel transfer pumps of the tank with smaller quantity of fuel. This is accompanied by extinguishing of the pump operation green light annunciators pertaining to that fuel tank and by illumination of amber light annunciator EQUALIZATION (ВЫРАВНИВАНИЕ) relating to T 2 (LEFT, RIGHT) (Б № 2 (ЛЕВ, ПРАВ)) or T 3 (LEFT, RIGHT) (Б № 3 (ЛЕВ, ПРАВ)) respectively. After the fuel quantities in the counterpart tanks are made equal, the fuel equalizer reverses the pumps and light annunciators to the initial state.

(cont'd)

In case the fuel quantity difference between the counterpart tanks reaches (800 ± 200) kg the fuel equalizer is switched off automatically, in which case its green light annunciator extinguishes, the fuel transfer pumps previously disengaged by the fuel equalizer are put into action again, and all amber light annunciators EQUALIZATION T 2, T 3 (LEFT and RIGHT) (ВЫРАВНИВАНИЕ Б № 2, Б № 3 (ЛЕВ и ПРАВ)) come on again.

In the event of failure of the fuel equalizer, its green light annunciator extinguishes.

The fuel equalizer receives electrical power from the 115/200 VAC right junction box through circuit breaker АЗФИК-2 and 27 VDC from the right CB panel through the АЗСИК-2 circuit breaker EQUALIZER (АВТОМАТ ВЫРАВН.).

- (c) The automatic fuel control system serves to transfer fuel in accordance with a preset fuel management schedule (Ref. 8.3.4.1 (2)).

The automatic fuel control system is put into action before starting the engines by actuating the FUEL MNGM (ABT PACX) switch located on the fuel control panel of the flight engineer's control panel.

Operation of the automatic fuel control system is monitored with reference to illumination of amber light annunciators TANK USAGE, TANKS 2, TANKS 3, TANKS 4 (ПОРЯДОК РАСХОДА БАКИ № 2, БАКИ № 3, БАКИ № 4) and to illumination and extinguishing of fuel transfer pump operation green light annunciators in accordance with the preset fuel management schedule, as well as by referring to the readings of the fuel quantity indicators.

In the event of failure of the automatic fuel control system, red light annunciator FUEL MNGM INOP (AP НЕ РАБ) comes on.

The automatic fuel management system is supplied with electrical power from the 115/200 VAC junction box through circuit breaker ИМ-2 and from the +27 VDC circuit breaker panel (right) through the АЗСИК-5 circuit breaker FUEL AUTO CONT (АВТОМАТИКА ТОПЛИВА).

- (d) The function of the pressure fueling automatic control unit is to automatically close the fueling valves during single-point pressure fueling of the airplane tanks. The pressure fueling automatic control unit receives electrical power from the right 115/200 VAC junction box through the ИМ-2 circuit breaker of the fueling control unit and from the refueling control panel (+27 VDC) through the АЗСИК-2 circuit breaker of the fueling control unit.
- (2) Warning of fuel remainder 3300 kg is indicated by a signal FUEL FR TANK No. 1 (РАСХОД ИЗ БАКА № I). After extinguishing of green annunciators indicating

(cont'd)

operation of all fuel transfer pumps of tanks Nos 2, 3 and 4, the amber annunciator FUEL FR TANK No. 1 (ПАСХОД ИЗ БАКА № 1) will be illuminated on the engine instrument panel.

- (3) Warning of fuel remainder 2500 kg is indicated by the illumination of the 2500 KG FUEL RESERVE (ОЧТАТОК ТОПЛИВА 2500) switch. As the quantity of fuel remaining in the service tank amounts to 2500 kg red light annunciator 2500 KG FUEL RESERVE (ОЧТАТОК ТОПЛИВА 2500) starts flashing on the engine instrument panel of the flight engineer's control panel, red light annunciator 2500 KG FUEL RSV (ОЧТАТОК ТОПЛИВА 2500) starts flashing on the pilot's instrument panel and a loudspeaker is switched on to sound continuously.

The warning level switch is fed with +27 VDC from the right CB panel through the circuit breaker 2500 KG RSV IND LT (СИГНАЛИЗ ОЧТАТОК ТОПЛИВА 2500).

8.3.4.6. Fuel Flowmeter System

The system is intended for remote measuring of the fuel flow rate (instantaneous) through each engine in kg/h and of the total fuel reserve in the airplane tanks in kg.

The flowmeter system is put into action before starting the engines with the switch FLOWMETER (ПАСХОДОМЕР) located on the fuel control panel of the flight engineer's control panel (Ref. 8.3.2) and is kept on throughout the engine operating time.

The flowmeter is designed to function on fuel of grades T-1, TC-1. The fuel grade selector switch (a selector knob located on the face of the total fuel quantity indicator and marked FG (CT) (fuel grade)) is set in position corresponding to the respective fuel grade mark (setting T-7 corresponds to fuel grade PT). The indication error of the total fuel quantity indicator is accumulated in the course of fuel consumption from the tanks and may reach ±2000 kg.

The flowmeter system receives 115-VAC electrical power from the right 115/200 VAC junction box and 27-VDC electrical power through the АЗСТК-2 circuit breaker FUEL FLOWMETER СИРТ-1 (ПАСХОДОМЕР СИРТ-1) located on the right CB panel.

8.3.4.7. Fuel Temperature Measurement System

The system consists of temperature sensors installed in tanks No. 3 and two fuel temperature indicators located on the engine start control panel. The system is aimed at monitoring the temperature limitations specified for fuel JET-A or its blends with fuel of other grades as outlined in 8.3.2 (6).

(cont'd)

Ty-154M

8.4. HYDRAULIC SYSTEM



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Hydraulic System

8.4. HYDRAULIC SYSTEM

8.4.1. Operational Limitations

Characteristic	Unit of measure	Minimum	Normal	Maximum
(1) Operating pressure	kgf/cm ²	200	210	220
(2) Actuation pressure of red light annunciators PRESSURE DROP 1, 2, 3 (HYD SYSTEMS 1, 2, 3) (ПАДЕНИЕ ДАВЛЕНИЯ I, 2, 3 (ГИДРОСИСТЕМЫ I, 2, 3)), EMERGENCY BRAKING (АВАРИЙНОЕ ТОРМОЖЕНИЕ)	kgf/cm ²	95	100	105
(3) Permissible pressure during airplane control in flight	kgf/cm ²	180	190	200
(4) Hydraulic fluid level in hydraulic reservoirs at temperature of 20 °C: At zero pressure in hydraulic systems and emergency brake accumulator (spoilers retracted, airplane parking brakes applied): in reservoir of H/SYS 1, 2 (I-2 °C) in reservoir of H/SYS 3 (3 °C)	l	47 23	48 24	49 25
At pressure within 200 - 220 kgf/cm ² in hydraulic systems: in reservoir of H/SYS 1, 2 in reservoir of H/SYS 3	kgf/cm ²	35 19	36 20	37 21
<u>NOTE:</u> Hydraulic fluid temperature change by every 10 °C causes fluid level change in reservoir of hydraulic systems 1 and 2 by 1 l and in reservoir of hydraulic system 3 by 0.5 l.				
(5) Reservoir pressurization in hydraulic systems 1, 2, 3	kgf/cm ²	1.8	2	2.3
(6) Bottle pressure	kgf/cm ²	10	-	15

(cont'd)

8.4.2. Normal Procedures

CONDITION (PROCEDURE)	REQUIRED ACTION
(1) Before engine start	<p>Check:</p> <p>Pilot</p> <p>BOOSTER CONTROL 1, 2, 3 (БУСТЕРНОЕ УПРАВЛЕНИЕ 1, 2, 3) - OFF, cap hinged out</p> <p>Amber light annunciator BOOSTERS (БУСТЕРА) - Illuminates</p> <p>FLAPS (ЗАКРЫЛКИ) - OFF</p> <p>WHEEL STEER (РАЗВОРОТ КОЛЕСА) - OFF</p> <p>SPOILERS (ИНТЕРЦЕНТОРЫ) - 0 position</p> <p>LG RETR EXT (ШАССИ УБОРКА ВЫПУСК) - Neutral</p> <p>Pressure on indicators HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) and EMERGENCY BRAKING (АВАРИЙНОЕ ТОРМОЖЕНИЕ) (relieve pressure, if any) - About 0</p> <p>Red light annunciators HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) and EMERGENCY BRAKING (АВАРИЙНОЕ ТОРМОЖЕНИЕ) - Illuminate</p> <p>Report from ground crew "Hydraulic reservoir pressurization normal" - Receive</p> <p>Copilot</p> <p>Handle LANDING GEAR EMERGENCY EXTENSION (ШАССИ АВАРИЙНЫЙ ВЫПУСК) - Sealed</p> <p>Switch LG EXTSN USING H/SYS 3 - OFF (ШАССИ ВЫПУСК ОТ 3 Г/СИСТ - ВЫКЛ) - OFF, cap closed, sealed</p> <p>Flight Engineer</p> <p>STBY HYD PUMP H/SYS 2, H/SYS 3 (НАСОСНАЯ СТАНЦИЯ 2 ГС, 3 ГС) - OFF</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>H/SYS 2 TO H/SYS 1 (ПОДКЛЮЧ 2 ГС, - OFF НА 1 ГС)</p> <p>Pressure on indicators HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) - About 0 and EMER BRAKE</p> <p>Red light annunciators PRESSURE DROP 1, 2, 3 (ПАДЕНИЕ ДАВЛЕНИЯ 1, 2, 3) and EMER BRAKE - Illuminate</p> <p>Fluid level gages:</p> <p>HYD RESERVOIRS H/SYS 1, 2 (ГИДРОБАКИ 1-2 ГС) - Press button, level normal</p> <p>HYD RESERVOIRS H/SYS 3 (ГИДРОБАКИ 3 ГС) - Press button, level normal</p>
(2) After starting APU (perform checks according to form B or in parking at transit airport in case of crew change, or if malfunctions were detected in operation of systems or equipment, or airplane parking time exceeds 10 hours, or if need arises to charge emergency brake hydraulic accumulator)	<p>F l i g h t E n g i n e e r</p> <p>STBY HYD PUMP H/SYS 2 (НАСОСНАЯ СТАНЦИЯ 2 ГС) - ON</p> <p>Pressure increase to 200 - 220 kgf/cm² within 14 s (maximum) as read off pressure indicator HYDR SYSTEMS 2 (ГИДРОСИСТЕМЫ 2) - Check</p> <p>Red light annunciator PRESSURE DROP 2 (ПАДЕНИЕ ДАВЛЕНИЯ 2) - Goes out</p> <p>P i l o t</p> <p>Fluid pressure by pressure indicator HYDR SYSTEMS 2 (ГИДРОСИСТЕМЫ 2) - 200 - 220 kgf/cm²</p> <p>BOOSTER CONTROL 2 (БУСТЕРНОЕ УПРАВЛЕНИЕ 2) switch - ON</p> <p>Deflect elevator 2 or 3 times from one extreme position to the other, at the same time extending flaps. In the event of rapid change of the elevator position pressure drop to below 100 kgf/cm² may occur as registered by pressure indicator HYDR</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>SYSTEMS 2 (ГИДРОСИСТЕМЫ 2), in which case light annunciator HYDR SYSTEMS 2 comes on; fluid pressure is then restored to normal with light annunciator fading out.</p> <p>BOOSTER CONTROL (БУСТЕРНОЕ УПРАВЛЕНИЕ 2) switch</p> <p>F l i g h t E n g i n e e r</p> <p>When airplane controls are actuated with the aid of hydraulic system, pressure drop below 100 kgf/cm² may occur in hydraulic system as registered by indicator HYDR SYSTEMS 2 (ГИДРОСИСТЕМЫ 2), in which case light annunciator PRESSURE DROP 2 (ПАДЕНИЕ ДАВЛЕНИЯ 2) becomes illuminated; as system pressure is restored to normal, light annunciator extinguishes.</p> <p>H/SYS 2 TO H/SYS 1 (ПОДКЛЮЧ 2 ГС НА 1 ГС) switch</p> <p>Pressure increase to 200 - 220 kgf/cm² within 14 s (maximum) as read off pressure indicators HYDR SYSTEMS 1, 2 (ГИДРОСИСТЕМЫ 1, 2)</p> <p>Red light annunciators PRESSURE DROP 1, 2 (ПАДЕНИЕ ДАВЛЕНИЯ 1, 2)</p> <p>P i l o t</p> <p>Readings of pressure indicators HYDR SYSTEMS 1, 2 (ГИДРОСИСТЕМЫ 1, 2)</p> <p>Red light annunciator HYDR SYSTEMS 1, 2 (ГИДРОСИСТЕМЫ 1, 2)</p> <p>BOOSTER CONTROL 1 (БУСТЕРНОЕ УПРАВЛЕНИЕ 1) switch</p> <p>Deflect elevator 2 to 3 times from one extreme position to the other, at the same time extending flaps. In case of rapid change of the elevator position, pressure drop to below 100 kgf/cm²</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>may take place as read off pressure indicators HYDR SYSTEMS 1, 2 (ГИДРОСИСТЕМЫ 1, 2) temporarily, which is accompanied by illumination of light annunciators HYDR SYSTEMS 1, 2 (ГИДРОСИСТЕМЫ 1, 2); as systems pressure is restored to normal, light annunciators extinguish.</p> <p>BOOSTER CONTROL 1 (БУСТЕРНОЕ УПРАВЛЕНИЕ 1) switch - OFF</p> <p>F l i g h t E n g i n e e r</p> <p>When airplane controls are actuated with the use of hydraulic system units, pressure drop below 100 kgf/cm² may occur as registered by pressure indicators HYDR SYSTEMS 1, 2 (ГИДРОСИСТЕМЫ 1, 2), in which case light annunciators PRESSURE DROP 1, 2 (ПАДЕНИЕ ДАВЛЕНИЯ 1, 2) become illuminated.</p> <p>ACCUM CHARG (ЗАРЯДКА АККУМ) button - Press</p> <p>Pressure increase by EMER BRAKE (АВАРИЙН ТОРМОЗ) indicator up to 200 to 220 kgf/cm² during 14 s (maximum) - Check</p> <p>EMER BRAKE (АВАРИЙН ТОРМОЗ) light annunciator - Goes out</p> <p>ACCUM CHARG (ЗАРЯДКА АККУМ) button - Release</p> <p>H/SYS 2 TO H/SYS 1 (ПОДКЛ 2 ГС НА 1 ГС) switch - OFF</p> <p>STBY HYD PUMP H/SYS 2 (НАСОСНАЯ СТАНЦИЯ 2 ГС) switch - OFF</p> <p>STBY HYD PUMP H/SYS 3 (НАСОСНАЯ СТАНЦИЯ 3 ГС) switch - ON</p> <p>Pressure increase to 200 - 220 kgf/cm² within 14 s (maximum) as read off pressure indicator HYDR SYSTEMS 3 (ГИДРОСИСТЕМЫ 3) - Check</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Light annunciator PRESSURE DROP 3 (ПАДЕНИЕ ДАВЛЕНИЯ 3)</p> <p>P i l o t</p> <p>Airplane parking brakes</p> <p>Fluid pressure by indicator HYDR SYSTEMS 3 (ГИДРОСИСТЕМЫ 3)</p> <p>HYDR SYSTEMS 3 (ГИДРОСИСТЕМЫ 3) light annunciator</p> <p>BOOSTER CONTROL 3 (БУСТЕРНОЕ УПРАВЛЕНИЕ 3) switch</p> <p>Deflection of elevator 2 or 3 times from one extreme position to the other</p> <p>Pressure change by HYDR SYSTEMS 3 (ГИДРОСИСТЕМЫ 3) indicator</p> <p>BOOSTER CONTROL 3 (БУСТЕРНОЕ УПРАВЛЕНИЕ 3) switch</p>
F l i g h t E n g i n e e r	<p>When airplane controls are hydraulically operated, pressure change with reference to HYDR SYSTEMS 3 (ГИДРОСИСТЕМЫ 3) indicator</p> <p>STBY HYD PUMP H/SYS 3 (НАСОСНАЯ СТАНЦИЯ 3 ГС) switch</p> <p>Hydraulic fluid levels with reference to level gages at 200 - 220 kgf/cm² pressure as read off HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) indicators</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
(3) In starting engines	<p>P i l o t</p> <p>Placing of chocks fore and aft of airplane wheels before starting engines - Check</p> <p>Actuating airplane controls, have hydraulic system pressure - Relieved</p> <p>Pressure as read off HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) indicators - About 0</p> <p>Pressure as read off EMERGENCY BRAKING (АВАРИЙНОЕ ТОРМОЖЕНИЕ) indicator - 200 to 220 kgf/cm²</p> <p>Red light annunciators HYDR SYSTEMS 1, 2, 3 - Come on</p> <p>To check functioning of hydraulic system pumps, start the engines in two alternative versions successively:</p> <p>Version 1: engines No. 1 ⇨ No. 2 ⇨ No. 3</p> <p>Version 2: engines No. 2 ⇨ No. 1 ⇨ No. 3</p> <p>During version 1 of engine starting hydraulic system pressure should rise as follows:</p> <p>in starting engine No. 1 - in hydraulic system 1</p> <p>in starting engine No. 2 - in hydraulic system 2</p> <p>in starting engine No. 3 - in hydraulic system 3</p> <p>If version 2 of engine starting is resorted to, hydraulic system pressure should rise as follows:</p> <p>in starting engine No. 2 - in hydraulic systems 1, 2</p> <p>in starting engine No. 1 - not checked</p> <p>in starting engine No. 3 - in hydraulic system 3</p>
(4) Before taxiing	<p>P i l o t</p> <p>Hydraulic system pressure by pressure indicators HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) and EMERGENCY BRAKING (АВАРИЙНОЕ ТОРМОЖЕНИЕ) - 200 - 220 kgf/cm²</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Red light annunciators HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ I, 2, 3) and EMERGENCY BRAKING (АВАРИЙНОЕ ТОРМОЖЕНИЕ) indicator - Dead</p> <p>BOOSTER CONTROL 1, 2, 3 (БУСТЕРНОЕ УПРАВЛЕНИЕ I, 2, 3) switches - ON, capped</p> <p>BOOSTERS (БУСТЕРА) amber light annunciator - Extinguished</p> <p>Control system operation - Check as instructed in 8.7</p> <p>Observe pressure with reference to HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ I, 2, 3) indicators - Not below 180 kgf/cm²</p> <p>F l i g h t E n g i n e e r</p> <p>Hydraulic system pressure by HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ I, 2, 3) and EMER BRAKE indicators - 200 - 220 kgf/cm²</p> <p>Red light annunciators PRESSURE DROP 1, 2, 3 (ПАДЕНИЕ ДАВЛЕНИЯ I, 2, 3) and EMER BRAKE (АВАРИЙНОЕ ТОРМОЖЕНИЕ) - Dead</p> <p>Refer to fluid level gages:</p> <p>HYD RESERVOIRS H/SYS 1, 2 (ГИДРОБАКИ I-2 ГС) - Press button, level normal</p>

