An-2

WYTWÓRNIA SPRZĘTU KOMUNIKACYJNEGO »PZL - MIELEC«

FLIGHT MANUAL

APPROVED BY:

ASST DIRECTOR OF RESEARCH
AND DEVELOPMENT CENTER FOR
DESIGN AND TESTING

....
Y. KIEPIEL /MSc/

APPROVED BY:

MINISTRY OF TRANSPORT
CENTRAL AUTHORITY OF CIVIL AVIATION
/CACA/
CIVIL AIRCRAFT INSPECTORATE

....

This airplane is to be operated in accordance with limitations and rules contained in this Manual.

This manual must be available in airplane at all times.

An-2 DESIGN DEPARTMENT,
MANAGER

....
A. GALAS, Mech.Eng.

AGREED WITH
CIVIL AIRCAFT INSPECTORATE
REGION VI, MIELEC

....

Polish version of this manual approved by CACA on 16.04.84 Foreign language version approved by manufacturer under delegated authority by CACA

Signed by ....

authorized manufacturer's
representative

April 5, 83 Edition

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WYTWÓRNIA SPRZĘTU KOMUNIKACYJNEGO PZL-MIELEC

TRANSPORT EQUIPMENT WORKS WSK "PZL-MIELEC"

Sygn. WSK PZL Mielec
Nr An-2/10/85

FLIGHT MANUAL

for An-2 AIRPLANE
WITH ASz-62IR ENGINE

VERSIONS: An-2R AGRICULTURAL
An-2T CARGO TRANSPORT
An-2TP PASSENGER TRANSPORT
(21) An-2TD TRANSPORT PARACHUTE
An-2P PASSENGER

Registration No. . . . . MFRS Serial No. . . . . . .

Approved by: MINISTRY OF TRANSPORT
CENTRAL ADMINISTRATION OF CIVIL AVIATION
(CACA)

Civil Aircraft Inspectorate
Warsaw 1970

Mielec
November 15, 1970
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SECTIONS

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LOG OF REVISIONS AND AMENDMENTS

to Flight Manual for An-2 Aircraft issued on April 5, 1983

No of amend. No of design. change sheet Bulletin No	No of page in Manual or Section	Short Description of Revision	Approved by Civil Aviation Inspectorate

NOTE:

This complemented and revised edition of the manual contains all hitherto effective changes as well as the following alterations:

- introducing measurement units of SI System;
- text alteration resulting from withdrawal of R-860 and R-842 radio-stations and from introducing RS-6102 transceiver;
- introducing updated inspection check list;
- supplementing the section 4-40 "Ag-technical Flight Procedure" by a paragraph: "Air-field preparatory works for ag. flight operations";
- introducing the existing supplements to appropriate sections;
- introducing the list of valid pages;
- extension of Manual validity for TP and T versions.

Pages altered are marked by a date of April 5,83 as below.

1	1-00/4 1-10/15 1-30/3 4-00/1,3,8,25, 32,56,57,62,67 4-20/6-7 4-30/1 4-40/4,5,6,18, 19,22.23,25 5-00/2,4,8, 9-12,13	These revisions eliminate the errors found in the manual	85-01-15
2	0-00/9 7-00/0-1 7-00/1 7-00/3 7-00/5,6,7,8,9	Airplane adaptation for transportation of patients /Supplement No 3/	85-02-15

(12)

No of amend. No of design. change sheet Bulletin No	No of page in Manual or Section	Short decription of revision	Approved by Cyvil Aviation Inspectorate
3	0-00-9 7-00-0-1 7-00-11,12,13,14	"BAKLAN-5" transceiver servicing /Supplement No 4/	85-05-06
4 KDK 44679	0-00-7 2-00-0 2-00-4 2-00-5 2-00-6	Designation of range of indications of tachometer and engine operation control devices	85-08-29
5 KDK 44777	0-00-4 0-00-7 0-00-8 0-00-9 1-20-7 4-20-1 7-00-0-1 7-00-15 7-00-16 7-00-17 7-00-18 7-00-19 7-00-20 7-00-21	Introduction of USW "reserve" transceiver and supplement, as a consequence of An-2R adaptation for transportation of passengers /Supplement No 5/	85-12-03
6 KDK 44[illegible]2	1-20-6	Change of the text of note	86-01-30
7 KDK 450[illegible]6	0-00-4 0-00-5 1-20-4 1-40-3 1-40-4 4-00-32 7-00-25/26	Alternation of set of agricultural and aerodrome equipment, and introducing Supplement, conc. the transportation of 11 passengers. /Supplement No 6/	85-06-10
8 KDK 45[illegible]3	0-00-4 1-20-4 4-00-70 0-00-7,8	Installation of the sound signalling system of fuel residue	86-06-25

No. of amend. No. of design. change sheet bulletin No.	No. of page in Manual or Section	Short Description of Revision	Approved by Civil Aviation Inspectorate
9 KZK 45092	7-00-5	On this page the following numbers of airplane are added: 1G214-06 1G214-07	86-08-29
10 KZK 45190	0-00-7 0-00-8 0-00-9 4-00-0-1 4-00-0-2 7-00-0-1 7-00-0-2 7-00-3/4 7-00-9/10 7-00-16 7-00-17 7-00-23/24	Considering, that the mentioned pages should correspond to pages given in the Specification of pages their numbers and edition data are changed. The text alteration on pages 7-00-16 and 7-00-17 resulting from changes conc. the airplane structure.	86-12-03
11 KZK 45226	0-00-5 0-00-9 7-00-0-2 7-00-27/28	Installation of tail wheel with welded frame without tail wheel blocking in neutral position /Supplement No 7/	87-01-23
12 KZK 45302	0-00-5 0-00-9 7-00-0-2 7-00-29-30	Installation of light sygnalling for slat displacement /Supplement No 8/	87-03-10
13 KZK 45318	0-00-5 0-00-7 1-20-4	Installation of light sygnalling for emergency exit	87-05-29
14 KZK 45427	0-00-5 0-00-9 7-00-31/32	Installation of slats displacement light signalling and lamps with inscriptions "EXIT" and "EMERGENCY EXIT" (Supplement No 9)	87-06-20

No. of amend. No.of design. change sheet Bulletin No.	No od page in Manual or Section	Short Description of Revision	Approved by Civil Aviation Inspectorate
15 KZK 45714	0-00-5 0-00-9 7-00-0-3 7-00	Supplement No.10 added relating to the operation of the AR 3201 and AR 3202 VHF transceivers, KR 87 automatic direction finder and ATC 2000 transponder.	88-03-25
16 KZK 45908	0-00-5 0-00-9 7-00-0-3 7-00-51 7-00-52	Supplement No.11 added describing the operation of the R-842 long range transceiver.	88-04-07
17 KZK 45914	0-00-6 0-00-9 7-00-0-3 7-00-53÷56	Supplement No.12 added concerning the operation of the KX 1758 comm transceiver and KI 206 nav indicator.	88-04-14
18 KZK 461[illegible]	0-00-6 0-00-9 7-00-0-3 7-00-57 7-00-5[illegible] 7-00-5[illegible] 7-00-6[illegible] 7-00-[illegible]1/62	Supplement No.1[illegible] added applying to the opera-tion of the [illegible]-76A transponder with the [illegible]A [illegible]30 encoding altimeter .	[illegible]9-01-1[illegible]
19 KZK 461[illegible]7	0-00-6 0-00-7 1-40-[illegible] 1-40-[illegible] 1-40-10÷13 2-00-[illegible] 2-00-[illegible] 2-00-[illegible]	Pages updated as a result of agricultural equipment modification /Loading sleeve/ and change of instrument marking.	89-0[illegible]-[illegible]
20 KZK 46202	0-00-6 0-00-[illegible] 1-20-[illegible]÷[illegible] 2-00-[illegible] 4-[illegible]0-7÷[illegible]	Pages updated as a result of the A-037 altimeter installation /licence change/ instead of the [illegible].	89-0[illegible]-[illegible]7

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No. of amend. No. of design. change sheet Bulletin No.	No of page in Manual or Section	Short Description of Revision	Approved by Civil Aviation Inspectorate
21 KZK 46517	Title page 0-00-7÷10 2-00-4 4-00-33 6-00-6 7-00-4 7-00-63÷70	Supplements added (no.14 and 15) concerning Operation of An-2TD transport-parachute version and An-2P passenger version.	89-10-20
(22) KZK 46583	0-00-7; 0-00-10; 7-00-0-4; 7-00-71-87	Supplement No 16 describing operation of "KING" radio-navigational equipment added	89-12-22
23 KZK 47[illegible]	0-00-7 7-00-04 7-00-89 7-00-90 7-00-91÷92	Added Supplement No.17 regarding operation of An-2PK enhanced comfort aircraft.	90-08-28
24 KZK 47046	0-00-6a 0-00-9 7-00-4 7-00-93÷97/98	Added Supplement No.18 regarding the operation of An-2TP aircraft with variable completion of passenger cabin and radio-navigational equipment.	
(25)	1-10/13; 1-10/14; 1-10/15.	Pages updated due to the introduction of agricultural version cockpit ventilation system with the use of air conditioner and filters.	90-20-05
25	1-10/3	The page is up-to-dated, by adding the Aeroshell Fluid 41 oil as a substitution of AMG-10 oil.	90-12-18

LIST OF VALID PAGES

Page No.	Edition	Page No.	Edition	Page No.	Edition
Title page	25.10.89	1-20-1	05.04.83	2-00-0	05.04.83
		1-20-2	05.04.83	2-00-1	20.12.75
0-00-1	05.4.83	1-20-3	15.11.70	2-00-2	15.11.70
0-00-2	05.4.83	1-20-4	10.02.89	2-00-3	15.11.70
0-00-3	05.4.83	1-20-5	10.02.89	2-00-4	20.10.89
0-00-4	05.4.83	1-20-6	10.02.89	2-00-5	15.01.89
0-00-5	05.4.83	1-20-7	15.11.85	2-00-6	15.01.89
0-00-6	05.4.83	1-20-8	05.04.83		
0-00-7	20.10.89	1-20-9	05.04.83		
0-00-8	20.10.89	1-20-10	15.11.70		
0-00-9	20.10.89	1-20-11	22.05.81		
0-00-10	20.10.89	1-20-12	15.11.70		
		1-20-13	15.11.70		
		1-20-14	15.11.70		
1-00-0	05.04.83	1-20-15	15.11.70		
1-00-1	15.11.70	1-20-16	15.11.70		
1-00-2	05.04.83	1-20-17	15.02.80		
1-00-3	05.04.83	1-20-18	05.04.83		
1-00-4	15.11.70			3-00-0	05.04.83
				3-00-1	05.04.83
				3-00-2	05.04.83
1-10-1	15.11.70				
1-10-2	05.04.83	1-30-1	05.04.83		
1-10-3	19.12.90	1-30-2	05.04.83		
1-10-4	15.11.70	1-30-3	05.04.83		
1-10-5	05.04.83	1-30-4	05.04.83		
1-10-6	05.04.83	1-30-5	05.04.83		
1-10-7	05.04.83	1-30-6	05.04.83		
1-10-8	05.04.83				
1-10-9	05.04.83			4-00-0-1	05.12,86
1-10-10	05.04.83			4-00-0-2	05.12.86
1-10-11	05.04.83			4-00-1	15.11.70
1-10-12	05.04.83			4-00-2	15.11.70
25 1-10-13	30.11.90	1-40-1	15.01.89	4-00-3	15.11.70
1-10-14	30.11.90	1-40-2	25.03.80	4-00-4	15.11.70
1-10-15	30.11.90	1-40-3	10.06.86	4-00-5	15.11.70
1-10-16	05.04.83	1-40-4	10.06.86	4-00-6	15.11.70
1-10-17	05.04.83	1-40-5	01.10.79	4-00-7	05.04.83
1-10-18	05.04.83	1-40-6	05.04.83	4-00-8	05.04.83
		1-40-7	05.04.83	4-00-9	05.04.83
		1-40-8	05.04.83	4-00-10	15.11.70
		1-40-9	05.04.83	4-00-11	05.04.83
		1-40-10	15.01.89	4-00-12	05.04.83
		1-40-11	15.01.89	4-00-13	05.04.83
		1-40-12	15.01.89		
		1-40-13	15.01.89		
		1-40-14	01.10.79		

wsk –342-82 3ooo szt. ew. 158-9:81

LIST OF VALID PAGES /continued/

Page No.	Edition	Page No.	Edition	Page No.	Edition
4-00-14	05.04.83	4-00-63	15.11.70	4-30-1	05.04.83
4-00-15	05.04.83	4-00-64	15.11.70	4-30-2	05.04.83
4-00-16	05.04.83	4-00-65	05.04.83	4-30-3	05.04.83
4-00-17	05.04.83	4-00-66	05.04.83	4-30-4	05.04.83
4-00-18	05.04.83	4-00-67	05.04.83	4-30-5	05.04.83
4-00-19	15.11.70	4-00-68	05.04.83	4-30-6	05.04.83
4-00-20	05.04.83	4-00-69	05.04.83		
4-00-21	05.04.83	4-00-70	25.06.86		
4-00-22	05.04.83	4-00-71	05.04.83		
4-00-23	05.04.83	4-00-72	05.04.83		
4-00-24	05.04.83	4-00-73	05.04.83		
4-00-25/26	05.04.83	4-00-74	05.04.83		
4-00-27	05.04.83				
4-00-28	05.04.83				
4-00-29	05.04.83				
4-00-30	05.04.83				
4-00-31	05.04.83				
4-00-32	10.06.86			4-40-1	15.11.70
4-00-33	20.10.89			4-40-2	05.04.83
4-00-34	05.04.83			4-40-3	05.04.83
4-00-35	05.04.83			4-40-4	05.04.83
4-00-36	15.11.70			4-40-5	05.04.83
4-00-37	05.04.83			4-40-6	05.04.83
4-00-38	05.04.83			4-40-7	05.04.83
4-00-39	05.04.83			4-40-8	05.04.83
4-00-40	15.11.70	4-10-1	15.11.70	4-40-9	05.04.83
4-00-41	05.04.83	4-10-2	15.11.70	4-40-10	05.04.83
4-00-42	05.04.83			4-40-11	05.04.83
4-00-43	05.04.83			4-40-12	05.04.83
4-00-44	05.04.83			4-40-13	05.04.83
4-00-45	05.04.83			4-40-14	05.04.83
4-00-46	05.04.83			4-40-15	05.04.83
4-00-47	05.04.83			4-40-16	05.04.83
4-00-48	15.11.70			4-40-17	05.04.83
4-00-49	05.04.83			4-40-18	05.04.83
4-00-50	15.11.70	4-20-1	15.11.85	4-40-19	05.04.83
4-00-51	05.04.83	4-20-2	05.04.83	4-40-20	05.04.83
4-00-52	05.04.83	4-20-3	05.04.83	4-40-21	05.04.83
4-00-53	05.04.83	4-20-4	15.02.80	4-40-22	05.04.83
4-00-54	15.11.70	4-20-5	15.02.80	4-40-23	05.04.83
4-00-55	05.04.83	4-20-6	10.02.89	4-40-24	05.04.83
4-00-56	05.04.83	4-20-7	10.02.89	4-40-25	05.04.83
4-00-57	05.04.83	4-20-8	10.02.89	4-40-26	05.04.83
4-00-58	15.11.70				
4-00-59	05.04.83				
4-00-60	05.04.83				
4-00-61	05.04.83				
4-00-62	05.04.83				

LIST OF VALID PAGES /continued/

Page No.	Edition	Page No.	Edition	Page No.	Edition
5-00-0	05.04.83	7-00-11	05.05.85	7-00-69	20.10.89
5-00-1	05.04.83	7-00-12	05.05.85	7-00-70	20.10.89
5-00-2	05.04.83	7-00-13/14	05.05.85	7-00-71	20.12.89
5-00-3	05.04.83	7-00-15	15.11.85	7-00-72	20.12.89
5-00-4	05.04.83	7-00-16	05.12.85	7-00-73	20.12.89
5-00-5	05.04.83	7-00-17	05.12.85	7-00-74	20.12.89
[illegible]	05.04.83	7-00-18	15.11.85	7-00-75	20.12.89
[illegible]	[illegible].04.83	7-00-19/20	15.11.85	7-00-76	20.12.89
[illegible]	05.04.83	7-00-21	15.11.85	7-00-77	20.12.89
[illegible]	05.04.83	7-00-22	15.11.85	7-00-78	20.12.89
[illegible]-10	[illegible]	7-00-23/24	05.12.86	7-00-79	20.12.89
[illegible]-11	[illegible].04.83	7-00-25/26	10.06.86	7-00-80	20.12.89
[illegible]-12	[illegible]	7-00-27/28	25.01.87	7-00-81	20.12.89
[illegible]	05.04.83	7-00-29-30	10.03.87	7-00-82	20.12.89
[illegible]	05.04.83	7-00-31, 32	20.06.87	7-00-83	20.12.89
6-00-0	05.04.83	7-00-33	05.01.88	7-00-84	20.12.89
6-00-1	15.11.70	7-00-34	05.01.88	7-00-85	20.12.89
6-00-2	05.04.83	7-00-35	05.01.88	7-00-86	20.12.89
6-00-3	05.04.83	7-00-36	05.01.88	7-00-87/88	20.12.89
6-00-4	05.04.83	7-00-37	05.01.88	7-00-[illegible]	[illegible]
6-00-5	05.03.78	7-00-38	05.01.88	7-00-[illegible]	[illegible]
6-00-6	20.10.89	7-00-39	05.01.88	7-00-91, 92	[illegible]
7-00-0-1	05.12.86	7-00-40	05.01.88	7-00-93	25.10.90
7-00-0-2	05.12.86	7-00-41	05.01.88	7-00-94	25.10.90
7-00-0-3	05.01.86	7-00-42	05.01.88	7-00-95	25.10.90
7-00-0-4	20.10.89	7-00-43	05.01.88	7-00-96	25.10.90
7-00-1	05.04.83	7-00-44	05.01.88	7-00-97/98	25.10.90
7-00-2	05.04.83	7-00-45	05.01.88		
7-00-3/4	05.12.86	7-00-46	05.01.88		
7-00-5	15.02.85	7-00-47	05.01.88		
7-00-6	15.02.85	7-00-48	05.01.88		
7-00-7	15.02.85	7-00-49	[illegible]		
7-00-8	15.02.85	7-00-50	[illegible]		
7-00-9/10	05.12.85	7-00-51	05.04.88		
		7-00-52	05.04.88		
		7-00-53	12.04.88		
		7-00-54	12.04.88		
		7-00-55	12.04.88		
		7-00-56	12.04.88		
		7-00-57	05.01.89		
		7-00-58	05.01.89		
		7-00-59	[illegible]		
		7-00-60	05.01.89		
		7-00-61/62	05.01.89		
		7-00-63	20.10.89		
		7-00-64	20.10.89		
		7-00-65	20.10.89		
		7-00-66	20.10.89		
		7-00-67	[illegible]		

SECTION 1–00

GENERAL DATA

CONTROL DATA

CONTENTS

SECTION 1

AIRPLANE DESCRIPTION

1. General

The An-2 airplane of agricultural version /An-2R/ with ASz-61IR engine and AW-2 propeller is a metal-structure biplane designed for agricultural operations including seeding,, fertilizing as well as pest control with the use of liquid and powdered chemicals. After removing the ag. equipment the plane can be used, similarly to its cargo-transport version, for transporting cargo, passengers or parachutists and paratroopers, or on installing sanitary out-fit - for transporting the sick.

As far as design is concerned the An-2R airplane differs from standard version /An-2T/ only in minor detail. Only the changes enabling the installing and functioning of ag. equipment have been made on the airplane.

Besides, to lengthen the life of the airplane the fuselage and wings are painted with enamels resistant to chemicals used in agricultural practice.

Entrance door and frames, 5th and 15th /together with the door/ are sealed.

2. Technical Date of Ariplane

A. Basic Dimensions

/1/ Upper wing span	18176±36 mm
/2/ Lower wing span	14236±28 mm
/3/ Airplane length in flight line	12735±25 mm
/4/ Airplane length on the ground	12400±25 mm
/5/ Height in flight plane	6097 mm

/6/	Height on the ground	4013 mm
/7/	Track of main wheels	3454±20 mm
/8/	Distance between main landing gear and the tail wheel	8190 mm
/9/	Span of tail control surfaces	7200±25 mm
/10/	Ground angle of the plane	11°50'
/11/	Anti-turnover angle	27°
/12/	Propeller clearance above ground in flight line	690 mm
/13/	Entrance door height	1419 mm
/14/	Entrance door width	810 cm
/15/	Length of mean aerodynamic chord /MAC/	2269^{+10}_{-15} mm

B. Weight Data and Center-of-Gravity

/1/ Empty weight and C.G. position determination.

Airplane name and designation	Maximum empty weight of airplane Q_w /kg/	Center-of-gravity position X /%MAC/
Ag. version An-2R		
- with spreader	3484	20.4±1
- with spraying system	3478	20.6±1
- transport	3380	20.8±1

Equipment comprising the empty weight of the airplane is specified in section 6-00 page 6.

/2/ Max. acceptable airplane weight for take-off is Q_c= 5500 kg.

/3/ Max. acceptable plane weight for landing Q_c=5250 kg

NOTE: The weight acceptable for emergency landings is equal to total weight of airplane i.e. Q_c=5500 kg.

/4/ Acceptable range of center-of-gravity position.	17-32% MAC
/5/ Reccommended range o. center-of-gravity position.	23-27% MAC

C. Fuel and Oil in Airplane.

/1/ Total volume of six fuel tanks	1200 l
/2/ Total volume of oil tank	125 l
/3/ Acceptable quantity of poured-in oil:	
maximum	85 l
minimum	35 l
/4/ Reccommended quantity of oil:	
maximum	70 l
minimum	50 l

D. Volume of hopper:

- total volume of the tank	1350 l

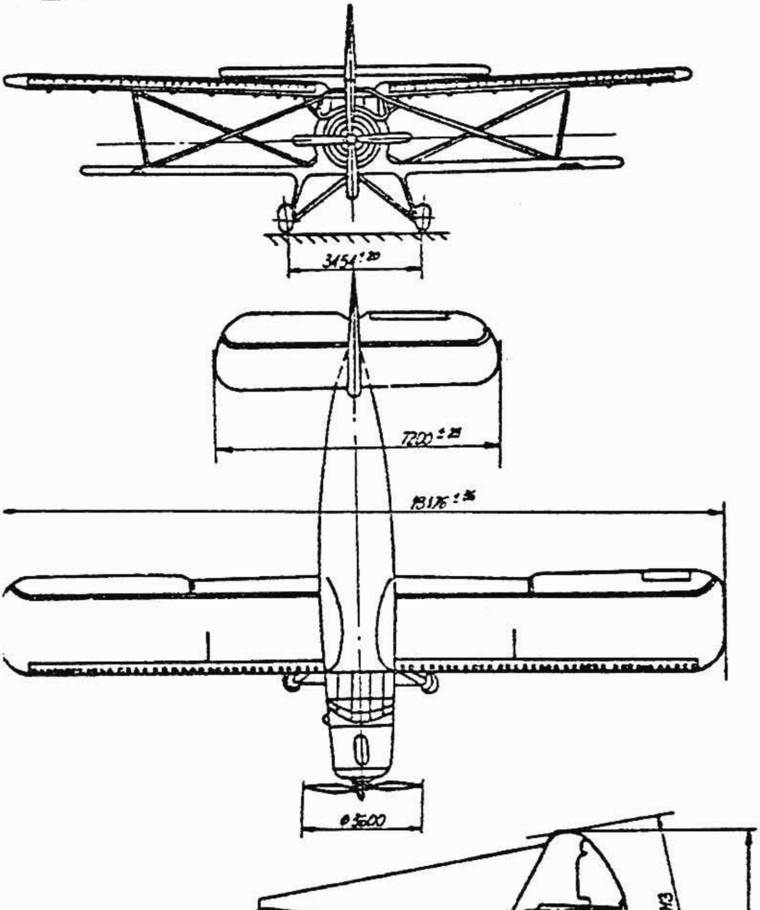

Fig. 1.1. An-2 Airplane

AIRPLANE DESIGN /SHORT DESCRIPTION/

1. Fuselage

The fuselage of An-2 airplane is of semi-monocoque structure. The carrying structure of fuselage is formed by a framework and a duralumin sheet skin.
The fuselage framework consists of 26 frames, longerons, carrying beams end of the floor in cargo-passenger cabin.

2. Wings

The wing set consists of upper and lower wings, inter-wing struts, four supporting tie-rods and six carrying ones.
Wing structure is of double-spar type, coated with canvas with a profile of PIla-14% constant all along wing span.
The upper wing is fitted with slotted ailerons provided with mass and aerodynamic compensation with differential displacement. Ailerons may also be used as flaps while not loosing their main function of ailerons.
The left aileron has a balancing flap electrically controlled. All along the span of upper wing the automatic slats are hung. Both the upper and lower wing are fitted with slotted flaps provided with axial-aerodynamic compensation and electric control. The upper wings contain six sheet-metal fuel tanks.

3. Control Surfaces

Control surfaces consist of horizontal stabilizer, two struts, elevator, fin and rudder.
The elevator unit is mounted to fuselage by means of steel fittings and two struts.

4. Controls

The An-2 airplane has double flight controls enabling the control of the plane by two pilots.
The aileron control system within the fuselage and the elevator and rudder control systems are of cable type.The flap and aileron control systems in wings are of push-rod type.
The trimming tabs and ailerons are displaced by means of electromechanisms UT-6D installed in the control surfaces and controlled through switches on central control desk; the lights beside the switches indicate the neutral position of the tabs.
The flaps of upper and lower wing are displaced by means of UZ-1AM electromechanisms installed above the ceiling and below the floor of the cockpit between the frames 7 and 8.
The electromechanisms are controlled by push-buttons located as follows: Flap lowering push-button - on throttle lever handle flat retraction push-button - on central control desk.
Emergency flap retraction switch is on central control desk.

5. Landing Gear

Landing gear system is of classic type. The main landing gear of the airplane is fixed of piramid type and consists of legs, shock absorbers, front and rear struts and of wheels 800x260 mm provided with double action pneumatic brakes. Brake control is realized by means of a lever installed on the left control wheel, or by means of a lever installed on the right control wheel on which there is also a brake release push button. It permits the trainer to release wheel brakes if improperly braked by a trainee at the left control wheel.
The tail landing gear consists of a leg, shock absorber and self-adjusting wheel 470-210.
Application of electropneumatic valve and pneumatic cylinder enables locking of the tail wheel in neutral position (symmetric) which makes keeping of direction easier when driving airplane on the ground. Shock-absorbers are to be filled with

AMG-10 oil and nitrogen. Nitrogen pressure in front shock-absorbers is about 2.94 - 0.095 MPa /30_{-1} kG/cm^2/, while that in tail one is 2,45$^{+0,19}$ MPa /25^{+2} kG/cm^2/.
Instead of AMG-10 oil, the Aeroshell Fluid 41 oil, specification OM-15, acc.to the DTD 585B-shell standard can be used. This oil may be mixed with the AMG-10 oil.

6. Cabins

A. Cockpit

The cockpit is at the front of the airplane behind power plant. It contains all navigational instruments as well as controls for both airplane and engine.
The window panes of cockpit dome ensure very good visibility.
The upper part of the dome is provided with emergency exit through which the airplane may be left in case the fuselage door would become blocked /e.g. in emergency cases/.
The cockpit is separated from passenger cabin by a wall with a door shut from cockpit side.
Two pilot seats are provided with safety belts and vertical adjustment to set the seats as required for pilot's height.

B. Cargo-Passenger Cabin.

/1/ Cabin dimensions:

- length	14,1 m
- width	1,5 m
- height	1,8 m

/2/ Cabin Description

The cargo-passenger cabin is provided with 12 folded seats intended for transporting passengers or paratroopers /airborn landing force/ or - in ag.variants for installing the main hopper.

Under the cabin ceiling in transport variant two steel-wire cords are hung to hook the parachute self-release devices for parachutists.
Between the 11th and 15th frame there is a cargo-loading door to be opened outside upwards, which enables transporting large-size cargo.
Within the cargo-loading door there is a passenger door to be opened inside the airplane.
The right wall of the cabin is provided with inscriptions informing about correct arrangement of cargo.
Cargo is to be fixed by means of locating catches permanently mounted to walls and detachable ones screwed into threaded holes in the floor. The cargo is to be fixed with 9 cords /when of large size/ or with cord net /small cargo/.
For transporting the sick the mounting of 5 stretchers is provided for, three on each side at three levers.
To separate the cabin with stretchers from the entrance vestibule the thermo-insulating curtain is spun on the pins of frames 11 and 12.
Additionally the places for installing first-aid kit, thermos and bedpan have been provided.

7. Airplane Systems

A. Pneumatic System /see Fig. 1.2/.

The pneumatic system of An-2R airplane serves for the controlling of the brakes of main landing gear wheels, for locking the tail wheel in neutral position and for controlling the ag. equipment.

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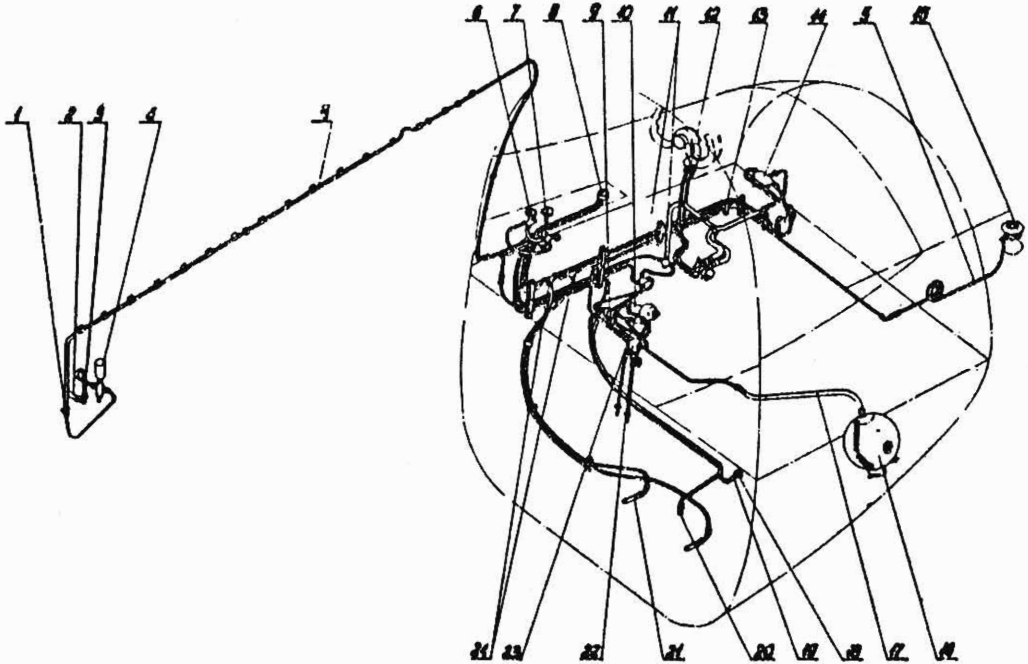

Fig. 1.2. Pneumatic System

1-T-pipe with blanking plug for loading the pneumatic unit /tube/ and rear shock-absorber; 2-Flexible hose; 3-Elbow; 4-Electropneumatic valve 694700; 5-Pipe; 6-Filling valve KN-9750/D; 7-Pressure gauge, MW-80M; 8-Pointer pressure gauge, MW-12; 9-Through-flow filter, 57-685; 10-Pressure control unit AD-50; 11-Cross pipe; 12-Reducing valve, PU-7; 13-Blanking plug; 14-Distributing valve, PU-8/1; 15-Compressor, AK-50M1 or AK-50P; 16-Compressed air cylinder; 17-Flexible hose; 18-Board charging fitting; 19-Check valve; 20-Stub-pipe for charging pneumatic units and shock absorbers of front landing gear wheels; 21-Flexible h[illegible]s to wheel brakes; 22-Decanter filter PT-1300; 2[illegible] [illegible]heck valve; 24-T-pipe.

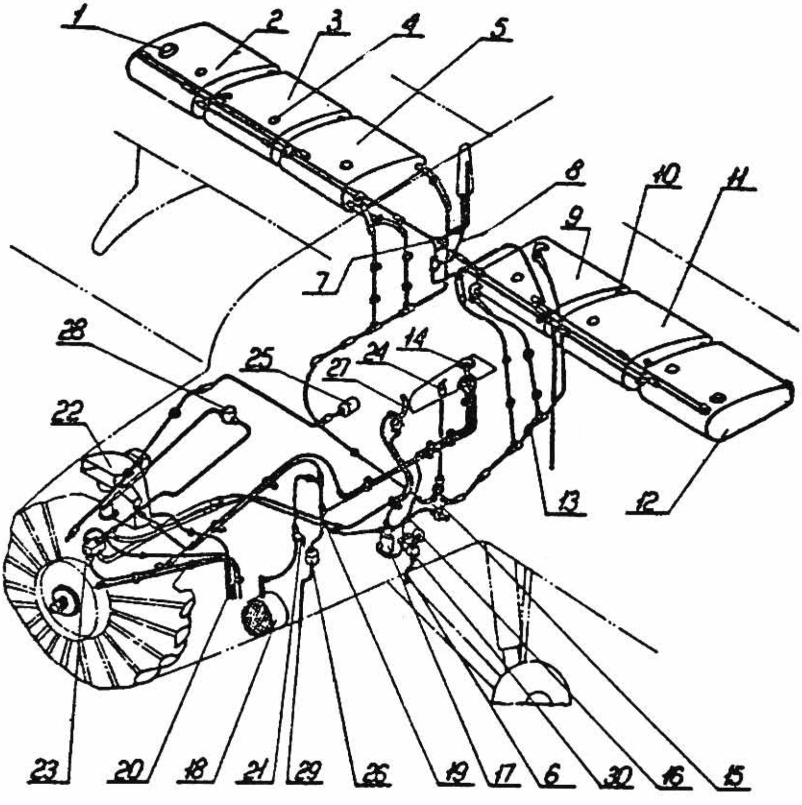

Fig. 1.3. Fuel System

1-Fuel filler opening; 2,3,5,9,11,12-Fuel tanks; 4-Fuel meter sensor, 5BES-1447; 6-Flexible hose; 7-Drain valve; 8-Pipe; 10-Check valve, Sz6101-38; 13-Check valve, Sz6101-38; 14-Primer pump, 74 C500; 15-Four position valve 625000; 16-Shutt-off alve; 17-Fuel filter; 18-Oil cooler, 1106/Kr; 19-Damper, M154003; 20-Drain; 21-Oil dilution valve, 772A; 22-Carburetor, AKM-621RA; 23-Fuel pump, BNK12BK; 24-Four-position valve lever; 25-Manifold pressure gauge MW-16U; 26-Pressure sensor; 27-Manual fuel pump RNA-1BX; 28-Fine fuel filter 12TF29-1; 29-Flexible hose; 30-Pump BPK-4.

In field conditions the air system may be used for provisional charging of tubes and shock absorbers of the main and tail landing gears.
The air vessel is a compressed air cylinder of a volume of 8 l.
Pressure in the system is about 5.0 MPa /50 kG/cm^2/.
Working pressure in individual systems:

/1/ Brake	980 kPa /10 kG/cm^2/
/2/ Locking	5,0 MPa /50 kG/cm^2/
/3/ Spreader control	1.56 MPa /16 kG/cm^2/
/4/ Spraying system control	1.17 MPa /12 kG/cm^2/

Filling the cylinder with air is done from airfield cylinder while connecting it to charging end with flexible hose available in the ground equipment.
In flight the air content in the cylinder is completed by the piston compressor installed on the engine.
The air pressure control in the system is realized with automatic pressure control unit AD-50.
Pressure of air supplied to wheel brakes is reduced by means of the reduction valve PU-7.

B. Fuel System /see Fig. 1.3/

Fuel from tanks/2,3,5,9,11,12/ is supplied through check valves /13/ to four-position valve /15/ in the cockpit.
Depending on position of valve lever fuel is supplied from one or both tanks.
On shifting the lever to "TANKS OPEN" position fuel is supplied from both groups of tanks and, on shifting it to "RIGHT OPEN" or "LEFT OPEN" position fuel is supplied from right or left group of tanks.

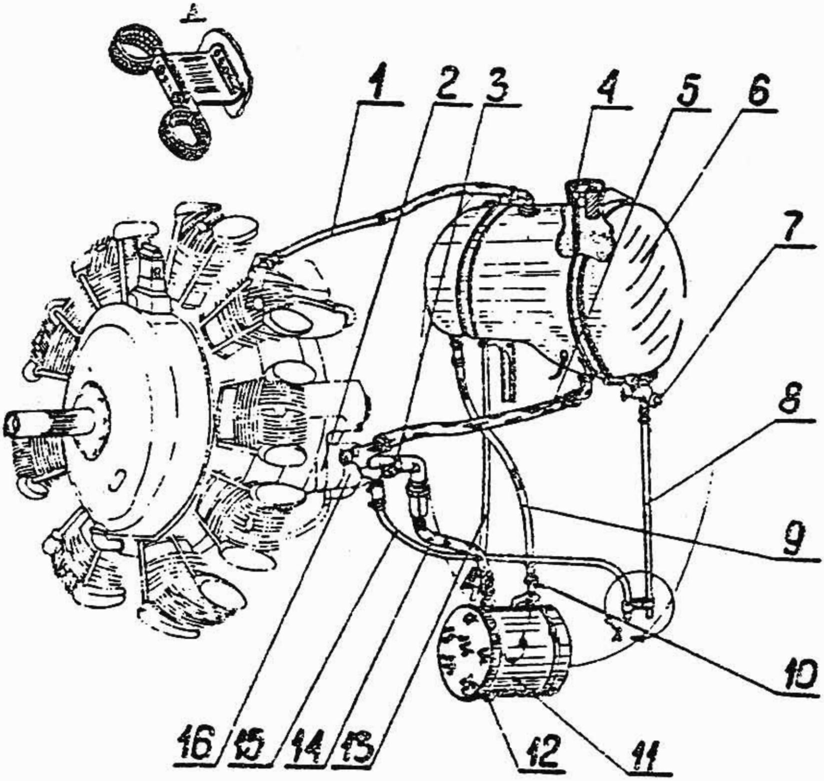

Fig. 1.4. Oil System

1. Engine Vent Pipe
2. Oil pump, MSz-8A
3. Drain valve
4. Oil filler opening
5. Tank-pump line
6. Oil tank
7. Drain valve
8. Tank drain pipe
9. Pipe for oil supply from cooler to tank
10. Stub-pipe for diluting oil with gasoline
11. Oil cooler, 1106/Kr
12. Drain plug
13. Drain pipe
14. Flexible hose for oil supply to cooler
15. Drain pipe
16. Centrifugal oil-filter TCM-25.

From valve /15/ fuel is directed to cut-off valve /16/. Then it flows through filter /17/ to fuel pump /23/ installed on the engine. From the fuel pump it is delivered to fine filter /26/ and then to carburettor /22/.
The fuel pump BPK-4R /30/ is permanently installed in the fuel system and serves for filling the airplane with fuel in field conditions.
The pump is driven from electric motor supplied with power from board battery.
The amount of fuel in tanks is indicated by the sensors of fuel meter SBES-1447 which are installed in each tank.

C. Oil System /see Fig. 1.4/.

Oil system consists of tank, cooler, pipes and fittings and oil pump. Oil is sucked from the tank by an oil pump and is pumped to the engine. After circulating in the engine, oil is sucked out of engine by the same pump and pumped back to oil tank.
While circulating from engine to the tank, oil passes through a cooler where it cools down.
The oil tank is mounted by means of tapes to a bed located on fire-wall.
The oil cooler is mounted to a special bed under airplane fuselage and guarded by a tunnel with movable curtains shifted by UR-10 electromechanism controlled from cockpit.

D. Heating System in Cabins /see Fig. 1.5/

/1/ Description

This system serves to heat the cockpit, the cargo-passenger cabin and the right front window pane of cockpit windscreen.

The air warmed by exhaust gases in the heat exchanger on the exhaust pipe is utilized as a heating medium. The heating system consists of the cold air intake, heat exchanger on the exhaust pipe, warm air distributor, distributor throttle control system, piping and valves for switching the heating on and off.

/2/ Principle of Operation

Air from post-propeller stream flows into the intake /4/ and then to heat exchanger /6/.
The heat exchanger is a section of exhaust pipe to which the copper plates are soldered to increase the surface of heat exchange. The whole is shielded by sheet metal jacket.
The air, flowing between the jacket and the pipe with plates, takes over the heat of exhaust gases.
The air warmed in the heat echanger passes over to the distributor /3/.
The throttles controlled by means of bowden cables /8/ through the lever /9/, are located near the right wall on the floor of the cockpit.
When the levet is in "OFF" position the air flows outside the airplane, when it is in "ON" position the warmed air gets, depending on opening of individual heating valves, to particular cabins or to the double pane of the windscreen.

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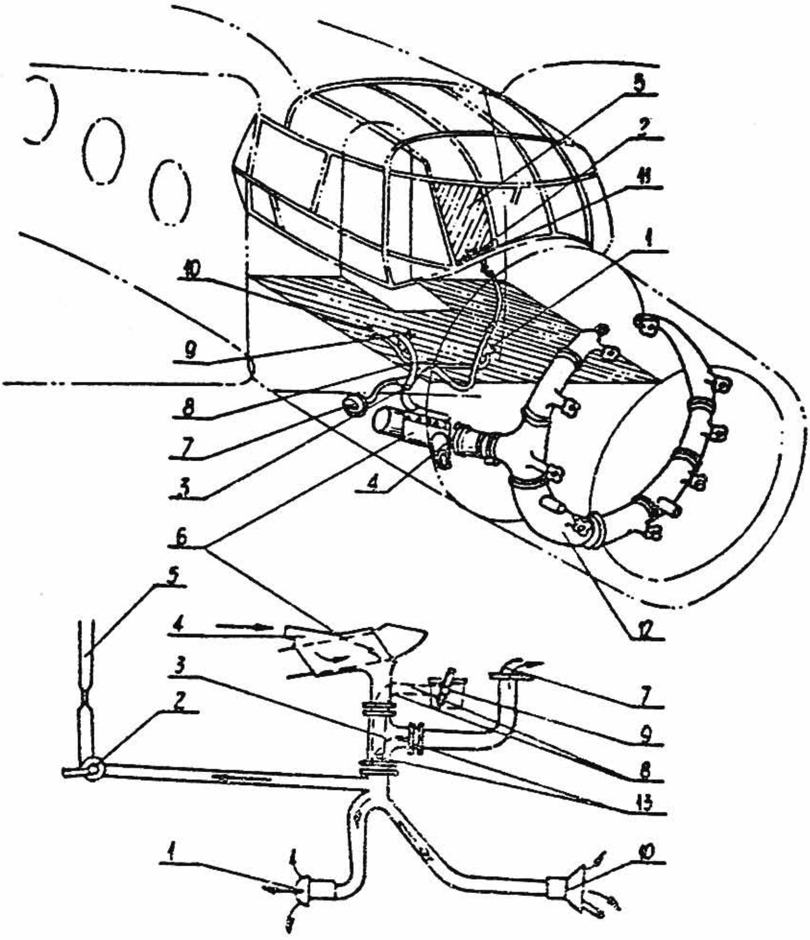

Fig. 1.5. Cabin Heating System

1. Cockpit heating valve
2. Windscreen pane heating valve
3. Distributor
4. Air intake
5. Heated windscreen
6. Air heat exchanger
7. Warm air outlet
8. Distributor control cables
9. Distributor control lever
10. Cargo-cabin heating valve
11. Box
12. Collector
13. Throttle

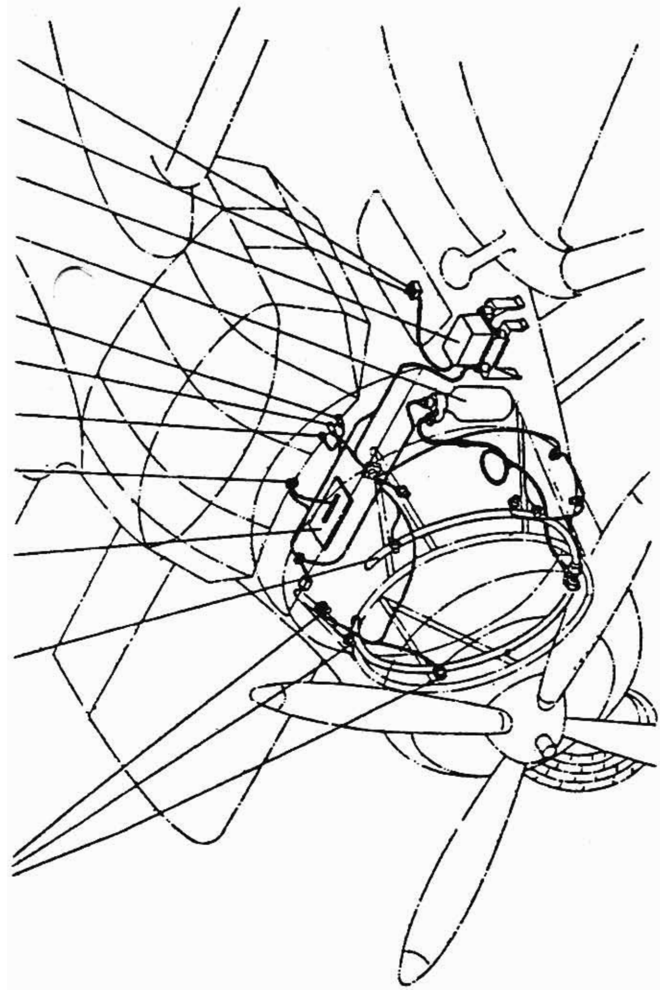

Fig. 1.6. Antifire System

1. Thermo-signalling devices
2. Fire extinguishing manifold
3. Plus bus
4. AZS /automatic overcurrent switch of fire protection system
5. Fire warning light
6. Cylinder actuation press-button
7. Cylinder efficiency checking light
8. Cylinder with pyrohead
9. Slave block, B1-2AU
10,11-Switch for system efficiency check

E. Fire Protection System /Fig.1.6/.

The fire protection system serves for signalling excessive rise of temperature in engine compartment and filling the engine compartment with fire-extinguishing gas.
The fire protection system of type SSP-1A installed on the airplane consists of 9 fire sensors of type DPA-1AG, the slave system BI-IIAju, electric circuit and signal light in the cockpit.
The six fire sensors are located on the engine mount, one in the first frame and two on oil cooler mounting bracket.
The cylinder with compressed inert gas /CO_2/, with built-in ignition cartridge, serves for fire extinguishing.
Ignitting of the ignition cartridge takes place after pressing the push button in the cockpit. The gas escaping from the cylinder flows through a pipe to the manifold and, through holes in the manifold it enters the engine compartment.
Manual fire extinguishers OU-2 are mounted on the rear wall of cargo-passenger cabin and in the cockpit in the area between the right pilot seat and right wall on the floor.

F. Ventilation System /Fig. 1.7, 1.8/.

1. The cockpit ventilation system, depending on the aircraft version, consists of the following sub-systems:
   - Upper cockpit part blowing system from the blowing intakes 1 /Fig. 1.8/,
   - Lower cockpit part blowing system from the air intake 12 /Fig.1.8/,
   - Lower cockpit part and cockpit seat ventilation system /Fig. 1.7/, that is installed in lots, in agricultural version.

23 Functioning of the cockpit ventilation system is as follows:
Air enters upper cockpit part through opened blow intakes 1 /Fig.1.8/. The air intake cover is controlled by a handle located in the upper part of the instrument panel.
The direction of air stream depends on the position of a ventilation outlet 15. Blowing onto the lower cockpit part is obtained by opening the valve 8 /Fig.1.8/. On the aircraft agricultural version /Fig.1.7/, air intakes 16 and 20 are installed under upper wings. The air is sucked from air intakes through fans /7 and 14/ to the gauze filters /3 and 13/ and to the chemical cleaning filters /8 and 12/.

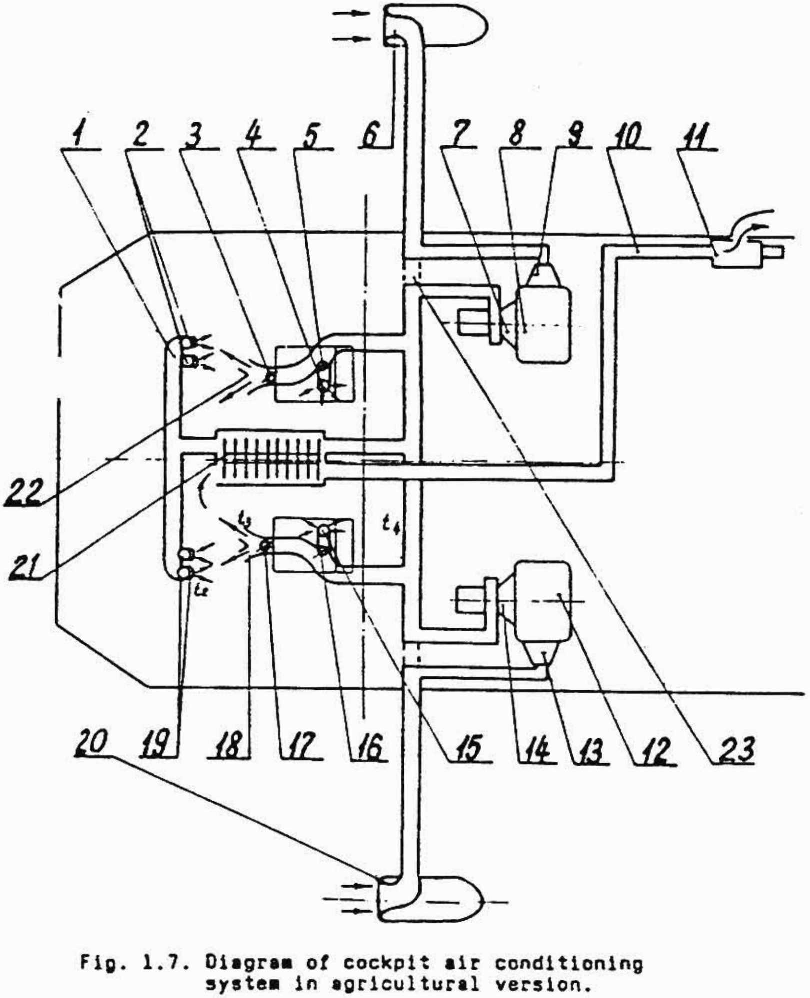

Fig. 1.7. Diagram of cockpit air conditioning system in agricultural version.

1-Manifold; 2÷4,15,18,19,22-Ventilation outlets; 3,5,16,17-Shutters; 6,20-Air intakes; 7,11,14-DW-201 Fans; 8,12-Chemical cleaning filters; 9,13-Gauze filters; 10-Air duct; 21-Air conditioner; 23-Connectors.

A certain amount of filtered air is forced through ducts to the lower cockpit part, from where it is directed to the seat blowing intakes and on the crew legs. The intensity of this air stream is regulated by means of shutters 3,5,16,17 of which control levers are located adjacent to seats. The remaining portion of air is forced to the air conditioner where it is cooled and directed to the manifold 1 with ventilation outlets /2 and 19/, enabling the change of air stream intensity and direction.

The warmed air is sucked out of the cockpit by the suction fan 11 through the upper air conditioner part and then it is expelled outside.

The 27 V D.C. power supply DW-2C1 fans are mounted in the cargo cabin. The 2PPNG-15 switch mounted on the LH desk under the "FAN-AIR CONDITIONER" inscription serves to turn the ventilation system ON. When the switch is in the "FAN" position, three DW-201 fans are actuated. When it is set to the "AIR CONDITIONER", the fans and air conditioner begin to operate.

25 <u>WARNING</u>: It is forbidden to turn ON the air conditioner /"AIR CONDITIONER" position/ when the suction fan is inefficient, and with the aircraft illumination lights and windscreen heating "ON"

The cockpit ventilation system can be also used with a connector installed instead of the air conditioner, and without filters /8,9,12, 13/ and fans /7 and 14/ which are then replaced by connectors 23. If this is the case, the air entering the cockpit will be uncooled and non-filtered, only during the flight when air pressure occurs.

2. If the An-2 airplane is modified for transport purposes of cargo passengers or parachutists, the ventilation system is extended by adding two more ventilation manifolds 4 installed in the passenger cabin /see Fig.1.8/.
   The manifolds are connected with under-wing air intakes.
   The ventilator 2 ensures the natural circulation of air.
   The cockpit is then ventilated with air from intakes arranged on the fuselage and by shifting off the panes of the cockpit dome.

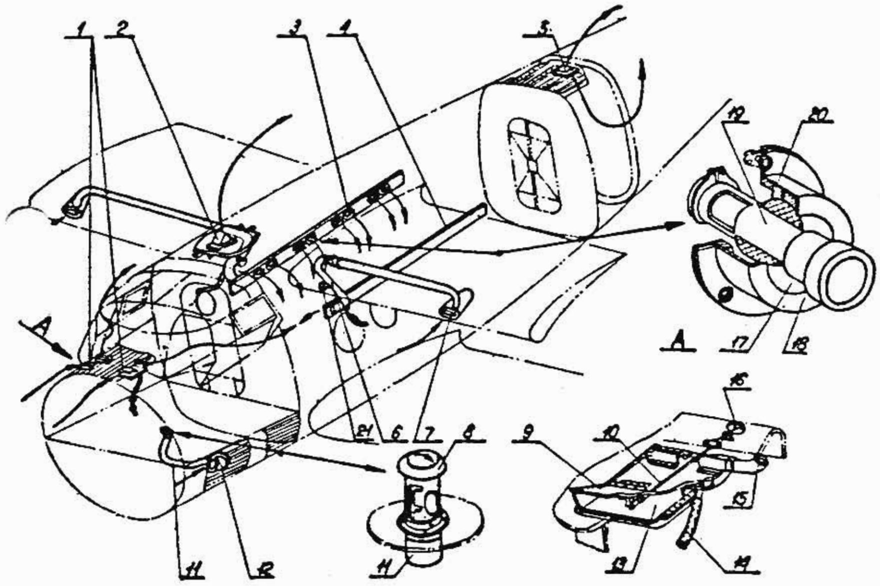

Fig. 1.8. Cabin Ventilation

1-Through-blow air intakes
2-Ventilator
3-Ventilator ends
4-Left ventilation manifold
5-Ventilator
6-Ventilating pipe
7-Air intake
8-Ventilation valve
9-Air intake cover
10-Fixing tie-rod
11-Blowing pipe
12-Air intake
13-Air intake casing
14-Drain
15-Outlet pipe
16-Handle
17-Spherical insert
18-Body,
19-Ventilating end
20-Shroud
21-Ventilation valve knob

C. Electric System

The airplane electric system is supplied with direct current of a voltage of 27V from the GSN-3000M converter and from two board batteries 12-A-30 which are the reserve power source of direct current.

Both these power sources are connected in parallel

At peak loading, when loading current exceeds the rated current of the generator, the difference between these currents is compensated by the batteries. The additional power supply source for engine starting on the ground may also be the airfield battery.

The direct-current electric system and the alternating current system of 115V are made as single-wire systems: minus pole is constituted by the bonding. The electric system of the 3-phase alternating current of 36V is made as 3-wire system.

The following voltages are used in the electric system of the airplane.

/a/ Direct-current voltage of 27V serving for the supply of electric units with direct current: engine starting accessories, engine operation control instruments, convertors, window pane heating accessories, heating of clock and air receiver, outer and inner lighting, contact and relay signalling, gyroinduction compass and some radio equipment.

/b/ 2-Phase alternating-current voltage of 36V which supplies gyro-inductive compass, course indicator and artificial horizon.

/c/ One-phase alternating-current voltage of 115V which supplies automatic direction finder, radio altimeter, flight signalling device.

Electric system is protected against overloading currents or those of shorting with automatic overcurrent switches of AZS type safety devices of IP type and with fuses of SP type. Individual electric currents requiring pilot control are protected by automatic overcurrent switches AZS.

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AIRPLANE EQUIPMENT

1. Navigational and Radio Equipment

/1/ Short-range radio-station, RS-6102 /1 or 2 units/

/2/ Intercom, SPU-7

/3/ Automatic direction finder, ARK-9

/4/ Radio altimeter, RW-UM

/5/ Airspeed indicator, US-35U /2 items/

/6/ Variometer, WR-10U /2 items/

/7/ Altimeter, WD-10 /2 items/

/8/ Magnetic compass, KI-13A

/9/ Induction compass, GIK-1

/10/ Indicator GPK-48

/11/ Artificial horizon, AGK-47B

/12/ Clock, ACzS-1

/13/ Flight signalling device, MRP-56

2. Engine Instruments

/1/ Engine unit gauge, EMI-3K

/2/ Fuel meter, SBPS-1447

/3/ Tachometer indicator TE-45

/4/ Cylinder head thermometer, 2TCT-47

/5/ Pressure gauge MW-16U for delivered mixture pressure

/6/ Mixture thermometer TUE-48

3. Auxiliary equipment

/1/ TUE-48 outside air thermometer

/2/ UZP-47 flap position indicator and UZP-48 oil cooler shutter position indicator

/3/ MW-60 ag. system pressure gauge

/4/ MW-16 ag. system pressure gauge

4. Additional equipment

/1/ Brief case with a set of tools in accordance with the Illustrated Specification of Spare Parts 1:1

/2/ Flare pistol with 12 flares

/3/ First-aid kit

/4/ Board type bag

/5/ Pilot's urinal

/6/ Ground equipment in accordance with the Illustrated Specification of Spare Parts 1:1

/7/ Covers

NOTES: 1. The operator is responsible for the contents of the first-aid kit.

2. In addition the operation may equip the airplane with thermos bottles and food containers.

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Recommended contents of the first-aid kit:

1. First air instructions	
2. Dressing, short	4 pcs.
3. Dressing, long	4 pcs.
4. Antiseptic gauze, small packet	1 pc.
5. Sticking plaster "Poloplast"	1 pc.
6. Sticking plaster "Prestoplast"	5 pcs.
7. Cotton wool	1 pc.
8. Safety pin	5 pcs.
9. Scissors	1 pc.
10. Haemostatic forceps	1 pc.
11. "Cardiamid"	1 phial
12. "Novotein" in tablets	10 tablets
13. Bromular tranquilizer	10 tablets
14. Menthol drops	1 bottle
15. Valerian drops	1 bottle
16. 2% Mercurochrome	g 50
17. 3% solution of sodium carbonate	1 bottle

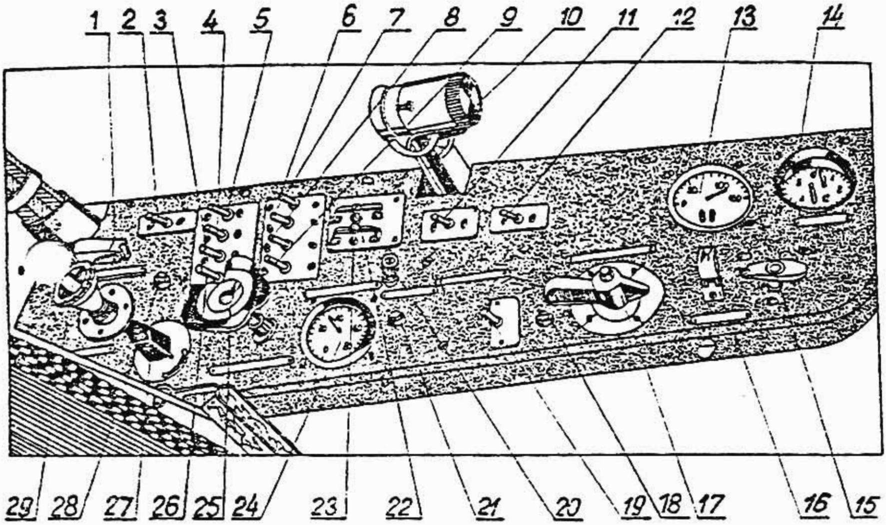

Fig. 1.8. Left Control Panelk

1-AZS /automatic overcurrent switches/ for oil dilution.
2-AZS of light sygnalling for emergency exit (on special Buyer's demand)
3-Right windscreen pane wiper switch.
4-Left windscreen pane wiper switch.
5-AZS for wipers.
6,7,8-AZS es for windscreen pane heating.
9-AZS for the left ventilator. 10-UFO* light.
11-Switch for ventilation system
12-A-037 radio altimeter switch WG-15-2s
13-Ag. equipment pressure gauge, MW-60
14-Brake system pressure gauge, MW-12
15-Transformer TR-60 for RA indicator illum. level control.
16-AZS of fuel pump; 17-Fuel valve handle.
18-Press button 204K for checking the filings monitor system.
19-Fuel gauge switch.
20-Heating indicator light, PWD-6M.
21-Heating indicator switch, PWD-6M
22,23-Switch for checking fire protection system.
24-Pneumatic system pressure gauge, MW-80M.
25-Air system charging valve.
26-AZS of fuel residue system
27-UFO light resistor;
28-Press button 204K for checking the fuel residue system
29-Primer pump

*/ ultraviolet lighting.

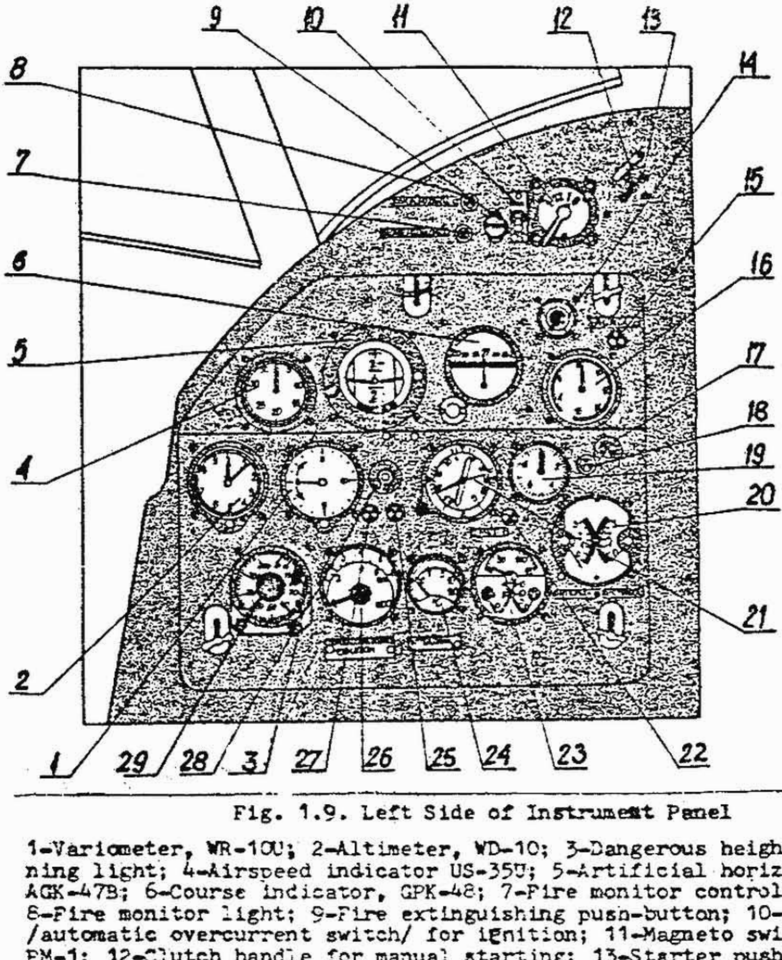

Fig. 1.9. Left Side of Instrument Panel

1-Variometer, WR-10U; 2-Altimeter, WD-10; 3-Dangerous height warning light; 4-Airspeed indicator US-35U; 5-Artificial horizon, AGK-47B; 6-Course indicator, GPK-48; 7-Fire monitor control light; 8-Fire monitor light; 9-Fire extinguishing push-button; 10-AZS /automatic overcurrent switch/ for ignition; 11-Magneto switch, PM-1; 12-Clutch handle for manual starting; 13-Starter push-button; 14-Ammeter, A-1; 15-Converter operation signal light; 16-Manifold pressure gauge, MW-16U; 17-Oil dilution indicator light; 18-Filings warming light, SLM-51/red/; 19-Indicator, TE-45, 20-Cylinder head thermometer indicator, 2TCT-47; 21-Indicator UGR-1 of compass set GIK-1; 22-Cruise indicator light; 23-Indicator UKZ-1 of engine unit gauge, EMI-3K; 24-Mixture thermometer indicator TUE-48; 25-Low fuel level warning light for the right group of tanks; 26-Fuel gauge indicator SBES-1447; 27-Low fuel level warning light for the left group of tanks; 28-GIK-1 compass slaving push-button; 29-Indicator A-034-4-16 from A-037 Radio Altimeter Set.

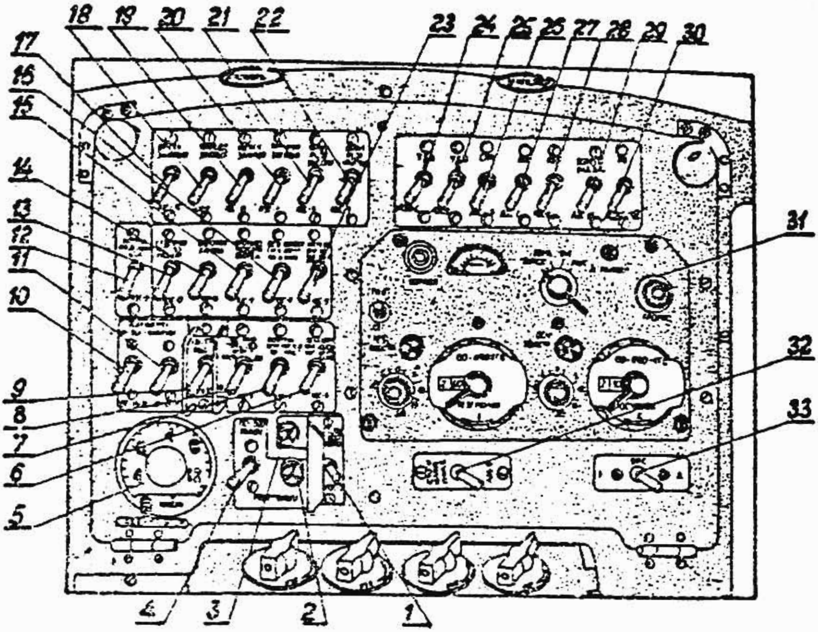

Fig. 1.10. Central Panel of Instrument Board

1-AZS of tail gear locking; 2-PO-500 reserve converter operation indicator light; 3-Landing gear locking signal light; 4-Converter switch PO-500; 5-Voltammeter WA-3; 6-AZS for lighting under floor and central panel UFO light; 7-AZS of portable lamp plug and UFO lamp on the control stick; 8-AZS for UFO of the right side, left control desk and left lamp KLSRK; 9-AZS of PAD-6M heating; 10-cargo cabin lighting switch; 11-cockpit lighting switch, 12-AZS for wheel brake release; 13-AZS for oil cooler shutters; 14-AZS for engine cowlings; 15-AZS for fire extinguishing equipment; 16-AZS for lighting system behind instrument panel, and signalling of door and passenger cabin lighting; 17-AZS for upper flap; 18-AZS for flap control; 19-AZS for lower flaps; 20-AZS for aileron trimming tab; 21-AZS for elevator trimming tab; 22-AZS for rudder trimming tab; 23-AZS for right KLSRK lamp, lighting of rear part of fuselage, cockpit lighting of left UFO lamp; 24-for first VHF radiostation; 25-AZS for second VHF radiostation; 26-AZS for intercom SPU-7; 27-AZS for radiocompass ARK; 28-AZS for cruise indicator light MRP-56P; 29-AZS for anticollision lights; 30-AZS for radio altimeter A-037; 31-Control table for ARK-9 automatic direction finder; 32-AZS for flight direction signalling device; 33-switch "Near-Far" 20

CAUTION: Items with indexes 12, 25,29 und 32 are optional. 6

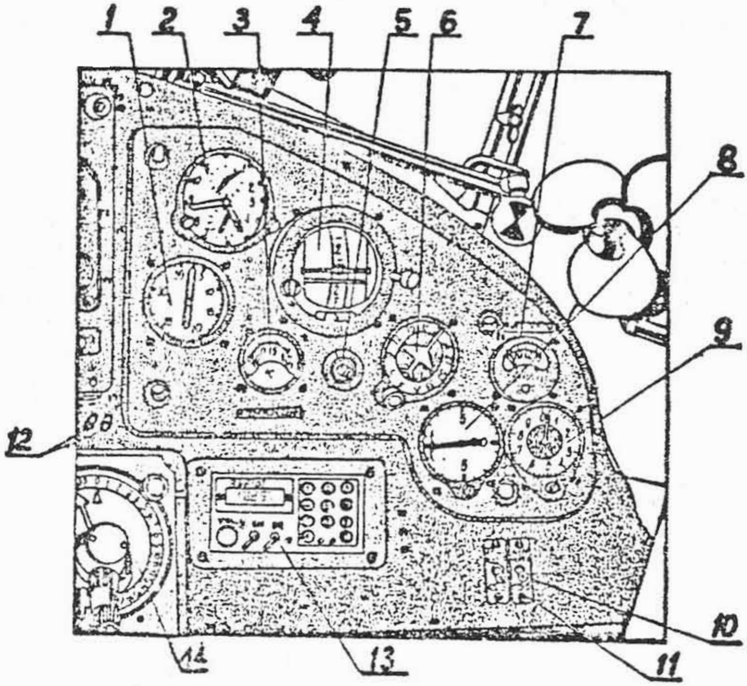

Fig. 1.1 Instrument Panel

1-Airspeed indicator, US-35U
2-Clock, ACzS-1
3-Indicator for TUE-48 thermometer for autside air
4-Artificial horizon, AGK-47B
5-GIK-1 compass slaving push button
6-UK-3 indicator from GIK-1 set
7-Voltmeter, WF-150
8-Variometer, WR-10U
9-Altimeter, WD-10
10-AZS for ACzS-1 clock heating
11-AZS for right fan
12-Battery control press-buttons
13-USW transceiver "reserve" or hole plug
14-Course indicator BSUSz-2 from ARK-9 set.