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Hydraulic System

CONDITION (PROCEDURE)	REQUIRED ACTION
(5) At holding position	<p>HYD RESERVOIRS H/SYS 3 (ГИДРОБАКИ З ГС) Pilot</p> <p>Hydraulic system pressure by HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ I, 2, 3) and EMERGENCY BRAKING indicators</p> <p>Red light annunciators HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ I, 2, 3) and EMERGENCY BRAKING</p> <p>BOOSTER CONTROL (БУСТЕРНОЕ УПРАВЛЕНИЕ) Flight Engineer</p> <p>Pressure values as checked with reference to HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ I, 2, 3) and EMER BRAKE indicators</p> <p>Red light annunciators PRESSURE DROP (ПАДЕНИЕ ДАВЛЕНИЯ) 1, 2, 3 and EMER BRAKE (АВАРИЙН ТОРМОХ)</p>
(6) Cruise	<p>Pilot</p> <p>Pressure with reference to HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ I, 2, 3) and EMERGENCY BRAKING indicators</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Red light annunciators HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) and EMERGENCY BRAKING (АВАРИЙНОЕ ТОРМОЖЕНИЕ)</p> <p>F l i g h t E n g i n e e r</p> <p>Pressure with reference to HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) and EMER BRAKE indicators</p> <p>Red light annunciators PRESSURE DROP (ПАДЕНИЕ ДАВЛЕНИЯ) 1, 2, 3 and EMER BRAKE</p> <p>Refer to fluid level gages:</p> <p>HYD RESERVOIRS H/SYS 1, 2 (ГИДРОБАКИ 1-2 ГС)</p> <p>HYD RESERVOIRS H/SYS 3 (ГИДРОБАКИ 3 ГС)</p>
(7) In final approach	<p>P i l o t</p> <p>Pressure with reference to HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) and EMERGENCY BRAKING indicators</p> <p>Red light annunciators HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) and EMERGENCY BRAKING (АВАРИЙНОЕ ТОРМОЖЕНИЕ)</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>F l i g h t E n g i n e e r</p> <p>Pressure with reference to HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) and EMERGENCY BRAKING indicators</p> <p>Red light annunciators PRESSURE DROP 1, 2, 3 and EMER BRAKE</p> <p>Refer to fluid level gages:</p> <p>HYD RESERVOIRS H/SYS 1, 2 (ГИДРОБАКИ 1, 2 ГС) - Press button, level normal</p> <p>HYD RESERVOIR H/SYS 3 (ГИДРОБАК 3 ГС) - Press button, level normal</p>

(cont'd)

8.4.3. Troubles

TROUBLE	CORRECTIVE ACTION
<p>(1) On pilot's instrument panel and on hydraulic control panel at flight engineer's station:</p> <p>(a) Light annunciators HYDR SYSTEMS 1 (ГИДРОСИСТЕМЫ I), PRESSURE DROP 1 (ПАДЕНИЕ ДАВЛЕНИЯ 1) illuminate, pressure by HYD SYSTEM 1 (ГИДРОСИСТЕМА I) indicator is below 100 kgf/cm²</p>	<p>Trouble is indicative of failure of hydraulic system 1.</p> <p>F l i g h t E n g i n e e r</p> <p>PA-56 SERVO HYDR POWER YAW 1, ROLL 1, PITCH 1 (ГИДРОПИТАНИЕ PA-56 КУРС I, КРЕН I, ТАНГАЖ I)</p> <p>Green light annunciator AFCS OPERABLE (ИСПР АЕСУ)</p> <p>Fluid level by HYD RESERVOIRS H/SYS 1, 2 (ГИДРОБАКИ I-2 ГС)</p> <p>Normal fluid level is indicative of the pump failure. The fluid level of less than 26 l indicates that the hydraulic system is leaky.</p> <p>Prior to extending landing gear, STBY HYD PUMP H/SYS 2 (HACOЧНАЯ СТАНЦИЯ 2 ГС) switch</p> <p>P i l o t</p> <p>Command for emergency extension of landing gear</p> <p>While extending flaps bear in mind that flaps extension time increases twice as much (up to 36 to 46 s).</p> <p>During and after extension of the flaps green annunciator FLAPS S/CH 1 (ЗАКРЫЛКИ I П/К) may be alight.</p> <p>Middle and inboard spoilers are not controllable.</p> <p>During landing run apply emergency brakes and engine reverse thrust.</p> <p>C o - p i l o t</p> <p>Operate the LANDING GEAR EMERGENCY EXTENSION (ШАССИ АВАРИЙНЫЙ ВЫПУСК) handle (by the pilot's command)</p> <p>- OFF</p> <p>- Extinguishes</p> <p>- Check by depressing button</p> <p>- Turn on</p> <p>- Give to the co-pilot</p> <p>- Extend LG</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
(b) Light annunciators HYD SYSTEMS 2, PRESSURE DROP 2 alive, pressure read off HYD SYS- TEM 2 indicator is below 100 kgf/cm ²	<p>Indicative of failure of hydraulic system 2.</p> <p>F l i g h t E n g i n e e r</p> <p>PA-56 SERVO HYDR POWER YAW 2, - OFF ROLL 2, PITCH 2 switches</p> <p>Green light annunciator AFCS - Goes out OPERABLE</p> <p>Fluid level with reference to HYD - Check RESERVOIRS H/SYS 1, 2 gage by pres- sing test button</p> <p>Prior to landing, in case fluid level in hydraulic reservoir is normal (26 l, minimum):</p> <p>Have STBY HYD PUMP H/SYS 2 switch - ON</p> <p>Prior to landing, in case fluid level is below specified level (less than 26 l):</p> <p>Have STBY HYD PUMP H/SYS 3 switch - ON</p> <p>P i l o t</p> <p>If STBY HYD PUMP H/SYS 2 switch has been turned on before land- ing, perform normal landing.</p> <p>In case STBY HYD PUMP H/SYS 3 switch was actuated before land- ing, during extension of flaps bear in mind that flap extension time is two times greater (36 - 46 s); during and after exten- sion of flaps green light annunciator FLAPS S/CH 2 (ЗАКРЫЛКИ II II/K) may be alight.</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
	Nose wheel steering control will be inoperative. Maintain direction in the course of landing roll by means of rudder and selective application of LG wheel brakes.
(c) Light annunciators HYD SYSTEMS 3, PRESSURE DROP 3 are alive, pressure read off HYD SYSTEM 3 indicator is below 100 kgf/cm ²	<p>Indicative of failure of hydraulic system 3.</p> <p>F l i g h t E n g i n e e r</p> <p>PA-56 SERVO HYDR POWER YAW 3, ROLL 3, PITCH 3 switches</p> <p>Green light annunciators AFCS OPERABLE</p> <p>Fluid level with reference to HYD RESERVOIRS H/SYS 3 gage by pressing test button</p> <p>Prior to landing, in case fluid level in reservoir is normal (17 l, minimum), have STBY HYD PUMP H/SYS 3 switch</p> <p>Prior to landing, in case fluid level in hydraulic reservoir is below specified level (less than 17 l), have STBY HYD PUMP H/SYS 2 switch</p>
(d) Light annunciators HYDR SYSTEMS 1, 2 and PRESSURE DROP 1, 2 are alive, pressure values as read off HYD SYSTEM 1, 2 indicators are below 100 kgf/cm ²	<p>Indicative of failure of hydraulic systems 1 and 2.</p> <p>P i l o t</p> <p>Abrupt movement of controls</p> <p>To nearest airfield</p> <p>Manual control of horizontal stabilizer and extension of slats</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
	<p>Middle and inboard spoilers - Not controllable</p> <p>Receive report from flight engineer on hydraulic fluid level in reservoir of hydraulic systems 1, 2.</p> <p>In case fluid level in reservoir is below normal (26 l) flaps and nose LG steering control is rendered impossible.</p> <p>In case fluid level in reservoir is within specified limits, have standby hydraulic pump H/SYS 2 switches on and bear in mind that flap extension time is two times greater (36 - 46 s).</p> <p>Command to extend landing gear - Give to the co-pilot using hydraulic system 3 (Ref. 8.9.2(8))</p> <p>In landing run by applying emergency brakes and engine reverse thrust - Brake</p> <p>To reduce landing run after touch-down, have engine No. 2 - Shutdown</p> <p>C o - p i l o t</p> <p>Operate the hydraulic system 3 - Extend LG (by the pilot's command)</p> <p>F l i g h t E n g i n e e r</p> <p>STBY HYD PUMP H/SYS 3 switch - ON</p> <p>PA-56 SERVO HYDR POWER YAW 1, 2, 3, - OFF ROLL 1, 2, 3, PITCH 1, 2, 3 switches</p> <p>Green light annunciator AFCS - Goes out OPERABLE</p> <p>Fluid level with reference to HYD RESERVOIRS H/SYS 1, 2, gage by pressing test button - Check</p> <p>On hydraulic fluid level in reservoir of H/SYS 1, 2 - Inform the pilot</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
(e) Light annunciators HYDR SYSTEMS 1, 3 and PRESSURE DROP 1, 3 are alive, pressure values as read off HYD SYSTEM 1, 3 indicators are below 100 kgf/cm ²	<p>If fluid level in reservoir is normal, have STBY HYD PUMP H/SYS 2 switch, prior to landing approach - ON</p> <p>Trouble is indicative of failure of hydraulic systems 1 and 3.</p> <p>P i l o t</p> <p>Abrupt movement of controls - Avoid</p> <p>To nearest airfield - Fly</p> <p>Middle and inboard spoilers are not controllable.</p> <p>Command to extend landing gear by operating LANDING GEAR EMERGENCY EXTENSION handle - Give to the co-pilot</p> <p>During extension of flaps bear in mind that flaps extension time is two times greater in this case (36 - 46 s).</p> <p>During and after extension of flaps green light annunciator FLAPS S/CH 1 may be alight.</p> <p>In landing run by applying emergency brakes and engine reverse thrust - Brake</p> <p>C o - p i l o t</p> <p>Operate LANDING GEAR EMERGENCY EXTENSION handle (by the pilot's command) - Extend LG</p> <p>F l i g h t E n g i n e e r</p> <p>STBY HYD PUMP H/SYS 2 switch - ON</p> <p>PA-56 SERVO HYDR POWER YAW 1, 2, 3, ROLL 1, 2, 3, PITCH 1, 2, 3 switches - OFF</p> <p>AFCS OPERABLE green light annunciator - Extinguishes</p> <p>Fluid level with reference to HYD RESERVOIRS H/SYS 3 gage by pressing test button - Check</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
	If fluid level in reservoir of H/SYS 3 is normal (17 l, minimum), have STBY HYD PUMP H/SYS 3 switch before final approach - ON
(f) Light annunciators HYDR SYSTEMS 2, 3 and PRESSURE DROP 2, 3 are alive, pressure values as read off HYDR SYSTEMS 2, 3 indicators are below 100 kgf/cm ²	Trouble is indicative of failure of hydraulic systems 2 and 3. P i l o t To nearest airfield - Fly Abrupt movement of controls - Avoid Report from the flight engineer on fluid levels in hydraulic reservoirs of hydraulic systems 1, 2 and 3 - Receive During extension of flaps take into consideration that flap extension time is two times greater in this case (36 - 46 s). During and after extension of flaps green light annunciator FLAPS S/CH 2 may be alight. In case fluid level in reservoir of H/SYS 1, 2 is less than specified and STBY HYD PUMP H/SYS 2 is not engaged, nose LG steering control will be inoperative. Hold airplane heading during landing roll by means of rudder and selective application of LG wheel brakes.
	F l i g h t E n g i n e e r PA-56 SERVO HYDR POWER YAW 1, 2, 3, - OFF ROLL 1, 2, 3, PITCH 1, 2, 3 switches Green light annunciator AFCS OPERABLE - Extinguishes

(cont'd)

TROUBLE	CORRECTIVE ACTION
	<p>Fluid level with reference to HYD RESERVOIRS H/SYS 1, 2, and H/SYS 3 gages</p> <p>If fluid level in reservoir of H/SYS 1, 2 is normal (not less than 26 l), prior to landing approach, have STBY HYD PUMP H/SYS 2 switch</p> <p>In case fluid level in reservoir of H/SYS 3 is normal (not less than 17 l), prior to landing approach, have STBY HYD PUMP H/SYS 3 switch</p> <p>On hydraulic fluid level in reservoirs and on switching of standby hydraulic pumps</p>
(2) Failure of engine No. 1	<p>Pilot</p> <p>Flight Engineer</p> <p>During extension of landing gear:</p> <p>Pressure values as read off HYDR SYSTEMS 1 indicator</p> <p>Light annunciators HYDR SYSTEMS 1 and PRESSURE DROP 1</p>
(3) Failure of engine No. 2	<p>If engine failure takes place in the course of takeoff run:</p> <p>Flight Engineer</p> <p>STBY HYD PUMP H/SYS 2 switch immediately</p> <p>If engine failure takes place in flight:</p> <p>Pilot</p> <p><u>CAUTION: EXTEND LANDING GEAR AND FLAPS IN LEVEL FLIGHT.</u></p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
	<p>During extension of landing gear pressure values as read off HYDR SYSTEMS 1 indicator</p> <p>Light annunciator HYDR SYSTEMS 1</p> <p>F l i g h t E n g i n e e r</p> <p>Prior to landing approach, have STBY HYD PUMP H/SYS 2 switch</p> <p>During extension of landing gear pressure value as read off HYDR SYSTEMS 1 indicator</p> <p>Light annunciator PRESSURE DROP 1</p>
	<p>- May drop momentarily below 100 kgf/cm²</p> <p>- May come on momentarily</p> <p>- ON</p> <p>- May drop momentarily below 100 kgf/cm²</p> <p>- May drop momentarily</p>
(4) Failure of engine No. 3	<p>F l i g h t E n g i n e e r</p> <p>Prior to landing, have STBY HYD PUMP H/SYS 3 switch</p>
(5) Failure of engine Nos 1 and 2 in flight	<p>P i l o t</p> <p>Middle and inboard spoilers are not controllable.</p> <p>Command to extend landing gear by operating LANDING GEAR EMERGENCY EXTENSION handle</p> <p>During extension of flaps mind that flaps extension time is two times greater in this case (36 - 46 s).</p> <p><u>CAUTION: EXTEND LANDING GEAR AND FLAPS IN LEVEL FLIGHT.</u></p> <p>During extension of landing gear and flaps observe fluid pressure values:</p> <p>HYDR SYSTEMS 1 indicator</p> <p>HYDR SYSTEMS 2 indicator</p>
	<p>- Give to the co-pilot</p> <p>- About 0</p> <p>- Below 100 kgf/cm² for a short time period</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
	<p>Red light annunciators HYD SYSTEMS 1, 2</p> <p>C o - p i l o t</p> <p>Operate LANDING GEAR EMERGENCY EXTENSION handle (by the pilot's command)</p> <p>F l i g h t E n g i n e e r</p> <p>STBY HYD PUMP H/SYS 2 switch</p> <p><u>CAUTION:</u> PRIOR TO SWITCHING ON HYDRAULIC PUMP MAKE SURE THE LOAD OF THE GENERATOR OPERATING ON THE MAIN SYSTEM DOES NOT EXCEED 110 A.</p> <p>If the engine failed at approach, then prior to switching on of hydraulic pump in order to decrease the load on the generator, switch off:</p> <ul style="list-style-type: none"> - general (central and side) lighting of compartments; - power supply to fuel pumps of tanks Nos 2, 3, 4; - radar display. <p>During extension of flaps and landing gear read off pressure by indicators:</p> <p>HYD SYSTEM 1</p> <p>HYD SYSTEM 2</p> <p>Red light annunciators PRESSURE DROP 1, 2</p>
(6) Failure of engines Nos 1 and 3 in flight	<p>P i l o t</p> <p>Take into consideration an increase in extension time of flaps and landing gear, fluid pressure as read off HYD SYSTEM 1 indicator may drop below 100 kgf/cm² for a short period of time.</p> <p>Light annunciators HYDR SYSTEMS 1</p> <p>- About zero</p> <p>- Drops below 100 kgf/cm² for a while</p> <p>- Come on</p> <p>- May come on momentarily</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
	<p>F l i g h t E n g i n e e r</p> <p>Under conditions similar to those - ON outlined for the case of failure of engines Nos 1 and 2, have STBY HYD PUMP H/SYS 3 switch</p> <p>During extension of flaps and landing gear pressure value read off HYD SYSTEM 1 indicator may drop below 100 kgf/cm² for a short period of time.</p> <p>Red light annunciator PRESSURE - May come on momentarily DROP 1</p>
(7) Failure of engines Nos 2 and 3 in flight	<p>P i l o t</p> <p><u>CAUTION:</u> EXTEND LANDING GEAR AND FLAPS IN LEVEL FLIGHT.</p> <p>Take into consideration an increase in extension time of flaps and landing gear.</p> <p>During extension of landing gear and flaps pressure values read off HYDR SYSTEMS 1 and 2 indicators may drop below 100 kgf/cm² for a short period of time.</p> <p>Red light annunciators HYD SYSTEMS 1, 2 - May come on for a short period of time</p>
	<p>F l i g h t E n g i n e e r</p> <p>Under conditions similar to those - ON outlined for the case of failure of engines Nos 1 and 2, have STBY HYD PUMP H/SYS 2 switch</p> <p>During extension of flaps and landing gear pressure values read off HYDR SYSTEMS 1 and 2 indicators may drop below 100 kgf/cm² for a short period of time.</p> <p>Red light annunciators PRESSURE - May come on for a short period of time DROP 1, 2</p>

(cont'd)

8.4.4. Brief Description

- (1) Provision is made in the airplane for three independent hydraulic systems 1, 2 and 3.
- (2) Hydraulic fluid pressure in hydraulic system 1 is maintained by two pumps driven from engines Nos 1 and 2; that in hydraulic system 2 is kept with the aid of pump driven from engine No. 2 and of electrically-driven standby hydraulic pump, that in hydraulic system 3 is maintained by a pump driven from engine No. 3 and electrically-driven standby hydraulic pump.

The standby hydraulic pumps are alternate hydraulic power sources switched on by the flight engineer during ground checks of the hydraulic systems, as well as in flight in case of failure of the main pumps or in case of their insufficient capacity (if engines fail) by means of switches STBY HYD PUMP H/SYS 2, H/SYS 3 (НАСОСНАЯ СТАНЦИЯ 2 ГС, 3 ГС).

If need arises to test hydraulic system 1 on the ground, standby hydraulic pump of hydraulic system 2 may be actuated for use by means of the H/SYS 2 TO H/SYS 1 (ПОДКЛЮЧ 2 ГС НА 1 ГС) switch.

CAUTION: DO NOT OPERATE H/SYS 2 TO H/SYS 1 SWITCH IN FLIGHT.

- (3) The operating pressure in the hydraulic system is within 200 - 220 kgf/cm².

Operation of the hydraulic system is monitored by the pilot and flight engineer with reference to the pressure indicators HYDR SYSTEMS 1, 2, 3 (ГИДРОСИСТЕМЫ 1, 2, 3) and red light annunciators HYDR SYSTEMS 1, 2, 3 and PRESSURE DROP 1, 2, 3 which come on as soon as fluid pressure drops below 100 kgf/cm².

- (4) Hydraulic system 1 provides for:

Retraction and extension of landing gear (main control).

LG wheel main brakes control.

Flaps control (sub-channel 1).

Middle and inboard spoilers control.

Control of flight spoilers, ailerons, elevator, rudder (channel 1).

Control of hydraulic servos of ailerons, rudder, elevator (channel 1).

(cont'd)

Charging of emergency brake hydraulic accumulator.

Braking LG wheels after taking off.

(5) Hydraulic system 2 provides for:

Emergency extension of landing gear.

LG nose wheels steering control.

Flaps control (sub-channel 2).

Control of flight spoilers, ailerons, elevator, rudder (channel 2).

Control of hydraulic servos of ailerons, elevator, rudder (channel 2).

(6) Hydraulic system 3 provides for:

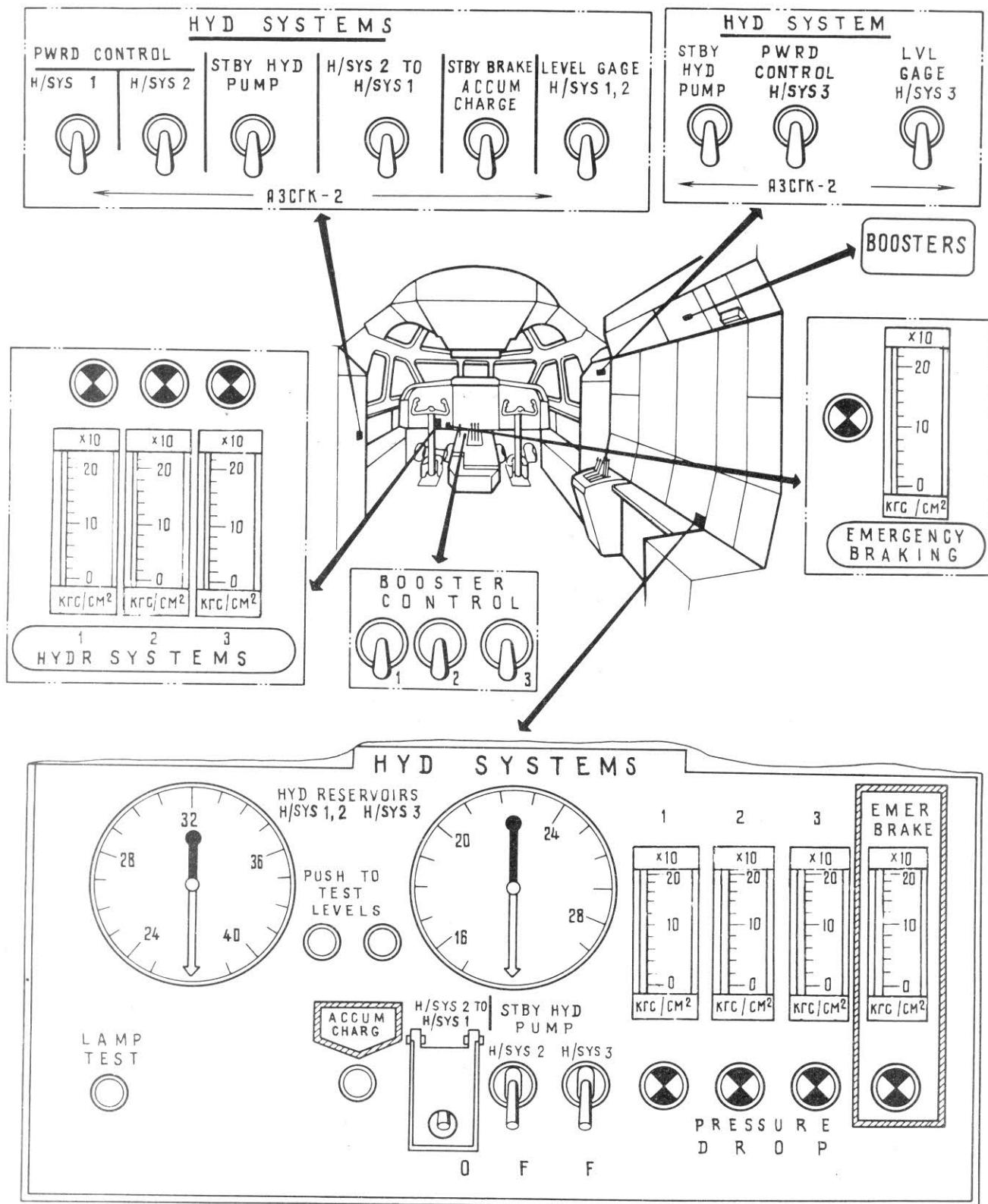
Duplicate emergency extension of landing gear.

Control of flight spoilers, ailerons, elevator, rudder (channel 3).

Control of hydraulic servos of ailerons, elevator, rudder (channel 3).

For the arrangement of the hydraulic system controls in the flight compartment refer to Figure 8.4.1.