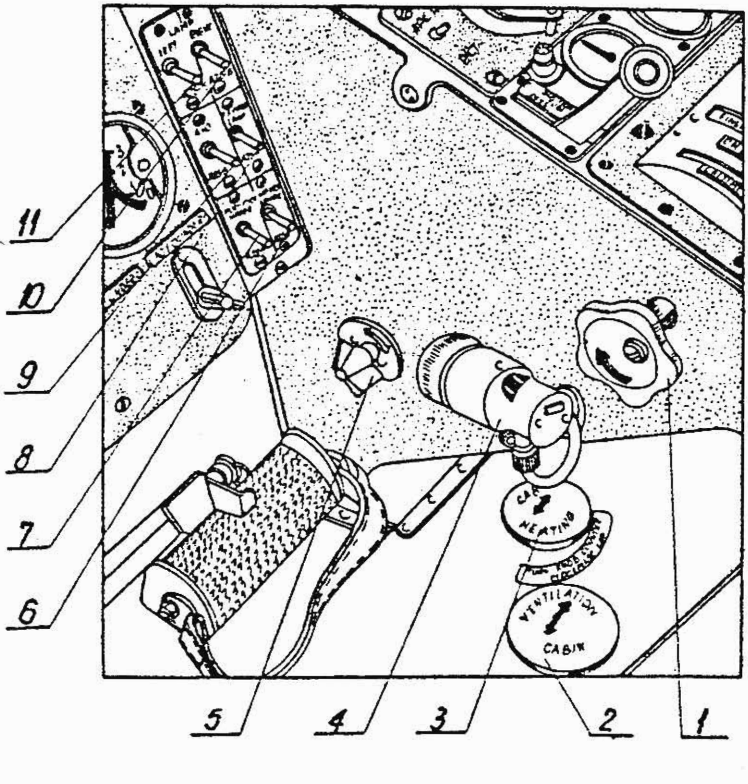

Fig. 1.12. Central Control Desk /left side view/

Lever locking knob; 2-Filling valve; 3-Cockpit ventilation alve; 4-Cockpit heating valve; 5-Ultraviolet lamp; 6-Light intensity control for left UFO lamp; 7-AZS for lower marking lights; 8-AZS for upper marking lights; 9-AZS for taxying headlight; 10-AZS for navigation lights; 11-AZS for right headlight; 12-AZS for left headlight.

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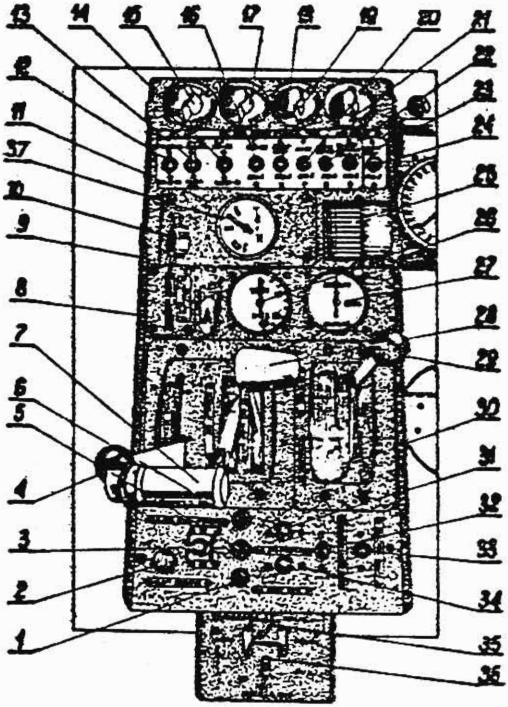

Fig. 1.13. Central Control Desk

1-Signal light for aileron trimming tab; 2-Flap control push--button; 3-Elevator trimming-tab switch; 4-Altitude corrector lever; 5-Signal light for elevator trimming tab; 6-Signal light for rudder trimming tab; 7-Throttle lever; 8-Emergency flap retraction switch; 9-Door signal light; 10-Lever controlling the shutter of air inlet to carburetor /only for T-TP versions/; 11-Blanking plug; 12-Converter switch; 13-Battery switch; 14-Switch for GIK-1 compass and for AGK-47B artificial horizon; 15-Resistor of left UFO lamp; 16-AZS for AGK-47B artificial horizon and for gyro-compass GPK-48; 17-Resistor of front UFO lamp; 18-AZS for SBES-144 fuel meter, filings signalling device; 17-Resistor of rear UFO lamp; 20-AZS for EMI-3K; 21-Resister of right UFO lamp; 22-AZS for indicators UZP-47 or UPZ-48; 23-AZS for mixture thermistors TUE-48; 24-AZS-5 for ag. equipment; 25-Frequency schedule; 26-UZP indicator of flap position; 28-Propeller pitch lever; 29-Engine stopping lever; 30-Carburetor heat lever; 31-Elevator trimming tab switch; 32-Oil cooler shutters switch; 34-Aileron trimming tab switch; 35-"Left-right" control switch PPG-15-2s; 36-Switch PPNG-15; 37-Elevator trim tab position indicator /optional/.

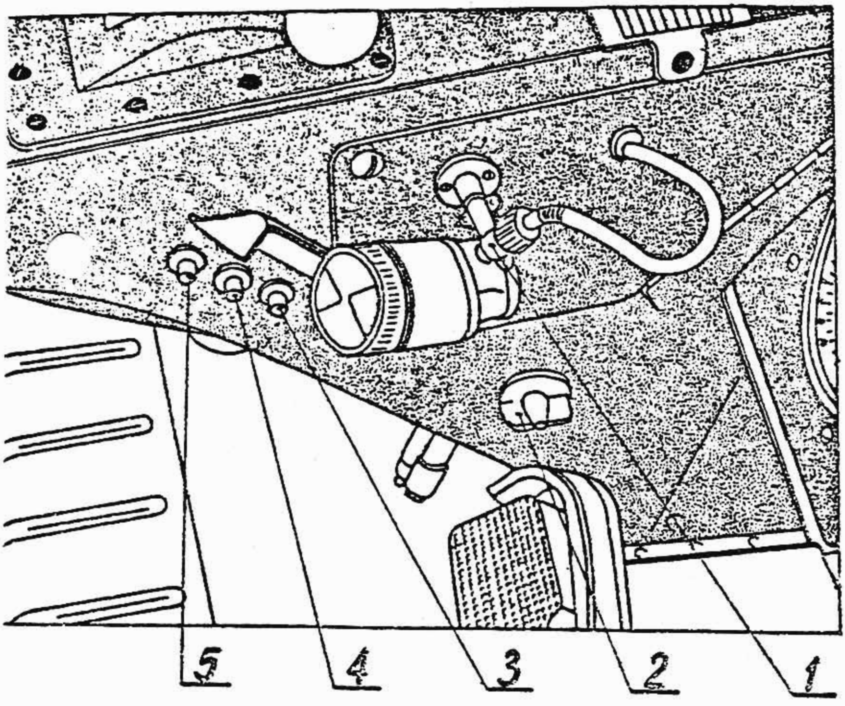

Fig. 1.14. Central Control Desk /view from right side/

1-Ultraviolet light
2-Light intensity regulator for right UFO lamp
3-Press button for signalling landing troop jump
4-Press button for signalling landing troop preparation
5-Press button for signalling landing troop readiness

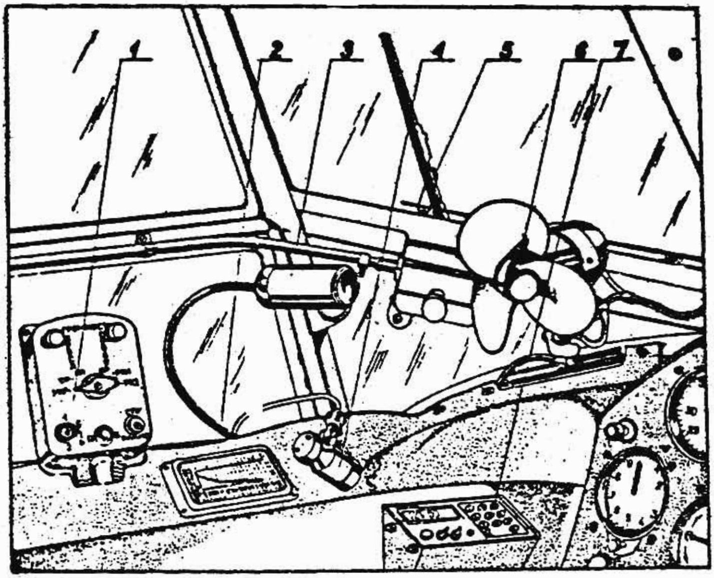

Fig. 1.15. View of Left Upper Part of Cockpit

1-Control table, SPU-7
2-Oil dilution diagram
3-Cockpit lighting lamp /KLSEK/
4-Ultraviolet lighting lamp /UFO/
5-Windsereen wiper
6-Ventilator
7-Transmission-receiving block of RS6102 radiostation.

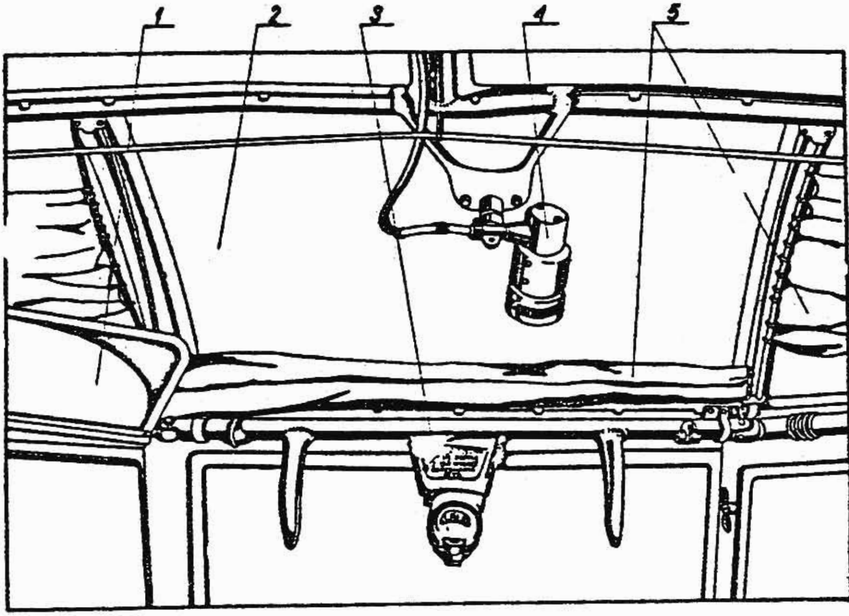

Fig. 1.16. View of Front Upper Part of Cockpit

1-Antiglare blind
2-Emergency exit from cockpit
3-Magnetic compass, KI-13A
4-Ultraviolet lighting /UFO/
5-Sun curtains

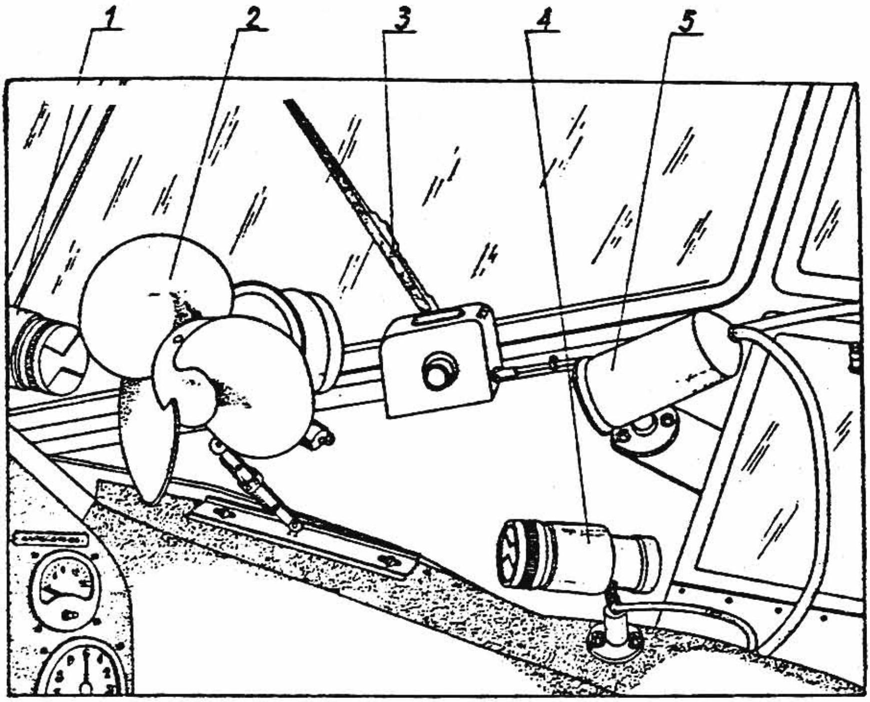

Fig. 1.17. View of Right Upper Part of Cockpit

1 and 4 - Ultraviolet lighting /UFO/

2-Ventilator

3-Windscreen wiper

4-Cockpit lighting /KLSRK/

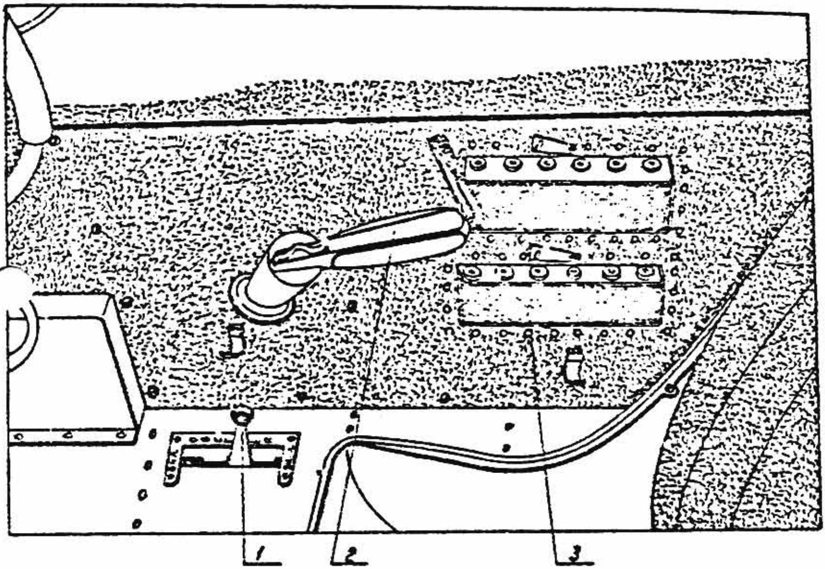

Fig. 1.16. View of Right Lower Part of Cockpit

1 - Cockpit heating control lever

2- Rocket pistol

3- Rockets

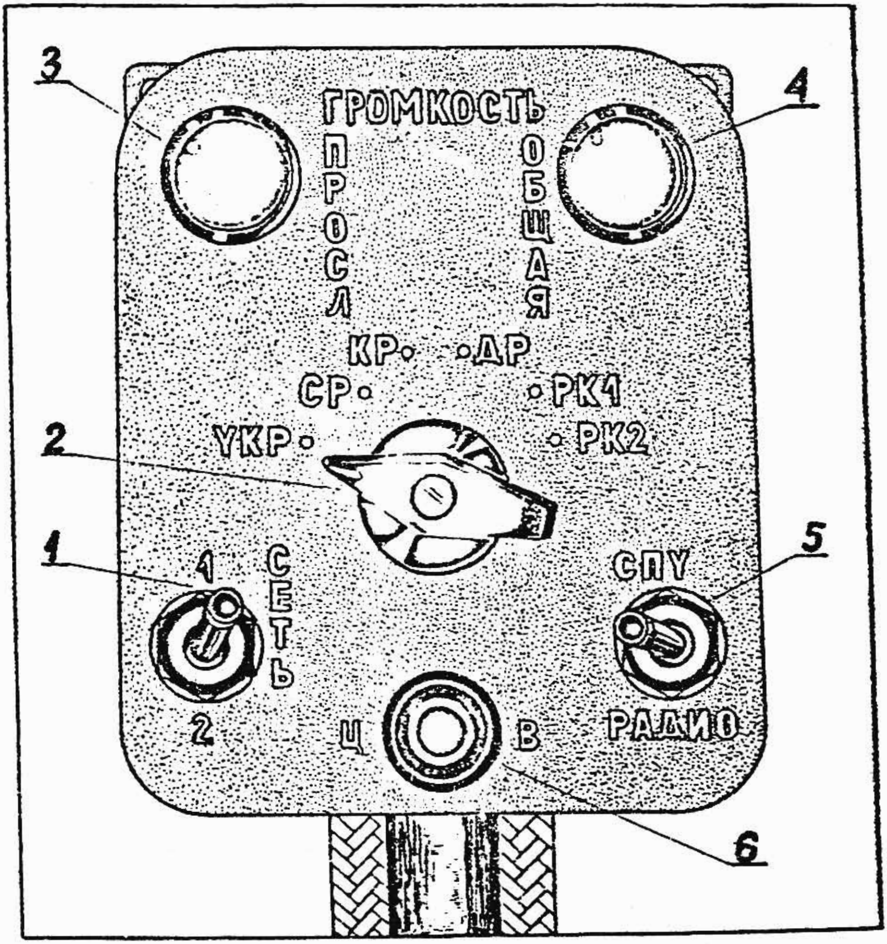

Fig. 1.19. Control Panel for SPU-7 Intercom

1-Mains /Power Supply/ Switch /always in position "1"/,
2-Operation mode switch
3-Listening-in model switch
4-General volume control
5-Switch "SPU-RADIO"
6-Push-button for general call

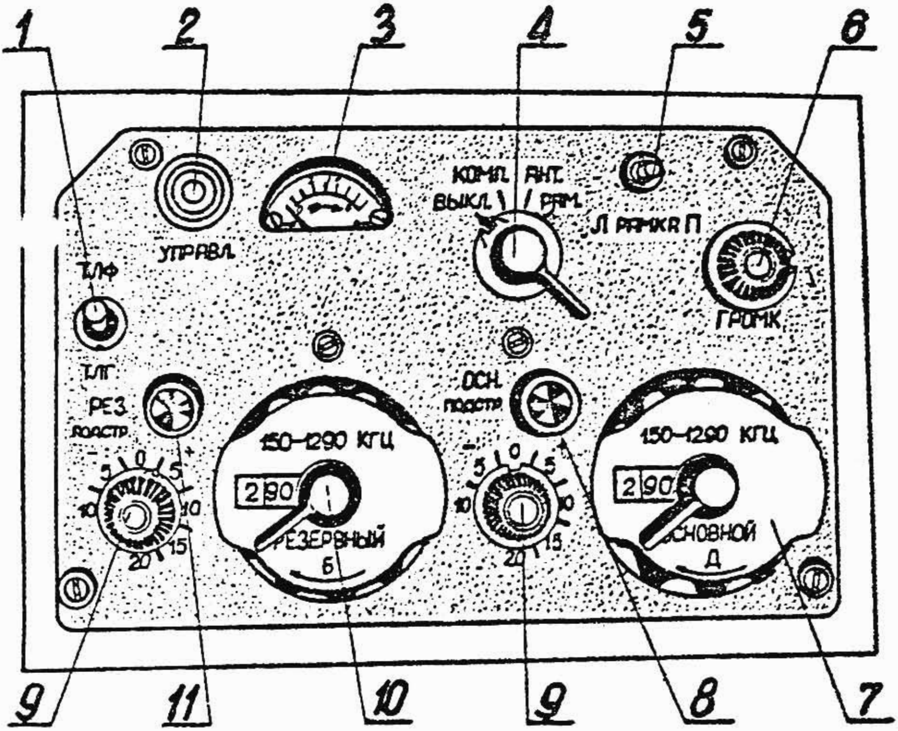

Fig. 1.20. Control Panel of ARK-9 Automatic Direction Finder

1-Switch TLF-TLG;
2-Switch for connecting one of two control panels /when two panels are available/;
3-Tuning indicator;
4-Operation mode indicator;
5-Frame rotation control switch;
6-Volume control;
7-Subrange switch for "far" guiding;
8-Signal light for switching the "basic" channel;
9-Potentiometer for fine tuning;
10-Subrange switch for "near" guiding;
11-Signal light for switching the "reserve" channel.

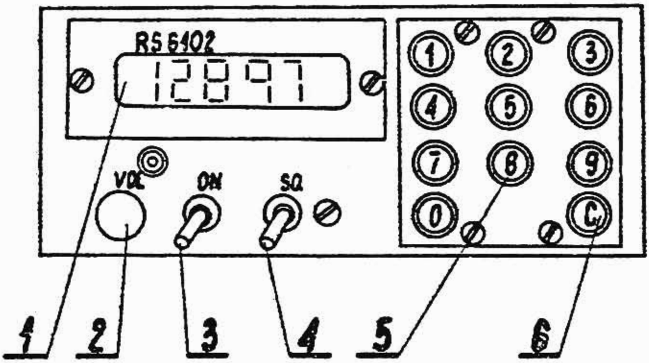

Fig. 1.21.Control Desk for RS6102 Radiostation

1-Operation Frequency Display;

2-Volume control knob;

3-Radio station switch;

4-Noise suppression blocking switch;

5-Frequency programming push-buttons "0-9";

6-Frequency cancelling push-button.

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POWER PLANT

1. Design Description of ASz62IR

The ASz62IR of series XVI is a 9-cylinder 4-stroke air-cooled carburetor-type engine of single row arrangement. It has a planetary reducing gear-box for propeller speed and a single-speed centrifugal supercharger in the fuel supply system.
Four-blade metal propeller, AW-2, is installed on the end of engine shaft.

Engine is equipped with the following accessories:

- propeller speed governor R-9SM2 - on reducer cover;
- carburetor AKM-62IRA, fuel pump BNK-12BK and oil filter MFM-25, centrifugal filter TCM-25 - on the rear part of supercharger housing;
- two magnetos BSM-9, electric inertia starter RIM-U-24W, converter GSN-3000M, oil pump MSz-8A, piston compressor AK-50P-12 - on the rear cover;
- two ignition plugs each in cylinder heads.

Engine starting takes place by means of inertia starter RIM-U-241R supplied with electric power.

2. Basic Technical Data

/1/ Engine type	ASz-62IR
/2/ Cooling System	air
/3/ Number of cylinders	9
/4/ Cylinder numbering	clockwise /looking from the rear of the engine; top cylinder first/.

/5/ Sense of rotation /as seen from the rear of engine/:

/a/ crankshaft	– clockwise
/b/ propeller shaft	– clockwise
/6/ Swept volume of all cylinders	29.67 dcm^3
/7/ Pressure ratio	6.4±0.1
/8/ Reduction gear-box	planetary, with six roller satelites
/9/ Reduction gear-box ratio	0.637
/10/ Compressor in fuel system	centrifugal, single one-gear
/11/ Compressor drive ratio /10/	7
/12/ Ignition sequence	1-3-5-7-9-2-4-6-8
/13/ Ignition plugs	type SD-48BSM
/14/ Speed governor:	
/a/ sense of rotation	anticlockwise
/b/ drive ratio	1.14
/15/ Weight of dry engine	579 kg ±2%

NOTE: Weight of dry engine does not comprise the weights of:
- starter
- converter
- piston compressor
- oil in the engine

3. Operating Conditions

/1/ Recommended Fuel Grades

Aviation gasoline grades of octane number min. 91 e.g.:

/a/ B-91/115, B95 acc. to GOST 1012/72 /USSR Standard/
/b/ 91/96, 100/130 acc. to D.Eng.R.D.2485 /U.K. Standard/
/c/ 100, 100LL acc.to ASTM-D910-75 /US Standard/
/d/ 100/130 acc.to MIL-G-5572-F /US Standard/

wsk -343-82 3000 szt. ew. 158-9.81

/2/ Recommended Lubrication Oil Grades.

Mineral aviation oil of 20-22 cSt viscosity at 100°C /3.07-3.19°E/ for operating in summer and in winter e.g. the grades:

a/ MS-20, MK-22 acc. to GOST 21743-76 /USSR Standard/
b/ Aero Shell W100 or its counterparts acc.to D.Eng. R.D.2450 /U.K. Standard/, MIL-L-22851B /U.S. Standard/, 3-GP-315.320.321 /Canada/.

/3/ Recommended Propellers

Engine with speed governor R-9SM-2 cooperates with the AW-2 propeller while in seaplane with RW-101 governor - AW-2R propeller.

/4/ Recommended Ignition Plugs

The use of ceramic ignition plugs SD-48BSM is recommended.

/5/ Operational Recommendations

/a/ The time od shifting the throttle lever from idle speed position to take-off power position must be within 2-3s at cylinder head temperature of minimum 120°C.
Sudden shifting of throttle lever and too low temperature of cylinder heads may cause a break in engine operation.

/b/ The drop in engine speed while switching from double to single ingition /while consecutive magnetos are switched on/ must not exceed 60 r.p.m., at the range of 2030 r.p.m. and low pitch of the propeller.

/c/ The smallest engine speed at high pitch of the propeller /adjusted with speed governor/ must not be smaller than 1450 r.p.m. at manifold pressure max. 800 mmHg.

/6/ Recommended Parameters of Engine Operation

/a/ Cylinder head temperature:

- minimum for starting 5°C,
- recommended during operation 150-215°C.

/b/ Oil Temperature at the Entrance to Engine:

- minimum for starting 5°C,
- recommended during operation 60-75°C

/c/ Fuel Pressure Before Carburetor:

- at any effective power 24.5-34.2 kPa /0.25-0.35 kgf/cm^2/
- at idle speed 14.7 kPa /0.15 kgf/cm^2/.

/d/ Oil Pressure at Effective Power measured in rear cover: 390-490 kPa /4-5 kgf/cm^2/

/7/ Operational Data of Accessory Units:

/a/ Starter

- rated supply voltage 24 V
- number of consecutive startings /with minimum break between startings of 20s/ - 4
- time of switching on the electric motor - 13 s
- time of turning the starter /mannally/ 5-6 min.

/b/ Piston Compressor AK-50P-12:

- manifold pressure	4413-4903 kPa /45-50 kgf/cm^2/
- cylinder temperature	max. 110°C
- time of filling the bottle of 8 dm^3 capacity to the pressure of 4903 kPa /50 kgf/cm^2/ at engine speed of 1770 r.p.m.	11 minutes
- quantity of oil thrown out to compressor outlet duct at engine speed of 1770 r.p.m.	20 cm^3/h
- speed of air cooling compressor in the duct 25 x 100 mm	14,0 m/s

/c/ Converter GSN-3000M

- rated voltage	28.5 V
- rated current of loading	100A
- max. current during max. 2 minutes.	150 A
- required cooling air flow at the temperature of 20±5°C and under the static pressure of 150 mmHg at the inlet to converter	40 dm^3/s

/d/ The SD-48BSM ignition plugs must be replaced by new ones after 500 hours of operation.

/e/ Rated Power /Maximum Continous/

It is recommended to use rated power in a continuous manner. For optimum operation it is advantageous that the period of operation at take-off power is within 5% of the total time of engine operation.
Not observing these recommendations may cause the need to shorten the the TBO's of the engine and shorten its total service life.

4. En[illegible]e Performance

Power rating	Crankshaft speed-r.p.m. n±1%	Rated Power		Specific fuel consumption		Manifold pressure P_K		Altitude
		kW	HP /metric/	g/kWh	g/HP.h	kPa	mmHg	m
Take-off	2200	721	990	min.408	min.300	140±3.3	1050±25	0
Rated / max.	2100	591	804	381-408	280-300	120±1.3	900±10	0
continous/	2100	605	823	381-408	280-300	120±1.5	900±10	1500
0.9 of rated power	2030	543	738	354-381	260-280	111±2	830±15	0
0.75 of rated power	1910	452	615	326-347	240-255	99±2	745±15	0
0.6 of rated power	1770	362	492	292-320	215-235	89±2	665±15	0
0.5 of rated power	1670	302	410	292-313	215-230	82±2	615±15	0

Maximum engine speed .... 2200 r.p.m.

Specific oil consumption at 0.9 max. continous power is to be max. 20.4 g/kWh /15 gHPh/

CAUTION: 1. ASz-62IR is an altitude engine; its "critical" altitude at rated power is 1500m above sea level.

2. Specified power values are referred to ISA conditions at sea level /s.l./ i.e. to the temperature t_o=15°C and barometric pressure B_o=1013.2 hPa /760 mmHg/.

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AIRPLANE AGRICULTURAL EQUIPMENT

1. Description of ag. equipment

Ag. equipment may be divided - depending on substances used - into two basic types:

- dusting equipment - used for solid substanses like /dust, granules and the like/;
- spraying equipment - used for liquid chemicals.

The dusting equipment consists of the following main assemblies:

- hopper with loading sleeve ;
- tunnel spreader with closing throat;
- mechanical agitator with a drive /fan/.

The complete spraying equipment contains:

- hopper /the same as that for dusting/ with filling pipe and hydraulic agitator;
- sprayer, Sz7628-215 /pumping unit with fan and brake/;
- under wing distribution pipes;
- sprayer with ejector /Sz7636-0/;
- under fuselage pipes with suction tanks.

Spraying equipment delivered by the Manufacturer may be installed and used in the following three basic versions:

/1/ For spraying with chemicals without sucking the liquid from underwing pipes.
This version is used for spraying liquid with average flow rates per second and while using all kinds of nozzles and valves on the outlets of distributing pipes /booms/.

/2/ For spraying with chemicals with sucking from under wing pipes. This version is used for spraying with small flow rates per second, without using choking valves at the outlets of pipes.

/3/ For spraying with chemicals with large flow rates /without any choking valves/.

Elements of agricultural equipment comprising each of a/m versions are given in Tables on pages 4 and 5.

2. Description of Radio Equipment, Radionavigational Equipment and Other Units for Ag. Version of Airplane

Prior to installing the ag.equipment the following units and elements must be removed from airplane:

- receiver of automatic direction finder /radiocompass/ ARK-9;
- frame antenna ARK-9 together with components serving for its mounting;
- power supply for ADF ARK-9;
- covers of holes for tank throat
- ceiling between frames 6 and 8.

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To adapt airplane to agricultural flights the following must be additionally dismounted:

- curtains in cargo cabin;
- passenger seats /folded/;

7

- airplane anchorage.

Elements of Ag. equipment for spraying
for various versions

Version of spraying / Elements of ag. equipment used	Without suction	With suction at underwing pipes	With the use of injector	Notes
1	2	3	4	5
Chemical tank with covers mounted in holes of loading chute	x	x	x	
Sprayer Sz7628-215	x	x	x	
Sprayer with injector			x	
Hydraulic agitator	x	x		
Connecting pipes with elongated outlet ends	x		x	
Suction tanks and connecting pipes with short ends		x		
Underwing distributing pipe	x	x 1/	x	1/ The pipes are turned outlets upwards and additionally the end pipe is transfered from right wing to the left one and contrariwise.

wsk -342-82 3000 szt. ew. 158-9:81

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1	2	3	4	5
All kinds of nozzles and valves installed on the outletn of underwing pipes	x		x	
Nozzles		x		
Chokes	x		x	
Nozzles with pipe for fine-drop-let spraying	x	x	x	

3. Main Technical Data of Ag. equipment

A. SPREADER

Fan speed /working/	3000 r.p.m.
Fan power	4.4 kW /6 HP/
Gear ratio between fan and shaft of agitator	40:1
Time of gate opening and closing	1÷1.5 s
Maximum flow rate od powder substances	71.6 kg/s
Working swath width	36–40 m
Weight of complete duster	max. 164 kg

B. SPRAYER

Fan speed /working/	3200 r.p.m.
Fan power	5.9 kW /8 HP/
Pressure in sprayer pump	300 kPa /3 kgf/cm²/
Time of opening and closing the valve	1 - 1,5 s
Maximum flow rate of chemicals	18.5 l/s
Working swath width	up to 60 m
Weight of complete sprayer	max. 130 kg
Capacity of suction tanks /for version with ejector suction/	8 l

4. Short Description of Ag. equipment Operation

Dusting equipment is presented in Fig. 1.23.
The functionning of this equipment consists in spreading in flight the powdery chemicals using the tunnel spreader /8/ installed under fuselage and connected with main tank /1/ through the shroud of the closing throat /4/.
The powder substances go under their own weight from the hopper to the closing throat which makes possible the closing of hopper outlet. The diaphgrams of the closing throat, controlled by means of electropneumatic installation from cockpit, enable closing and opening of hopper outlet and the adjustment of flow rate by means of screw governor.
The mechanical agitator /20/, which is in the tank and is driven by a fan /17/, serves for ensuring the uniform pouring of chemical substances from hopper to spreader.
From tunnel spreader the powder substances are spread outside as a result of air stream action during flight.
The spraying equipment in three different versions is presented in Fig. Nos. 1.24; 1.25; 1.26.
The functionning of this equipment consists in spraying in flight the liquid chemicals through distributing pipes installed under lower wing of the airplane.
The liquid from the hopper gets into the pump driven by a fan, wherefrom it 's delivered under pressure to the underwing pipes.
The changeable nozzles in pipes make possible the adjustment of both the required flow rate and the size of droplets.
Additional adjustment of flow rate is realized at the valves installed in the outlets of underwing pipes, from which the rubber glands are to be removed if necessary.

Two kinds of sprayers, both delivered in the set of ag. equipment: the Sz7628-215 sprayer or the sprayer with ejector. Their range of application - refer to Table on pages 4 and 5. While using the sprayer Sz7628-215 the hydraulic agitator connected with pump by flow channel is to be installed in the hopper.

When the pump operates and the switch PPNG-15 set on the left arm of the left control wheel or at the extension of central control desk is switched to position "AGITATING" /MIESZANIE/ the liquid circulates between pump and hopper, due to which its mixing is obtained. When ejector sprayer is used the agitator function is realized by ejector pipe of the pump routed to the lower area of the hopper.

Two suction tanks /12 - in Fig. 1.25/ in the version with Sz7628-215 sprayer and with ejector suction serve for sucking the liquid remaining in underwing pipes after the ag. equipment is switched off. This system functions automatically after switching the PPNG-15 switch on the left arm of the left control wheel or on the extension of control desk, into OFF /WYŁĄCZONE/ position.

5. Electropneumatic System in Agricultural Version

Each airplane built in agricultural version has, besides the main air system as for transport version /1.2/, the additional electropneumatic system for the control of ag. equipment while performing agricultural operations.

This system is presented in Fig. 1.27.

Upon opening the filling valve on left control desk the air pressure is reduced with reduction valve /9/, installed under the floor, to a value of 1.56 /16 kgf/cm^2/ in dusting system and 1.17 MPa /12 kgf/cm^2/, in spraying system and then - after opening tht the cut-off valve /8/ installed on cockpit floor it will fill the the electropneumatic control system of the equipment.

The whole system is ready for controlling the ag equipment after checking whether the ag equipment control switches are in OFF position and whether the WG-15-2s switch on the left side at frame no. 10 is put into position "DUSTING" or "SPRAYING", depending on operation mode and after switching ON the AZS-5 "AG EQUIPMENT" /11/.

The ag equipment is controlled with PPNG-15 switch on the left control wheel or with the switch installed on the extension of central control desk. To switch the ag equipment control to the pilot or the second crew member /the flight engineer/ the switch located on the ag equipment control panel is used. In "LEFT" position the pilot controls the system while in "RIGHT" position the flight engineer controls the system. Depending on the switch position the air is ducted to corresponding cylinders through electropneumatic and reducing valves.

<u>NOTE</u>: While working with powder chemicals the ag equipment control switch must not be left in position "MIXING".