(cont'd)



Hydraulic System Controls

Figure 8.4.1

— ooo —

Ty-154M

8.6. ELECTRICAL POWER SUPPLY

8.6. ELECTRICAL POWER SUPPLY

8.6.1. Operational Limitations

Characteristic	Unit of measure	Minimum	Normal	Maximum
(1) Main (primary) electrical power supply system				
(a) Voltage:				
External power source	V	117	119	121
Generator				
Auxiliary power unit (APU) generator	V	117	119	121
115/200 VAC, aircraft electrical system				
(b) Frequency:				
External power source	Hz	390	400	410*
Generator				
APU generator	Hz	390	400	410
115/200 VAC, aircraft electrical system				
(c) Load current:				
External power source	A	>0	-	170
Generator	A	>0	-	110
Generator with slats anti-icer ON	A	>0	-	138
APU generator				
With air bleed for air conditioning	A	>0	-	110
With air bleed for engine starting	A	>0	-	110
In flight	A	>0	-	138
(2) Secondary electrical power supply systems				
(a) Electrical system supplied by:				
Transformers	V	35	36	39.5
ITTC-250 inverters	V	33.5	36	39.5
Rectifiers	V	27	28	30
Storage batteries	V	≥20	-	25
Storage battery voltage:				
During test before storage battery connection to the circuit	V	26	-	-
During test under load	V	24	-	-
During test in flight	V	24	-	-
(b) Load current:				
Rectifier	A	0	-	200
Storage battery (during test)	A	80	90	100
Storage battery charging current (during test)	A	-	-	25
(3) Flight duration with storage batteries connected to the circuit (with fuel pumps inoperative)	min	-	-	30

* The frequency may increase up to 418 Hz with the APU ON in flight.
(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Electrical Power Supply

Characteristic	Unit of measure	Minimum	Normal	Maximum
(4) Limitations on switching on HC-46 pump units				
(a) With one generator (engine) failed and the slats anti-icers switched on:				
In enroute flight it is allowed to switch on one HC-46 pump unit without limitations. During approach it is allowed to switch on one HC-46 pump unit, provided the load of the generator operating for the main electrical system shall not exceed 110 A before the pump unit is switched on. In case of a higher load the pilot shall give a command to switch off the central and side lighting of the cabins fuel pumps of tanks Nos 2 and 3; at this, fuel will be supplied to the engine only from service tank No. 1, GROZA-154 weather radar. As soon as the pump unit is switched on, the flight engineer shall monitor the generator load to prevent overloading in excess of 138 A.				
(b) With any two generators (engines) failed, the HC-46 pump units connection procedure is the same as in the case of one failed generator (engine) with the slats anti-icers switched on (Ref. Item (a)), but the slats anti-icers in this case are supplied from the APU generator.				
(c) In case of manual disconnection of three generators from the main electrical system (should the electrical equipment be on fire, or electrical smoke be detected) and if necessity to switch on hydraulic pump units arises, it is allowed to connect one of the generators to the main electrical system after switching off the emergency selector switch of the generator connected. As soon as the pump unit is switched on, the flight engineer shall monitor the generator load to prevent overloading in excess of 138 A.				

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Electrical Power Supply

8.6.2. Normal Procedures

CONDITION (PROCEDURE)	REQUIRED ACTION
(1) Engine starting procedure	<p>(a) Initial positions of electrical power supply system controls</p> <p>Circuit breakers on circuit breaker panels and in junction box (JB)</p> <p>All the load master switches on the control panels, consoles and panels</p> <p>Generators 1, 2, 3 selector switches</p> <p>APU switch</p> <p>External power receptacle (EXT PWR) switch</p> <p>ПОС-125 inverter switch</p> <p>SYS TO XFMR SELECTION MAN - AUTO (ПОДКЛЮЧЕНИЕ СЕТЕЙ НА ТР-РЫ РУЧНОЕ-АВТОМАТ) selector switches</p> <p>ITC-250 INV No. 1 (ITC-250 № 1) selector switch</p> <p>ITC-250 INV No. 2 (ITC-250 № 2) selector switch</p> <p>RECT No. 1 (BY № 1) and RECT No. 2 (BY № 2) selector switches</p> <p>Storage batteries Nos 1, 2, 3, 4 switches</p> <p>SYSTEMS MAN TIE (РУЧНОЕ СОЕДИНЕНИЕ СЕТЕЙ) switch</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>EMERGENCY GENERATORS CONNECTION TO INDEPENDENT BUSES 1, 2, 3 (АВАРИЙНОЕ ВКЛЮЧЕНИЕ ГЕНЕРАТОРОВ НА АВТОНОМНЫЕ ЛИНИИ 1, 2, 3) selector switches</p> <p>(b) Testing and connection of storage batteries to the circuit</p> <p>BAT TEST (ПРОВЕРКА АККУМ) - Open the cap and switch on switch</p> <p>SYSTEMS MAN TIE (РУЧНОЕ СОЕДИНЕНИЕ СЕТЕЙ) switch - Open the cap and switch on</p> <p>Voltmeter selector switch - Set sequentially to the BAT No. 1 (AK № 1), BAT No. 2 (AK № 2), BAT No. 3 (AK № 3), BAT No. 4 (AK № 4) positions</p> <p>Voltage of storage battery before connecting it to the circuit - Check for the voltmeter readings</p> <p>Left circuit ammeter selector switch and voltmeter selector switch - Set to the BAT No. 1 (AK № 1) position</p> <p>Fuselage lights selector switches - Set to the EXTEND (ВЫПУСК) and LANDING (ПОСАДОЧНЫЙ) positions</p> <p>Wing lights selector switch - Set to the TAXI (РУЛЕЖНЫЙ) position</p> <p>Storage battery No. 1 switch - Set to position No. 1</p> <p>Storage battery No. 1 voltage (at a load current of 80 to 100 A) - Check for the voltmeter readings in conformity with Para. 8.6.1.</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p><u>CAUTION:</u> 1. STORAGE BATTERY TEST TIME AT A CURRENT VALUE OF 80 TO 100 A SHOULD NOT EXCEED 5 SECONDS.</p> <p>2. IF THE STORAGE BATTERY VOLTAGE IS BELOW 26 V DURING THE TEST BEFORE CONNECTING THE BATTERY TO THE CIRCUIT OR BELOW 24 V WHEN TESTED UNDER A LOAD, REPLACE THE STORAGE BATTERY.</p> <p>Storage battery No. 2 switch - Set to No. 2 position</p> <p>Right circuit ammeter selector switch and voltmeter selector switch - Set to the BAT No. 2 (AK № 2) position</p> <p>Storage battery No. 1 switch - Set to the OFF (ВЫКЛЮЧЕНО) position</p> <p>Test storage batteries Nos 2, 3 and 4 in the way similar to that of storage battery No. 1.</p> <p>Fuselage lights selector switches - Set to the RETRAC (УБОРКА) and OFF (ВЫКЛ) positions</p> <p>Wing lights selector switch - Set to the OFF (ВЫКЛ) position</p> <p>SYSTEMS MAN TIE (РУЧНОЕ СОЕДИНЕНИЕ СЕТЕЙ) switch - Set to the OFF (ВЫКЛ) position and safeguard</p> <p>BAT TEST (ПРОВЕРКА АККУМ) switch - Set to the OFF (ВЫКЛ) position and close with the cover</p> <p>Storage batteries Nos 1, 2, 3, 4 switches - Switch on</p> <p>The following light annunciators come on: LEFT SYSTEM FROM BAT (ЛЕВАЯ СЕТЬ ОТ АККУМ), RIGHT SYSTEM FROM BAT (ПРАВАЯ СЕТЬ ОТ АККУМ), LIGHT ON - GENERATOR OUT 1, 2, 3 (ЛАМПА ГОРИТ - ГЕНЕРАТОР НЕ РАБОТАЕТ 1, 2, 3), IFNS BUS SELECT LEFT TO SYS 3, RIGHT TO SYS 1 (ПОДКЛЮЧЕНИЕ ШИН НИК ЛЕВАЯ НА СЕТЬ III, ПРАВАЯ НА СЕТЬ I), L SYS TO XFMR No. 2 (ЛЕВАЯ СЕТЬ НА</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	TP № 2), R SYS TO XFMR No. 1 (ИПАВ СЕТЬ НА ТР № 1), ИTC-250 INV No. 1 INOP (ИTC-250 № 1 НЕ РАБОТАЕТ), ИTC-250 INV No. 2 TO SYS (ИTC-250 № 2 НА СЕТЬ).
(c) Testing ИTC-250 inverters	
ИTC-250 INV No. 1 - OFF (ИTC-250 № 1 - ВЫКЛ) switch	- Open the safety guard and switch on. ИTC-250 INV No. 1 INOP (ИTC-250 № 1 НЕ РАБОТАЕТ) annunciator goes out
ИTC-250 INV No. 2 - No. 1 (ИTC-250 № 2 - № 1) selector switch	- Set to No. 1 position
36-VAC electrical system voltmeter selector switch	- Set to ИTC-250 INV AB, BC, AC positions in turn
ИTC-250 INV No. 1 circuit voltage	- Check for the voltmeter readings as described in Para. 8.6.1
ИTC-250 INV No. 1 - OFF (ИTC-250 № 1 - ВЫКЛ) switch	- Set to the OFF (ВЫКЛ) position and safeguard
Check for the illumination of the ИTC-250 INV No. 1 INOP (ИTC-250 № 1 НЕ РАБОТАЕТ) annunciator.	
ИTC-250 INV No.2 - No.1 (ИTC-250 № 2 - № 1) selector switch	- Set to position No.2
36-VAC electrical system voltmeter selector switch	- Move to the ИTC-250 INV AB, BC, AC positions in turn
ИTC-250 INV No.2 (ИTC-250 № 2) inverter circuit voltage	- Check for the voltmeter readings and refer to Para. 8.6.1

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Electrical Power Supply

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>ITC-250 INV No. 2 MAN - AUTO (ITC-250 № 2 РУЧНОЕ - АВТОМАТ) selector switch</p> <p>36-VAC electrical system voltmeter selector switch</p> <p>ITC-250 No. 2 circuit voltage</p> <p>ITC-250 INV No. 2 MAN - AUTO (ITC-250 № 2 РУЧНОЕ - АВТОМАТ) selector switch</p>
	<p>- Set to the MAN (РУЧНОЕ) position</p> <p>ITC-250 INV No. 2 TO SYS (ITC-250 № 2 НА СЕТЬ) an- nunciator is ON</p> <p>- Set to the ITC-250 INV AB, BC, AC positions in turn</p> <p>- Check for the voltmeter readings referring to Para. 8.6.1</p> <p>- Set to the AUTO (АВТОМАТ) position</p>
	<p><u>CAUTION:</u> PREVENT STORAGE BATTERIES DISCHARGING. TO RETAIN THEIR CAPACITY USE THE AC EXTERNAL POWER SOURCE OR APU GENERATOR AND AIRCRAFT RECTIFIERS FOR CHECKING THE SYSTEMS AND DURING PROLONGED POWER SUPPLY TO CONSUMERS.</p>
(d) Switching on AC external power source to the aircraft electrical system	<p>115/200-V external power source cable receptacle</p> <p>Storage batteries Nos 1, 2, 3, 4 switches</p> <p>Voltmeter and frequency meter selector switch and voltmeter and frequency meter phase selector switch</p> <p>External power source voltage and frequency</p> <p>- Connect to the aircraft</p> <p>- Make certain they are switched on</p> <p>- Set to the EXT PWR, A, B, C (ПАII, А, В, С) positions</p> <p>- Check for the voltmeter and frequency meter read- ings referring to Para. 8.6.1</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>EXT PWR - OFF (ПАУ - ВЫКЛЮЧЕНО) switch</p> <p>- Set to the EXT PWR (ПАУ) position, the external power source light annunciator comes on</p> <p>The following annunciators go out:</p> <p>IFNS BUS SELECT LEFT TO SYS 3, RIGHT TO SYS 1 (ПОДКЛЮЧЕНИЕ ШИН НИК ЛЕВАЯ НА СЕТЬ III, ПРАВАЯ НА СЕТЬ I), L SYS TO XFMR No. 2 (ЛЕВ СЕТЬ НА ТР № 2), R SYS TO XFMR No. 1 (ПРАВ СЕТЬ НА ТР № 1), ПТС-250 INV No. 2 TO SYS (ПТС-250 № 2 НА СЕТЬ)</p> <p>Voltmeter and frequency meter selector switch and voltmeter and frequency meter phase selector switch</p> <p>- Set in turn to the SYS 1 A, B, C (СЕТЬ I A, B, C) SYS 2 A, B, C (СЕТЬ II A, B, C) SYS 3 A, B, C (СЕТЬ III A, B, C) positions</p> <p>115/200- VAC electrical system voltage and frequency</p> <p>- Check for the voltmeter and frequency meter readings</p> <p>RECT No. 1 (БУ № 1) and RECT No. 2 (БУ № 2) selector switches</p> <p>- Set to the RECT No. 1 (БУ № 1) and RECT No. 2 (БУ № 2) positions respectively.</p> <p>The LEFT SYSTEM FROM BAT (ЛЕВАЯ СЕТЬ ОТ АККУМ), RIGHT SYSTEM FROM BAT (ПРАВАЯ СЕТЬ ОТ АККУМ) annunciators go out</p> <p><u>NOTE:</u> With AC power loads connected, the LEFT (RIGHT) SYSTEM FROM BAT annunciators may be flashing momentarily.</p> <p>27-V electrical system voltmeter selector switch</p> <p>- Set to the L SYS (ЛЕВ СЕТЬ), R SYS (ПРАВ СЕТЬ) positions in turn</p> <p>27-V right and left electrical systems voltage</p> <p>- Check for the voltmeter readings</p> <p>RECT No. 2 (БУ № 2) selector switch</p> <p>- Set to the RECT STBY (БУ PE3) position. The RECT STBY RIGHT SYSTEM (БУ PE3</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>ПРАВАЯ СЕТЬ) annunciator lights up</p>
Right electrical system ammeter selector switch	<ul style="list-style-type: none"> - Set to the RECT STBY (BY PE3) position
Standby rectifier load	<ul style="list-style-type: none"> - Check for ammeter readings
RECT No. 2 (BY № 2) selector switch	<ul style="list-style-type: none"> - Set to the RECT No. 2 (BY № 2) position. The RECT STBY RIGHT SYSTEM (BY PE3 ПРАВАЯ СЕТЬ) annunciator goes out
RECT No. 1 (BY № 1) selector switch	<ul style="list-style-type: none"> - Set to the RECT STBY (BY PE3) position. <p>The RECT STBY LEFT SYSTEM (BY PE3 ЛЕВАЯ СЕТЬ) annunciator lights up</p>
Left electrical system ammeter selector switch	<ul style="list-style-type: none"> - Set to the RECT STBY (BY PE3) position
Standby rectifier load	<ul style="list-style-type: none"> - Check for the ammeter readings
36-VAC electrical system selector switch	<ul style="list-style-type: none"> - Set to the LEFT AB, BC, AC (ЛЕВАЯ AB, BC, AC) and RIGHT AB, BC, AC (ПРАВАЯ AB BC, AC) positions
36-VAC electrical system voltage	<ul style="list-style-type: none"> - Check for the voltmeter readings
HTC-250 INV No. 2 - No. 1 (HTC-250 № 2 - № 1) selector switch and 36-VAC electrical system voltmeter selector switch	<ul style="list-style-type: none"> - Set to the HTC-250 INV No. 2, AB, BC, AC (HTC-250 № 2, AB, BC, AC) and HTC-250 INV No. 1, AB, BC, AC (HTC-250 № 1, AB, BC, AC) positions in turn

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>HTC-250 INV No. 1 and No. 2 - Check for the voltmeter electrical systems voltage readings</p> <p><u>CAUTION:</u> TAKEOFF WITH THE "DOMESTIC EQPMT" (БЫТ ОБОРУД) SWITCH SET TO ON <u>IS PROHIBITED</u> SINCE THE AUTOMATIC CIRCUIT CHANGE-OVER SYSTEM DOES NOT OPERATE WITH THE GENERATORS FAILED. THE SWITCH IS SWITCHED ON ONLY ON THE GROUND FOR TESTING DOMESTIC EQUIPMENT.</p> <p>The above checks being accomplished, the aircraft equipment is allowed to be prepared for a flight, including the APU starting.</p> <p>(e) Connecting APU generator to the aircraft electrical system</p> <p>After the APU is started and gains power:</p> <p>115/200-VAC electrical system voltmeter and frequency meter selector switch - Set to the APU (BCY) position</p> <p>Ammeter selector switch - Set to the APU (BCY) position</p> <p>APU-OFF (BCY-ВЫКЛЮЧЕНО) switch - Set to the APU (BCY) position</p> <p>115/200-VAC electrical system voltmeter and frequency meter phase selector switch - Set to A, B, C positions in turn</p> <p>APU AC generator voltage and frequency - Check for the voltmeter and frequency meter readings</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>115/200-VAC electrical system ammeter phase selector switch</p> <p>APU generator load</p> <p>Voltmeter and frequency meter selector switch and 115/200-VAC electrical system voltmeter and frequency meter phase selector switch</p> <p>115/200-VAC electrical system voltage and frequency</p> <p>36-VAC electrical system voltmeter selector switch</p> <p>36-VAC electrical system voltage</p> <p>HTC-250 INV No. 2 - No. 1 (HTC-250 № 2 - № I) selector switch and 36-VAC electrical system voltmeter selector switch</p> <p>HTC-250 inverters No. 1 and No. 2 electrical system voltage</p> <p>RECT No. 1 (BY № I) and RECT No. 2 (BY № 2) selector switches</p>
	<ul style="list-style-type: none"> - Set to A, B, C positions in turn - Check for the ammeter readings - Set in turn to the positions: SYSTEM 1 A, B, C (СЕТЬ I A, B, C), SYSTEM 2 A, B, C (СЕТЬ II A, B, C), SYSTEM 3 A, B, C (СЕТЬ III A, B, C) - Check for the voltmeter and frequency meter readings - Set in turn to the positions: LEFT AB, BC, AC (ЛВАЯ AB, BC, AC) RIGHT AB, BC, AC (ПРАВАЯ AB, BC, AC) - Check for the voltmeter readings - Set in turn to the positions: HTC-250 INV No. 2 AB, BC, AC (HTC-250 № 2 AB, BC, AC) HTC-250 INV No. 1 AB, BC, AC (HTC-250 № I AB, BC, AC) - Check for the voltmeter readings - Set to the RECT No. 1 (BY № I) and RECT No. 2 (BY № 2) positions (if the APU has

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>been started from the storage batteries only)</p>
	<p>27-V electrical system voltmeter selector switch - Set to the following positions in turn: L SYS (ЛСБ СЕТб), R SYS (РСБ СЕТб)</p>
	<p>27-V electrical systems (left and right) voltage - Check for the voltmeter readings</p>
	<p>After the electrical systems voltage is checked, the consumers are permitted to be switched on.</p>
(2) Prior to taxiing-out (after engines starting)	<p>(a) Testing/switching on AC primary generators to electrical system</p> <p>After all the engines are started and gain idling power:</p> <p>115/200-VAC electrical system voltmeter and frequency meter selector switch and voltmeter and frequency meter phase selector switch - Set in turn to the following positions of the generator being tested: A, B, C</p> <p>Selector switch of generator being tested - Set to the TEST (ИПОБЕПКА) position</p> <p>Voltage and frequency of generator being tested - Check for the voltmeter and frequency meter readings</p> <p>Repeat the above actions for the three generators.</p> <p>Generator No. 1 selector switch - Set to the ON (ВКЛЮЧЕНО) position. The LIGHT ON - GENERATOR OUT (ЛАМПА ГОРИТ - ГЕНЕРАТОР РАБОТАЕТ) announcer goes out</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Voltmeter and frequency meter selector switch and voltmeter and frequency meter phase selector switch</p> <p>System 1 and independent left buses voltage and frequency</p> <p>Switch on generators No. 2 and No. 3 in a similar way, but check for the voltage and frequency:</p> <ul style="list-style-type: none"> - at switching on generator No. 2 - at switching on generator No. 3 <p>- In system 2</p> <p>- In system 3 and independent right buses</p> <p>After the three generators and the consumers are switched on:</p> <p>200/115-VAC electrical system ammeter selector switch and ammeter phase selector switch</p> <p>Generator load</p> <p>36-VAC electrical system voltmeter selector switch</p> <p>36-VAC electrical system voltage</p> <p>- Set in turn to the following positions:</p> <p>GENERATOR 1, A, B, C (ГЕНЕРАТОР 1, А, Б, С)</p> <p>GENERATOR 2, A, B, C (ГЕНЕРАТОР 2, А, Б, С)</p> <p>GENERATOR 3, A, B, C (ГЕНЕРАТОР 3, А, Б, С)</p> <p>- Check for the ammeter readings</p> <p>- Set in turn to the following positions:</p> <p>L SYS, AB, BC, AC (СЕТЬ ЛЕВАЯ, АВ, ВС, АС)</p> <p>R SYS, AB, BC, AC (СЕТЬ ПРАВАЯ, АВ, ВС, АС)</p> <p>- Check for the voltmeter readings</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>HTC-250 INV No. 2 - No. 1 (HTC-250 № 2 - № I) selector switch and 36-VAC electrical system voltmeter selector switch</p> <p>HTC-250 inverters No. 1 and No. 2 systems voltage</p> <p>After caging the gyro horizons, slaving the БКК-18, СНІ-1 compass system and with the AFCS O.K. (ИСПР АЕСУ) annunciator illuminated at a signal applied from the pilot:</p> <p>36-VAC electrical system (left or right) SYS TO XFMR SELECTION MAN - AUTO (ПОДКЛЮЧЕНИЕ СЕТЕЙ НА ТР-РУ РУЧНОЕ-АВТОМАТ) selector switches</p> <p>Check:</p> <ul style="list-style-type: none"> - Illumination of the L SYS TO XFMR No. 2 (ЛЕВ СЕТЬ НА ТР № 2) (R SYS TO XFMR No. 1 (ИПАВ СЕТЬ НА ТР № I)) annunciator. - Serviceability of the main gyro horizons by the absence of the GYRO (АГ) flags on the face panels of the flight director indicator ПКИ-1 and the difference in readings on roll and pitch with the readings of the gyro horizon as well as the serviceability of the course-line computers. <p><u>NOTES:</u></p> <ol style="list-style-type: none"> 1. The check time from the standby transformer should not exceed 10 seconds. 2. In case of malfunction of the gyro horizons deenergize the airplane, find and eliminate the trouble.

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>36-VAC electrical system voltmeter selector switch</p> <p>- Set to the L SYS A, B, C (СЕТЬ ЛЕВАЯ А, Б, С) (R SYS A, B, C (СЕТЬ ПРАВАЯ А, Б, С)) position</p>
	<p>36-VAC electrical system (left/right) voltage</p> <p>- Check for the voltmeter readings</p>
	<p>36-VAC electrical system (left/right) SYS TO XFMR SELECTION MAN-AUTO (ПОДКЛЮЧЕНИЕ СЕТЕЙ НА ТР-РН РУЧНОЕ-АВТОМАТ) selector switch</p> <p>Check for going out the L SYS TO XFMR No. 2 (ЛЕВ СЕТЬ НА ТР № 2), R SYS TO XFMR No. 1 (ПРАВ СЕТЬ НА ТР № 1) annunciator.</p> <p><u>CAUTION:</u> SIMULTANEOUS SETTING OF TWO SELECTOR SWITCHES "SYS TO XFMR SELECTION" (ПОДКЛЮЧЕНИЕ СЕТЕЙ НА ТРАНСФОРМАТОРЫ) TO "MAN" (РУЧНОЕ) POSITION IS PROHIBITED.</p>
	<p>RECT No. 1 (BY № 1) and RECT No. 2 (BY № 2) selector switches</p> <p>- Make certain that they are in RECT No. 1 (BY № 1) and RECT No. 2 (BY № 2) positions</p>
	<p>27-V electrical system (left/right) voltmeter selector switch</p> <p>- Set to the L SYS (ЛЕВ СЕТЬ) (R SYS (ПРАВ СЕТЬ)) position</p>
	<p>Left (right) electrical system voltage</p> <p>- Check for the voltmeter readings</p>
	<p>Left (right) electrical system ammeter selector switch</p> <p>- Set to the RECT No. 1 (BY № 1) (RECT No. 2 (BY № 2)) position</p>
	<p>RECT No. 1 (BY № 1) (RECT No. 2 (BY № 2)) load</p> <p>- Check for the ammeter readings</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
(b) Switching off external power supply source and APU generator	<p>With the main generators, rectifiers and storage batteries connected to the aircraft electrical system:</p> <p>EXT PWR - OFF (РАИ- ВЫКЛЮЧЕНО) or APU - OFF (BCУ-ВЫКЛЮЧЕНО) switch - Set to the OFF (ВЫКЛЮЧЕНО) position</p> <p>Order to switch off the external power source and disconnect it from the aircraft.</p>
(3) At all stages of flight	<p>Operation of the electrical power systems by illumination of annunciators - Check</p> <p>AC and DC systems instrument readings - Check periodically</p> <p>The 27-V electrical system voltmeter selector switch should be in the L SYS (ЛЕВ СЕТЬ) (R SYS (ИПАВ СЕТЬ)) position and the 115/200-VAC electrical system voltmeter selector switch - in the SYSTEM I (СЕТЬ I) or SYSTEM 3 (СЕТЬ III) position.</p> <p>Check the AC system voltage and generator load before take-off, periodically during flight and 15 to 20 minutes before landing.</p> <p>In 30 to 50 minutes of flight check the storage batteries charging current and voltage:</p> <p>27-V electrical system (left) ammeter selector switch - Set in turn to the BAT No. 1 (AKK № I), BAT No. 3 (AKK № 3) positions</p> <p>Storage batteries No. 1 and No. 3 charging current - Check for the ammeter readings</p> <p>27-V electrical system (right) ammeter selector switch - Set in turn to the BAT No. 2 (AKK № 2), BAT No. 4 (AKK № 4) positions</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>Storage batteries No. 2 and No. 4 charging current</p> <p>27-V electrical system voltage selector switch</p> <p>Battery No. 1 switch</p> <p>Battery No. 1 voltage</p> <p>Battery No. 1 switch</p> <p>Check storage batteries Nos 2, 3 and 4 voltage similarly.</p>
	<p>- Check for the ammeter readings</p> <p>- Set to the BAT No. 1 (AKK № 1) position</p> <p>- Switch off</p> <p>- Check voltmeter readings</p> <p>- Set to the BAT No. 1 (AKK № 1) position</p>
(4) Before engine shutdown	<p>Consumers not required</p> <p>EXT PWR (АЭРОД ПИТ) cable receptacle for cooling landing gear wheels</p> <p>EXT PWR - OFF (РАП-ВЫКЛЮЧЕНО) switch of AC circuits</p> <p>If the AC external power source is not available</p> <p>APU</p> <p>After the APU gains higher power:</p>
	<p>- Switch off</p> <p>- Connect</p> <p>- Set to the EXT PWR (РАП) position</p> <p>- Start</p> <p>APU - OFF (BCУ-ВЫКЛЮЧЕНО) switch</p> <p>Generators selector switches</p> <p>- Set to the OFF (ВЫКЛ) position. The LIGHT ON - GENERATOR OUT 1, 2, 3 (ЛАМПА ГОРИТ - ГЕНЕРАТОР НЕ РАБОТАЕТ 1, 2, 3) generators annunciators illuminate</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>After the engines shutdown and all the operations required are accomplished:</p> <p>EXT PWR - OFF (РАП-ВЫКЛЮЧЕНО) switch - Set to the OFF (ВЫКЛЮЧЕНО) position</p> <p>External power source cable receptacle - Disconnect</p> <p>With the external power source not available, the APU - OFF (ВСУ-ВЫКЛЮЧЕНО) switch - Set to the OFF (ВЫКЛЮЧЕНО) position</p> <p>IIOC-125 INV switch - Make sure it is in the OFF (ВЫКЛ) position</p> <p>ITTC-250 INV No. 1 (ITTC-250 № I) switch - Set to the OFF (ВЫКЛ) position</p> <p>Storage batteries Nos 1, 2, 3, 4 switches - Switch off</p>

(cont'd)