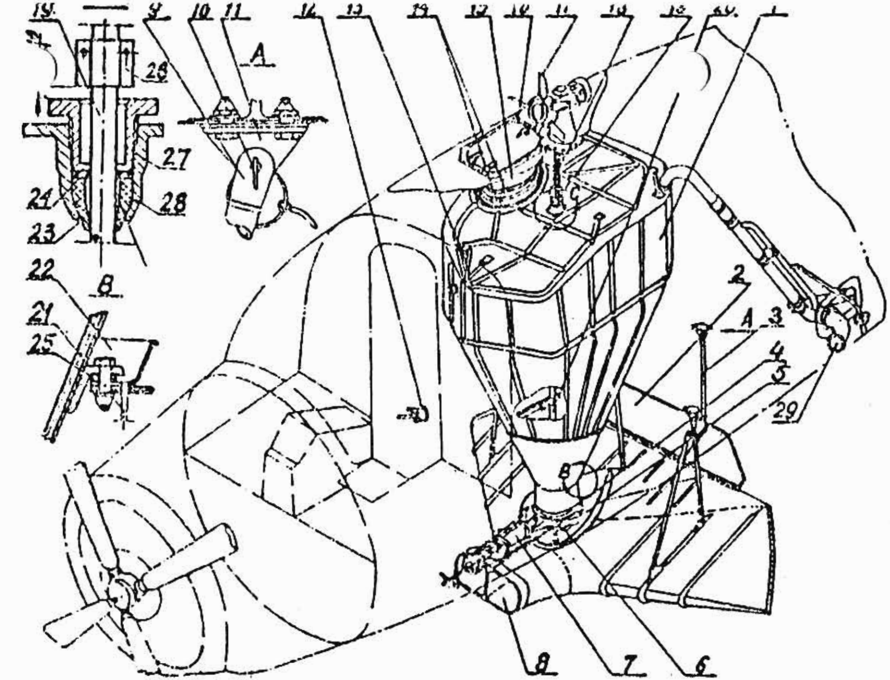

Fig. 1.23. Positioning Dusting Equipment RTSz-1M on Airplane.

1-Tank; 2-Guard; 3-Telescopic angle struts; 4-Lift of closing throat; 5-Closing neck; 6-Lock; 7-Shroud mounting the closing throat; 8-Tunnel spreader RTSz-1M; 9-Angle struts; 10-Locking pin; 11-Bracket; 12-Mirror; 13-Tank mounting angle struts; 14-Worm clamp; 15-Loading sleeve; 16-Lid; 17-Agitator fan; 18-Upper connection shaft; 19-Central connection shaft for agitator; 20-Agitator; 21-Drain pipel; 22-Dish; 23-Gasket; 24-Rubber washer; 25-Washer; 26-Protective shroud; 27-Nut; 28-Body; 29-Air intake.

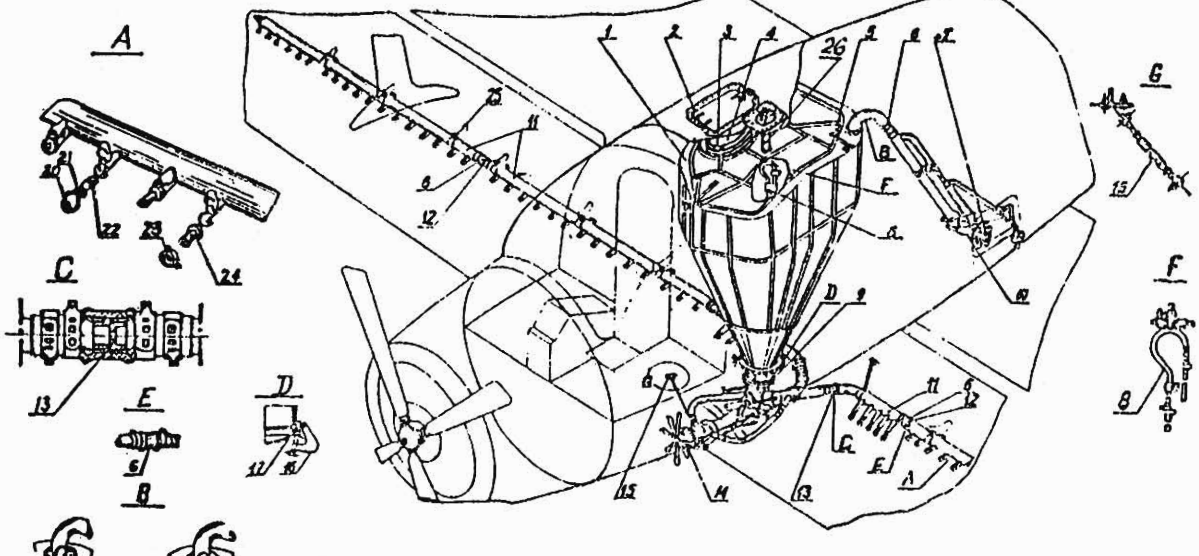

Fig. 1.24. Positioning Spraying Equipment Sz7628-215.

1-Tank; 2-Lid; 3-Worm clamp; 4-Loading sleeve; 5-Tank mounting angle struts; 6-Reinforced-plastic connector; 7-Check valve; 8-Hydraulic agitator; 9-Removable yoke with shrouds; 10-Filling pipe; 11-Subwing pipes; 12-Puller; 13-Gland; 14-Sprayer; 15-Sprayer mounting angle strut; 16-Crimping shround; 17-Rubber separator; 18-Foam extinguishing pipe; 19-End of filling /priming/ pipe; 20-Nozzle; 21-Rubber washer; 22-Shut-off valve; 23-Cap; 24-Valve; 25-Mounting assembly for sub-wing pipe for flap extention arm; 26-Venting pipe.

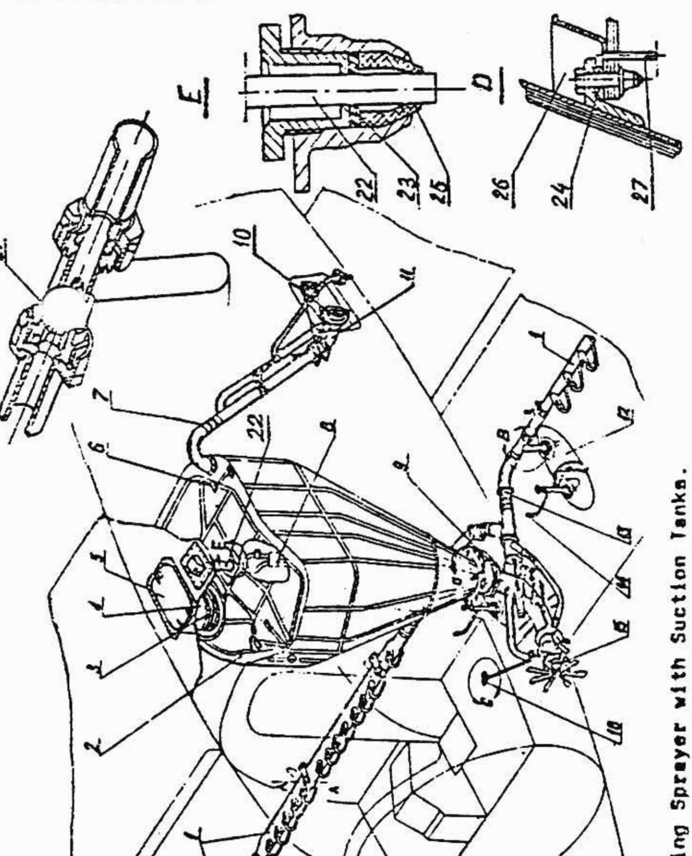

Fig. 1.25. Positioning Sprayer with Suction Tanks.

1-Under-wing pipes; 2-Tank; 3-Worm clamp; 4-Loading sleeve; 45-Lid; 6-Tank attachment angle struts; 7-Reinforced plastic connector; 8-Hydraulic agitator; 9-Removable yoke with shrouds; 10-Check valve; 11-Filling pipe; 12-Suction tank; 13-Gland; 14-Angle strut for mounting the suction tank; 15-Sprayer; 16,17-Sprayer attachment angle strut; 18-Reinforced-plastic connector; 19-Fuller; 20-Reinforced plastic connector; 21-Nozzle; 22-Venting pipe; 23-Washer; 24-Washer; 25-Gasket; 26-Dish; 27-Drain pipe.

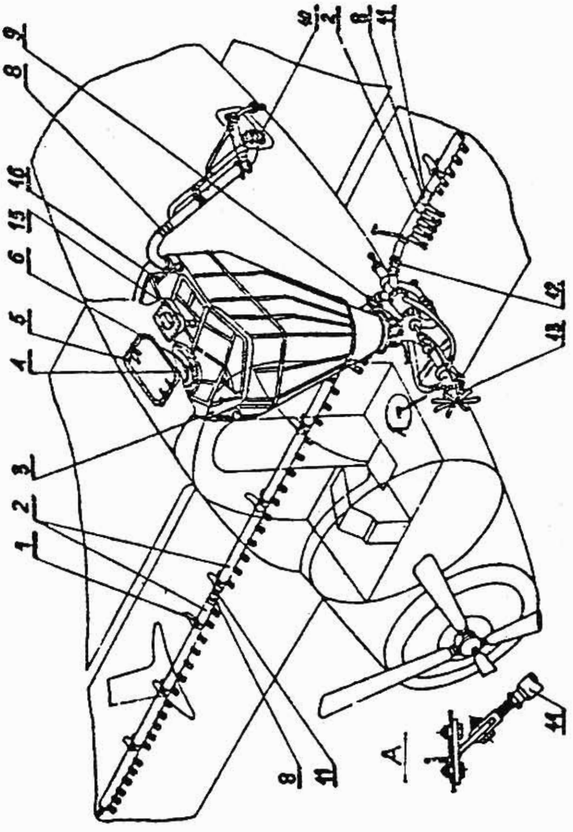

Fig. 1.26. Positioning Sprayer with Injector.

1-Under wing pipe attachment fitting; 2-Underwing booms; 3-Tank; 4-Loading sleeve; 5-Lid; 6-Worm clamp; 7-Hydraulic mixer; 8-Reinforced plastic connector; 9-Removable yoke with shroud; 10-Filler pipe; 11-Puller; 12-Gland; 13-Sprayer with injector; 14-Sprayer attachment angle strut; 15-Venting pipe; 16-Tank attachment angle struts.

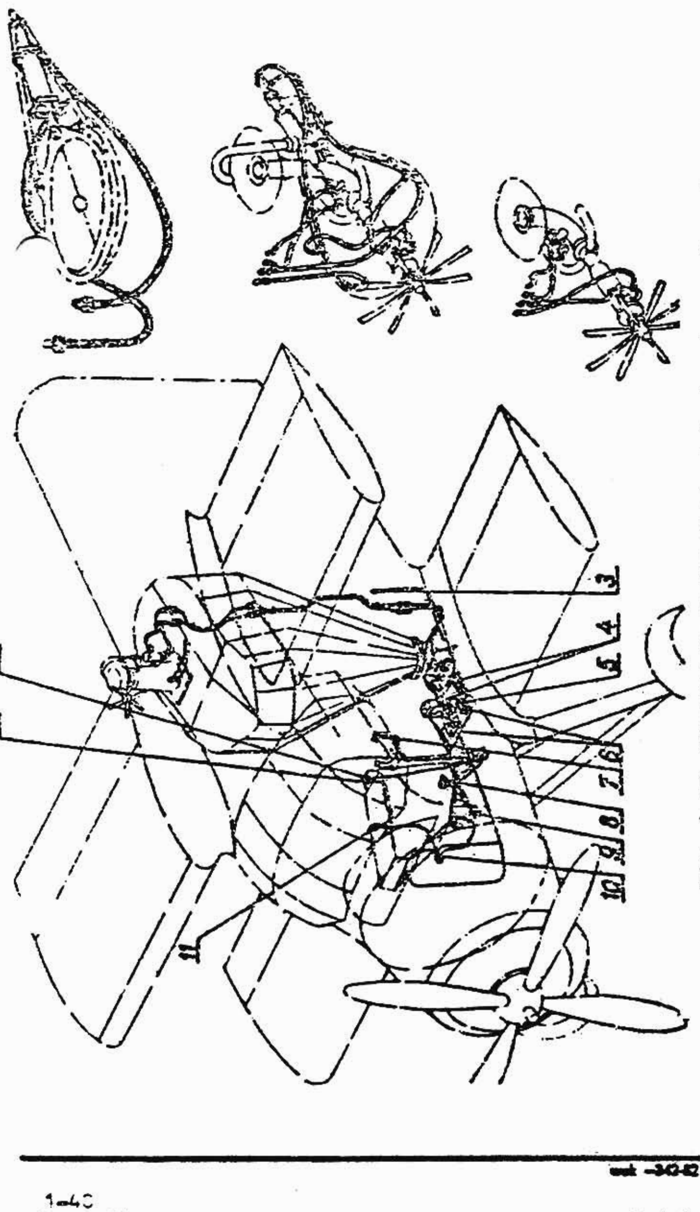

Fig. 1.27. Electropneumatic Control System Ag. equipment

1-PPG-15-2s switch for "Left-Right" control; 2-PPNG-15 Switch; 3-WG-15-2s switch; 4-Reducing valve; 5-Central switch board; 6-Electropneumatic valve; 7-PPNG-15 switch; 8-Shut-off valve; 9-Reducing valve PU-7; 10-Relay, TKE-21PDT; 11-AZS switch.

SECTION 2-00
OPERATING CONDITIONS AND LIMITATIONS

SECTION 2-00

OPERATING CONDITIONS AND LIMITATIONS

OPERATING CONDITIONS AND LIMITATIONS

CONTENTS

SECTION 2

OPERATING CONDITIONS AND LIMITATIONS

1. Airplane Crew

The minimum number of airplane crew are two persons with currently valid authorization for performing aviation operations.
Depending on the kind of flight the airplane crew shall consists of:

- in flights according to VFR rules - two pilots or pilot and navigator or pilot and flight engineer;
- in flights acc.to IFR rules - two pilots or pilot and navigator;
- in agricultural flights - two pilots or pilot and flight engineer.

NOTE: 1. In case the crew consists of three persons the additional member of the crew should take one of the seats in passenger-cargo. cabin.
It is forbidden to seat on safety belts in the cockpit.

2. The agricultural /working/ flights may be carried out with minimum number of crewmen as specified above.

2. Permissible Kinds of Flights

The airplane is admitted to the following flights:

/1/ School flights /with limitation of C.G. to 30% MAC/;
/2/ Training flights.
/3/ In the night /with C.G. limited to 30% MAC/.

/4/ Day-light and night flights with or without the visibility of the ground.

/5/ Flights at low altitudes while observing rules currently in force.

The following are forbidden:

/1/ Acrobatic flights.

/2/ Entering the icing hazard zone.

/3/ Night flights without parachutes.

/4/ Flight without visibility when the centre of gravity is beyond 30% MAC

/5/ Night flights with childern on board.

3. Operational Data

A. Acceptable overloadings.

Coefficient of acceptable overloading:

/a/ for agricultural version /with spreader or sprayer/ + 3.0; -1.0

/b/ for transport or sanitary version + 3.7; -1.0

B. Maximum acceptable altitude of flight:

- with oxygen outfit - not limited;
- the maximum acceptable flight altitude without oxygen outfit is determined by a separate aviation regulation.

C. Acceptable airspeeds V_{pp} /km/h/:

	agricultural version	transport passenger-transport versions
- in storry air	175	190
- with crude control	180	195
- in diving flight at max. speed of 2200 r.p.m.	250	300
- for opening the flaps	150	150
- with flaps opened at 39,5°	130	130
- with flaps opened at 30°	150	150

wsk -342-82 3000 szt. ew. 158-9:81

- minimum acceptable speed in horizontal flight	120	120

D. Accepted Speed of Engine /r.p.m./

- rated	n = 2100
- maximum	n = 2200
- minimum on the ground	n = 500

E. Limitations Due to Wind

/a/ Take off and landing may be carried out at the following wind speeds /m/s/:

	Normal airstrip	Slippery airstrip
- head wind	up to 16.0	up to 8.0
- cross wind 45 deg	up to 7.0	up to 4.0
- cross wind 90 deg	up to 5.0	up to 3.0
- cross wind 90 deg while landing with flaps extended	down to 4.0	down to 3.0

- slippery airstrip - slippery asphalt or concrete tramped show, wet grass,
- normal airstrip - dry asphalt, concrete or grass very wet asphalt or concrete

CAUTION: Asphalt or concrete is to be considered slippery:
- when it starts raining and individual drops are not joined with each other;
- in the morning when there is a slight frost and dew or rime.

When the asphalt or concrete is coated with a layer of dust, which absorbs rainwater to from a layer of mud.

/b/ Taxying

It is permissible to taxy at wind of up to 16 m/s when airstrip is normal or up to 8 m/s when airstrip is slippery - indendently of he direction of wind.

F. Bank limitations.

Airplane may be banked within following limits:

a/ Up to 15° at a speed of V= 130 km/h in directional slide.
b/ Up to 45° - in turn.

G. Antifire Limitations.

It is forbidden to carry out fire-promoting operations in cockpit or passenger cabin.
Smoking is forbidden, as it is clearly stated by means of the inscription on frame 5 on the right side.

H. Other Limitations.

/1/ It is forbidden to carry out agricultural operations without visibility.

/2/ It is forbidden to use toilet during take-off, climbing, and landing.

/3/ Maximum acceptable time of continous operation at take-off power range is 5 minutes.

/4/ Maximum acceptable time of continous operation at rated power is 1 hour.

I. Maximum weights:

- maximum take-off weight	5500 kg
- maximum landing weight	5250 kg
- emergency landing weight	5500 kg

(21)

4. Marking of range of airspeed indicator and engine control system devices /engine instruments/.

Measuring range of airspeed indicator.

The speed which shall not be exceded /descent, diving in quiet air/ — red dash - 300 km/h

Safety range — yellow arc 225 - 300 km/h

Normal operating range

green arc 100-225 km/h

Range of operation with flaps

white arc 100-130 km/h

8. Engine instrument indication range

Engine instruments	Red radial	Yellow arc	Green arc	Yellow arc	Red radial
	MINIMUM	PRECAUTIONARY range	NORMAL	PRECAUTIONARY range	MAXIMUM
RPM indicator	558	-	550-2100	2100-2200	2200
Manifold pressure gauge hPa /mm Hg/	-	-	706-1200 /530-900/	1200-1435 /900-1075/	1435 /1075/
Cylinder head temp. indicator /°C/	120	120-150	150-215	215-245	245
Engine unit gauge: - oil temp. °C	50	50-60	60-75	75-85	85
- oil pressure kPa /kG/cm²/	148 /1,5/	148-390 /1,5-4/	390-490 /4-5/	490-686 /5-7/	686 /7/
- fuel pressure kPa /kG/cm²/	14,8 /0,15/	14,8-24,5 /0,15-0,25/	24,5-34,5 /0,25-0,35/	-	34,3 /0,35/

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SECTION 3–00
AIRPLANE PERFORMANCE

SECTION 3-00

AIRPLANE PERFORMANCE

wsk –342-82 3000 szt. ew. 158-9:81

AIRPLANE PERFORMANCE

CONTENTS

SECTION 3

AIRPLANE PERFORMANCE

/Take-off weight of Q=5250 kgs/

The performance cited below applies to the transport version except for items 1b and 1e which apply to all versions. The effects of installing the agricultural equipment on the airplane performance are discussed in section 4-40.

1. Airplane Speed

/a/ Maximum airspeed:

- at the altitude of H=0	$V=234_{-15}$ km/h
- at calculated altitude	$V=253_{-15}$ km/h

/b/ Minimum level flight airspeed $V_{pp}=120$ km/h

/c/ Cruising speed.
Cruising speed at the pressure of P_k=975.5 hPa /720 mmHg/ speed n=1700 r.p.m, and altitude H=800 m — 190 km/h

/d/ Rate of climb near the ground $3_{-0.3}$ m/s
for agricultural version:

- with sprayer	2.0 m/s
- with spreader RTSz-1M	$1.9_{-0.2}$ m/s

/e/ Touch-down speed $V=85^{+5}$ km/h

2. Climbing Time

Climbing Time at altitudes of:

H=500 m	$2.7^{+0.3}$ minutes
H=1000 m	$5.4^{+0.6}$ minutes
H=2000 m	$11^{+1.5}$ minutes

3. Take-off Run Distance at Q=5250 kgs.

/a/ From concrete airstrip with the airplane held with brakes:

- at take-off power and with flaps lowered to 30 deg. — 180 m
- at rated power and with flaps lowered to 30 deg. — 200 m

/b/ From grassy airstrip with airplane held with brakes:

- at take-off power and with flaps lowered to 30 deg. — 200 m
- at rated power and with flaps lowered to 30 deg. — 220 m

4. Landing Run Distance

/a/ on concrete airstrip, flaps lowered to 39.5 deg and brakes used — 225 m

/b/ on grassy airstrip, flaps lowered to 39.5 deg and brakes used — 210 m

5. Range

Airplane range in flight at an altitude of H=1000 m, with take-off weight of Q=5250 kgs with fuel of 1200 litres at the speed of n=1510 r.p.m. and pressure of P_k=893 hPa /670 mmHg/ in horizontal flight is 1390 km.

6. Ceiling

The airplane ceiling at the weight of Q=5250 kg is 4400_{-250} m.

SECTION 4–00
NORMAL PROCEDURES

NORMAL PROCEDURES

CONTENTS

wzk -342-82 3000 szt. ow. 158-9:81

SECTION 4

AIRPLANE OPERATION

Performance data contained in para 1 of this section concern the transport version. Correction of these data for ag.version of the plane /cruise speeds, take-off and landing run distances/ are to be obtained on the grounds of guidelines in section 4-40.

1. Preparing for Flight

Preparing for flight should ensure safe and economic performing of each flight.

The basic elements in preparing for flight are as follows:

/1/ Determining most favourable flight conditions, the required amount of fuel and airplane center of gravity range while making the flight schedule.

/2/ Filling the airplane with fuel and with lubricating oil as it results from calculations for a given flight schedule.
The actual filling of airlane with gasoline and oil is checked during the preparing for flight /through filling necks/ by a crewman appointed by the airplane commander.

/3/ Arrangement of cargo must be in accordance with calculation of airplane balancing.

Determining Most Favourable Flight Conditions:

This task consists of the following:

- determining most favourable flight altitude;
- determining engine operation conditions in a flight at the selected altitude;
- determining the neccessary amount of fuel.

A. Determining Most Favourable Flight Altitude.

In widless weather or when wind is uniform at all altitudes the following altitudes are the most favourable/depending on route length without landing/:

e.g.: at route length of 300 km - altitude of 1000 m
at route length of 600 km -- altitude of 2000 m

The a/m most favourable altitudes may serve only for general guidance when selecting the altitude.
When information on winds at different altitudes is available the most favourable flight altitude is to be determined on the basis of calculations.
At the same engine power rating and hourly fuel consumption the actual speed of the plane is higher at altitude than it is on the ground.
The increase in speed is achieved due to reduction of air resistance. For An-2 airplanes the increase of speed in cruising conditions is on average 5 km/h for each 1000 m of the altitude.
Table 1 presents the procedure of calculating the most favourable altitude.
The letters ΔV /para 6/ in the calculation procedure denote the airspeed increase due to reduction in air resistance for the engine cruising power constant for all altitudes.
The direction and speed of the wind in the calculation procedure /paras 2 and 3/ are to be entered from meteorological news communicated to the pilot before flight by meteorological service.

wsk -342-82 3000 szt. ew. 158-9.81

Procedure for Calculation of the Most Favourable Altitude at the True Track Angle /RzKD-260°/.

Table 1

1.	Altitude, m	500	1000	1500	2000	3000
2.	Wind direction /meteorological - wherefrom it comes/ deg.	70	60	50	30	360
3.	Wind speed /km/h/	10	20	30	30	40
4.	Meteorological wind angle, deg.	170	160	150	130	100
5.	Difference between ground and true airspeeds due to wind /Δ V/km/h/	+10	+19	+26	+18	+2
6.	Increase in speed depending on altitude /Δ V/km/h/	2	5	7.5	10	15
7.	Total increase in flight speed due to altitude and wind /W-V + Δ V/km/h/	12	24	33,5	28	17

The wind direction is to be specified from meteorological news i.e. where it comes from while the wind speed is specified in kilometers per hour.

The values of /A-V/ depending on wind angle are specified in Table 2.

These values may as well be determined for various altitudes using any navigational slide-rule enabling the determination of the ground speed or directly the difference between the ground speed and airspeed.

While using navigational slide-rule the airspeed vector is to be taken according to altitude warying it by 5 km/h for each 1000 m.

Determining Wind Effectiveness /A-V/

The top horizontal line of Table 2 specifies the wind speed while the left vertical column- the meteorological wind angle. The wind angle is the angle between travel line and wind direction. To avoid errors in determining the wind direction it is recommended to use the wind rose presented in Fig. 4.1.
In this Fig. the wind has a meteorological direction /where from it blows/ of 40 deg, while the flight direction /where it blows to/ is 260 deg. Thus the angle between these two directions is the meteorological angle of the wind.
With the use of Fig. 4.1. the wind angle is to be determined always acc. to the same principle as an angle between directions of wind and flight.
While doing that, the angle to be taken is that smaller than 180 deg because the table is juxtaposed for wind angles from 0 deg to 180 deg, and for angle greater than 180 deg the /A-V/ values are repeated.
Most favourable flight altitude, after calculating according to presented procedure, is to be determined in the terms of maximum cumulative increment /or minimum cumulative/ of speed /item 7 in procedure of calculating in table 1/.
The cumulative increment is achieved by adding appropriate values from lines 5 and 6.

wsk -342-82 3000 szt. ew. 158-9.81

Determining A-V on the Basis of Wind Angle for Airplane with Flight Speeds 150 - 220 km/h

Table 2

Meteo. angle of wind	Wind speed km/h													
	5	10	15	20	25	30	35	40	45	50	60	70	80	
0°	5	10	15	20	25	30	35	40	45	50	60	70	80	
5°	5	10	15	20	25	30	34	39	44	49	59	69	79	
10°	5	10	15	20	25	29	34	39	44	49	59	69	79	
15°	5	10	15	19	24	29	34	38	43	48	58	68	78	
20°	5	9	14	19	24	29	33	38	43	48	58	67	77	
25°	5	9	14	18	23	28	32	37	42	47	56	66	76	
30°	4	9	13	17	22	27	31	36	40	45	54	64	74	
35°	4	8	12	16	21	26	30	34	39	43	52	62	71	
40°	4	8	12	15	20	24	28	32	37	41	50	59	69	
45°	3	7	11	15	19	22	26	30	35	39	47	56	66	Head wind /-/
50°	3	6	10	13	17	20	24	29	33	36	44	53	62	
55°	3	6	9	12	16.	19	22	25	30	33	41	49	58	
60°	2	5	8	11	14	17	20	23	27	30	37	45	54	
65°	2	4	7	9	12	15	18	21	25	27	33	41	40	
70°	2	3	6	8	10	13	16	19	21	23	29	36	44	
75°	1	3	5	[illegible]	8	10	13	15	16	20	25	31	38	
80°	1	2	3	4	6	8	10	12	14	16	20	26	[illegible]	
85°	1	1	2	3	4	[illegible]	7	8	10	12	15	20	[illegible]	
90°	0	0	1	1	2	3	4	4	[illegible]	7	10	14	15	
						0	1	1	2	3	5	[illegible]	11	
												2	4	
95°	0	1	1	1	0									
100°	1	2	2	2	2	3	2	2	2	2	[illegible]			
105°	1	2	3	4	4	5	5	[illegible]	[illegible]	[illegible]	[illegible]	5	[illegible]	
110°	2	3	5	6	[illegible]	8	[illegible]	9	10	10	11	14	[illegible]	
115°	[illegible]	4	5	7	9	10	12	13	14	15	17	18	[illegible]	
120°	[illegible]	[illegible]	7	9	11	13	15	[illegible]	19	20	22	24	26	
125°	3	[illegible]	6	10	13	15	[illegible]	19	[illegible]	24	[illegible]	30	33	
130°	3	[illegible]	9	12	15	19	21	23	25	[illegible]	32	[illegible]	[illegible]	
135°	[illegible]	[illegible]	10	13	[illegible]	20	24	[illegible]	[illegible]	[illegible]	[illegible]	42	[illegible]	
140°	4	8	11	15	19	22	26	[illegible]	32	[illegible]	42	[illegible]	[illegible]	
145°	4	[illegible]	12	15	[illegible]	20	[illegible]	[illegible]	35	[illegible]	[illegible]	[illegible]	60	
150°	4	[illegible]	13	[illegible]	21	25	[illegible]	33	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Tail wind /+/
155°	4	[illegible]	13	18	[illegible]	[illegible]	[illegible]	35	39	[illegible]	[illegible]	[illegible]	60	
160°	5	10	[illegible]	19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
165°	5	10	[illegible]	19	24	[illegible]	[illegible]	38	42	[illegible]	[illegible]	[illegible]	[illegible]	
170°	5	[illegible]	15	19	24	29	34	39	43	48	[illegible]	[illegible]	[illegible]	
175°	5	[illegible]	15	20	[illegible]	[illegible]	34	39	[illegible]	49	59	[illegible]	79	
180°	5	10	15	20	25	30	35	40	45	50	60	70	80	

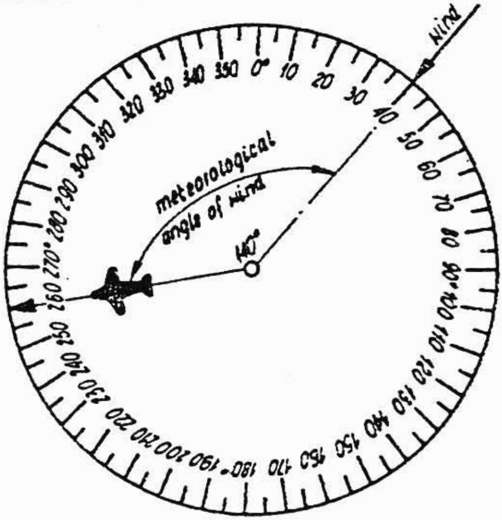


Fig. 4.1. Wind Rose

In the example shown in Table 1 the most favourable altitude obtained is 1500 m. At this altitude the wind increases the airplane speed by 26 km/h, while due to reduction in air resistance the speed rises by 7.5 km/h. At the remaining altitudes the cumulative increment of speed will be smaller than that at the altitude of 1500 ..

Determining Engine Operating Conditions

Range of cruising speeds for An-2 airplane in horizontal flight is from 145 to 225 km/h according to the airspeed indicator.

wak -342-82 3000 szt. ow. 158-9-81

Engine operating conditions ensuring mentioned speeds are within the following limits:

engine power between 40 and 70% of rated power /max. continous/

engine speed from 1500 to 1800 r.p.m.;

manifold pressure from 706.5 to 1013 hPa /530 and 760 mmHg/;

fuel consumption from 117 to 220 l/h.

In the mentioned horizontal flight speed range there are several characteristic conditions:

1. Conditions for Longest Flight. It corresponds to calibrated airspeed of 145 km/h.
   In these conditions the hourly fuel consumption is the minimum. For engine operating at 1500 r.p.m. for such an airspeed, depending on altitude and airplane weight in flight the manifold pressure is to be determined from 706.5 to 800 hPa /530 and 600 mmHg/.
   Fuel consumption at such conditions of engine operation /also depending on altitude and airplane weight in flight/ is between 110 and 150 l/h.
   The lower flight altitude the smaller hourly fuel consumption at constant indicated speed. Therefore the longest flight with a definite reserve of fuel may be achieved at low altitudes.

2. Condition of Largest Flight Range. At this condition the fuel consumption per kilometer is the smallest.
   It correcponds to indicated speeds from 147 to 175 km/h and depends only on airplane weight in flight: for the weight of 5250 kg the indicated speed is 175 km/h, while for the weight of 4000 kg - 147 km/h.
   When engine operates at 1500 r.p.m, these speeds require keeping the manifold pressure from 706.5 to 900 hPa /530 and 675 mmHg/ and fuel consumption is then about 0.83 liters/km.

At the above mentioned /indicated/ speeds the fuel consumption per kilometer is almost identical at all altitudes and therefore the flight range with a certain fuel reserve is practically the same at all altitudes. The greatest range condition is to be used in flights when time is not critical and the economic fuel consumption is of paramount importance.

3. Condition of Maximum Cruising Power

The maximum cruising power which may be used in long ferry flights corresponds to 70% of the max. continuous power of ASz-62IR engine.
The cruising speed in horizontal flight at this engine operating conditions is the highest. The indicated speed varies with the altitude and weight of the airplane in flight from 200 to 225 km/h while the true airspeed varies from 210 to 240 km/h.
The power equal to 70% of the rated power is obtainable when ASz-62IR engine operates at 1800 r.p.m. with manifold pressures from 919.8 to 1013 hPa /690-760 mmHg/.
The manifold pressure of 919.8 hPa /690 mmHg corresponds to flights at an altitude of 3000 m while that of 1013 hPa /760 mmHg/ - to flights just above the ground.
The fuel consumption is then 220 litres/h while the consumption per kilometer is within 0.92 and 1.04 l/km.
The maximum cruising power is permitted to be used in the cases when high speed is required during long duration flight.
In chartered flights acc. to flight schedule any conditions may be used - from maximum range condition to maximum cruising power condition.

wsk -342-82 3000 szt. zw. 158-9.81

All acceptable cruising flight conditions are specified in Table 3 "Cruising conditions for horizontal flight on An-2 airplane". The table ~~specifies~~ for each airspeed the most favourable engine r.p.m. as well as the values of manifold pressure depending on weight in flight and altitude. The selection of this or other mode of operation depends on time of planned flight.

For instance if the planned time involves the ground speed of 180 km/h, the flight takes place with head wind of 20 km/h, then the table should be used to find a condition corresponding to true airspeed of 200 km/h.

When the weight in flight is equal to 4500 kg and the altitude is 1000 m the most favourable engine operating condition, ensuring airspeed corresponding to 200 km/h, will be as follows:

$n=1540$ r.p.m.;
$p_k=906.5$ hPa /680 mmHg/

The calibrated airspeed achieved is 192 km/s while fuel consumption is 167 l/h.

Table 3 juxtaposes altogether 86 horizontal flight conditions for four weights in flight and for five altitudes. The altitudes in the table are specified at standard temperature /i.e. on condition that air temperature near the ground is +15°C and decreases by 6.5 deg each 1000 m of altitude rise/.

If the actual temperature differs from standard one by more than 10 deg then the true airspeed determined from appropriate table will not correspond to the a/c engine operating condition.

More precisely, the most favourable flight conditions may be determined from the diagram of cruising conditions.

This diagram may also be used to take into account the worsening of aerodynamic characteristics of a given airplane and to introduce appropriate correction because the table is made for the data of master airplane.

Diagram of Cruising Conditions

The basic aim of the diagram is to determine the most favourable engine operating conditions and those of fuel consumption for horizontal flight at any cruising speed, any flight altitude and at all acceptable airplane weights in flight.

Description of Cruising Conditions Diagram

In the upper part of the diagram there is an altitude scale according to altimeter $/H_{750}/$. In the lower part there is an indicated-speed scale without instrument or aerodynamic corrections. The speed calculated according to such ideal /indicator/ instrument is called the equivalent speed and the scale of indicated speed is marked by V_o.

Above it there is a scale of calibrated airspeed.

It is marked by V_{pp}.

The difference between scales V_o and V_{pp} gives the aerodynamic correction of the flight speed indicator.

The instrument correction of the flight speed indicator is to be taken for each individual unit. In the left part of the diagram there is an altitude scale acc. to international standard atmosphere /IAS/, marked by a letter H_Δ.

In the centre of the diagram there are 12 inclined lines for the temperature of outside air from +50°C to -50°C. The middle of this lines, signifying 0°C, is marked by a more thick line for convenient temperature reading.