8.6.3. Troubles

TROUBLE	CORRECTIVE ACTION
(1) The LIGHT ON-GENERATOR OUT (ЛАМПА ГОРИТ - ГЕНЕРАТОР НЕ РАБОТАЕТ) annunciator of one of the generators illuminates	<p>Generator load</p> <ul style="list-style-type: none"> - Check for the ammeter reading <p>With no load:</p> <p>Generator selector switch</p> <ul style="list-style-type: none"> - Set to the TEST (ПРОВЕРКА) position <p>Generator voltage and frequency</p> <ul style="list-style-type: none"> - Check for the voltmeter and frequency meter readings <p>If the voltage and frequency are within the limits:</p> <p>Generator selector switch</p> <ul style="list-style-type: none"> - Set to the OFF (ВЫКЛ) and then to the ON (ВКЛЮЧЕНО) positions <p>If the LIGHT ON - GENERATOR OUT (ЛАМПА ГОРИТ - ГЕНЕРАТОР НЕ РАБОТАЕТ) annunciator did not go out:</p> <p>Generator selector switch</p> <ul style="list-style-type: none"> - Set to the OFF (ВЫКЛ) position <p>115/200-VAC electrical system voltage</p> <ul style="list-style-type: none"> - Make certain that it is available <p><u>NOTE:</u> In case of failure of generator No. 1 and with the AFCS switches on a momentary motion of the control column is possible.</p> <p>If one or two generators (engines) fail, they are automatically disconnected from the aircraft electrical system and the circuits are switched over to serviceable generators.</p> <p>In case of failure of one generator with the slats anti-icer switched on the domestic equipment power supply is automatically switched off.</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
(2) Voltage in one of 115/200-VAC electrical system is beyond permissible limits	Selector switch of generator of this system - Set to the OFF (ВЫКЛЮЧЕНО) position Proceed as in the case of failure of one generator.
(3) Two LIGHT ON - GENERATOR OUT (ЛАМПА ГОРИТ - ГЕНЕРАТОР НЕ РАБОТАЕТ) annunciations illuminate	Proceed as in the case of failure of one generator. <u>CAUTION:</u> IN DESCENT AND APPROACH <u>DO NOT</u> SET POWER TO THE ENGINE WHOSE GENERATOR IS OPERATING BELOW 62 % HP COMPRESSOR RPM.
(4) Storage battery charging current is more than 25 A or battery voltage is less than 24 V	Switch of faulty storage battery - Set to the OFF (ВЫКЛЮЧЕНО) position
(5) L SYS TO XFMR No. 2 (ЛЕВ СЕТЬ НА ТР № 2) (R SYS TO XFMR No. 1 (ПРАВ СЕТЬ НА ТР № 1)) annunciator illuminates	36-VAC electrical system (left/right) voltage - Check for the voltmeter readings <u>NOTE:</u> If one of the transformers fails, the 36-VAC system left and right circuits are automatically tied. If 36-VAC electrical system (left/right) voltage is not available: SYS TO XFMR SELECTION LEFT (RIGHT) (ПОДКЛЮЧЕНИЕ СЕТЕЙ НА ТР-РН ЛЕВ (ПРАВ)) system selector switch - Set to the MAN (РУЧНОЕ) position
(6) 36-VAC electrical system (left/right) voltage is beyond permissible limits	SYS TO XFMR SELECTION LEFT (RIGHT) (ПОДКЛЮЧЕНИЕ СЕТЕЙ НА ТР-РН ЛЕВ (ПРАВ)) system selector switch - Set to the MAN (РУЧНОЕ) position
(7) HTC-250 INV No. 1 INOP (HTC-250 № 1 НЕ РАБОТАЕТ) annunciator illuminates	The HTC-250 No. 1 inverter system is automatically switched over to power supply from 36-VAC electrical system (right). Check for the availability of the HTC-250 No. 1 inverter system voltage.

(cont'd)

TROUBLE	CORRECTIVE ACTION
(8) HTC-250 INV No. 2 TO SYS (HTC-250 № 2 HA CETб) annunciator illuminates	HTC-250 No. 2 inverter system voltage If the voltage is not available: HTC-250 INV No. 2 MAN - AUTO (HTC-250 № 2 РУЧНОЕ - АВТОМАТ) selector switch - Check for the voltmeter readings
(9) RECT STBY LEFT (RIGHT) SYSTEM (BY PE3 ЛЕВАЯ (ПРАВАЯ) CETб) annunciator illuminates, no left (right) system ammeter load current	Standby rectifier load <u>NOTE:</u> The standby rectifier is automatically connected instead of the failed one. If the RECT STBY (BY PE3) load is not available: RECT No. 1 (BY № 1) (RECT No. 2 (BY № 2)) selector switch - Check for the ammeter readings
(10) LEFT (RIGHT) SYSTEM FROM BAT (ЛЕВАЯ (ПРАВАЯ) СЕТЬ ОТ АККУМ) annunciator illuminates, RECT No. 1 (No. 2) (BY № 1 (№ 2)) and RECT STBY (BY PE3) load current not available	27-V system connection switch SYSTEMS TIED (СЕТИ СОЕДИНЕНЫ) annunciator illuminates and LEFT (RIGHT) SYSTEM FROM BAT (ЛЕВАЯ (ПРАВАЯ) СЕТЬ ОТ АККУМ) annunciator goes out - Open the safety guard and switch on - Check
(11) After the external power source switch is switched on the AC circuits are de-energized. The external power source light annunciator fails to come on	EXT PWR (ПАИ) switch Airplane Trouble - Switch off - De-energize - Shoot

(cont'd)

TROUBLE	CORRECTIVE ACTION
(12) The LIGHT ON - GENERATOR OUT (ЛАМПА ГО-РУТ - ГЕНЕРАТОР НЕ РАБОТАЕТ) annunciators of three generators become illuminated and the LEFT SYSTEM FROM BAT (ЛЕВАЯ СЕТЬ ОТ АККУМ), RIGHT SYSTEM FROM BAT (ПРАВАЯ СЕТЬ ОТ АККУМ) annunciators become illuminated	Refer to Para 6.6.2 FLIGHT WITH ALL GENERATORS FAILED

(cont'd)



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Electrical Power Supply

8.6.4. Brief Description

The following electrical power systems are used in the airplane:

Three-phase, 200/115 VAC, 400 Hz primary generation system.

Three-phase, 36 VAC, 400 Hz secondary generation system.

27-VDC secondary generation system.

8.6.4.1. Three-Phase, 200/115 VAC, 400 Hz Primary Generation System

The system consists of three generation circuits.

The electrical power sources are:

(1) The main - three generators Nos 1, 2 and 3 installed one on each engine.

(2) The standby - the APU generator.

(3) The emergency - the IIOC-125 static inverter.

The generator regulation, protection and control equipment ensures the automatic testing of generators, their connection to the circuit, maintaining their parameters within the specified limits, disconnection of unserviceable generation circuit at different failures with the operation of the LIGHT ON - GENERATOR OUT (ЛЯМПА ГОРИТ -- ГЕНЕРАТОР НЕ РАБОТАЕТ) annunciator.

The AC generation system is divided into three circuits: circuit 1 is for a port side, circuit 3 is for a starboard and circuit 2 is for slats anti-icer.

At normal operating conditions generator No. 1 produces power for the left circuit 1, generator No. 3 supplies power to the right circuit 3. Generator No. 2 supplies power to circuit 2 to which the slats anti-icer is connected.

In case of failure of generator No. 1 or No. 3 generator No. 2 is automatically switched on instead of a failed one (if the anti-icer has not been switched on). With the slats anti-icer on, the circuits redundancy is provided by their connection (circuits 1 and 3). In this case the domestic equipment is automatically switched off. In case of failure of generator No. 2 and with the slats anti-icer switched on, the slats anti-icer circuit 2 is connected to generator No. 1, circuits 1 and 3 are connected and are powered by generator No. 3.

In case of failure of two generators the remaining serviceable generator powers circuits 1 and 3 and the slats anti-icer is powered (in case of necessity to switch it on) from the APU generator.

(cont'd)

The system is provided with independent left and right buses. Any two of the three generators can be connected to the independent left or right buses at emergency disconnection of the three generators from the main buses:

Generator No. 1 or No. 2 can be connected to the left buses.

Generator No. 3 or No. 2 can be connected to the right buses.

The AC generation system is provided with the flight-navigation system left and right buses to reduce the intervals in the flight-navigation system power supply.

At normal operating conditions they are powered from circuit 1 and circuit 3, respectively.

In case of trouble in circuit 1 (3) the flight-navigation system left (right) buses are automatically changed over to circuit 3 (1) by means of the АИМ-3М bus tie relay No. 1 (No. 2) and the КОЧ-62Б frequency protection unit No. 1 (No. 2).

The external power source is connected through the external power receptacle.

The AC generation system is controlled and monitored by the flight engineer:

From the electrical power control panel.

From the AFCS monitor panel.

From the warning light panel.

Provision is made in the system for installation of the ЕКН 115-В unit which is intended for preventing connection of the faulty external power source as well as to disconnect it should its electrical parameters be out of the allowable limits.

To control the 115/200-VAC generation system and to monitor its functioning the following controls are used:

Three selector switches of generators Nos 1, 2 and 3.

Three red annunciators LIGHT ON - GENERATOR OUT 1, 2, 3 (ЛАМПА ГОРИТ - ГЕНЕРАТОР НЕ РАБОТАЕТ 1, 2, 3) indicating disconnection of the generators.

EXT PWR (PAII) switch.

APU switch.

НОС-125 INV switch.

(cont'd)

Voltmeter and frequency meter wafer rotary selector switch.

Voltmeter and frequency meter phase wafer rotary selector switch.

Ammeter wafer rotary selector switch.

Ammeter phase wafer rotary selector switch.

Two IFNS BUS SELECT LEFT TO SYS 3, RIGHT TO SYS 1 (ПОДКЛЮЧЕНИЕ ШИН НИК ЛЕВАЯ НА СЕТЬ 3, ПРАВАЯ НА СЕТЬ 1) amber annunciators.

Voltmeter and frequency meter for measuring generators Nos 1, 2, 3, APU, external power source, circuits 1, 2, 3 voltage and frequency.

Ammeter for measuring generators Nos 1, 2, 3, APU, external power source current.

Three selector switches (located on the AFCS monitor panel) for emergency switching on of generators Nos 1, 2, 3 to the independent buses.

EXT PWR green light annunciator

BKH FAILURE amber light annunciator (on the indicating panel)

Besides, located on the right-side instrument panel is a DOMESTIC EQPMT (ЕНТ ОБОРУД) switch providing switching off automatic circuit change-over interlocking.

8.6.4.2. Three-Phase, 36 VAC, 400 Hz Secondary Generation System

The electrical power sources are the following:

- (1) The main power sources are 200/36 VAC transformers powered by the three-phase, 115/200 VAC, primary generation system.
- (2) The emergency electrical power sources are ITC-250 static inverters No. 1 and No. 2.

Under normal operating conditions the left circuit is supplied from transformer No. 1, the right one is fed from transformer No. 2 which are powered by the left and right 115/200-VAC circuits.

If one of the transformers fails, the circuit of the failed transformer is connected to the serviceable transformer automatically or manually.

Inverter No. 1 is used for self-contained power supply to the gyro horizon at normal operation of the electrical power supply system.

(cont'd)

The 36-VAC secondary generation system is controlled and monitored from the electrical power control panel (36 VAC SYSTEMS (СЕТИ ~ 36 В)).

For controlling the system and monitoring its operation the following controls are used:

Voltmeter intended for measuring circuit voltage.

Voltmeter wafer rotary selector switch.

HTC-250 INV No. 2 - No. 1 (HTC-250 № 2 - № 1) selector switch used for connecting the circuits to the voltmeter selector switch.

Two SYS TO XFMR SELECTION MAN - AUTO (ПОДКЛЮЧЕНИЕ СЕТЕЙ НА ТР-РН РУЧНОЕ-АВТОМАТ) selector switches.

Two L SYS TO XFMR No. 2 (ЛЕВ СЕТЬ НА ТР № 2), R SYS TO XFMR No. 1 (ПРАВ СЕТЬ НА ТР № 1) amber annunciators.

HTC-250 INV No. 1 - OFF (HTC-250 № 1 - ВЫКЛ) switch.

HTC-250 INV No. 1 INOP (HTC-250 № 1 НЕ РАБОТАЕТ) amber annunciator.

HTC-250 INV No. 2 MAN - AUTO (HTC-250 № 2 РУЧНОЕ - АВТОМАТ) selector switch.

HTC-250 INV No. 2 TO SYST (HTC-250 № 2 НА СЕТЬ) amber annunciator.

8.6.4.3. 27-VDC Secondary Generation System

The 27-VDC secondary generation system consists of two circuits (systems): the left and the right.

The electrical power sources are the following:

- (1) The main power sources are rectifier No. 1 for the left circuit and No. 2 - for the right circuit.
- (2) The emergency power sources are storage batteries No. 1 and No. 3 for the left circuit and No. 2 and No. 4 for the right circuit.

The system is provided with a standby rectifier (RECT STBY (BY PE3)) that can be connected to the left or right circuit automatically or manually instead of the failed main rectifier. In case of failure of rectifiers No. 1 and No. 2 the standby rectifier (RECT STBY (BY PE3)) is connected to the left circuit.

During APU start the standby rectifier is automatically connected to the left and right circuits, which is followed by illumination of the RECT STBY LEFT SYSTEM, RECT STBY RIGHT SYSTEM (BY PE3 ЛЕВАЯ СЕТЬ, BY PE3 ПРАВАЯ СЕТЬ) annunciators.

(cont'd)

The rectifiers are powered by appropriate buses of the 115/200-VAC primary generation system.

A provision is made for automatic (at starting the APU) and manual (if required) connection of the circuits.

Each circuit is provided with main buses powered both by the rectifiers and storage batteries, and switched-off buses which are energized only when the rectifiers are operating. In case of emergency disconnection of the three generators powered from the AC main buses a provision is made for supplying electrical power to standby rectifier from the independent left-side buses. In this case standby rectifier supplies power to the DC circuit main buses. The circuits must be connected manually.

The system is controlled and monitored from the electrical power control panel (27 VDC SYSTEMS (СЕТИ = 27 В)).

To control the system and monitor its functioning the following controls are used:

Voltmeter used for measuring left, right circuits, BAT No. 1 (AK № 1), BAT No. 2 (AK № 2), BAT No. 3 (AK № 3), BAT No. 4 (AK № 4) voltage.

Voltmeter wafer rotary selector switch.

Left circuit ammeter.

Wafer rotary selector switch used for measuring rectifier RECT No. 1 (BY № I), standby rectifier RECT STBY (BY PE3), BAT No. 1 (AK № 1), BAT No. 3 (AK № 3) currents.

Right circuit ammeter.