BASIC SPEEDS OF HORIZONTAL FLIGHT FOR An-2 AIRPLANE

Table No.3

Take-off weight / kg /	Conditions of smallest fuel consumption per km: n, r.p.m.	P_k hPa /mmHg column/	V_{pp} km/h	V_{cruise} km/h	q l/h	q l/km	Altitude at standard temperature, m	TRUE flight speed 160 km/h: n, r.p.m.	160 km/h: P_k hPa /mmHg column/	160 km/h: V_{pp} km/h	160 km/h: q l/h	190 km/h: n, r.p.m.	190 km/h: P_k hPa /mmHg column/	190 km/h: V_{pp} km/h	190 km/h: q l/h	200 km/h: n, r.p.m.	200 km/h: P_k hPa /mmHg column/	200 km/h: V_{pp} km/h	200 km/h: q l/h	210 km/h: n, r.p.m.	210 km/h: P_k hPa /mmHg column/	210 km/h: V_{pp} km/h	210 km/h: q l/h	Altitude at standard temperature, m	Maximum cruising power 70% of rated power: n, r.p.m.	P_k hPa /mmHg column/	V_{pp} km/h	V_{cruise} km/h	q l/h	q l/km
5250	1500	900 /675/	175	176	153	0,87	At the ground	1510	919,8 /690/	179	157	1575	955 /715/	191	174	1665	986,5 /740/	202	191	-	-	-	-	At the ground	1800	1015 /760/	212	210	220	1,05
	1500	893 /670/	175	180	155	0,86	500	1500	886,5 /665/	175	155	1550	840 /709/	186	170	1650	957,5 /720/	196	185	1750	993 /745/	207	210	500	1800	1000 /750/	211	214	220	1,03
	1510	880 /660/	175	184	158	0,86	1000	-	-	-	-	1540	906 /680/	181	167	1635	946,5 /710/	192	183	1710	966,5 /725/	202	202	1000	1800	986,5 /740/	210	218	220	1,01
	1535	866,5 /650/	175	193	166	0,86	2000	-	-	-	-	-	-	-	-	1590	893 /670/	183	176	1675	926,5 /695/	192	198	2000	1800	957,5 /720/	204	223	220	0,99
	1575	853 /640/	175	203	174	0,86	3000	-	-	-	-	-	-	-	-	1555	848,5 /635/	172	172	1640	873 /655/	181	183	3000	1800	920 /690/	198	227	220	0,97
5000	1500	886,5 /650/	170	171	147	0,86	At the ground	1500	900 /675/	179	153	1510	946,5 /710/	191	167	1660	980 /735/	202	187	1780	1006 /755/	212	216	At the ground	1800	1015 /760/	214	212	220	1,04
	1500	860 /645/	170	175	149	0,85	500	1500	873 /655/	175	152	1535	926 /695/	186	164	1620	953 /715/	196	180	1710	980 /735/	207	205	500	1800	1000 /750/	212	213	220	1,02
	1500	835 /640/	170	179	151	0,84	1000	1500	860 /645/	171	152	1520	893 /670/	181	161	1600	940 /705/	192	177	1690	957,5 /720/	202	197	1000	1800	986,5 /740/	210	218	220	1,02
	1505	840 /630/	170	187	157	0,84	2000	-	-	-	-	1510	846,5 /835/	172	150	1550	890 /660/	182	170	1610	920 /690/	192	187	2000	1800	957,5 /720/	206	225	220	0,98
	1530	835 /625/	170	197	164	0,83	3000	-	-	-	-	-	-	-	-	1535	840 /630/	172	166	1600	860 /645/	181	177	3000	1800	920 /690/	201	231	220	0,95
4500	1500	780 /585/	159	160	134	0,84	At the ground	1500	856,5 /650/	179	146	1510	926 /695/	191	159	1600	957,5 /720/	202	177	1710	1000 /750/	212	202	At the ground	1800	1015 /760/	218	215	220	1,00
	1500	773 /580/	159	164	136	0,83	500	1500	840 /630/	175	145	1500	886,5 /665/	186	155	1555	940 /705/	196	171	1675	965,5 /725/	207	192	500	1800	1000 /750/	217	219	220	1,00
	1500	776 /575/	159	168	138	0,82	1000	1500	813 /610/	171	144	1500	860 /645/	181	153	1540	906,5 /680/	192	167	1650	846,5 /710/	202	185	1000	1800	983,5 /740/	214	222	220	0,99
	1500	766 /575/	159	177	143	0,81	2000	1500	780 /585/	162	144	1500	813 /610/	172	150	1515	853 /640/	182	160	1595	893 /670/	172	175	2000	1800	957,5 /720/	211	230	220	0,96
	1500	766 /575/	159	185	148	0,80	3000	-	-	-	-	1500	795,5 /590/	163	150	1500	813 /610/	172	155	1510	820 /615/	181	157	3000	1800	920 /690/	206	236	220	0,93
4000	1500	713 /535/	147	149	120	0,81	At the ground	1500	820 /615/	179	141	1500	886,5 /665/	191	151	1540	946,5 /710/	202	167	1665	980 /735/	212	189	At the ground	1800	1015 /760/	223	219	220	1,00
	1500	713 /535/	147	152	123	0,81	500	1500	800 /600/	175	141	1500	860 /645/	186	149	1520	915 /685/	196	161	1630	953 /715/	207	182	500	1800	1000 /750/	221	223	220	0,99
	1500	706,5 /530/	147	156	126	0,81	1000	1500	780 /585/	171	140	1500	825,5 /620/	181	147	1510	880 /660/	192	158	1595	933 /700/	202	176	1000	1800	986,5 /740/	219	227	220	0,97
	1500	706,5 /530/	147	164	133	0,81	2000	1500	740 /555/	162	140	1500	780 /585/	172	144	1500	820 /615/	182	152	1535	856,5 /650/	192	165	2000	1800	957,5 /720/	215	234	220	0,94
	1500	706,5 /530/	147	172	137	0,80	3000	1500	720 /540/	154	140	1500	746,5 /560/	165	144	1500	786,5 /590/	172	150	1505	820 /615/	181	157	3000	1800	920 /690/	210	240	220	0,92

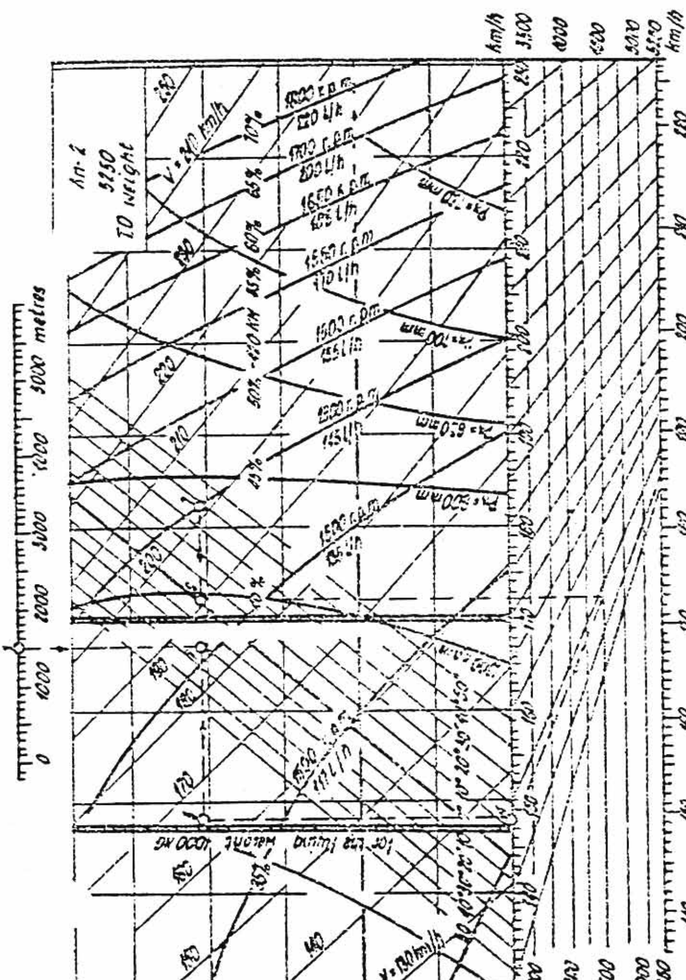


Fig. 4.2. Diagram of Flight Cruising Conditions

The mutual arrangement of temperature lines and altitude scales is calculated so that the crossing of any altitude acc. to indicator /altimeter//pressure/ and of one of temperature lines determines the altitude acc. to air density i.e. acc. international standard atmosphere.
Thin curve lines designated by speeds from 130 to 250 km/h are for true speed. For each altitude and each temperature of outside air a different ratio is obtained between the calibrated airspeed /on scale V_{pp}/ and the true airspeed. Engine characteristics are plotted on the diagram set with designations. Thick lines present engine power as a percentage of rated power. On each line the engine speed is given and appropriate hourly fuel consumption. The range of cruise powers inscribed in the diagram is between 35 and 70% of rated power while the hourly fuel consumption is from 117- to 220. l/h.
Engine cruising speed /r.p.m./ is marked from 1500 to 1800 r.p.m.
In correspondence to engine power and speed /r.p.m./ six curve lines are plotted to represent manifold pressure within the limits from 666.5 to 999.7 hPa /500 to 750 mmHg/.
Two shaded narrow bands marked by letters $P_{max.}$ limit the speeds of horizontal flight corresponding to minimum fuel consumption per kilometer.
The left of these bands concerns the weight in flight of 4000 kgs the right one - 5000 kgs. Other weights in flight may be infered by interpolation or extropolation. For the weight of 5250 kgs this band will be shifted to the right by 5.75 of the division.
In the lower part of the diagrm of cruising conditions there is an additional diagram ,plotted, which takes into account the necessary changes in engine operating conditions, depending on weight in flight.

Example of Using Cruising Conditions' Diagram

Task 1

The orders say the flight time is to be kept exactly to schedule. Take-off at 1000 hours and landing at 1300 hours. Flying time according to plan - 3 hrs. The distance between airports is 550 km. The actual angle of airway is 260 deg, the wind forecast at various altitudes is such as stated in the procedure for calculating the most favourable flight altitude /Table 1/.
The flight altitude on agreeing with the dispatcher is being chosen as 1500 m acc. to to most favourable altitude.
The condition for the exercise is that the average speed from take-off to landing is:

550 km : 3 hours = 183 km/h

To determine the necessary cruising speed in horizontal flight the time loss for monoeuvering around airports after take-off and before landing /4 minutes/ and additional time loss for corning to right altitude /2 minutes for each 1000 m/ must be taken into account.
The total time loss being 4+3 = 7 minutes the grount speed in horizontal flight must be as follows:

550 : 2 hours 53 minutes = 191 km/h

As a chosen altitude, acc. to calculation from table 1 the wind component /W-V/ appears to be tail type and amounts to 26 km/h.
The time airspeed in turn should be:

191 - 26 = 165 km/h

The indicated speed, engine operating conditions and fuel consumption is determined acc. to cruising conditions diagram for true airspeed of 165 km/h and weight in flight at the begining of flight equal to 4500 kgs.

wzk -342-82 3000 szt. zw. 158-9:81

The air temperature at the altitude of 1500 m is to be calculated acc. to temperature gradient when we know the temperature on the ground, or it is to be determined directly in flight. For instance let's take a temperature of +20°C.
Solution for this instance /see Fig.4.2/. From scale division corresponding to indicated altitude of 1500 m /item 1/ a vertical line is to be plotted downwards to cross the outside-air temperature line of +20°C /point 2/, at this level the altitude is to be read acc. to air density which is 2050 m.
Then the obtained point is to be transfered horizontally to the left to cross the line of true airspeed of 165 km/h /point 3/.
Then the obtained point is to be transfered horizontally to the left to cross the line of true airspeed of 165 km/h /point 3/.
Then again the vertical line is to be plotted downwards to the calibrated airspeed scale /point 4/ where we read

$$V_{pp} = 148 \text{ km/h}$$

Now the engine operating conditions may be determined. For this a line is to be drawn from a point corresponding to the calibrated airspeed of 148 km/h /item 4/ parallel to inclined lines to cross the line representing the weight in flight of 4500 kgs /item 5/.
Then the obtained point is to be transfered vertically upwards to a level which shows the altitude acc. to air density of 2050 m /point 6/.
In the obtained point we read:
- required engine power equal to 42% of the rated power, speed - 1500 r.p.m. manifold pressure - 733.2 hPa /550 mmHg/ and fuel consumption of 139 l/h.

Task 2

The conditions of minimum fuel consumption are given per kilometer in a flight at an altitude of 1200 m with weight in flight of 500 kgs.and at outside air temperature of +10°C.

To be found are the engine speed and its operating conditions in which fuel consumption per kilometer will be the minimum.

Solution.

Vertical line is to be plotted downwards from the point representing the altitude of 1200 m /acc. to H-760 scale/ to cross the +10°C temperature line.
Then the point obtained is to be transfered horizontally to the right to the line of $R_{max.}$ for the weight of 5000 kg where we can read the true airspeed of 182 km/h and then vertically downwards to the V_{pp} scale, on which the calibrated airspeed of 170 km/h can be read.
In order to determine the engine operating conditions for the found speed with the smallest fuel consumption per kilometer, the point of indicated speed of 170 km/h must be transfered towards the inclined lines to a level of weight in flight of 5000 kg and then vertically upwards to the level of H_{Δ} altitude where the line of indicated altitude crosses the line of outside air temperature.
In the obtained point, the power of 49% of rated power, fuel consumption of 153 l/h and engine speed of 1500 r.p.m., and manifold pressure of 846 hPa /635 mmHg/ may be read.

Task 3

Engine power is given. While checking airplane performance, when it is demanded to determine whether airplane speed has not been reduced due to long-term operation and repeated overhauls, the cruising conditions diagram may be used. For this purpose the specified mode of engine operation must be established /one of the modes specified in the diagram/ the speed of horizontal flight measured in those conditions. If speed differs from the speed read from the diagram by no more than 3% it is to be considered as not deviating from the standard.

Example:

Airplane speed is to be determined with the weight in flight of 4000 kg at an altitude of 1000 m and outside-air temperature of $-10^{\circ}C$ as well as with engine power equal to 60% of rated power.

Solution:

Plot a vertical line from scale division H=760 representing the altitude of 1000 to cross the outside-air temperature of $-10^{\circ}C$.
Then the obtained point is to be transfered horizontally to the right to the 60% power line.
In the point obtained we read the engine operating conditions.

n = 1650 r.p.m.
P_k= 966.5 hPa /725 mmHg/

Then the obtained point is to be transfered vertically downwards to the line of weight of 4000 kg and from it parallel upwards to inclined lines to V_{pp} scale where we can read:
calibrated airspeed - 209 km/h.
For the precise check of airplane data in flight the speed indicator corrections and those of manifold pressure indicator must necessarily be taken into account, while the flight itself must take place in quiet atmosphere.

Utilizing Cruising Conditions Diagram for Airplanes with Deteriorated Aerodynamic Characteristics.

As a result of long-term operation the aerodynamic characteristics of the airplane may undergo considerable /perceptible/ deterioration.
In such airplanes the flight speed at a definite engine power is smaller than that determined from cruising conditions diagram. While using cruising conditions diagram /see Fig. 4.2/ to determine the parameters in flight for the airplane with deteriorated aerodynamics one must know exactly by how much airplane speed has been reduced.

To determine this, the indicated speed must be measured exactly in one of the flights at any cruising power of those specified in the diagram.
Then the measured speed is to be compared with that obtained from determining the speed according to cruising conditions diagram for the same engine operating conditions with the same weight and at the same altitude and temperature.
While measuring the speed, take into account the indicator corrections of engine speed indicator, manifold pressure indicator and that of airspeed indicator. The difference between actually measured calibrated airspeed and the calibrated airspeed read from the diagram gives the speed correction for a given airplane.
To determine engine operating conditions for obtaining required flight speed with this airplane, one operation must be added to the procedure of solving tasks acc. to diagram i.e. point 6 /see Fig. 4.2 in Task 1/ is to be transfered ~~to~~ the right by a value of speed correction and engine operating conditions is to be read there.
If, for instance, it is known that the flight speeds of any airplane are smaller by 10 km/h the task 1 shall be solved by transfering point 6 to the right by 10 km/h /point 7/.
We shall find that to keep the true air speed at 165 km/h we require: power equal to 45% of rated power, engine speed of 1500 r.p.m. and manifold pressure of 786.5 hPa /590 mmHg/.
The fuel consumption will then be 145 l/h instead of 139 l/ /point 6/ for airplanes with normal performance.

C. Calculating Necessary Amount of Fuel.

The amount of fuel necessary for carrying out the flight is to be calculated from the following formula:

$$G_{fuel} = G_{fl} + G_{n.r.} + G_{gr}.$$

where: G_{fl} - amount of fuel used in flight within calculated time since the moment of take-off till landing without navigational reserve;

$G_{n.r.}$ - navigational reserve of fuel

G_{gr} - amount of fuel used on the ground while engine is warmed up and tested as well as during taxying

/1/ Amount of fuel used in flight $/G_{fl}/$ is determined by previously computing the calculated time of flight $T_{calc.}$ For the calculated time of flight, depending on given engine power /in percent/ in horizontal flight according to fuel consumption diagram /see. Fig. 4.3/, the amount of fuel used $/G_{fl}/$ may be found.

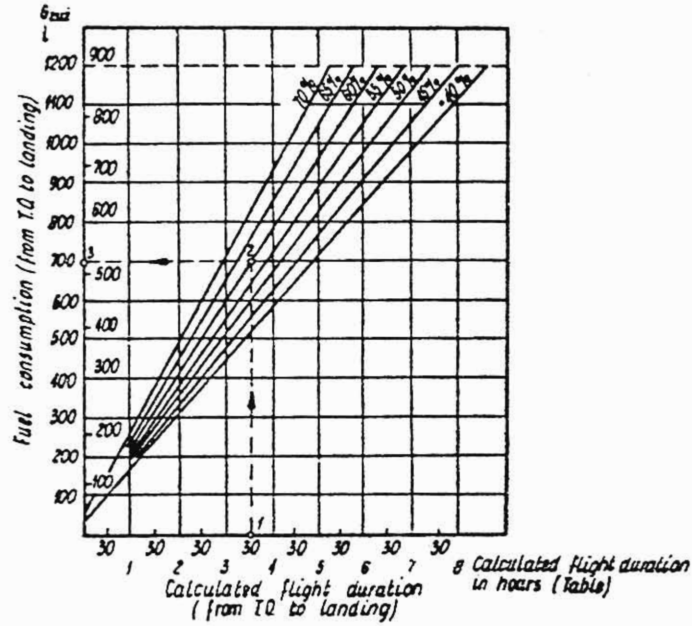


Fig. 4.3. Fuel Consumption Diagram

/2/ The necessary navigational fuel reserve is to be determined according to Detailed Regulations for Airplane Operation.

/3/ Fuel intended for warming up and testing the engine as well as that for taxying is not taken into account during calculation of airplane loading.
The refueling is done each time according to actual conditions /according to fuel consumption specifications when engine is operated on the ground – 45 kg/h /, but not more than 20 kgs. This amount of fuel is usually used up till the moment of airplane take-off.

Example:

Determine the amount of fuel used in flight /$G_{fl.}$/ when the calculated time of flight /$T_{calc.}$/ is equal to 3 hours and 30 minutes and the power, required for carrying out the flight, determined according to cruising conditions diagram, is 60% of the rated power.
Use the diagram in Fig.4.3. From point 1, representing calculated time $T_{calc.}$ = 3 hours and 30 minutes, a vertical line is to be drawn upwards to a level of line N_e=60% /point 2/.
On the scale of $G_{fl.}$ we read the appropriate quantity of consumption of fuel /since take-off till landing/: 700 liters or 525 kgs.

D. Airplane Loading

Correct loading of the airplane is a very important factor contributing to correct course of the flight itself. In this light each time before the flight, the center of gravity of loaded airplane must be determined on the basis of center-of-gravity determination diagram, so that it does not go beyond acceptable limits.

wsk –342-82 3000 szt. ew. 158-9.81

In the passenger-transport version of the plane the transport of 12 passengersor parachutists with full equipment is permissible.
In case number of passengersor parachutists is less than 12 persons the free places are to be left at the rear of cargo-passenger cabin.
While loading airplane with cargo,the arrows painted on the right wall of fuselage, with the weight of cargo marked, may be utilized.
Against the green arrow with inscription, Up to 1500 kg any cargo may be located as far as it does not exceed 1500 kg as the center of gravity will then be within the range of 24-25.5% MAC.
Red a rows with inscriptions of: 1000, 850, 700, 600, 400, 280 and 250 indicate the extreme position of cargo with which the center of gravity of loaded airplane is within the limits of 31.2% MAC.

Example:

One load of a weight of 600 kg may be placed in any place between green arrow with the inscription "Up to 1500 kgs" and the red arrow with inscription "600 kgs". If the load consists of many parts it is to be arranged so that the resultant center of gravity of the load is opposite the red arrow with the inscription equalling the cumulative weight of the cargo,is against the red arrow or in front of it up to the green arrow with the inscription "up to 1500 kgs/.
When there is a large quantity of loads, the position of the center of gravity is to be checked by means of the diagram.

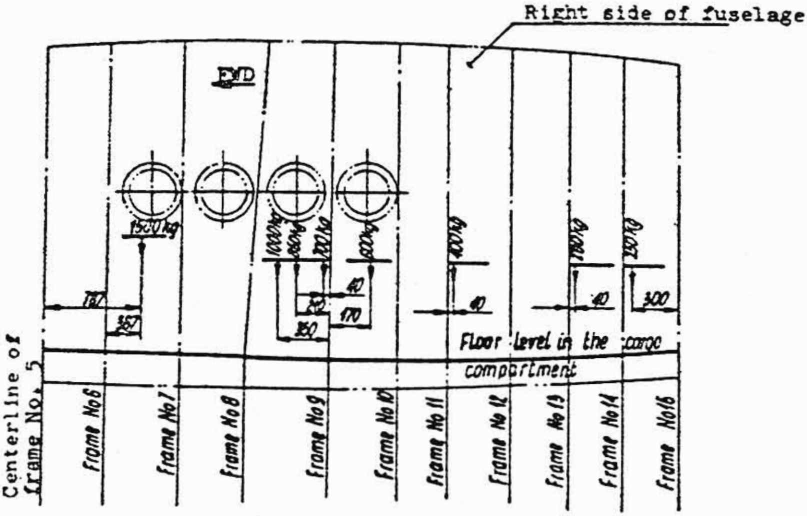


Fig. 4.4. Position of Arrows Indicating Acceptable Arrangement of Cargo

/1/ Using the Balancing Diagram.

Loading example:	Version I	Version II
- empty airplane with center of gravity at 20.8% MAC /as an instance/	3300 kgs	3300 kgs
- passenger /12x75 kg/	900 kgs	-
- parachutists /12x100 kg/	-	1200 kgs
- crew	160 kgs	160 kgs
- oil	75 kgs	75 kgs
- fuel	900 kgs	765 kgs
Airplane loaded for take-off	5335 kgs	5500 kgs
Center of gravity acc. to diagram is	29.6%	31.3%

wsk –342-82 3000 szt. ew. 158-9:81

The position of the center of gravity is to be determined from diagram on page 25 as follows:
Draw a vertical line downwards from the crossing point of center-of-gravity line and empty-airplane weight line /upper part of the diagram to the scale for appropriate case of loading. Then measure the horizontal distance of the value representing the given load on the scale, in the direction shown by the arrow.
Subsequently draw a vertical line downwards to the scale from the end of that distance /section/ with the following determinant case of loading and measure from its end the horizontal section the value and direction of which are to be determined as previously. Continue in this manner while considering all actual cases of airplane loading i.e. all kinds of loaded cargos and their arrangement on the airplane.
After laying off the section representing the quantity of fuel at the last horizontal scale, draw a vertical line downwards from the end of that section to cross the horizontal line corresponding to total weight of the plane /the lower part of the diagram/, The crossing point shows the position of the center of gravity of the airplane loaded for take-off.

/2/ Determining Position of the Center of Gravity by Static-Moment Method.

To determine the position of the center gravity by the method of static moments the values of individual weights /G/ must be written out in the table as well as the distances of their centers of gravity from frame No 5. and static moment equal to products of G . x /see example on page 24 for partially loaded airplane/.
Distances from frame No. 5 to the rear of airplane are to be treated as positive while those towards the front - a negative
The distance of the center of gravity of the empty airplane is specified in the weighing sheet as well as in the extract

from weighing sheet of the airplane on page 5, section 6. In the example in question a distance of 0.538 m, has been accepted which corresponds to 21.5 % MAC.

Type of cargo	Weight G /kg/	Arm X /m/	Moment GX /kgm/
Empty airplane	3350	0.538	1802
Crew /two members/	160	-0.336	-54
Fuel	50	0.944	47
Oil	50	-1.586	-79

$\Sigma G = 3610$ $\Sigma GX = 1716$

Distance of the center of gravity from frame No. 5 /m/:

$$X_{cg} = \frac{\Sigma GX}{\Sigma G}$$

Position of the center of gravity in per cent of MAC /mean aerodynamic chord/:

$$X_{cg} = \frac{X_{cg} - L}{b_{MAC}} \cdot 100$$

Where: L - distance of MAC begining from frame No.5 equal to 0.05 m

b_{MAC} - length of mean aerodynamic chord equal to 2.26[illegible] m

Substituting values to above formulas we get /for the example in question/:

$$X_{cg} = \frac{1716}{3610} = 0.475\ m$$

$$X_{cg} = \frac{0.475 - 0.05}{2.26[illegible]} \cdot 100 = 18.7\%\ MAC$$

wsk -342-82 3000 szt. ew. 158-9:81

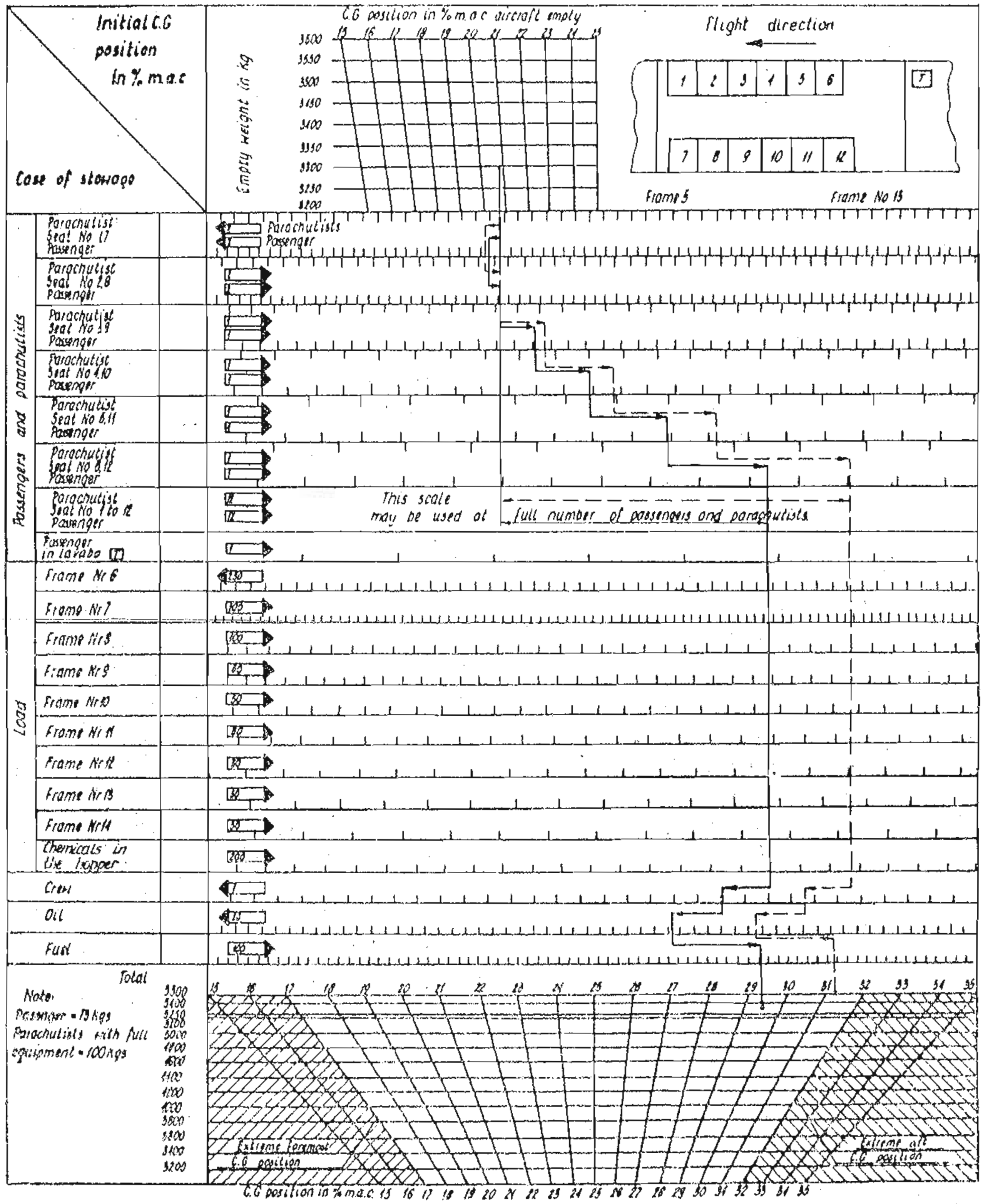


Fig. 4.5. Diagram for Determining Position of Center of Gravity.

NOTE: Continuous line represents version I, dashed line represents version II

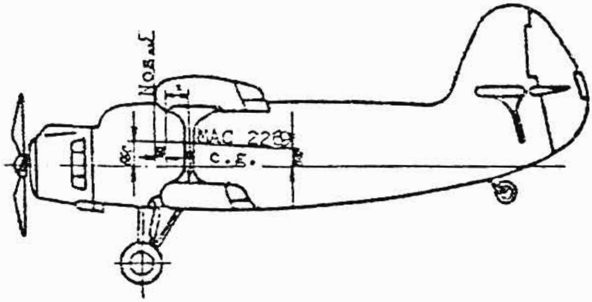


Fig. 4.6. Position of Mean Aerodynamic Chord /MAC/

E. Determining Airplane Take-off Run Distance

Prior to starting the airplane commander is to determine /acc. to nomogram in Fig. 4.7/ the distance of take-off run and to estimate the obstacles on the airstrip.

Nomogram for Determining Take-off Run Distance

Nomogram may be used to determine the distance of take-off run for various conditions as: air temperatures, atmospheric pressures, winds, various conditions of airfield surface /soil surface, firm, soft, sandy, snow, rammed, unrammed – for airplane with skids, concrete surface/ airfield inclination, various manners of take-off /take-off at rated conditions without using flaps and with flaps lowered to 25 deg/, various take-off weights of the airplane /from 4500 to 5500 kgs/.

The method of using the "Nomogram for Determining Take-off Run Distance of An-2 Airplane" /see Fig. 4.7/ may be reduced to the following.

/a/ From the actual temperature at the ground we find on diagram "A" the crossing point of the line drawn from bottom scale /vertically upwards/ with one of the curves representing the actual pressure.

/b/ The crossing point found is to be transfered /horizontally to the right/ onto the diagram "B" to cross the line representing the actual speed of wind.

/c/ From diagram "B" the point found is to be transfered downwards onto the diagram "C" to cross the line representing the condition and type of airstrip surface.

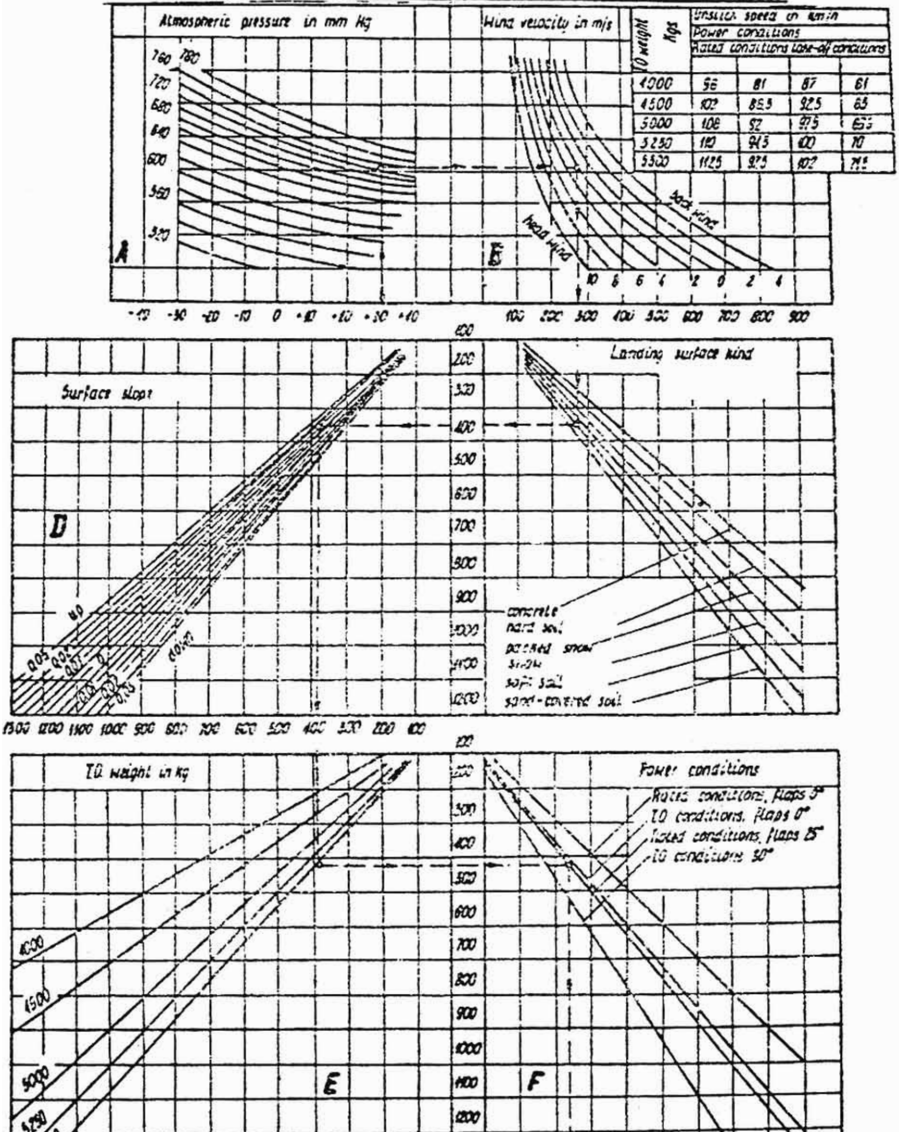
/d/ From diagram "C" the crossing point is to be transfered horizontally to the left onto diagram "D" to cross the line of take-off airstrip inclination"upwards" or "downwards".

/e/ From diagram "D" the point is to be transfered /vertically downward/ onto the diagram "E" to cross the line of take-off weight.

/f/ From diagram "E" the crossing point is to be transfered horizontally to the right /onto diagram "F"/ to cross the straight line representing the conditions and angle of flaps. After transfering the point obtained /vertically downwards/ onto the lower scale /L_{T-O}/ the obtained take-off run distance, corresponding to actual take-off conditions can be read.

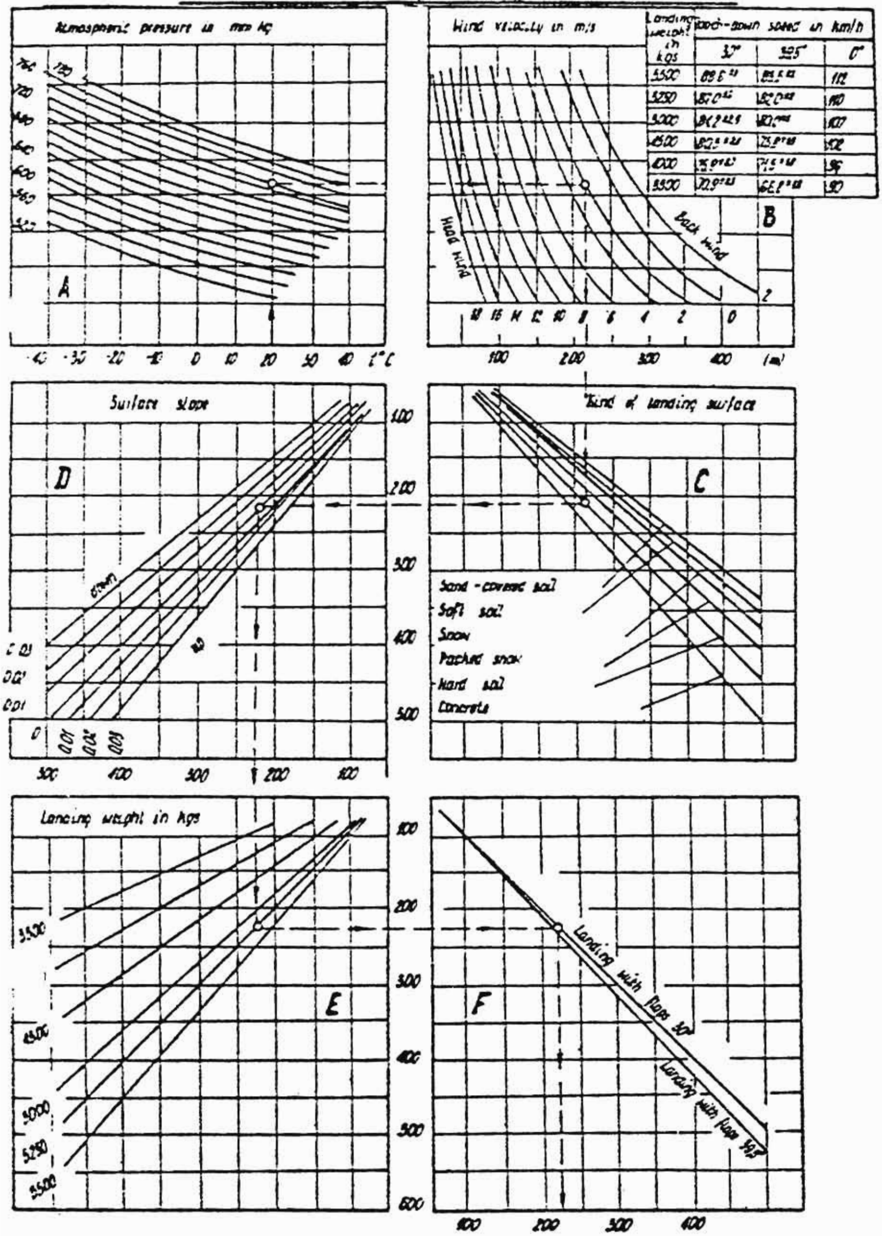
Example:

Determine the take-off run distance for An-2 airplane under following conditions.



TO weight kgs	Unstick speed in km/h			
	Power conditions			
	Rated conditions	take-off conditions		
4000	96	81	87	61
4500	102	85.5	92.5	65
5000	108	92	97.5	65.5
5250	110	94.5	100	70
5500	112.5	97.5	102	71.5

Fig. 4.7. Nomogram for Determining the Take-off Run Distance of the Airplane



Landing weight in kgs	Touch-down speed in km/h		
	30°	38.5°	0°
5500	[illegible]	[illegible]	112
5250	[illegible]	[illegible]	110
5000	[illegible]	[illegible]	107
4500	[illegible]	[illegible]	102
4000	[illegible]	[illegible]	96
3500	[illegible]	[illegible]	90

Fig. 4.8. Nomogram for Determining Airplane Landing Run Distance

Air temperature	+30°C
Atmospheric pressure	973 hPa /730 mmHg/
Head wind	2 m/s
Take-off surface	salf ground
Inclination upward	0.01
Weight for take-off	5500 kg
Engine operating conditions	max. contin.
Flap extension angle	25 deg

Proceed acc. to above explanations to find the take-off run distance for the given conditions equal to 335 m. The solution of this example is presented by dotted line and by arrows in nomogram diagrams.

F. Determining Airplane Landing Run Distance

Landing run distance is to be determined acc. to diagram /Fig. 4.8/. The method of using the nomogram is similar to that of using nomogram for take-off run.

Example:

Determine the airplane landing run distance in following conditions:

Air temperature	+20°C
Atmospheric pressure	960 hPa /720 mmHg/
Head wind	2 m/s
Landing surface	firm ground
Surface inclination	0,1 upwards
Weight for landing	5250 kgs
Flap extension angle	30°C

For specified conditions the landing run distance of An-2 airplane is 225 m. The solution of this example is presented by dotted line and by arrows in nomogram charts.

2. INSPECTION BEFORE FLIGHT

Before carrying out the inspection the captain is obliged to inspect airplane board log books, to make sure whether defects discovered in previous flight have been removed and obtain information on the type of operations carried out by ground personnel on a given airplane.

Check the presence of fire fighting media near the airplane, wheel chocks under landing gear wheels, make sure the control surface locking difices and covers are removed from airplane, engine and on air pressure sensor as well as whether anchorage is disconeeved.

In winter it is to be checked whether snow, hoar frost and ice are removed from all the surfaces of the airplane and carry out inspection of the airplane.

/1/ Engine group

Examine the propeller, engine cowlings, make sure no fuel oozes out from under engine cowlings and no oil flows out of oil cooler.

If the undisconnective dust filter is mounted on the airplane check the position of the air intake shutter installed on the upper cover of engine cowling. At the temperature 0°C and lower 7 the shutter shall be closed, i.e. in vertical position.
At the temperature higher than 0°C the shutter shall be in open position.

/2/ Main Landing Gear

Examine the landing gear and make sure the compression of shock absorbers and pressure in wheels /acc. to flattening/is normal.
The compression of shock absorbers acc. to scale marked on the piston is to be as follows:

90 ± 9 mm when airplane weight is 3500 kgs
117 ± 17 mm when airplane weight is 4200 kgs
135 ± 14 mm when airpalne weight is 4800 kgs
148 ± 15 mm when airplane weight is 5250 kgs
154 ± 15 mm when airplane weight is 5500 kgs

/3/ Left and Right Wing Chambers

Examine wings for general condition to make sure that canvas skin has no defects or whether the tightening of holding and carrying tapes is not too weak.

Make sure there are no gasoline leaks at the lower surfaces of upper wing and whether the cover has been removed from air pressure sensor.
Check that glasses of navigational lights and head lights are clean.

/4/ Right Side of Fuselage

Examine the fuselage skin for cracks and deformation.

/5/ Tail Landing Gear

Make sure that the compression of shock absorbers is normal and no oil leaks as well as that pressure in rear wheel tire is correct. The compression of shock absorber at standstill, depending on airplane loading is within limits of 50 to 70 mm /when the mark on piston pin coincides with the nut it represents a compression of 70 mm/.

/6/ Control Surfaces

Examine for general condition to make sure that the canvas skin on horizontal stabilizer /tail plane, elevator, and rudder has no defects.
Examine the fairings for damage and for loose or lost fairing mounting screws. Check that tail light glass is undamaged.

/7/ Left Side of Fuselage.

Examine similarly as the right side.

/8/ Cargo-Passenger Cabin and Cocpit.

/a/ Check airplane loading, arrangement and mounting of cargo. Check whether the airplane balancing is within acceptable range, remove mandrel securing emergency exit lock of passenger cargo cabin /if emergency exit is installed on the aircraft/.

21

wsk –342-82 3000 szt. ew. 158-9:81

/b/ Make sure the locking device of hand and foot flying controls has been removed;

/c/ Check that emergency manhole is closed and secured.

/d/ Make sure whether magneto switch is in position "O" - /off/ and the engine control levers are in position for engine starting.

/e/ Check the functioning of ailerons and control surfaces by deflecting controls to their extreme positions and make sure they move freely and deflect correctly.

/f/ Check air pressure in the air system /it must be minimum 4 Mpa /40 kgf/cm^2/; and in the brake system.

/g/ Check the voltage of board battery /it must be minimum 24 V/. When voltage is lower the battery requires replacement.

/h/ Switch on the power supply and check:
- efficiency of fuel quantity indicator and fuel level in the left and right tank group;
- deflection of flaps and trimming tabs;
- deflection of oil cooler shutters and the engine cowl flaps.

/i/ Examine general condition of all instruments. Switch on the power supply to indicators and observe indications to make sure the are efficient. Check the operation of artificial horizon AGK-47B.

/j/ Adjust the pointers of barometric altimeters WD-10 at "O" and compare indications on the scale of barometric pressure with actual atmospheric pressure existing on the airfield.

wsk -342-82 3000 szt. aw. 158-9.81

The difference must not exceed 2 hPa /1,5 mmHg/
Check the agreement of the position of movable markers with the zero on altitude scale with barometric scale positioned at the division 1013,2 hPa /760 mmHg/. Deviation in coincidence of barometric scale must not exceed 10 m.

/k/ Correct the indication of board clock.

/l/ Compare the zero position of variometer function.

/ł/ Compare the indications of manifold pressure gauge with the atmosferic pressure existing on the airfield /difference in indications must not be greater than 13.3 hPa /±10 mmHg/.

/m/ Check the position of fuel valve control.

Upon making sure by above inspection that the airplane is ready for flight, carry out the starting and check run the engine.

3. Starting and Testing Engine in Summer Season

A. Preparing Engine for Starting.

Following operations are to be carried out prior to starting the engine:

/1/ Switch on the battery and check the voltage in electric system /with power supplied from board battery/.

/2/ Open the air system valve and brake the wheels with the help of parking brake.

/3/ Switch on the following switches on central control desk and on instrument board:

- fuel meter;
- for EMI-3K engine unit gauge;
- for flap position indicator and oil cooler shutters position indicator;
- for mixture thermometer - ambient temperature thermometer;
- for oil cooler shutters;
- for engine cowl flaps;
- for fire fighting equipment;
- for door position indicator, instrument-board background lighting;
- for cockpit lighting /if necessary/;
- for position lights if necessary.

/4/ Check the efficiency of fire fighting equipment. A yellow light indicating the efficiency of pyrohead should be on when the fire fighting equipment switch is switched on /see para.3/.

Upon switching on the switches, PN-45M with inscription "Fire fighting system check" installed on the left control desk the red light for fire monitoring should be on.

NOTE: The cap on the push button with inscription "Fire must be sealed with leaden seal.

/5/ Check the efficiency of electric circuit of the signalling device. Press the press-button on the left control desk below the inscription " FILINGS MONITORING".
The red light on the left instrument panel under inscription " FILINGS IN" must light on upon pressing. After releasing the press-button the light must go off.

/6/ Adjust propeller pitch control lever to "fine pitch" and and altitude corrector control lever – to position corresponding to mixture enrichment, throttle control lever – to engine speed of 700 – 800 r.p.m. Close the engine cowl flaps and oil cooler shutters.

/7/ Open the four-position valve adjusting the knob to "open tanks" position which corresponds to simultaneous switching on of both groups of tanks.

/8/ Use manual fuel pump to generate a pressure of 24.4–34.3kPa /0.25 – 0.35 kgf/cm^2/ in the system.

/9/ Turn the propeller 3 to 5 times after previous making sure that magnetos are switched off.

/10/ While revolving the propeller, inject fuel into cylinders after 2-3 revolutions; use syringe pump to carry out/2-5 injections in summer and 5-8 injections in winter

WARNING! DO NOT PRIME THE CYLINDERS WITH MORE FUEL AS THIS MAY LEAD TO WASHING OIL OFF THE CYLIDER BEARING SURFACE.

wzk –342-82 3000 szt. ew. 158-9:83

/11/ If engine is re-started soon after stopping and when head temperature is within 40 to 80°C it is sufficient to make 2 to 3 fuel injections while turning the propeller by 2 to 3 revolutions.

CAUTION: Upon injecting fuel, shift the syringe pump lever to "OFF" position.

WARNING! DO NOT TURN PROPELLER AND DO NOT INJECT FUEL WHEN HEAD TEMPERATURE IS HEIGHER THAN. 80°C!

/12/ Engine is to be started with electric starter power supplied from board battery or airport battery.

B. Starting Engine with Electric Starter.

Give a command "Clear off the propeller" after making sure that engine is ready for starting and proceed to starting upon receiving answer "Yes, the propeller clear". Following operations are necessary:

/1/ Switch on the automatic overcurrent switch /AZS/ "Starting" and pull a handle with inscription "Starter" holding it in this position for 8-12 seconds in summer and 15-17 sec. in winter i.e. as long as necessary for the starter to stabilize its speed. Then press in the holder to interconnect starter with engine shaft. Switch on magnetos after propeller turns by 1 to 2 revolutions by adjusting knob to "1-2" position.

/2/ After first firings use manual pump to maintain fuel pressure before carburetor at 24.4 - 34.3 kPa /0.25 - 0.35 kgf/cm^2/ until engine operates uniformly.

CAUTION: If engine after starting does not go over to carburetor fuel supply upon using the primed fuel you may shift engine acceleration lever vigorously but smoothly to the stop forwards and backwards two or three times /not more/ to supply fuel with accelerating pump.

If engine fires back into carburetor a few smooth injections are to be carried out with syringe pump while not touching the acceleration lever i.e. additional amount of fuel is to be supplied for normal engine operation to be established.

WARNING: SHOULD FUEL START BURNING IN CARBURETOR DURING THE BACKFIRE INTO IT, THE IGNITION MUST IMMEDIATELY BE SWITCHED OFF AND ENGINE SHAFT IS TO BE TURNED WITH STARTER WHILE NOT TOUCHING THE ACCELERATION LEVER. IF FLAMES DO NOT GO OUT, ENGINE STARTING IS TO BE INTERRUPTED AND FIRE-FIGHTING EQUIPMENT IS TO BE SWITCHED ON.
IT IS FORBIDDEN TO TOUCH THE ACCELERATION LEVER SINCE AT THAT TIME THE ACCELERATING PUMP SUPPLIES ADDITIONAL PORTION OF FUEL AND THUS AGGRAVATES FIRE!.

/3/ Only after engine operates uniformly the carburetor throttle is to be adjusted to a position ensuring engine speed of 700 to 800 r.p.m. while observing indications of oil manometer. If the pressure will not reach 294 kPa /3 kgf/cm^2/ within 10 seconds, the engine is to be stopped to identify reasons for lack of pressure.

CAUTION: If engine did not start successfully , prime it again with fuel and repeat a/m operations.

WARNING:
1. Prior to every starting with priming, the propeller must necessarily be turned manually in the oposite direction by 4-6 revolutions to remove fuel from previous.starting and to prevent hydraulic shock.
2. Electric starter must not be switched on more than four times in series with time breaks smaller than 40 seconds.

After each four trials of starting electric motor of the starter must necessarily be cooled down for 30 minutes and only then engine may be re-started!

/4/ If it is impossible to make electric coupling of the starter the mechanical coupling is to be made.

/5/ Upon completing the starting; switch the "STARTING" switch to OFF.

C. Manual Starting of Engine.

In case the electric starter become damaged or the airport power supply is not available and board battery is not sufficiently charged it is exeptionally permissible to to carry out the starting by using the manual drive of the starter. Engine starting is to be carried out in following sequence.

/1/ Switch on the board battery.

/2/ Check whether the ignition is switched off, turn the propeller manually as it regularly turns by 5-6 revolutions and prime the engine while doing that.

/3/ Insert the crank of manual engine starting into the sleeve of manual starting and turn it clockwise while gradually increasing speed of rotation to 80 r.p.m.

/4/ Switch on magnetos and couple the starter electrically or mechanically with the engine.

/5/ Further starting procedure as during normal starting.

wsk –342-82 3000 szt. zw. 158-9:81

D. Warming up Engine

/1/ After completing starting, switch on the generator and keep engine at 700-800 r.p.m. until oil temperature at the entrance to engine begins to rise though not less than 3 minutes.

/2/ Increase engine speed to 1000-1200 r.p.m. /in winter to 1400 r.p.m. and warm up the engine to cylinder head temperature of minimum 100°C and to oil temperature at the entrance to engine of 30°C.
Then increase engine speed gradually to 1600 r.p.m. and continue warming up the engine.

/3/ While warming the engine up close engine cowl flaps and oil cooler shutters to reach cylinder head temperature of 120°C and oil temperature at the entrance to engine of 50°C.

/4/ Engine is warmed adequately when cylinder head temperature reaches 120°C and oil temperature at the entrance to engine is minimum 50°C.
Upon reaching above temperatures, start checking engine operation at the effective power ranges.

E. Engine Test

/1/ Establish the parameters of rated /max. cont/ power /n=2100 r.p.m, p_k=1200 hPa /900±10 mmHg//.

/2/ Check whether the indications of instruments correspond to following values:
- oil pressure in the rear cover 390-490 kPa /4-5 kgf/cm²/;
- fuel pressure at the entrance to carburetor 24.5-34.5 kPa /0.25-0.35 kG/cm²/;
- temperature of entering oil 60-75°C;
- cylinder head temperature max. 215°C

Engine must operate uniformly and without jolting.

/3/ Using throttle lever reduce engine speed to 2030 r.p.m. and check the operation of magnetos and ignition plugs.
Each of magnetos is to be switched off in turn for 10-15 seconds for that purpose.
Prior to each switching from one magneto to another switch on both magnetos for 15 to 20 seconds to restore correct operation of ignition plugs. After switching to one magneto the engine should operate uniformly without jolting.
The reduction of engine speed while switching to one magneto must not exceed 60 r.p.m.

/4/ Check the operation of propeller control mechanism and that of the propeller itself.
Use throttle lever to stabilize engine speed to 1900 r.p.m. and leave it at unchanged position while shifting engine speed governor lever from "fine pitch" to "coarse pitch". Engine speed must be reduced as a result to 1450 through 1550 r.p.m.
After re-shifting engine speed governor to "fine pitch the engine must regain initial speed i.e. 1900 r.p.m.

CAUTION! In winter two to three changes of propeller blade angle are necessary to warm up oil in propeller hub.

/5/ Check propeller operation at the established engine speed. Adjust engine speed governor lever to "fine pitch" and throttle lever to 2100 r.p.m.
Then load the propeller to 1900 r.p.m. with governor control lever, stabilize it, and afterwards use throttle lever to increase manifold pressure by 133 to 200 hPa /100-150 mmHg/.
Engine speed must remain constant.
Use throttle lever to reduce engine speed to 900-1000 r.p.m. then swiftly but smoothly increase the manifold pressure to the initial value.

At the first moment the engine speed may increase to 2000-2050 r.p.m. but it should stabilize within 3-5 seconds at previous range i.e. 1900 r.p.m.

/6/ Check operation of the generator. Adjust throttle lever to 1850 r.p.m. At that speed the generator voltage must be minimum 75.5 V.

/7/ Check the functioning of carburetor altitude corrector. At the speed of 1850 r.p.m. the altitude corrector.lever is to be shifted smoothly **forward.**
When carburetor and corrector are properly regulated and lever positioned 10 to 20 mm from extreme **forward** position, engine speed will drop quickly and smoothly, backfiring into carburetor will appear and engine will show a tendency to stop. After these symptoms appear, the altitude corrector control lever is to be shifted to normal position.
Engine speed must then rise quickly to previous position and engine is to begin to operate uniformly.

<u>CAUTION!</u> The rise in engine speed after shifting corrector lever from normal position testifies that the mixture is too **rich.**

/8/ Check the functioning of the heater of air entering the carburetor. For this purpose the air heater must be turned on at a speed of 1850 r.p.m. The reduction of manifold pressure, drop in speed by about 150-250 r.p.m. as well as the increase in mixture temperature testify that heater is efficient.
Shift heater control lever to "OFF" position after 10-15 seconds. The manifold pressure and engine speed must then return to previous values.

WARNING! SHOULD ENGINE BACKFIRE INTO CARBURETOR OR OPERATE RREGULARLY AFTER SWITCHING ON THE HEATER THE ENGINE MUST IMMEDIATELY BE STOPPED. AND THE CONDITION OF FLAME TUBE IS TO BE EXAMINED.
BACKFIRING INTO CARBURETOR WHEN HEATER IS ON IS USUALLY CAUSED BY THROUGH-BURNING OF THE FLAME TUBE OF THE EXHAUST MANIFOLD!

/9/ Check engine operation within 10 to 15 seconds in the range of take-off power /at fine pitch of propeller/, engine must operate at 2150-2200 r.p.m. range with manifold pressure max. 1400±33 hPa /1050 mmHg/, should manifold pressure exceed that value under high ambient pressure and full opening of throttles the throttles should hot be fully opened for take-off power.

CAUTION! To run in engine components better it is recommended to use take-off power only after 10 hours of engine operation.

/10/ Check engine operation at idle speed. Check whether instrument indications

engine speed	550 r.p.m.
oil pressure	147 kPa /1.5 kgf/cm^2/$_2$
fuel pressure	14.7 kPa /0.15 kgf/cm /
temperature of oil entering the engine	60 - 75 $^\circ$C

Engine must operate uniformly and stably /without any jolts/.

/11/ While checking engine at idle speed, check the return current and the moment when generator starts to operate..

- When engine speed becomes reduced or switching the generator off and lighting the red converter failure warning light record the value of maximum deviation of ammeter pointer to the left from zero.
  The return current must be within 15-35 A.

wsk -342-82 3ooo szt. ew. 158-9:81

- When engine speed rises the lamp should go out at 900-110 r.p.m. i.e. at the moment the generator starts to operate.

/12/ Check engine transitions. Shift smoothly the throttle lever within 2-3 seconds from idle speed position to rated power range.

Engine speed must rise uniformly to rated power speed /2100 r.p.m./ without jolting and breaks within 5-6 seconds /2-3 seconds in flight/.

During transition test the cylinder head temperature must be minimum 120°C. Transitions are to be checked at fine pitch of the propeller.

CAUTION: Avoid long term engine operation on the ground at high powers as cylinder heads are not sufficiently cooled.

At rated power the test must not last longer than 15-20 seconds.

Cylinder head temperature must not exceed 215°C and oil temperature - 75°C.

Avoid long-term engine operation at a speed below 700 r.p.m. to prevent oiling of ignition plugs and overfilling of the oil sump with oil as a result of poor pumping-off of oil from engine at low engine speed.

WARNING: 1. IF ENGINE IS WARMED UP AT HIGH AIR HUMIDITY DRIZZLING RAIN OR SLUSH THE HEATER OF AIR ENTERING THE CARBURETOR MUST BE PUT ON AND THE TEMPERATURE OF FUEL MIXTURE KEPT ABOVE MINIMUM +3 to +5°C.

2. AVOID, ESPECIALLY IN WINTER, SUDDEN INCREASES OF ENGINE SPEED WHILE STARTING IT WITH COLD OIL TO AVOID BURSTING OF OIL COOLER AND THE TEAR-OFF OF TEXTILE-FIBERREINFORCED PLASTIC PIPES!

/13/ Time required for carrying out engine testing in a given range is 3-4 minutes.

/14/ Diagram for engine test - refer to page 6-00/5.

CAUTION! While carrying out the engine test the control wheel is to be kept in backward position all-through the time of the test.

F. Engine Stopping

/1/ Prior to stopping, cool down the engine to cylinder head temperature of 140-160°C.
It requires following operations:

/a/ Open completely the engine cowl flaps the oil cooler shutters.

/b/ Adjust propeller to fine pitch.

/c/ Reduce engine speed to 800-900 r.p.m. and keep at this range till the a/m cylinder head temperatures are reached.

WARNING: HOT ENGINE MAY BE STOPPED ONLY IN CASES OF DIRE NECESSITY, SINCE ENGINE STOPPING AT THE CYLINDER HEAD TEMPERATURE ABOVE 160°C CAUSES THE DRIPPING OF OIL FROM CYLINDER

LINING AND CONSEQUENTLY LEADS TO INCREASED WEAR OF CYLINDER LINING AND CYLINDER RINGS, AND EVEN TO SEIZURE OF PISTONS AT THE NEXT SUBSEQENT STARTING. BESIDES, THE STOPPING OF HOT ENGINE CAUSES A CONSIDERABLE INCREASE OF TEMPERATURE UNDER COWLINGS /AS A RESULT OF INTERRUPTED BLOWING/, WHICH MAY LEAD TO DAMAGE OF IGNITION PLUG INSULATION.

/2/ Upon cooling the engine, increase engine speed for 1-10 sec. to about 1700 r.p.m. /to restore good burning on ignition plugs/ and then reduce speed to 800-900 r.p.m. and stop engine with shut-off valve.

/3/ On breaking engine operation, switch off the ignition and smoothly open completely the carburetor throttle.

/4/ If engine does not stop with shut-off valve it is to be stopped by switching off the ignition.
This requires following operations:

/a/ Cool down the engine /in similar sequence as when stopping it with shut-off valve/.

/b/ Increase engine speed to about 1700 r.p.m. for 7-10 seconds, then reduce it to 1000 r.p.m., switch off the ignition and smoothly open the throttles.

WARNING: 1. IT IS FORBIDDEN TO STOP ENGINE BY BURGING FUEL OUT OF CARBURETOR i.e. BY CLOSING FUEL VALVE.

2. IF SIGNAL LIGHT LIGHTS ON WHEN PRESS-BUTTON "FILINGS MONITORING" IS RELEASED DURING ENGINE GROUND TEST, STOP ENGINE AND IDENTIFY THE REASON FOR THE LIGHT TO BE ON.

/5/ Procedure After Stopping Engine.

- move the shut-off valve control lever to forward position
- close fuel valve;
- shift the throttle control lever to rear position;
- close oil cooler shutters;
- lock the controls and ailerons.

/6/ When cylinder head temperature becomes reduced to 80°C close the engine cowl flaps and then switch off all electric switches.

4. Engine Starting and Testing in Winter Season

/1/ Starting and warming up the engine with diluted oil does not differ in any way from those operations with undiluted oil. Oil dilution is used at temperatures below -5°C.

/2/ Engine testing with diluted oil is to be started when oil temperature at the inlet reaches the value +35°C and cylinder head temperature is 120°C.

/3/ At ambient temperature down to -15°C, as well as in case of using diluted oil on previous day the engine is to be warmed up only to cylinder head temperature of 20-30°C /using the airport heater/.

/4/ In case of still lower temperatures oil cooler is to be warmed up as well as engine.

5. Taxying

/1/ Operations Before Taxying

/a/ Switch on the power supply to flaps and trimming tabs and make sure that their positions are neutral.

/b/ Switch on power supply for artificial horizons, course indicator and gyro compass.

/c/ At ambient temperature below $0^{o}C$ or in case of snow fall the electric heating of air pressure sensor must be switched on.

/d/ Switch on the automatic overcurrent switch "UKF" and "SPU" on the central panel and make sure the radiostation and intercom operate normally.

/e/ Switch on power supply to automatic direction finder /radio-compass/, radio-altimeter and course indicator, and radio-beacon if necessary. In such a case the converter PO-500 must also be switched on by putting the switch to " ON " position,

/f/ Carry out the checking according to check list - - para "Before Taxying".

/g/ After receiving by radio the permission for taxying, reduce engine speed to minimum, give the order "remove chocks" making at the same time appropriate hand movements or, at night, blinking with position light.
Upon receiving a reply "chocks removed", make sure there are no obstacles on the taxying strip and on receiving a signal from a technician /ground engineer/, ask for permission to taxy out - by raising right hand up by day, or by short switching on and off the taxying headlight at night.

/h/ Prior to taxying for training flight turn on the brake release switch on central instrument panel and check the functioning of brake system from the right control wheel.

wsk -342-82 3000 szt. ew. 158-9.83

/2/ Operations During Taxying

/a/ Check the operation of brakes at the beginning of taxying. Brakes must hold at a speed of n=2000 r.p.m. and with propeller pitch lever at "fine pitch".

/b/ Avoid sudden braking when taxying on sandy or muddy airfield surfaces.
The radius of turning must not be smaller than half of wing span.

/c/ During rainfall and slush and at mixture temperature below 0°C, taxy to to take-off with heater switched on and keep the temperature of mixture between +8 and +10°C.
Heater is to be switched off before take off.

/3/ Taxying Airplane on Skids.

/a/ Moving the airplane on skids from its place takes place as follows: on tramped snow at 1400-1500 r.p.m., on untramped /soft/ snow at 1500-1600 r.p.m. on wet snow at 1600-1900 r.p.m.

WARNING: IF THE AIRPLANE SKIDS HAVE FROZEN TO THE PLACE OF STAY IT IS FORBIDDEN TO MOVE AIRPLANE BY INCREASING THE MANIFOLD PRESSURE /OF GAS/. TO MOVE THE FROZEN-TO--GROUND SKIDS, USE A WOODEN BAT OR HEAVY OBJECT KNOCKING THROUGH A PIECE OF WOODEN BOARD AT THE FRONT SIDE SURFACE OF THE SKID !

/b/ To carry out a turn in required direction, the appropriate pedal must be displaced and brake lever must be smoothly pressed with simultaneous increase of engine power.
It should be remembered that fast turning with one skid braked is unacceptable as it causes severe loading of the landing gear.

wak -342-82 3000 szt. ew. 156-9:81

The radius of turning must be similar as with wheel landing gear i.e. not smaller then a half of wing span.

/c/ While taxying on untramped snow carrying-out of the turning is to be made easier by displacing the control wheel to forward position to reduce the loading on the tail skid.

/d/ While taxying on untramped snow the manoeuvrability of the airplane deteriorates as a result of reduction in efficiency of skid brakes. Therefore, near the obstacles the taxying must be careful as the airplane may extend its motion despite full braking of skids.

/e/ The taxying of the airplane along straight line in windless weather should take place as follows: on the tramped snow at 1200 - 1400 r.p.m., on untramped snow at 1400-1500 r.p.m.

/f/ The airplane permits maintaining a straight direction on well tramped snow surfaces under side wind of up to 12 m/sec. or on untramped snow under wind of up to 8 m/sec.

/g/ At outside air temperatures above $-5^{\circ}C$ the taxying is to be carried out at reduced speed but without stopping to avoid freezing of skid to the ground.

/h/ On uneven surface and with snow drifts as high as 0,60 m the taxying is to be done at increased engine speed, 1600-1700 r.p.m., while taking care to avoid the plunging of wing into snow and overheating the engine; taxying with flaps lowered is forbidden in such conditions.

6. Preparing for Take-off

/1/ Carry out a check according to check list - para "before take-off".

/2/ Switch the air inlet louver out and, if the air is dusty, switch it on again after take off /in airplanes of An-2T version/.

/3/ Both in summer and in winter the take-off is to be carried out with heating of air entering carburetor completely switched off and at a position of altitude correction corresponding to maximum enrichment of mixture.
The detailed method of using the heater of air entering the carburetor has been described in para 15 "Servicing of the Heating System for Air Entering the Carburetor".

7. Take-off Without Using Flaps

/1/ The take-off without using flaps is to be carried out at a rated power of the engine i.e. at 2100±40 r.p.m., p_k=1200 hPa /900±10 mmHg/.

/2/ After the lift-off the holding down is to be carried out with stepwise increase of altitude and speed up to 140 km/h.

/3/ Upon reaching the speed of 140 km/h, go over to climbing flight.

CAUTION: During the take-off run a tendency of the airplane to drift to the left from required direction is noticeable.

8. Take-off with Use of Flaps

Lowering of flaps while taking off shortens the take-off run distance and take-off distance by 30-35%. Depending on the condition of airfield and on airplane loading the take-off is to be carried out with flaps lowered to 25° or to 30 deg.

/1/ With flaps lowered to 25 deg, the take-off is to be carried out at rated power of the engine /max. continuous/

/2/ If the take-off strip is limited or airplane take-offs with maximum weight /5500 kgs/ the take-off is to be carried out with flaps lowered to 30 deg end with engine take-off power.

CAUTION: Airplane lift-off /from the ground/,with flaps lowered to 25-30°, takes place at a speed of 85 to 90 km/h. In some airplanes during T-O with lowered flaps the slats are displaced and they remain displaced until a speed of 85 km/h is reached. On reaching this speed the slats will draw in completely.

/3/ On reaching the altitude of 50 m and speed of 120 km/h the drawing-in of flaps is to be commenced. This operation is to be carried out gradually /by impulses/ while observing the position of flaps both through the indicator and directly watching flaps themselves.
Increase airplane speed simultaneously so that in the moment of full drawing in of the flaps it is within 135-140 km/h.

/4/ Upon retraction of the flaps, go over to climbing.

WARNING: 1. SHOULD THE RETRACTION OF THE FLAPS BECOME IMPOSSIBLE AFTER TAKE-OFF WITH LOWERED FLAPS, BECAUSE OF FLAP CONTROL SYSTEM FAILURE THE PILOT MUST IMMEDIATELY LAND ON THE AIRFIELD FROM WHICH HE TOOK OFF. WHILE APPROACHING THE LANDING WITH FLAPS LOWERED DO NOT ALLOW SHARP TUNRS EXCEEDING 10 TO 15 deg, AS WELL AS SPEED EXCEEDING 150 km/h.

2. IT IS FORBIDDEN TO CARRY OUT THE STARTING WHILE USING ONLY UPPER OR ONLY LOWER FLAPS!

CAUTION: Flaps may be used during starting when wind speed is max. 10m/sec.

/5/ The take-off on skids is to be carried out according to the same principles as that on wheel landing gear.

CAUTION! For the take-off of airplane on skids one must keep in mind that at a temperature of 0°C and higher and especially on slush or wet snow the take-off run distance may be longer by 10-20% than that a temperature of minus 10°C.
The take-off run distance on well tramped snow is as follows:
- at rated power $\delta_{fl}=0°$ - 320 m
- at rated power $\delta_{fl}=25°$ - 260 m
- at take-off power $\delta_{fl}=30°$ - 190 m

9. Stalling

/1/ During the take-off configuration and at the transition to go around /configuration with engine operating at rated or higher power/ the airplane stalls only reluctantly despite full displacement of the elevator with trimming tab positioned according to trimming speed typical for a given configuration.
The stalling is typical; the airplane does not show any tendency to fall into spin or into deep falling spiral. The airplane does not warn before stall, but an accidental stalling is rather impossible because the airplane stalls only reluctantly.

/2/ In cruise configuration when stalled the airplane falls into mushing without any clear signs of warning.

/3/ In landing configuration with engine throttled the airplane does not stall neither with flaps retracted nor with lowered.

The minimum speed of steady flight is 105 km/h with center-of-gravity position a_0=30% MAC and the weight of 5250 kg and it is 100 km/h with center of gravity at a_0=20% MAC and airplane weight for take-off Q=4600 kgs.

/4/ Turning Flight and Accelerated stalls.
The airplane does not stall while turned at an angle equal to 30°. Accelerated stall also bears no real stall characteristics.
Is is rather a mushing of the airplane. It occurs only in take-off configuration when the manifold pressure is p_k=1200 hPa /900 mmHg/ or higher.

10. Climbing

Climbing is to be carried out at the speed of 140–150 km/h. To obtain maximum speed of climbing it is recommended to carry it out, to an altitude of 500 m, with flaps lowered by an angle of 5 deg.
The climbing above this altitude is recommended to be performed with flaps retracted.

/1/ After drawing in flaps the climbing is to be continued with one of following two engine power ratings:

P_k=1106 hPa /830 mmHg/ n= 1850 r.p.m.
P_k= 933 hPa /700 mmHg/ n= 1850 r.p.m.