Wafer rotary selector switch designed for measuring rectifier RECT No. 2 (BY № 2), standby rectifier RECT STBY (BY PE3), BAT No. 2 (AK № 2), BAT No. 4 (AK № 4) current.

Circuit connection switch.

SYSTEMS TIED (СЕТИ СОЕДИНЕНЫ) amber annunciator.

Two RECT No. 1 - RECT STBY (BY № I - BY PE3) and RECT No. 2 - RECT STBY (BY № 2 - BY PE3) selector switches.

Two RECT STBY LEFT SYSTEM (BY PE3 ЛЕВАЯ СЕТЬ) and RECT STBY RIGHT SYSTEM (BY PE3 ПРАВАЯ СЕТЬ) amber annunciators.

(cont'd)

Storage batteries Nos 1, 2, 3, 4 switches.

Two LEFT SYSTEM FROM BAT (ЛВВАЯ СЕТЬ ОТ АККУМ), RIGHT SYSTEM FROM BAT (ПРАВАЯ СЕТЬ ОТ АККУМ) red annunciators.

Ground BAT TEST (ПРОВЕРКА АККУМ) switch (on the right-side instrument panel above the right CB panel).

A provision is made for heating the storage batteries on the ground. The storage batteries heating switch is in the access door near the external power receptacle.

— 000 —

Ty-154M

8.7. AIRCRAFT CONTROL



FLIGHT MANUAL

OPERATION OF AIRCRAFT SYSTEMS - Aircraft Control

8.7. AIRCRAFT CONTROL

8.7.1. Operational limitations are not specified.

8.7.2. Normal Procedures

CONDITION (PROCEDURE)	REQUIRED ACTION
(1) During external inspection of the airplane	<p>F l i g h t E n g i n e e r</p> <p>Control surface actuators are not leaky</p> <p>- Check</p>
(2) During internal inspection of the airplane	<p>P i l o t</p> <p>Make sure that:</p> <p>AILERONS and RUDDER TRIMMING (ТРИММИРОВАНИЕ ЭЛЕРОНЫ И РУЛЬ НАПРАВЛ) changeover switches</p> <p>EMER TRIM (АВАР ТРИММ) change- over switch</p> <p>MID SPOILER (ИНТЕРСИЛ СРЕДНИЙ) control handle</p> <p>- In the neutral position</p> <p>- Capped</p> <p>- Latched in the neutral position</p>
(3) Prior to engine starting	<p>C o - p i l o t</p> <p>ANNUNCIATOR LAMP TEST (ПРОВЕРКА ЛАМП ТАБЛО) button</p> <p>- Depress and release</p> <p>All the light annunciators shall illuminate and then extinguish</p> <p>P i l o t</p> <p>Make sure that:</p> <p>ROLL NEUTRAL (НЕЙТРАЛ КРЕН), YAW - Illuminated NEUTRAL (НЕЙТРАЛ КУРС), PITCH NEUTRAL (НЕЙТРАЛ ТАНГАЖ) green light annunciators</p> <p>MIDDLE (СРЕДН), INNER (ВНУТР) amber light annunciators</p> <p>- Not illuminated</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	Pilot Co-pilot Pedals (use the RUD PEDAL ADJUST (РЕГУЛИРОВКА ПЕДАЛЕЙ) changeover switch) - Adjust
(4) Before taxiing	Pilot Check for hydraulic system pressure - 200 to 220 kgf/cm ² BOOSTER CONTROL 1, 2, 3 (БУСТЕРНОЕ УПРАВЛЕНИЕ 1, 2, 3) switches - Switch ON and safeguard with the cap Check to see that the BOOSTERS (БУСТЕРЫ) light annunciator extinguishes RUD & EL ENROUTE FEEL (ПОЛЕТНЫЙ ЗАГРУЖАТЕЛЬ РН и РВ) changeover switch - Set to AUTO (АВТОМАТ) position and safeguard with the cap EL T.O. LAND (ВЗЛЁТ ПОС РВ), RUD T.O. LAND (ВЗЛЁТ ПОС РН) amber light annunciators - Illuminated Control column - Deflect as far as it will go and return to the initial position Check the elevator deflection angle against the position indicator. With the control column shifted to the extreme nose-up position the indicator pointer shall show at least 23°, or 18° if the control column is set to the extreme nose-down position. <u>NOTE:</u> The elevator extreme positions can be checked with the elevator enroute load feel mechanism disengaged and the LONG CONTR (ПРОДОЛЬНАЯ УПРАВЛЯЕМОСТЬ) signal disconnected.

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
YAW NEUTRAL (НЕЙТРАЛ КУРС) green light annunciator	- Illuminated
Right pedal	- Deflect forward In this case the foot effort increases with the pedal deflection
Right pedal	- Return to the neutral position and remove foot from pedal
RUDDER TRIMMING (ТРИММИРОВАНИЕ РУЛЬ НАПРАВЛ) changeover switch	- To the RIGHT (НПАВ) position In this case the right pedal shall deflect forward
RUDDER TRIMMING (ТРИММИРОВАНИЕ РУЛЬ НАПРАВЛ) changeover switch	- To the LEFT (ЛЕВ) position In this case the left pedal shall deflect forward
RUDDER TRIMMING (ТРИММИРОВАНИЕ РУЛЬ НАПРАВЛ) changeover switch	- To the RIGHT (НПАВ) position till the YAW NEUTRAL (НЕЙТРАЛ КУРС) green light annunciator illuminates
ROLL NEUTRAL (НЕЙТРАЛ КРЕН) green light annunciator	- Illuminated
Control wheel	- Turn to the left and right alternatively See to it that the efforts rise
AILERONS TRIMMING (ТРИММИРОВАНИЕ ЭЛЕРОНЫ) changeover switch	- To the RIGHT (НПАВ) position In this case the control wheel shall turn rightward from the neutral position

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
	<p>AILERONS TRIMMING (ТРИММИРОВАНИЕ ЭЛЕРОНОВ) changeover switch - To the LEFT (ЛЕВ) position</p> <p>In this case the control wheel shall turn leftward</p> <p>AILERONS TRIMMING (ТРИММИРОВАНИЕ ЭЛЕРОНОВ) changeover switch - To the RIGHT position till the ROLL NEUTRAL (НЕЙТРАЛ КРЕН) green light annunciator illuminates</p> <p><u>NOTE:</u> The test time of elevator deflection angles and trimming mechanisms operation is from 2 to 3 s.</p>
(5) After takeoff	<p>C o - p i l o t</p> <p>Make sure that the enroute load feel mechanisms are engaged after the flaps retraction, by referring to the EL T.O. LAND (ВЗЛЕТ ПОС PB) and RUD T.O. LAND (ВЗЛЕТ ПОС PH) green light annunciators, which shall extinguish</p> <p>If not so, RUD & EL ENROUTE FEEL (ПОЛЕТНЫЙ ЗАГРУЖАТЕЛЬ РН и РВ) changeover switch - Set to the ENROUTE (ПОЛЕТ) position</p>
(6) At all stages of flight	<p>P i l o t a n d c o - p i l o t</p> <p>At flight condition variations, reduce the force applied to the control column, wheel and pedals down to zero values.</p> <p>Admissible characteristics of longitudinal control are ensured only when the force is removed from the control columns by trimming the elevator under all conditions of straight flight, at transition from one flight condition to any other and at extension (retraction) of the high-lift devices.</p> <p><u>CAUTION:</u> INCORRECT ELEVATOR TRIMMING MAY CAUSE CONSIDERABLE FORCES TO APPEAR IN THE LONGITUDINAL CONTROL CHANNEL DUE TO THE ENGAGEMENT OF THE ENROUTE LOAD FEEL MECHANISM, OR CONSIDERABLE OVERLOADS DUE TO DEFLECTION OF THE CONTROL WHEEL WITH LITTLE EFFORTS. FOR QUICK SPEED AND ALTITUDE LOSS USE (EXTEND) THE MIDDLE SPOILERS.</p>

(cont'd)

CONDITION (PROCEDURE)	REQUIRED ACTION
(7) During approach	<p>C o - p i l o t</p> <p>With the flaps extended, make sure the enroute load feel mechanisms are disengaged (by illumination of the EL T.O. LAND and RUD T.O. LAND green light annunciators)</p> <p>If not so, RUD & EL ENROUTE FEEL changeover switch - TAKEOFF-LAND (ВЗЛЕТ ПОСАДКА)</p>
(8) During landing	<p>P i l o t</p> <p>At the end of landing run - Retract the spoilers</p>

(cont'd)

8.7.3. Troubles

TROUBLE	CORRECTIVE ACTION
(1) Airplane drift from initial flight condition, change of control column forces and impossibility to relieve them by depressing the ELEV TRIM (ТРИММР PB) buttons	Change over to elevator emergency trimming using EMER TRIM (АБАР ТРИМ) changeover switch. With the switch set either to the NOSE DWN (НИЖН) or NOSE UP (КАБР) position, elevator trimming is changed over from the ELEV TRIM buttons to the EMER TRIM changeover switch
(2) Airplane drift from initial flight condition, change of control column forces and impossibility to relieve them by depressing the ELEV TRIM buttons and the EMER TRIM changeover switch	<p>It is indicative of the total failure of the elevator trimming system.</p> <p>For crew actions refer to 5.6</p>
(3) With the flaps retracted, the EL T.O. LAND (ВЗЛЕТ ПОС PB) or RUD T.O. LAND (ВЗЛЕТ ПОС PH) green light annunciation illuminates or flashes for more than 30 s	<p>It is indicative of a failure to engage the enroute load feel mechanism of the elevator or rudder</p> <p>Cap of the RUD & EL ENROUTE FEEL (ПОЛЕТНЫЙ ЗАГРУЖАТЕЛЬ РН и РВ) changeover switch</p> <p>RUD & EL ENROUTE FEEL change-over switch - Set to the ENROUTE (ПОЛЕТ) position</p> <p>EL T.O. LAND (ВЗЛЕТ ПОС PB) and RUD T.O. LAND (ВЗЛЕТ ПОС PH) light annunciations start flashing.</p> <p>In 30 s they shall extinguish.</p> <p>If not so, proceed as instructed under 5.8</p> <p>During landing approach, simultaneously with extension of flaps, the RUD & EL ENROUTE FEEL changeover switch - Set to the TAKEOFF-LAND (ВЗЛЕТ ПОСАДКА) position</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
	<p>The EL T.O. LAND and RUD T.O. LAND annunciators start flashing and glow steadily in 30 s. If not so, proceed as instructed under 5.8</p>
(4) With the flaps extended, the EL T.O. LAND or RUD T.O. LAND green light annunciator illuminates or flashes for more than 30 s	<p>It is indicative of a failure to disengage the enroute load feel mechanism of the elevator or rudder</p> <p>RUD & EL ENROUTE FEEL changeover switch cap - Open</p> <p>RUD & EL ENROUTE FEEL changeover switch - Set to the TAKEOFF-LAND position</p> <p>After the enroute load feel mechanisms are disengaged, the EL T.O. LAND and RUD T.O. LAND annunciators shall illuminate.</p> <p>If the annunciators fail to illuminate, proceed as instructed under 5.6</p>
(5) The control column requires increased efforts to deflect	<p>It is indicative of increased forces appearing in the pitch control channel. If the cause of the increased control forces is unknown, disengage the elevator and rudder enroute load feel mechanisms. Fly the airplane carefully, avoiding sharp motions of the control column, as instructed under 5.6.</p> <p>Avoid excessive acceleration and roll angles.</p> <p>Land the airplane on the nearest airfield</p>
(6) With the RUDDER TRIMMING (ТРИММИРОВАНИЕ РУЛЬ НАПРАВЛ.) change-over switch depressed, the forces fail to be removed (the pedals are not trimmed)	<p>It is indicative of a failure of the rudder trimming system.</p> <p>Fly the airplane as instructed under 5.7</p>
(7) The pedals move spontaneously. With the RUDDER TRIMMING changeover switch depressed, the pedals	<p>It is indicative of a failure of the rudder trimming system.</p> <p>Fly the airplane as instructed under 5.7</p>

(cont'd)

TROUBLE	CORRECTIVE ACTION
fail to return to the required position	
(8) With the AILERONS TRIMMING (ТРИММИРОВАНИЕ ЭЛЕРОНОВ) change-over switch depressed, the control wheel force is not removed (the wheel does not move)	It is indicative of a failure of the ailerons trimming system. Fly the airplane as instructed under 5.7
(9) The control wheel moves inadvertently. With the AILERONS TRIMMING (ТРИММИРОВАНИЕ ЭЛЕРОНОВ) change-over switch depressed, the control wheel fails to return to the required position	It is indicative of a failure of the ailerons trimming system. Fly the airplane as instructed under 5.7
(10) The middle spoilers fail to be retracted by the control handle	It is indicative of a failure of the middle spoiler control system. Fly the airplane as instructed under 5.9
(11) The MIDDLE (СРЕДНЯЯ) amber light annunciators are illuminated on the pilots' centre instrument panel	It is indicative of a failure of the middle spoilers to be locked. Check the control handle of the middle spoilers for setting to position 0. If after the handle has been set true, the light annunciators are still illuminated, proceed as instructed under 5.9
(12) The MIDDLE amber light annunciators do not illuminate after the airplane touched down the runway and	It is indicative of a failure of the automatic extension system of the middle spoilers MID SPOILER (ИНТЕРШИП СРЕДНИЙ) handle - Set to position 45

(cont'd)

TROUBLE	CORRECTIVE ACTION
the main LG got compressed	
(13) The MID SPOILER (ИНТЕРШИТ СРЕДНИЙ) handle slowly moves towards 0°	<p>It is indicative of a pressure drop in hydraulic system No. 1. with the middle spoilers extended.</p> <p>When it is necessary to retract the middle spoilers quicker, shift the handle for retraction</p>
(14) Spoilers retraction or extension causes the airplane to roll	<p>It is indicative of increased middle spoiler control forces in one wing.</p> <p>If the airplane rolls when the middle spoilers are being extended, retract the spoilers.</p> <p>If the airplane rolls during middle spoilers retraction counteract the rolling moment by deflecting the ailerons</p>

(cont'd)

8.7.4. Brief Description

8.7.4.0. General

The aircraft control is effected by the control levers (columns, wheels and pedals) through rigid mechanical linkage and by the automatic flight control system (AECY) through the control surface actuators which operate from three independent hydraulic systems.