/2/ If there is an urgent need to reach quickly a given altitude /to avoid icing or for some other reason/ use the rated power of engine i.e. P_k= 1200 hPa /900 mmHg/ n=2100 r.p.m. which is the most favourable climbing power.

/3/ In case of climbing to service ceiling it is recommended that after each 1000 m /above engine altitude limit of 1500 m/ the indicated airspeed is to be reduced by 5 km/h.

/4/ Observe cylinder head temperature and oil temperature during climbing and keep these temperatures within the recommended range.

/5/ The adjustment of engine power is permitted to be carried out as follows:

- to reduce engine power in flight, decrease first the manifold pressure and then reduce engine speed to required values and correct the manifold pressure.

WARNING: THE PROPELLER MUST NOT BE LOADED WITHOUT PREVIOUS REDUCTION OF MANIFOLD PRESSURE BECAUSE IT MAY LEAD TO DETONATION IN ENGINE CYLINDERS AND TO OVERLOADING OF CRANK MECHANISM!

- to increase engine power in flight stabilize first the required engine speed with propeller pitch lever and then adjust to required manifold pressure.

11. Horizontal Flight

/1/ Conditions of engine operation in horizontal flight are to be determined while preparing the flight schedule using the diagram of cruise conditions or the table of cruise speeds of horizontal flight.

/2/ After gaining the planned flight altitude, determine the engine speed and manifold pressure according to chosen conditions ensuring the cruising speed of the flight according to schedule.

wsk -342-82 2000 egz. 158-9:81

If the chosen conditions cause a noticeable increase in the vibration of interwing strips the engine speed must be reduced or increased.

/3/ In cruising conditions the instrument indications should be as follows:

- temperature of inlet oil	60 - 70°C
- cylinder head temperature	120-215°C
- recommended cylinder head temperature	165-200°C
- oil pressure	390-490 kPa /4-5 kgf/cm^2/
- fuel pressure	24,5-34,5 kPa /0,25 - 0,35 kgf/cm^2/

/4/ In warm weather the heating of air entering the carburetor should be switched off as the high temperature of air entering the carburetor causes a drop in engine power and an increase in fuel consumption.

/5/ In all cases of horizontal flight in conditions of higher air humidity, as well as when temperature of the mixture is lower then 0°C or automatic drop of manifold pressure becomes perceptible the heating of air at the entrance to carburetor is to be switched on as described in para 15 of this section.

/6/ On switching on the heating of air at the entrance to carburetor, with consequent restoring of manifold pressure, the mixture becomes enriched. Therefore, in horizontal flight at an altitude not lower than 300 m and with power not greater than 65% of rated power - the mixture is to be leaned, upon switching the heating ON with altitude corrector while controlling the correctness of leaning according to cylinder head temperature and airspeed indicators.

While going over from rich to more lean mixture the cylinder head temperature rises at first and then, upon reaching maximum, when mixture is leaned further on, the temperature begins to drop.

Simulteneously with leaning the mixture a certain decrease in indicated flight speed is also taking place.
The adjustment of mixture quality and leaning control are to be carried out in the following sequence:

/1/ In stabilized horizontal flight, with altitude corrector control lever at full backward position /OFF/, read /and may be, record/ the value of cylinder head temperature and that of indicated flight speed.

/2/ Shift the altitude corrector control lever to "forward" position by 20-35% of its travel /i.e. by 10-20 mm/. Read new values of cylinder head temperature and indicated flight speed after 2-3 minutes.

/3/ Again shift the altitude corrector control lever slightly forward while observing changes in temperature and speed.

/4/ Displace the altitude corrector control lever forward by steps to control cylinder head temperature and indicated air speed till the moment when temperature begins to fall.
The begining of cylinder head temperature fall shows that fuel mixture is sufficiently lean and it corresponds to mixture composition that is most economic.

WARNING: WHEN ALTITUDE CORRECTOR CONTROL LEVER IS MOVED FORWARD ABOVE 35% OF ITS TRAVEL /MORE THAN 20 MM/ THERE IS A SUDDEN REDUCTION OF FUEL CONSUMPTION, WHILE WITH LEVER POSITION AT 60-70% OF ITS TRAVEL /35-40 MM/ UNSTABLE ENGINE OPERATION WILL RESULT!

wzk –342-82 3ooo egz. ew. 158-Y.81

/5/ While adjusting the mixture ratio consider the following:

- During the process of mixture quality adjustment the position of cowl flaps should not change until the required mixture quality is obtained;
- Cylinder head temperature must not exceed 215°C;
- The change of flight altitude requires a corresponding change in mixture adjustment;
- The variation in manifold pressure within 666 to 933 hPa /500 to 700 mmHg/, to increase or reduce the speed of horizontal flight, does not require any variation in mixture quality adjustment;
- If it is necessary to reduce the heating of air entering the carburetor the mixture must first be enriched /move the altitude corrector control lever fully backward/ to prevent its sudden leaning and then reduce the air heating;
- On increasing the air heating the mixture must additionally be leaned until cylinder head temperature begins to drop.

/6/ Should the engine operation become unstable due to mixture leaning or as a result of cylinder head overheating /above maximum acceptable temperature/ the altitude corrector control lever is to be moved fully backward.

/7/ In horizontal flight change the engine power following the sequence:

For power reduction:

- enrich mixture with altitude corrector while moving the corrector control lever fully backward;
- reduce manifold pressure with acceleration lever;

- reduce engine speed with propeller pitch control lever;
- adjust manifold pressure, if necessary;
- adjust mixture quality.

For power increase:

- enrich mixture with altitude corrector;
- increase engine speed with propeller pitch control lever;
- increase manifold pressure with acceleration lever;
- adjust mixture ratio.

NOTION: During the flight as fuel is consumed by the engine the center of gravity moves gradually forwards by a value of up to 2,5% MAC.
Irregular fuel consumption may also occur in both groups of tanks.
Refer to para 16 on page 68 of this section for the method of counteracting this phenomenon.

/8/ To facilitate the closing of cockpit door in flight the pane of dome window is to be shifted aside to equalize pressures between both cabins.

Descent

/1/ During passenger flight the rate of descent must not exceed 2 m/sec.

/2/ The speed of flight during descent must not exceed 200 km/h in quiet air and 190 km/h in turbulent air.

wak –342-82 2000 szt. ew. 158-P.81

/3/ During descent do not permit cylinder head temperature to be less than 120°C and the temperature of inlet oil be less than 50°C.
The recommended cylinder head temperature during descent is 160-170°C.

/4/ If with closed engine cowl flaps and oil cooler shutters the temperatures of oil and cylinder heads will drop below acceptable values the descent must be carried out by steps going back to horizontal flight whenever a risk of overcooling the engine appears.

/5/ In conditions of icing hazard and at a temperature of outside air below minus 15-20°C, switch on the heating of air entering the carburetor.

/6/ Reduction of Altitude at Rate of Descent of 4.5 m/s.

V, km/h	n, r.p.m.	p_k, hPa /mmHg/	Q, l/h	q, l/km
200	1500	840 /630/	125	0,625
180	1500	693 /520/	108,5	0,603
160	1500	533 /400/	72,5	0,455

The above data are, specified for three conditions of descent.
Adjusting engine operating during descent depends on gradual closing of the throttle at constant r.p.m. with the altitude drop so that manifold pressure at all altitudes is equal to that in the table for appropriate speed.

13. Landing

The approach to landing and the landing are to be carried out by chief commander /1st pilot/ himself.
The direct approach is to be carried out at fine pitch of the propeller and with fuel valve set for both groups of tanks.
Prior to landing the checks are to be carried out according to check list.

A. Landing with the Use of Flaps

/1/ The basic type of landing with the use of flaps is accepted for flaps to be extended to an angle of 30 deg.

/2/ Should the need arise for shortening the landing distance to minimum, full extension of flaps -39,5 deg - is to be used.

WARNING: IS IS FORBIDDEN TO FLY, WITH FLAPS LOWERED TO 30 deg, AND THE SPEED HIGHER THAN 150 km/h; TO 39,5 deg AND THE SPEED HIGHER THAN 130 km/h.
IT IS FORBIDDEN TO USE SEPARATELY UPPER OR LOWER FLAPS!

/3/ The speed of gliding flight with flaps lowered to 30 or 39,5° must be 125 or 120 km/h, respectively. This speed is to be kept till the moment of flattening out of the plane to be commenced at an altitude of 6-9 m.

/4/ Landing of An-2 airplane takes place with the use of automatic slats. Opening the slats takes place at a speed of V_{pp}=105 - 90 km/h.

/5/ The airplane touch-down speed with flaps lowered to 39,5 deg is 70-85 km/h /depending on airplane weight/. The distance of landing run with wheel landing gear is within 210-225 m, provided the landing is carried

out with flaps lowered to 39,5 deg and with the use of brakes.
Should the brake system appear inefficient the landing run distance shall be elongated to 300 to 350 m.

/6/ Sudden braking directly after touch-down may lead to airplane turnover.
Braking must be smooth and be done in a few phases.

B. Landing Without Using Flaps.

/1/ When airfield is sufficiently large and general situation permits it, flaps may not be used.
In such a case, the track of gliding flight shall be more flat and the landing run distance shall become longer. The speed of gliding during the approach to landing must be within 140 to 145 km/h. The flattening out of the airplane is to be started at an altitude of 4-5 m.

C. Landing with Side Wind.

The maximum acceptable values for side wind are specified in section 2 on page 3.
The landing with side wind is normally carried out without using flaps.
The speed of gliding flight during the approach to landing must be within 140-150 km/h. The use of flaps for landing with side wind is permissible only in cases of extreme need and then only when wind speed is below 4 m/s.

D. Landing on Skids.

Landing on skids is to be carried out similarly as that on wheeled landing gear.

WARNING: THE SHOCK ABSORBING CHARACTERISTICS OF LANDING GEAR WITH SKIDS ARE SLIGHTLY INFERIOUR AND THEREFORE IT IS FORBIDDEN TO LAND ON UNEVEN WAVY ICE OR TERRAIN COVERED WITH ICED STONES.

14. Go Round Again

/1/ Going round again is possible from both the gliding flight without using flaps as well with flaps lowered to any degree.

/2/ Go round again is possible at any phose of descent till and including the moment of flattening the airplane out.

/3/ In every case of go round the engine power is to be increased to rated power /or to take-off power if necessary/ and climb is to be resumed upon regaining the speed of:

- 140 km/h, when flaps were not lowered,
- 120 km/h, when flaps were lowered to 30 or 39,5 deg. In the last case the flaps are to be retracted at an altitude of 50 m according to para 3 on page 53 of this paragraph.

WARNING: IF FOR SOME REASON /INCORRECT ARRANGEMENT OF CARGO, UNINTENTIONAL SHIFTING OF CARGO BACKWARDS/ THE CENTER OF GRAVITY OF AIRPLANE MOVES BEYOND THE ACCEPTABLE LIMITS, THEN AT THE MOMENT OF DEVELOPING THE MAXIMUM ENGINE POWER WITH LOWERED FLAPS A PITCHING UP MOMENT WILL RESULT OF SUCH A VALUE THAT FULL DISPLACEMENT OF CONTROL WHEEL FORWARD MAY NOT BE SUFFICIENT TO BALACE THE AIRPLANE. IF NO PROPER COUNTERMEASURES ARE IMMEDIATELY UNDERTAKEN IN SUCH A CASE THERE IS A RISK OF AIRPLANE EXCEEDING THE CRITICAL ANGLE OF ATTACK.

THE ONLY PROPER MEASURE TO AVOID CONSEQUENCES OF INCORRECT AIRPLANE BALANCING IS TO REDUCE POWER SO MUCH THAT AIRPLANE MAY GO OVER TO NORMAL FLIGHT WITH CLIMBING, OR, SHOULD THAT BE IMPOSSIBLE, TO HORIZONTAL FLIGHT OR EVEN TO DESCENDING FLIGHT!

wsk -342-82 3000 szt. ew. 158-9:81

15. Servicing the Heating System of Air Entering the Carburettor.

The heating of air entering the carburettor aims at preventing carburettor icing, which may occur at a temperature of ambient air equal to +5°C or lower, in cloudy weather, during snow or rainfall as well as drizzle /drizzling rain/, and at improving the conditions of creating fuel mixture especially under low temperature conditions.
In operation, the cases of detonations, shaking and break in engine operation may result for the following reasons:

a/ Fuel mixture too rich in cylinders Nos. 4,5 and 6 because of irregular distribution of mixture to cylinders. This defect is most often noticed at altitudes above 1500 m and especially in fall-winter season.

b/ Icing of Carburettor Strainers, Jets, and Throttles.
To prevent engine trouble for a/m reasons the air entering the carburettor is to be warmed up. Following operations are required:

/1/ Switch on the heating of air entering the carburettor during taxying, when the temperature of ambient air is +5°C or lower, during cloudy weather, drizzling rain or snowing and when fuel mixture temperature is lower then 0°C and keep mixture temperature within the limits of +10 to +15°C.
At low temperatures of outside air, when it is not possible to keep recommended temperatures, full heating of air is to be switched on.

/2/ The take off at take-off power is to be carried out with heating switched off. The heating is to be switched off immediately before engine check on air strip.
After take-off and overcoming the obstacles on the boundary of the airfield when the temperature of ambient air is +5°C or lower, in conditions of high air humidity, during drizzle or snowing, as well as when fuel mixture temperature is lower than 0°C, switch on the heating of air entering the carburetor and keep fuel mixture temperature between +3 and +5°C

during climbing.
Is cases when keeping this temperature is impossible, switch on full heating of air and keep cylinder head temperature not lower than 150°C.
To improve engine operation at low temperatures of outside air it is permissible to carry out the take-off with switched on heating of air at the entrance to carburetter. For this the heating is to be switched on /or adjusted if switched on during taxying/ so that under idle speed conditions the temperature of fuel mixture is within 0 to +3°C.
If the take-off is to be carried out with heating switched on, the engine testing before take-off is also to be performed with heating on.
During starting with heating the airplane commander must take into account the fact that after switching on the heating, the take-off power of the engine will slightly be reduced, which leads to corresponding elongation of take-off run and distance.
With heating fully switched on the take-off run is longer by 18-24% while the take-off distance /to the altitude of 25 m/ is longer by 2 to 27%.
After take-off with heating the further servicing of heating system is to be carried out according to recommendations of para 2. In extreme conditions /snowing, snow-storm/ when there is a risk of ice formation behind the difusor, in channels and on strains of air filter of altitude corrector and carburettor it is permissible to perform the take-off with full carburettor air heating ON.
For this purpose full heating is to be switched on directly before take-off and the engine warmed up during engine testing for 2-3 minutes.

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In such a case the climbing flight and the begining of horizontal flight is as well to be carried out with full heating ON. In horizontal flight the heating is to be reduced by steps every 10 to 15 minutes to mixture temperature between +3 and +5°C while observing engine operation. At any symptoms of engine operation being unstable appear as a result of leaning of fuel mixture, the mixture temperature must be increased to ensure normal operation of the engine.

While taking off with full heating ON the chief commander must take into account the elongation of take-off run distance by up to 24% and that of take-off distance /to an altitude of 25 m/ by up to 27%.

/3/ In horizontal flight, when the temperature of outside air is +5°C or lower in cloudy weather, snow fall, rain or drizzle, as well as when fuel mixture temperature is lower than 0°C, switch on the heating of air entering the carburettor and keep the temperature of fuel mixture within the limits from +3 to +5°C.

If very low temperature of outside air makes the reaching of required temperature of fuel mixture impossible the heating may be fully switched on.

Should some symptoms of carburettor icing appear /such as a gradual drop of manifold pressure during the flight at constant altitude and under constant engine operating parameters/ the fuel-mixture temperature is to be gradually raised to +5°C to +8°C; upon switching on the heating the manifold pressure shall decrease slightly and then it should start to rise.

After the manifold pressure stops to rise the heating is to be reduced to fuel mixture temperature of +3 to +5°C.

NOTE: If the manifold pressure decreases steadily at fuel mixture temperature +5°C to +8°C under the conditions od intensive icing the heating is to be switched on fully for 1,5 to 2 minutes whenever the manifold pressure becomes reduced by 20 to 26 hPa /15-20 mmHg/.

/4/ During descent in conditions of carburettor icing risk or when fuel mixture temperature is lower than 0°C the mixture temperature is to be established at +3 to +5°C.

/5/ For the descent and landing approach the /time of/ switching on of the heating is to be calculated and carried out so that heating is off from the begining of possible go round.

/6/ After switching on the heating the reduction of manifold pressure takes place and therefore it is permissible to increase manifold pressure to the value to keep the required engine power /and flight speed/.

16. Servicing Fuel System

The following sequence of engine fuel supply is recommended:

/1/ During airplane take-off both groups of fuel tanks are to be switched on and the fuel valve control knob is to be adjusted to "open tanks" position.

/2/ Upon climbing to a determined altitude and going over to horizontal flight the engine is to be supplied from the right group of tanks and for that purpose the control knob /of the valve/ is to be set to "right tanks open" position.

/3/ Upon using 120 to 150 litres of fuel, switch engine fuel supply to left group of tanks and use that sequence on.

/4/ When the total amount of fuel in both groups of tanks is about 300 l, go over to fuel supply from both groups of tanks by adjusting the knob to "open tanks" position. Continuous fuel supply to the engine from both tanks during the flights may lead to the following.

a/ Uneven consumption of fuel from individual groups of tanks /generally more from the left group.

b/ Fuel overflow at banks of more than 2° from group of tanks in the higher wing to the group of tanks in the lower wing; in case of full tanks this overflow of fuel may lead to fuel outflow through vent holes as soon as 20 to 30 minutes of flight. The uneven consumption of fuel leads to conditions when the difference of fuel in the two groups of tanks reaches 200 litres or more there appears a tendency to incline the airplane downward toward that wing in which the fuel tank contains more fuel.

In agricultural airplanes /as opposed to cargo transport planes/ the take-off, all manoevers involved in agricultural operations /arrival and departure from cultivated area and descent till landing are to be carried out with engine being supplied from both groups of tanks.
Since the amount of fuel in tanks is insignificant and fuel meter indications are not precise enough the calculation of fuel consumption is to be done on the basis of the time the airplane has been in the air and that of engine operation on the ground, while additionally controlling the consumption according to total indications of fuel meter.

Remember that:

1/ When engine is supplied from both groups of tanks, more fuel is consumed from the left group.

2/ When performing all kinds of flight on planes /those for cargo transport as well as special versions/ it is recommended to observe the below specified principles when using the fuel system.

a/ It is forbidden to perform flights when the total amount of fuel in both groups of tanks is less than 150 liters as well as when the fuel level in tanks of the group is less than 75 liters no matter whether engine is supplied from one or two groups of tanks.

b/ Manipulate with the fuel consumption so that, till the moment of switching the fuel supply to both groups of tanks /when total amount of fuel in both groups does not exceed 50 liters.

After going over to engine fuel supply from both groups of tanks the uniformity of fuel consumption from both groups is to be checked after 25 to 30 minutes of flight.

/3/ When warning lights of both groups of tanks just become lighted and the bell SEZ-2 from the MRP-56P set rings it means the emergency reserve of fuel in tanks is 110 liters /55 liters in each group/ (8)
Sound signal /of the bell SEZ-2/ can be switched-off by means of AZS-2 automatic circuit-breaker.
The AZS-2 is installed on the L.H. panel under the inscription "SOUND.SIGNAL.SBES".

WARNING: WHEN THE LEVEL OF FUEL IN ONE OF THE GROUPS IS LESS THAN 75 LITERS THE POSSIBLE BREAK OF ENGINE OPERATION MAY OCCUR DUE TO FUEL OUTFLOW FROM THE FITTINGS OF FUEL TANKS AT TURNS, BANKS OR IN FLIGHT IN TURBULENT AIR.

CHECK LIST

I. PRIOR TO TAKE-OFF

Prior to Taxying

1. Arranging and fixing of cargo	- cargo
2. FWD /PIS/ cover bags, oil cooler plug	- removed
3. Fixing elements, controls locks	- removed
4. Displacement of control surfaces	- correct
5. Displacement of elevator trimming tab	- correct
6. Trimming tabs	- in neutral pos.
7. Flaps	- checked, operative
8. Engine control lever position	- correct
9. Indications of engine instruments	- correct
10. Fuel	- in tanks ..... liters
11. Converter	- operative
12. Artificial horizons	- switched on, unlocked, checked
13. ADF ARK	- switched on, tuned
14. GIK-1, GPK-48	- switched on, slaved
15. Barograph	- switched on
16. Air in the system	- as required /not less than 4 MPa /40 kgf/cm^2/
17. Door	- closed

18. Check operation of brakes and tail wheel locking during taxying

Take-off Preparation

1. Fuel valve	– set to both tank groups
2. Altimeters	– zero altitude pressure of ..... mmHg RW – on range – set
3. Elevator trimming tab	– for take-off
4. Flaps /acc. to indicator/	– for take-off
5. Brakes	– normal, checked during taxying

Actual Take-off Procedure

1. Locking of tail wheel	– on /off/
2. Displacement of control surfaces	– checked-movable
3. Artificial horizon	– checked, indications correct
4. GIK-1, GPK-48	– slaved course of .... deg unlocked adjusted to zero or take-off course

wsk –342-82 3000 egz. ow. 158-9:81

5. Indications of engine instruments - normal

6. Heating of air input receiver - on

7. Parking brake - off

II. PRIOR TO LANDING

Before Descent

1. Schedule /for landing/ - perused

2. Landing data - fuel .....liters weight.... kgs center of gravity ....%MAC landing distance .... m flattening out speed......km/h

3. RW - on, range /altitude/ adjusted

4. GIK-1, GPK-48 - slaved

Going Over to Airfield Pressure

1. Altimeters - pressure adjusted to ... mmHg

2. ADF ARK - tuned to ...... identified signals

Prior to Gliding Flight /Descent/

1. Fuel valve	- for both tank groups
2. Air in System	- as required /not less than 4 MPa /40 kGs/ cm^2/
3. Parking brake	- off, pressure in brakes "0"
4. Locking of tail wheel	- locked /unlocked/
5. Flaps /acc. to indicator/	- for landing

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OPERATING AIRPLANE IN DIFFICULT WEATHER CONDITIONS

1. Taxying, Take-off and Landing

/1/ Maximum speeds of wind acceptable for take-off, landing and taxying are specified in para 2-00, page 3.

/2/ While taxying with side wind, special attention is to be paid to a risk of overheating the brakes due to intensive use. Overheating the brakes may cause inefficiency in their functionning.

/3/ Take-off with Side Wind
During take-off with side wind the airplane is to be accelerated on the ground to a speed of 105 to 110 km/h. Lifting-off at minimum speed is dangerous because it risks mushing which would cause side hit and overloading of landing gear.
During take-offrun the control wheel is to be turned towards the wind with simultaneous displacement of rudder in opposite direction to retain the straight-line track of the take-off run.
As the speed is gained, both those displacements are to be gradually reduced so that airplane lift-off takes place from both wheels rather than from a single one.
After lift-off, keep a gentle bank against wind until you go over to climbing.

/4/ Landing with Side Wind
During the landing approach with side wind from an altitude of 150 to 100 m a gentle bank is to be kept against wind with simultaneous corresponding displacement of rudder in opposite direction to keep correct flight direction and to eliminate the drift. Use trimming tabs to bring to zero the forces on flight controls. Bring airplane to three-point horizontal position immediately before touch-down. After touch-down the linearity of landing

run is to be kept by means of rudder in the first half of the run and by means of brakes - in the second.

2. Night Flights

/1/ General

The navigational and radio equipment installed on the airplane ensures the possibility of performing night flights in various weather conditions /VMV, IMC/.
The lighting of cockpit and of control desks is adequate. The lighting of passenger-cargo cabin and that of tail part of fuselage is sufficient as well.
The headlights serving for taxying, take-off and landing cross their light beams at a distance of 57 m along the airplane center-line and 6 m to the left from centerline.

/2/ Take-off, Flight, Landing

The take-off by night does not practically differ from that during the day, except that it is to be carriedout with half lowered tail.
After taking-off, the headlights are to be switched off at the altitude of 50 m /if still on/ and the flight continued.
During landing, switch headlights on at an altitude of 100 to 50 m and land similarly as in normal conditions /during the day/.
Upon ending the landing run, switch off the /main/ headlights and switch on the taxying lights.

WARNING: IN CONDITIONS OF SNOWING AND RAINING THE SWITCHING ON OF HEADLIGHTS CREATS A LIGHT SCREEN WHICH MAKES THE DETERMINING OF DISTANCE FROM EARTH VERY DIFFICULT. THEREFORE IN SUCH CONDITIONS IT IS BEST TO LAND WITHOUT HEADLIGHTS - ACCORDING TO LANDING STRIP LIGHTS.

wsk -342-82 3000 szt. ew. 158-9:81

SERVICING RADIO-NAVIGATIONAL INSTRUMENTS DURING FLIGHT

1. Servicing Intercom SPU-7.

/1/ Switch on the AZS with the inscription "SPU".

/2/ Establishing Communication with Outside:

/a/ Adjust switch on subscriber box
"MAINS" to position "1"
"SPU-RADIO" to position "RADIO"

/b/ Adjust mode switch to position which depends on your choice of the equipment to be used: in position
"UKR" - in this position works "main" USW transceiver
5 "SR" - in this position works "reserve" USW transceiver
"RK-1, "ARK-9" is in operation.

/3/ Establishing Internal Communication.
Press the push button with inscription SPU on control wheel to get connection with the remaining subscribers.
Use volume knob to adjust general volume and crosstalk as in the description of subscriber box.

2. Servicing Radio-station RS6102

5 Switc the AZS-5 on central instrument board under inscription "UKF-I" or "UKF-II" prior to switching on the transceiver.

/1/ Switching Radio-station on.
- adjust the toggle of switch to ON position /upper/;
- press the push button to annul C;
- adjust required frequency with push-buttons 0-9;
- check the correctness of records on display;
- select optimum volume of reception of your correspondent's emission with volume control switch VOL.

/2/ Switching Radio-station off
- adjust the toggle of ON switch to lower position;
- switch off the AZS-5 on central instrument board
5 under inscription "UKF-I" or "UKF-II".

3. Servicing Automatic Direction Finder /ADF/ ARK-9

/1/ Switching on and Tuning.

- Switch on the AZS-2 with the inscription "ARK" on the instrument board and wait 2-3 minutes for warming up.
- Adjust operation mode switch to position "Antenna".
- Adjust "volume" knob to middle position.
- Adjust "B-D" switch according to tuned receiver.
- Use three knobs to chose required frequency and tune finely to reach maximum displacement of tuning pointer.
- Identify the identity mark of the radio-beacon.
- Change the position of operation mode to "Compass" /ADF/
- Turn the volume control knob to the stop clockwise.

CAUTION: The ADF ARK-9 enables a simultaneous tuning to two radio-beacons with receiving them in-turn using the "B-D" /Near-Far/ switch.

/2/ Flight Towards Radio-beacon by Passive Method /without taking drift angle into account/.
This method may be used without objections for flights for short distances with no wind or with wind along the flight line or with slight side wind.
It requires following operations:

/a/ Tune the receiver to required frequency.

/b/ Adjust operation mode switch to comm "COM" position, the course indication pointer shall turn and indicate the angle between airplane longitudinal axis and the direction of radio-beacon course angle /R-BCA/.

/c/ Adjust indicator pointer to zero by turning the airplane to align it with direction shown by the pointer.

wzk -342-82 3000 szt. ew. 158-9.81

/d/ Keep airplane course acc. to zero position of ADF course indicator pointer while turning airplane if neccessary where course indicator pointer indicated.

/e/ At the moment of flight over the guiding radio-station the course indicator pointer shall turn to indicate an angle of 180° deg.

/3/ Flight Towards Radio-range-beacon by Active Method /while taking drift angle into account/.

This method is to be used whenever the cruise flight is not along the prevalent direction of wind as well as while doing any procedures within airfield area in flights without ground visibility.

Following operations are to be carried out.

/a/ Tune ADF to required frequency of radio-range-beacon.

/b/ Adjust the adjustable pointer of UGR-1 indicator to required magnetic track angle /MTA/.

/c/ Introduce airplane on the required track line -visually /acc. to landmarks / or acc. to indications of ADF ARK and GIK. The airplane shall come to required line when the following relationship is satisfied for the flight towards radio-beacon: MC + R-BCA = MTA
/KM + KKR - KDM/

where MC is magnetic course.

CAUTION: If the sum od MC and R-BCA is more than 360° deg the value of 360 deg is to be substracted from it.

With the precision sufficient for practical purposes it may be assumed that the above condition is satisfied when the pointer ARK-9 on the UGR-1 indicator is aligned with the adjustable indicator set at MTA /in a flight towards the radio-beacon the sharp ends of both pointers are to coincide/.

/d/ as soon as the required track line is reached, take a compass course /CC/ calculated earlier from meteorological bulletin /or roughly determined/ and fly on while keeping this course.
If the a/m course has been calculated correctly in agreement with real conditions on the way, the course angle of the radio-beacon /R-B CA/ shall remain constant and both pointers on UGR-1 indicator will coincide.
But if on the other hand the R-BCA begins to change at a constant course of the compass /the pointers on UGR-1 cease to coincide/ it means that the calculated compass course is not correct and the airplane deviates from required track line. Increasing of the R-B CA testifies that airplane deviates to the left, while its decreasing - that it deviates towards the right.

/e/ if you find that airplane has drifted and is no longer on required track line the following operations are required:

- re-introduce airplane onto that line by using one of the methods known in radio-navigation;
- add corresponding correction to calculated CC;
- continue the flight while keeping corrected CC and observe a/m notes.

Remember that close to radio-beacon even a slight deviation from required track line will cause a substantial change in R-BCA.
To keep the high precision of approach to radio-beacon one must go over passive course-determining method at a distance of 3-5 km from it.

/4/ Flight from Radio-beacon
If the radio is situated at the initial point of the flight or on its extention /in a directon opposite to flight direction/, use the gyro-inductive compass or ADF to guide the airplane sufficiently precisely within aimed flight region.
The procedure to be observed in the flight from the radio-beacon is similar as that for flight toward radio-beacon

with active method,/para 3/, except for following differences:

/a/ Increasing of R-BCA during the flight from radio-beacon with constant CC testifies that airplane deviates to the right from track line while its decreasing testifies that airplane deviates towards left.

/b/ In the flight from radio-beacon the sharp end of the pointer of ADF ARK on UGR-1 indicator shall coincide with the blunt end of the adjustable pointer i.e. contrary to a situation in flight toward the radio-beacon.

/c/ With the time of flight the precision of indications falls /as the distance from radio-beacon increases/.

/d/ As a condition for the airplane to be on the required track line is the following relationship:

$$MC + R\text{-}BCA - 180^{\circ}/deg = MTA$$

If the sum on the left side of the equation is more than 360° , the value of 360 deg is to be subracted from it.

5. Determining Airplane Position by Bearing of Two Radio-beacons

One of the ways to determine the position of airplane is to take bearing of two radio-beacons.

In practice it is done as follows:

/a/ Tune the ADF ARK-9 to two radio-beacons situated not further than 160 km from the track.

It is also highly desirable that the bearings of these radio-beacons cross each other at an angle close to right angle.

/b/ Read $R\text{-}BCA_1$ for one radio-beacon and switch the ADF to the second radio-beacon immediately to read $R\text{-}BCA_2$.

/c/ Draw the line of radio-bearings from points marked on the map, where the radio-beacons are situated:

$$RGRB_1 = MC + \Delta M + R\text{-}BCA_1 \pm 180^{\circ}$$

$$RGRB_1 = MC + \Delta M + R\text{-}BCA_2 \pm 180^{\circ}$$

The place of crossing of this lines determines the approximate position of the airplane at the moment of taking bearings.

/d/ To obtain a more precise result, corrections must be introduced for the convergence angle of radio-beacon meridians and for airplane position as determined above a well as the value od ΔM is to be precised. (20)

Designations: RGRB - Reversed geographic radio bearing
MC - Magnetic course
ΔM - Magnetic declination /for a determined airplane position/

4. Using Induction Compass GIK-1

Switch on power supply not later than 3 minutes before take-off, slave the compass directly before take-off by pressing the slaving push-button. Keep the push-button pressed until indicator scale stops moving. The slaving time at maximum deviation of the position of transmitter and that of indicator must not exceed 20 seconds.

5. Operation of A-037 radio altimeter.

/1/ Turning ON of radio altimeter

- using the knob "Δ" set index /7/ on the radio altimeter indicator, located on LH instrument panel /Fig.4.8a/, to the altitude you consider dangerous or of which warning you need during flight or landing; (20)
- turn ON WG-15-2s switch on LH control desk under the inscription "RA";
- turn ON AZS-2 circuit breaker on central instrument panel under the inscription "RA".

NOTE: Radio altimeter is ready for operation under normal atmospheric conditions after a lapse of 2 minutes from the moment of actuation, whereas under high humidity and low temperature conditions after a lapse of 10-15 minutes.

/2/ Dangerous Altitute Warning.

After take-off and attaining required /selected/ altitude the light /8/ on the RA indicator glows up aconstic signal lasting from 3 to 9 sec. will be andible in earohones. In the event of achieving altitude above the indicator value limit /300 m/ or when altimeter is found inefficient, red flag appears on the indicator dial, and pointer moves to dark zone. Each time the airplane reaches dangerous
20 altitude previonsly set on the indicator, acoustic device and light give warning.

CAUTION: When flying over areas thickly coated with snow or ice, over forests and mountains and at bonks above 20°C, the radio altimeter indication error may be significent so it is recommended to observe precantions.

/3/ Light and indicator illumination level control

- adjust indicator light by setting thra light /8/ movable part properly;
- indicator dial illumination level is controlled by a transformer knob on LH control desk under the inscription "RA ILLUMINATION".

6. Switching the Receiver of MRP-56P MArkers to Operation

/1/ Switch on the switch "PD-500 OPERATING" on the central instrument panel.

/2/ Switch on AZS-2 with the inscription MRP on central instrument panel.
At the moment of flying over radio-beacon the light

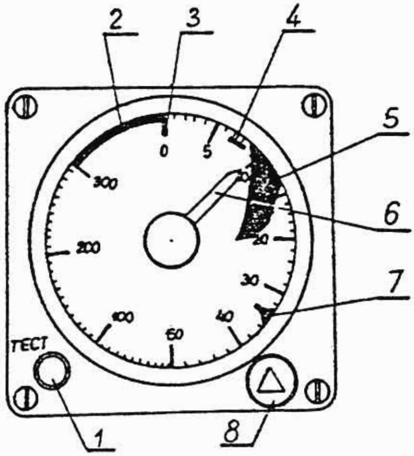

Fig. 4.8a. A-037 Radio altimeter indicator front panel.

1- Push-button "TEST"
2- Dark zone
3- Graduation "0"
4- Test zone
5- Flag
6- Pointer
7- Dangerous altitude index
8- Altitude selection knob "△" and dangerous altitude warning light with illumination level control.

(20)

with inscription "MARKER" on instrument panel starts to light and the bell on fifth frame in the cockpit begins to ting.

FLIGHT INVOLVING DROPPING OF PARACHUTISTS

1. In flights involving the dropping of parachutists the parachutist trainer or senior parachutist in charge of the dropping action must be present on board of the airplane.
   His duties are as follows:
   - ensure correct arrangement of parachutists in the airplane taking into account their weights and sequence of jumping;
   - calculate the point of airdrop and guide the pilot after reaching the area to this point;
   - determine correct frequency and sequence of dropping, give commands for jumping;
   - draw in the jumping cords into fuselage /if jumping was performed "onto cord";
   - protect parachutists against any danger all through the flight till the moment of jumping and provide help by all available means in agreement with pilot and chief commander.