Hydraulic power is applied to the actuators from hydraulic systems Nos 1, 2, 3 by means of three BOOSTER CONTROL 1, 2, 3 (БУСТЕРНОЕ УПРАВЛЕНИЕ 1, 2, 3) switches arranged on the pilots' centre pedestal (Ref. Fig. 8.7.1).

When switched on, the BOOSTER CONTROL 1, 2, 3 switches are capped. If the switches are uncapped, the BOOSTER (БУСТЕР) light annunciator and the NOT READY FOR T.O. (К ВЗЛІТУ НЕ ГОТОВ) red light annunciator are illuminated.

8.7.4.1. Elevator Control

The elevator control is effected by two three-chamber actuators (one actuator for each elevator half).

Included in the elevator control system are two spring load feel mechanisms, namely: the takeoff-landing one (engaged permanently) and enroute one (engaged in flight).

The takeoff-landing feel mechanism loads the control columns, while the enroute feel mechanism limits the elevator deflection in flight by applying an additional load to the control columns.

The enroute feel mechanism can be engaged and disengaged both automatically and manually. Normal is the automatic engagement/disengagement mode. The mode of operation of the feel mechanism is selected by means of the RUD & EL ENROUTE FEEL (ПОЛЕТНЫЙ ЗАГРУЖАТЕЛЬ РН и РВ) changeover switch arranged on the glare shield of the pilots' centre instrument panel (Ref. Fig. 8.7.1). The switch has three positions, namely: ENROUTE (ПОЛЕТ), AUTO (АВТОМАТ) and TAKEOFF-LAND (ВЗЛІТ ПОСАДКА).

When the changeover switch is set to the AUTO position, the enroute feel mechanism is controlled automatically, i.e. it is engaged at flap retraction and disengaged at flap extension.

The enroute feel mechanism is engaged with the changeover switch set to the ENROUTE (ПОЛЕТ) position, and disengaged with the switch set to the TAKEOFF-LAND position irrespective of the flaps position.

(cont'd)

The EL T.O. LAND (ВЗЛІТ ПОСІДАЧА) green light annunciator is provided on the pilots' centre instrument panel so as to indicate a load feel condition of the control column. It is illuminated when the enroute feel mechanism is disengaged and flashes during operation of the engagement mechanism. Before takeoff set the RUD & EL ENROUTE FEEL changeover switch to the AUTO (АВТОМАТ) position.

The forces of the elevator takeoff-landing and enroute feel mechanisms are trimmed simultaneously by one electric actuator which is controlled in three modes:

Automatic mode effected by the AFCS system when the system automatic modes of operation are engaged

Manual mode effected by the ELEV TRIM (ПРИМІРНЯВАННЯ) buttons arranged on the pilot's and co-pilot's control wheels

Emergency mode effected by the EMER TRIM (АВАРІЙНА ПРИМІРНЯВАННЯ) pressure switch provided on the pilots' centre control pedestal (Ref. Fig. 8.7.1).

The trimming actuator has two channels.

Emergency control is resorted to when the manual control fails (when the ELEV TRIM button sticks in one of its positions). When the emergency trimming switch is pressed to the NOSE DWN (НИЖНЯР) or NOSE UP (КАРП) position, the trimming control is changed over from the ELEV TRIM buttons to the emergency trimming control switch. The reverse changeover to the control by the ELEV TRIM buttons is effected (on the ground after the airplane has landed) by opening and closing the ELEV EMER TRIM (ПРИМІРНЯВАННЯ ПБ АВАРИЙН) circuit breaker. The elevator deflection angles range from $-25^\circ \pm 1^\circ$ to $+20^\circ \pm 1^\circ$.

The elevator deflection angles are checked against the combined elevator-and-horizontal stabilizer position indicator which is provided on the pilots' centre instrument panel (Ref. Fig. 8.7.1). The neutral position of the trimming mechanism is indicated by the illumination of the PITCH NEUTRAL (НЕЙТРАЛ ТАНГАК) green light annunciator on the pilots' centre instrument panel (Ref. Fig. 8.7.1).

8.7.4.2. Rudder Control

The rudder control is effected by a three-chamber actuator. Included in the rudder control system are two spring load feel mechanisms, namely: the takeoff-landing feel mechanism (engaged permanently) and the enroute one (engaged in flight).

The takeoff-landing feel mechanism loads the pedals and the enroute one limits the rudder deflection in flight by applying an additional load to the pedals.

The enroute feel mechanism can be engaged and disengaged both automatically and manually. Unlike the control of the elevator enroute feel mechanism, the control

(cont'd)

of the rudder enroute feel mechanism depends on the compression of the left MLG strut. When the RUD & EL ENROUTE FEEL (ПОЛЕТНЫЙ ЗАГРУЖАТЕЛЬ РН И РВ) changeover switch is set to the AUTO (АВТОМАТ) position, the rudder enroute feel mechanism gets engaged automatically when the left shock strut compression is relieved and the flaps are retracted, and the mechanism gets disengaged when the left MLG strut is compressed, or the flaps are being extended.

A load feel condition of the pedals is indicated by the RUD T.O. LAND (ВЗЛЕТ ПОС РН) green light annunciator which is provided on the pilots' centre instrument panel (Ref. Fig. 8.7.1). It illuminates when the rudder enroute feel mechanism is disengaged and flashes during operation of the engagement mechanism. The forces of the takeoff-landing feel mechanism are trimmed by an electric actuator which is controlled with the help of the RUDDER TRIMMING (ТРИММИРОВАНИЕ РУЛЬ НАПРАВЛ) changeover switch located on the glare shield of the pilots' centre instrument panel (Ref. Fig. 8.7.1).

The neutral position of the trimming mechanism is indicated by the illumination of the YAW NEUTRAL (НЕЙТРАЛ КУРС) green light annunciator provided on the pilots' center instrument panel.

When on the ground, the rudder is locked with the locking mechanism MC which locks the rudder in the neutral position when no pressure is present in all the three hydraulic systems, and unlocks the rudder when a hydraulic fluid pressure is applied to the rudder actuator from any of the three hydraulic systems.

The pedals adjustment for long-and-short leg positions is effected by the RUD PEDAL ADJUST (РЕГУЛИРОВКА ПЕДАЛЕЙ) changeover switches provided on the left-and-right-side consoles.

8.7.4.3. Aileron Control

The ailerons are controlled by two three-chamber actuators (one actuator for each aileron).

A spring load feel mechanism with trimming actuator is permanently engaged in the aileron control system so as to create control wheel forces. The trimming actuator of the aileron feel mechanism is controlled by the AILERONS TRIMMING (ТРИММИРОВАНИЕ ЭЛЛЕРОНЫ) changeover switch (Ref. Fig. 8.7.1) which is installed on the glare shield of the pilots' centre instrument panel. The neutral position of the trimming actuator is indicated by the illumination of the ROLL NEUTRAL (НЕЙТРАЛ КРЕН) green light annunciator located on the centre instrument panel.

Flight spoilers (left and right) are used to contribute to the effectiveness of the lateral control. Each flight spoiler is controlled by three single-chamber actuators which operate independently from hydraulic systems Nos 1, 2, 3.

(cont'd)

The actuators are driven by the ailerons through the mechanical linkage. The flight spoilers (left and right) can be deflected upward through an angle of up to $45^\circ \pm 2^\circ$ depending on the deflection angle of the respective aileron which ranges from $1.5^\circ \pm 15'$ to $20^\circ \pm 1^\circ$.

8.7.4.4. Middle Spoiler Control

The control of the middle spoilers can be effected:

Manually by the pilot, with the help of the MID SPOILER (ИНТЕРШИТ СРЕДНИЙ) handle which is connected to the input levers of the actuators with cables and push-pull rods (over a small section).

Automatically (extension) at compression of both MLG shock struts provided the throttle control levers are set to the IDLE (МАЛЫЙ ГАЗ) position and airplane speed exceeds 100 km/h, or by switching-on the thrust reversers of engines Nos 1 and 3.

A signal for automatic extension of the middle spoilers is fed to the electro-hydraulic actuator (ЭИМ) which develops a force and deflects the entire control linkage along with the control handle, thereby extending the middle spoilers. When the airplane speed drops to 100 km/h and the thrust reverser is switched off, the electric signal is removed, the ЭИМ stops developing a force but holds the middle spoilers in the extended position. The middle spoilers are extended only automatically and retracted only manually.

In addition to the automatic spoiler extension the ЭИМ ensures:

Switching ON/OFF of the hydraulic power supply of the middle spoiler actuators at manual control and switching ON of the hydraulic power supply when one of the spoiler sections is unlocked.

Locking of the middle spoiler control system in the retracted position after the handle is set to position 0.

Unlocking the middle spoiler control system in the retracted position and switching-ON the hydraulic power supply of the spoiler actuators are effected by depressing the button provided in the head of the middle spoiler control handle. Unlocking and switching-ON the hydraulic power supply of the spoiler actuators are possible even without depressing the button. To this end, the spoiler control handle should be shifted from the retracted position towards extension by approximately 30° , however, in this case an increased force of up to 25 kgf has to be overcome. The middle spoiler deflection angles are checked against the scale arranged near the control handle.

The maximum deflection angle of the middle spoilers is $45^\circ \pm 2^\circ$.

(cont'd)

Unlocking of even one of the middle spoiler sections is indicated by the illumination of the amber light annunciators arranged on the pilots' center instrument panel.

8.7.4.5. Inner Spoiler Control

The inner spoiler control (extension and retraction) is of an electrohydraulic type effected only automatically.

The inner spoilers extend automatically when both shock struts of the main landing gear are compressed, the throttle control levers are set to the IDLE (МАЛЫЙ ГАЗ) position and airplane speed exceeds 100 km/h, or when the thrust reversers of engines Nos 1 and 3 are switched on.

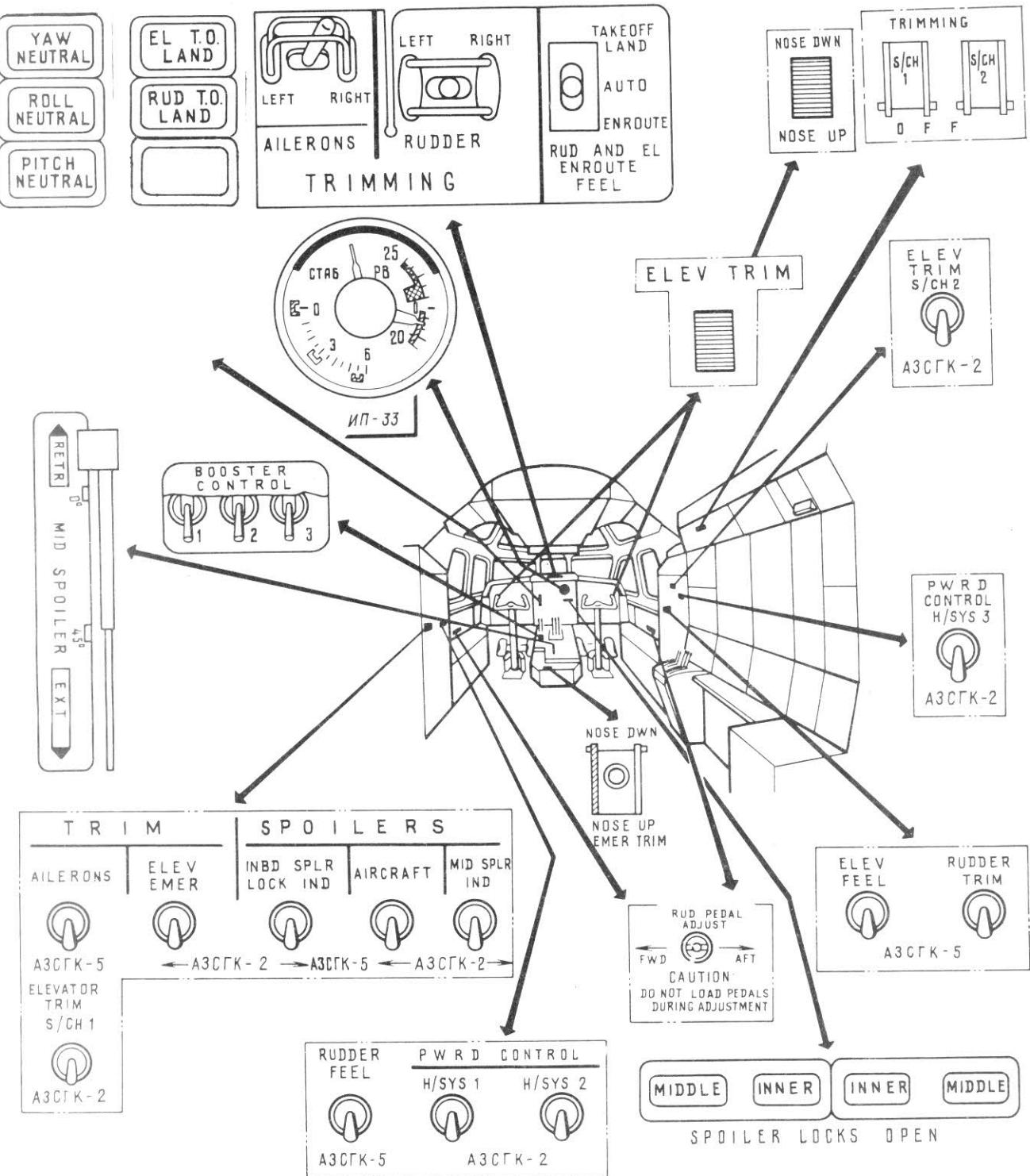
The signal for automatic extension of the inner spoilers is fed to the hydraulic valve feeding pressure into respective chambers of the hydraulic cylinders that extend the inner spoilers.

When the speed drops below 100 km/h and the engine thrust reversers are switched off, the circuits, feeding the electrical signal to the hydraulic valve, are switched-over and the valve supplies hydraulic pressure into other chambers of the hydraulic cylinders, and the inner spoilers are automatically retracted.

The maximum deflection angle of the inner spoilers is $50^\circ \pm 2^\circ$.

In the retracted position the spoilers are locked mechanically by the locks provided on the hydraulic cylinder rods; the open position of the locks is indicated by the illumination of two amber light annunciators INNER (БЫТ) arranged on the pilots' center instrument panel. At the same time the NOT READY FOR T.O. (К ВЗЛЕТУ НЕ ПОТОБ) red light annunciator illuminates.

(cont'd)



Arrangement of Aircraft Control, Monitoring and Indicating Devices

Figure 8.7.1