   The trainer or parachutist leading the dropping action should occupy in the airplane the place No.12, where from he has a possiblity to observe the terrain through the open door of cargo cabin and to guide the pilot through the intercom.
   If such person is also to jump he is to do it last.

2. The remaining parachutists in a number of up to eleven should take during flight the places 1-6 and 7-11.

3. The airplane crew must have safety belts fastened during the flight and must wear the rescue parachutes ready for immediate use.
   The airplane must be provided with signal flags /a white one and a red one/ and with rescue cord as well as an axe.

4. The minimum meteorologic conditions required for performing the jumps are specified in Parachute Jumping Procedure.

5. The technique of take-off with parachutist on board does not differ in any way from that used in other versions of airplane operation. Take-off may be carried out with both lowered and unlowered flaps depending on the length of the airstrip.

6. Climbing

/a/ While dropping parachutists in summer, it is desired, as a rule, that the altitude required for dropping be achieved as soon as possible. This requirement is met by the following parameters:

Fig. 4.9. Diagram of the most favourable speeds along the track during climbing versus the altitude.

- engine rated power: n = 2100 r.p.m., p_k=1200 hPa /900 mmHg/ /up to critical altitude and further - full acceleration/;
- flight speed corresponding to most favourable speed along the track during climbing.

The most favourable flight speed along the track during climbing is presented in the diagram.
In a warm season there is a possibility of an excessive increase of temperature of cylinder heads and oil during longer lasting climb at rated power. In case the cylinder-head and oil temperatures are found to be near the upper limit of acceptance, go over to horizontal flight for some time to cool the engine and then continue the climbing.

/b/ The climbing to required altitude must take place within the area of the airfield by following the over-airfield go-around shape and size of which depend on the required altitude and the desired direction of target approach. Turns must be carried out smoothly and uniformly while avoiding banks and overloadings.
The place of last turning prior to passing into a target approach course must be at a distance of few kilometers from the planned dropping point and flying into it must take place before airplane reached the altitude required for jumping.

7. Upon reaching the required altitude and passing into the target approach course the conditions of horizontal flight must be stabilized at a speed of 140-150 km/h as well as a command give "Prepare for jump" through intercom or by agreed method of light signalling. Since that moment the trainer or parachitits in charge should guide the pilot towards the calculated point of dropping. On reaching this point, after a signal from the trainer or parachutist in charge, the pilot establishes the conditions most favourable for the dropping.
These conditions are as follows:
- flap displacement 0 - 10 deg;
- horizontal flight;

- flight speed V_{pp}=120 km/h
- engine speed n=1700-1800 r.p.m.
- manifold pressure - as required

8. Descent

/a/ Upon completing the dropping the pilot is to fly straight for some -teen seconds and then he is to start descent and go around over airfield. During descent the pilot is obliged to observe the parachutists descending on parachutes as well as all airplanes in the air and keep safe distance from them.

/b/ The other crew member /2nd pilot or flight engineer/ is to go to cargo cabin after dropping the parachutists, close the door and return to his place in the cockpit.

CAUTION: It is permissible to land with the open door of cargo-passenger cabin·it is up to airplane commander to decide.

/c/ In flights involving the dropping of parachutists it is, as a rule, desired to descend quickly after the dropping. The quick descent is recommended to be carried out at following parameters:

- fine pitch of the propeller;
- manifold pressure p_k=400 hPa /300 mmHg/;
- flight speed V_{pp}=220 km/h in quiet air, and

  V_{pp}= max. 190 km/h in turbulent air.

The rate of descent of 11-9 m/s is obtained at these conditions /higher value for V_{pp}=220 km/h and lower value for V_{pp}=190/.

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CAUTION! With the propeller adjusted to course pitch and the remaining parameters unchanged the rate of descent obtained is smaller by about 2 m/s.

/d/ If the landing of parachutists and of the airplane takes place on the same airfield the pilot of the airplane must remain above the group of parachutists all through the time of descent and is allowed to land only after the last parachutist is on the ground;

/e/ The temperatures of cylinder heads and of oil are to be closely observed during descent and are to be kept within limits determined by this manual to avoid the overcooling of engine.
If necessary, the descent is to be broken and horizontal flight is to be resumed to warm up the engine.

/f/ The landing technique both with and without parachutists does not differ in any way from that used for other versions of the airplane and does not require explanation /it has been described previously in this manual/.

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PERFORMING AGRICULTURAL FLIGHTS

1. Effect of Agricultural Equipment on Airplane Performance

For agricultural flights the airplane is equipped with agricultural equipment /dusting or spraying system/. Installation of this equipment worsens the airplane performance in relation to its transport version:

- maximum rate of climb decreases by 10-1,2 m/s; the real value, depending on conditions, is to be determined from diagram /see Fig. 4.10/;
- horizontal flight speed is reduced by 25-30 km/h;
- take-off run is longer by 15-20% -the real value is to be determined, depending on conditions - according to nomogram in Fig. 4.7 while taking into account the a/m increase;
- take off distance is longer by 20-25 %.

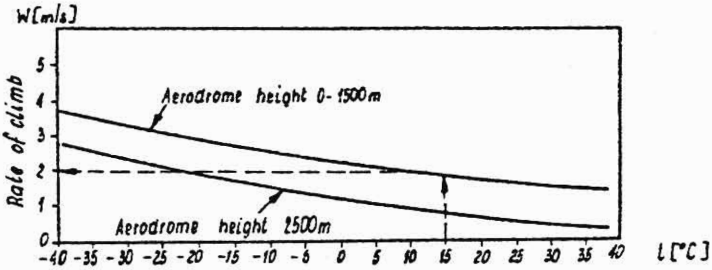

Fig. 4.10. Diagram of Climb Rate Versus Ambient Air Temperature.

Example: Ambient H=1000 m
Ambient air temperature t°=15 deg
Climbing rate of the airplane at this conditions is W = 2 m/s

During dusting flights there exists a possibility of chemicals sticking in the front part and in spreader channels. If chemical is sticking in considerable degree it creates an additional resistance which results in reduction of flight speed with unchanged parameters of engine operation.
To prevent this phenomenon the spreader must be regularly inspected and appropriate steps undertaken to prevent the sticking of the chemicals and impurities unto it.

2. Requirement for Landing Fields When Performing Agricultural Operations

1. The surface of airstrip of permanent and seasonal landing fields must be even, free of any obstacles, without elevations, hilts, concavities, furrows, and it should be shielded as far as possible. The height of grass, in case of grassy surface, must not exceed 30 cm.
2. Natural /ground/ airstrip of permanent landing field must have a size of minimum surface area of 500-60 m with terminal safety strips of 75 m each and side safety strips of 20 m on each side. The working airstrip with artificial surface of permanent landing field must have a size of minimum surface area of 500x60 m. The artificial surface must be spread on a surface of dimensions not smaller than 400 x 20 m.
3. The height of obstacles in areas of approach to permanent landing fields from the safety strip end is restricted by conventional planes of a tangent of the angle 1:30.
   From the sides of air strip the height of obstacles is restricted, from working air strip, by conventional planes of a tangent of the angle 1:8 to an altitude of 50 m and further by the plane of the tangent of an angle of 1:15.

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4. The seasonal landing field for agricultural operations must have the effective take-off strip of dimensions 500 x 60m with side safety strips 20 m on each side. The approach areas to seasonal landing fields from the side of take-off and landing in the area of 50 m from take-off must not have any obstacles above the limiting line of tangent of angle 1:50 and futher of tangent of angle 1:30.
5. In the area of side safety strips of permanent and seasonal landing fields no obstacles are permissible which could endanger airplane flight.
6. The end and side safety strips of permanent landing fields, the end strips of landingfields with artificial surface, the take-off strips and side safety strips of seasonal landing fields may be used for cultivating low-growth plants /not heigher than 0,5 m/ e.g. for clover or other multi-year grass types which do not require furrows for their growth.

CAUTION: The dimensions of take-off strips of landing field mentioned here are reduced to the conditions of standard atmosphere at sea level /p_o=760 mmHg, t_o=+15°C/

5. Preparatory Works on Airfield for Agricultural Operations

1. Prior to starting each flight day the flight commander carries out the inspection of airfield, correct arrangement of take-off and, with the help of 2nd pilot, determines the order of transport and people movement on the airfield.
2. The airplane commander is to carry out calculations acc. to nomograms of take-off and landing run distances. Depending on calculated data and airfield dimensions the take-off weight of the airplane is to be determined; the quantity of loaded chemicals determines the end of the take-off run, to be marked with red flag. The method of calculating the maximum acceptable take-off weight is as follows:

   a/ The maximum acceptable flight weight, at which the vertical climb rate min. 1.2 m/s is ensured at engine rated power, is to be determined according to nomogram in Fig. 4.13.

b/ The maximum acceptable take-off weight and flap position, for the condition of ensuring the climb gradient of 3.33% during take-off at engine take-off power, are to be determined from the nomogram in Fig. 4.14.

c/ As the maximum acceptable take-off weight is to be assumed the smallest of weights determined from nomograms in Figs. 4.13 and 4.14.. For the weight determined in this way and for appropriate position of flaps the take-off run distance is to be determined according to nomogram in Fig. 4.7 on page 29 in section 4-00 while taking account of its increase by 15-20%, see page 1 in section 4-40 para 1/.
If the take-off run distance obtained /calculated/ is greater than the available length of the take-off strip length, the take-off weight is to be reduced and the take-off run distance is to be determined again.

EXAMPLE 1: Determine the maximum acceptable take-off weight under following conditions.

Air temperature .... 23 °C
Atmospheric pressure on the airfield and on the treated field .... 688 mmHg

Calculation Procedure:

1. Determine the barometric altitude of the airfield for a pressure of 688 mmHg from the diagram in Fig. 4.11 - the result is 800 m.
2. Find the altitude of 800 m in the nomogram in Fig. 4.13 and plot a horizontal line.
If this line does not cross any of the curves of temperatures, it is to be extended to cross the weight limiting line /5250 kgs/.
Thus, for given conditions, the maximum acceptable flight weight has been limited by maximum acceptable weight for performing the agricultural operations.

3. If in our example the barometric altitude on the airfield /800 m/ is smaller than the initial altitude given in the nomogram

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/see Fig. 4.13/. Determine the required take-off run distance of the airplane for a given weight of 5250 kg.

EXAMPLE 2. Determine the maximum acceptable take-off weight under following conditions:

Air temperature .... +17°C
Atmospheric pressure on the airfield
andon the treated field 596mmHg
Calculation Procedure:

1. Determine the barometric altitude of the airfield for a pressure of 596 mmHg from the diagram in Fig. 4.11 - the result is 2000 m.

2. Determine air temperature in respect to ISA /international standard atmosphere/ for a temperature of +17°C and the altitude of 2000 - the result is ISA +15°C.

4. From the nomogram in Fig. 4.14 for the altitude of 2000 m and the actual air temperature of +17°C the maximum take-off weight is 4815 kgs when taking off with flaps at δ_{kl}=30 deg

5. As the maximum acceptable take-off weight is to be accepted the smallest of weights obtained according to nomogram in Figs. 4.13. i.e. 4750 kgs.
   The required airplane take-off run with flaps δ_{kl}=30 deg is to be determined for the weight of 4750 kgs.

EXAMPLE 3.: Determine the maximum acceptable take-off weight under following conditions:

Air temperature:

On the airfield .... +15°C

On the field to be treated .... +13°C

Atmospheric pressure:

On the airfield .... 585 mmHg

On the field to be treated .... 574 mmHg

Calculation Procedure:

1. Determine according to diagram in Fig. 4.11 the barometric altitude on the airfield - result is 2150 m, on the field to be treated - result is 2300 m.
2. Use the diagram in Fig. 4.12 to determine the temperature in respect to ISA for +13°C and the altitude of 2300 m; the result are ISA +13°C and maximum acceptable flight weight - 4540 kgs.
3. Use nomogram in Fig. 4.14 to find the barometric altitude of the airfield, 2150 m and plot a horizontal line. If this line does not cross the temperature curve /+15°C/ it is to be extended to cross the weight limiting line - the result is 5250 kgs for take-off with flaps at δ_{kl}=0°deg.
4. As the maximum acceptable take-off weight is to be accepted the smallest of the weights obtained from nomograms /see Fig.4.13/ and 4.14/ - i.e. 4540 kgs. The amount of fuel required to reach the altitude of treated field /G fuel/ is to be added to this weight. Then the airplane take-off run distance with a take-off weight of 4540 kgs + G fuel is to be determined for conditions on the airfield as in nomogram in Fig. 4.7 /see page 29, section 4-00/.

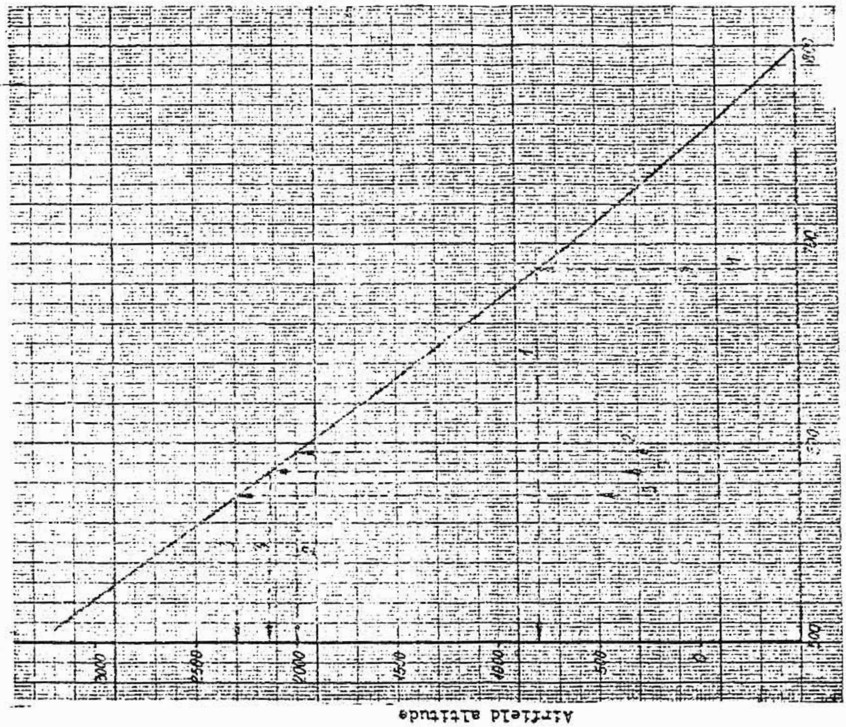


Fig. 4.11. Conversion from Barometric Pressure to Barometric Altitude of Airfield

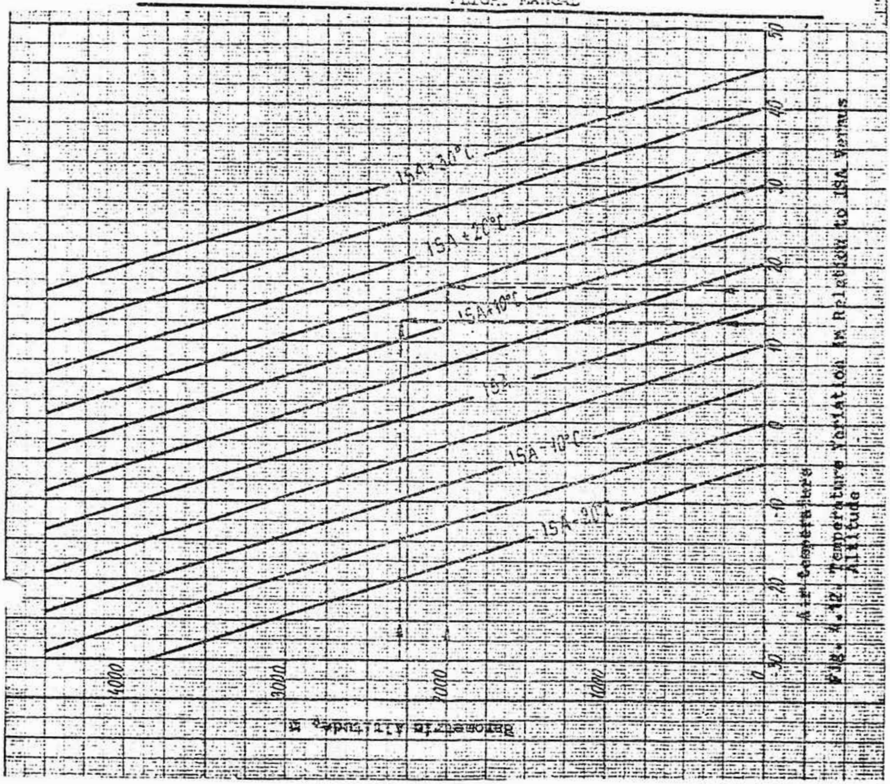


Fig. 4.12. Temperature Variation in Relation to ISA Versus Altitude

Fig. 4.17. Nomogram of Maximum Acceptable Flight Weight Versus Altitude and Air Temperature for the condition of ensuring climbing rate not smaller than 0.3 m/s.
Rated power of engine. Airplane with agricultural equipment.

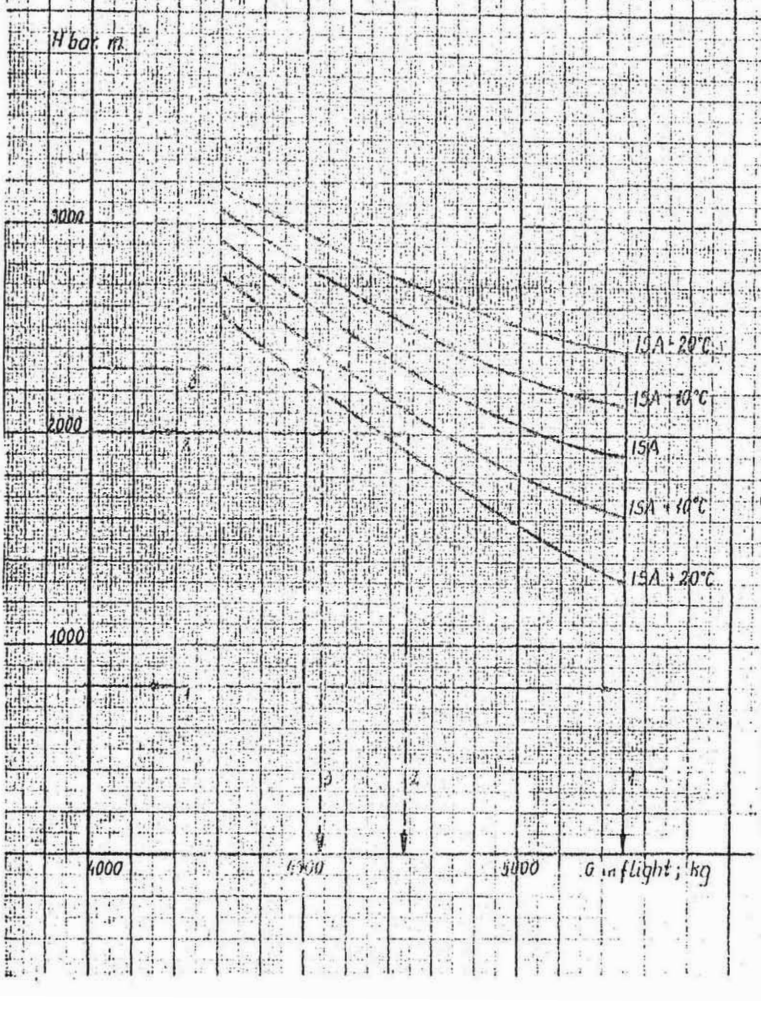
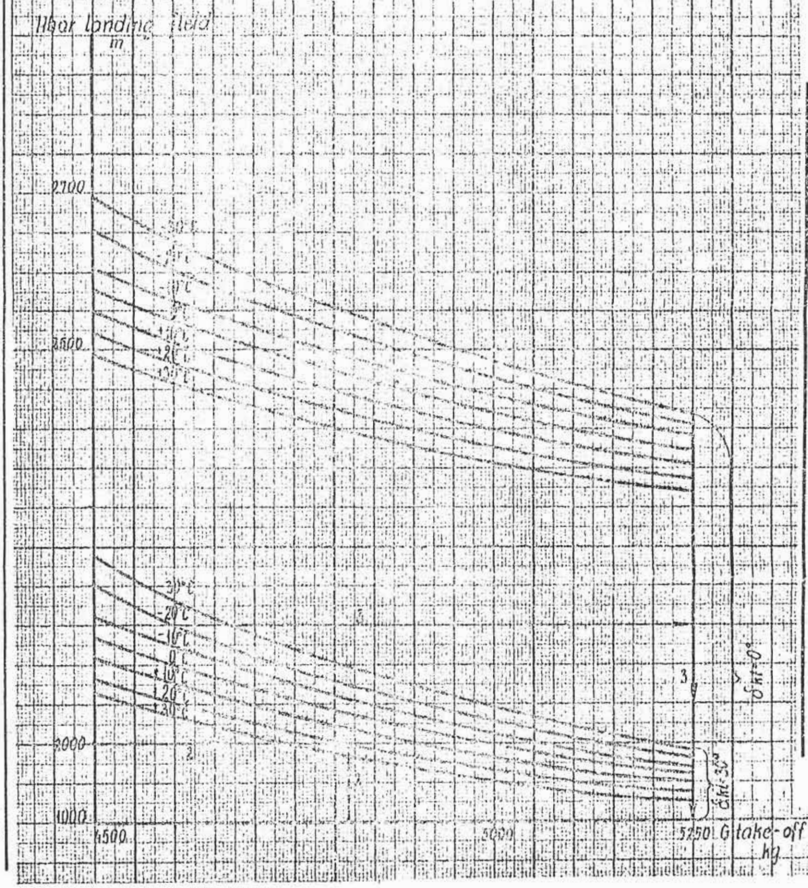


Fig. [illegible] Variation of Maximum Acceptable Take-off Weight versus Landing Field Altitude and Air Temperature from the condition of ensuring the take-off gradient of [illegible] for aircraft equipped with agricultural equipment. The take-off power of engine.



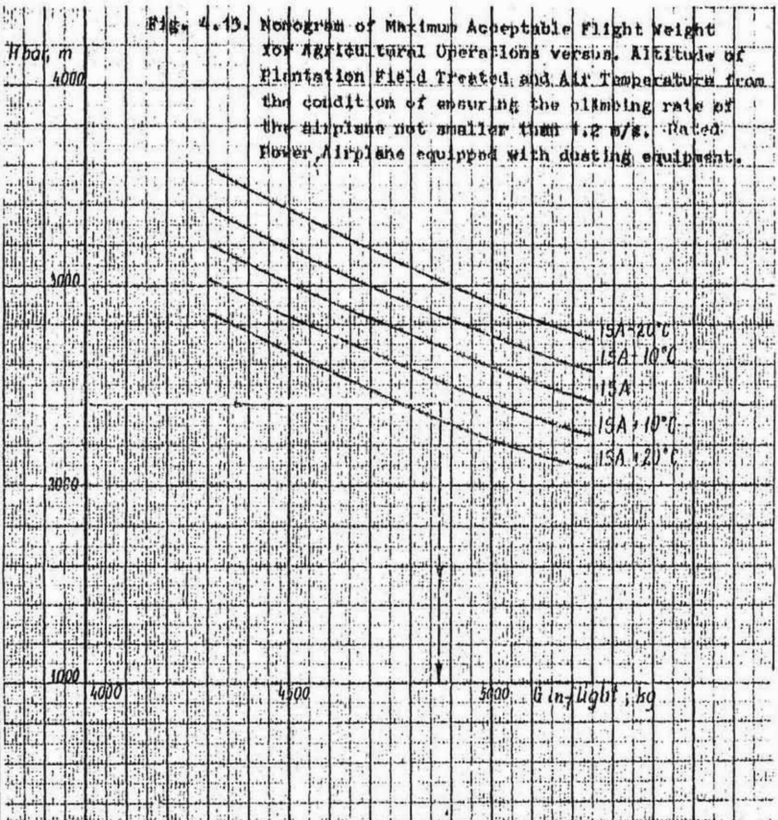


Fig. 4.13. Nomogram of Maximum Acceptable Flight Weight for Agricultural Operations versus Altitude of Plantation Field Treated and Air Temperature from the condition of ensuring the climbing rate of the airplane not smaller than 1.2 m/s. Rated Power, Airplane equipped with dusting equipment.

4. Flight Performing

/1/ Increased attention of the crew is required for piloting and precise carrying out of each flight element because of worsened airplane performance when equipped with agricultural equipment as well as because of flights at low altitudes with a large number of evolutions and manoevers. Besides, the airplane equipped with agricultural equipment, especially if it contains liquid chemicals, is more inert than transport version airplane and therefore the pilot must carry out all operations in time and more decisively.

/2/ The taxying to the place of take-off as a rule is to be carried out similarly as on transport-version airplane. Nevertheless, the more difficult field conditions are to be taken into accout and close attention paid to all possible obstacles.

/3/ The take-off from airfield with airplane fully loaded is, as a rule, to be carried out always at engine take-off power and with flaps lowered from 20 to 30 deg. The take-off run is to be carried out with three point levelling with only slight lifting of the tail in the final phose.

/4/ Climbing up to an altitude of $H_{min.}$=50 m is to be carried out in straight-line flight while gradually increasing the speed. At an altitude not smaller than 50 m and at flight speed of minimum 120 km/h the drawing in of flaps may be commenced. This operation is to be carried out gradually /by inching/ with simultaneous increase of speed so that, after complete drawing in of flaps, the flight speed is 140 km/h. Upon drawing in of flaps the engine power is to be reduced to rated value and then, on reaching altitude required for target flight to the field, establish the conditions as below /para 5/.

/5/ The target flight to the field is to be carried out along the shortest safe track while by-passing any groups of buildings and any terrain obstacles.

The target flight is to be carried out at minimum 50 m over any obstacles in flat terrain and minimum 100 m over hilly terrain and over forrest areas. Parameters for target flight to the field are as follows:

- engine speed 1750-1800 r.p.m.;
- indicated flight speed 150-160 km/h;
- manifold pressure - to be selected to suit the other parameters.

/6/ The first approach over the field is to be carried out from straight line or from the turn of maximum 90 deg. Descent to low flying is to be carried out at flight speed of $160^{\pm}5$ km/h and descent rate of max. 3 m/s in straight line flight. The returns to correct the approach angle may be carried out to max. 10 deg. with a bank of max. 15 deg and at altitude not smaller than 20 m.

/7/ Conditions for Operational Low Flying over worked Field:

- indicated flight speed $160^{\pm}5$ km/h;
- engine speed 1800-1850 r.p.m.;
- manifold pressure - to be selected to suit above conditions depending on airplane weight and on ambient temperature;
- flight altitude - depends on the kind of treatment, atmospheric conditions and is defined by separate rules. The determined flight altitude over the field is to be kept visually with possible extra check by radioaltimeter. The changes of direction during operational flight over the field are not permitted: slight deviations of up to 5 deg to correct the flight direction are to be made without banking the airplane.

/8/ Increase the manifold pressure to 800-860 mmHg at a distance of about 50 m before the end of treated section and then, on passing the limit of this section, go over to climbing with a vertical rate of max. 2,5-3 m/s. The flight speed in climb must be minimum 140 km/h.

The climbing is to be carried out along a straight line:
- to an altitude of 50 m above obstacles on even terrain;
- to an altitude of 100 m above obstacles on hilly terrain.

/9/ Increase flight speed to 1550-160 km/h on gaining the required altitude and then carry out the procedural turn or a 180 deg turn /depending on method used/.
All turns are to be carried out with a bank not greater than 30 deg, or 20 deg over forests and ravines, with full coordination kept. To come precisely onto the axis of the next swath run the effect of wind on flight track shape during the turn is to be taken into account.

/10/ Upon performing the turn the manifold pressure must be reduced to a value kept previously during flight over the worked field and the approach to low flight carried out similarly as previously.

/11/ In case of side wind, on coming to swath run axis /the axis of signal marking/, the course correction equal to drift angle must be introduced and kept all through the time of working flight over the field.

/12/ The flight back from worked field to landing field is to be carried out similarly as than from landing field to worked field with this exception that, because of smaller weight of the airplane engine speed must be reduced to within 1700÷1750 r.p.m. The flight speed 150-160 km/h does not change.

/13/ The landing approach is to be carried from straight flight or from a turn of max. 90 deg at an altitude of minimum 50 m over the obstacles.

/14/ On final approach to landing the flaps are to be lowered. As a rule each landing on provisional air field is carried out with flaps fully lowered /39.5 deg/. After lowering the approach is to be continued with /indicated/ speed 110 km/h.

With flaps lowered 30° the approach is to be performed at a speed of 120 km/h.
Braking after touch-down is to be started in the second half of the landing run.

5. Cooperation of Crew Members

/1/ Airplane acceptance from ground engineer:

- airplane commander accepts the report on airplane being ready for flying;
- He is to carry out the pre-flight inspection of airplane and its equipment in a sequence specified in section 4; besides he inspects the agricultural equipment;
- the 2nd pilot inspects the landing field during this time. If the crew consits of pilot and flignt engineer the duty of carrying out the landing field inspection lies with the pilot - chief commander.

/2/ Engine Starting and Checking

- crew are to be at their places in cockpit;
- carry out operations according to check list;
- the airplane commander or flight enginner /when crew consists of pilot and flight engineer/ starts the engine and carries out the test in a sequence presented in section 4-00;
- 2nd pilot or flight engineer is to carry out an inspection of right halfsphere and report to commander that no obstacles are present, then he is to carry out the commands given by chief commander.

/3/ Taxying

- carry out all operations called for by the check list prior to taxying out;
- taxying to the place of loading is to be performed by the chief commander according to signals of ground engineer.

- 2nd pilot /or flight engineer/ observes the right half-sphere during taxying, reports any obstacles noticed, checks the indications of instruments, keeps the engine working temperature within determined limits and carries out the commands given by airplane commander.

/4/ The airplane is in loading place:

- Airplane commander is to inspect the landing field, check the correct arrangement of take-off and determine from nomograms the take-off and landing runs, inform about quantity of chemicals to be loaded and determine the sequence of transport and people movement.

/5/ Taxying and Take-off:

- Upon receiving a signal from ground engineer, the airplane commander /or flight engineer/ starts the engine, checks according to check list the readiness to taxi out, asks by raising hand for the permission to taxy out to take-off point.
  The taxying to take-off point is carried out personnally by airplane commander;
- 2nd pilot /or flight engineer/ reports to airplane commander about the readiness for taxying out, inspects the right halfsphere, observes indications of instruments, keeps engine working conditions established by the commander as well as its temperature, monitors whether determined flight speed and altitude are kept and reports to airplane commander any variation of these values.
- Upon reaching the determined altitude the flight to the worked field is to be carried out by airplane commander or by 2nd pilot. Approach to worked field, flight over it, approach to the next swath run and climb after doing the work are to be carried out personally by the airplane commander: at this stoge of flight the second pilot /or flight engineer/ inspects the right halfsphere, keeps the engine working and temperature conditions established by airplane commander and reports to the airplane comman-

der about correct approach onto the signal line, airplane speed and altitude, observes the operation of agricultural equipment as ordered by airplane commander. During the flight from the worked field to landing the airplane is to be guided by the commander, or on his order, by 2nd pilot. The approach, calculation for landing, landing, braking and taxying to the place of loading are to be performed personally by chief commander.

Operating Details of An-2 Equipped with Dusting Equipment for Treating Fields Lying at High Altitudes.

/1/ When performing agricultural operations on fields lying above barometric altitude of 2000 m /pressure below 590 mmHg/ the maximum flight weight is to be determined from the nomogram in Fig. 4.15. Such flight weight ensures a climbing rate not smaller than 1.2 m/s.

/2/ If the landing field and worked fields lie at approximately the same altitude /$\pm$50 m/, the flight weight determined according to the nomogram is simultaneously the maximum aceptable take-off weight. If the landing field is situated at a lower altitude than the treated field the maximum take-off weight may be increased by a weight of fuel needed to reach the altitude of treated field.

/3/ For the maximum acceptable take-off weight determined from nomogram in Fig. 4.7. on page 29 in section 4-00 the take-off run is to be determined with flaps retracted to $\delta_{kl}=0^{\circ}$, and at take-off engine power.

Example: Determine the maximum acceptable take-off weight under following conditions:
- air temperature ....+15°
- atmospheric pressure at the airfield and treated field 566 mmHg

Calculation Procedure:

1. Use the diagram /see Fig. 4.11/ to determine barometric altitude for the pressure of 566 mmHg - the result is 2400 m.

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2. Use diagram /see Fig. 4.12/ to determine air temperature in relation to ISA for ±15°C and, for the altitude of 2400 m, we get ISA +16°C.
3. Use the nomogram /see Fig. 4.15/ to determine the maximum acceptable flight weight - 4870 kgs /it is as well the maximum acceptable take-off weight/.
   Determine the necessary distance of the take-off run of the airplane with flaps drawn to $\delta_{kl}=0°$, for a given weight of 4870 kg.

7. Loading Chemicals and Control of Agricultural Equipment

The airplane hopper in agricultural version is loaded with liquid chemicals through the loader valve at the left side of fuselage. The quantity of liquid chemicals is to be checked on the scale calibrated inside the hopper. The maximum acceptable quantity of chemicals is 1350 l or 1600 kg. The dry chemicals are loaded through the hopper filling port. Safety measures must be observed, according to industrial safety code, when filling the hopper. The spraying system control is to be performed in following sequence:

/1/ Before starting the engine, the PPNG-15 switches on the left part of left control wheel and on the extention of central control desk must be put to OFF /WYŁĄCZONE/ position and then the AZS-5 of AGRICULT.EQUIPM. must be switched on the central desk, the shut-off valve of the air system on the floor of cockpit between frames No.2 and 3 must be opened and the switch on left side at frame No.10 is to be put into position DUSTING or SPRAYING, depending on type of operation to be done.

/2/ Dusting.
The dusting may be switched on and off by the pilot with the switch on the left part of left control wheel or by the 2nd crew member on the extention of central desk after appropriate shifting of PPNG-15-2s switch to its LEFT position, for the control by pilot, or to its "RIGHT" position, for the control by 2nd member of the crew.

Switching on - Put the PPNG-15 switch from"OFF"position to"OPERATION"position.

NOTE: The electropneumatic system has no provisions for any separate mixing of loose chemicals. Therefore when dusting, the PPNG-15 switch must be switched from OFF position to"OPERATION"position and from "OPERATION"to OFF position.

Switching off - put the switch from"OPERATION"position to "OFF"position.

/3/ Spraying with Usual Chemicals

/a/ Sz7628-215, spraying system

Switching - put the PPNG-15 switch from OFF position to "OPERATION"position or put the PPNG-15 switch from"MIXING"position to OFF position and then, after 10 seconds, put it to"OPERATION"position.

Mixture - shift the PPNG-15 switch from OFF position to "MIXING"position or from"OPERATION"position to "MIXING"

Switching off - put the PPNG-15 switch from"OPERATION"position to OFF position.

/b/ Sz7636-0 spraying system with the injector.

Switching on - put the PPNG-15 switch from OFF position to OPERATION position or from"MIXING" to "OPERATION"

Mixing - put the PPNG-1 5 switch from "OFF" position to "MIXING" or from "OPERATION" position to "MIXING".

Switching off - put the PPNG-15 switch from "OPERATION" position first into "MIXING" position to suck out the chemicals from sub-wing pipes and then to "OFF" position.

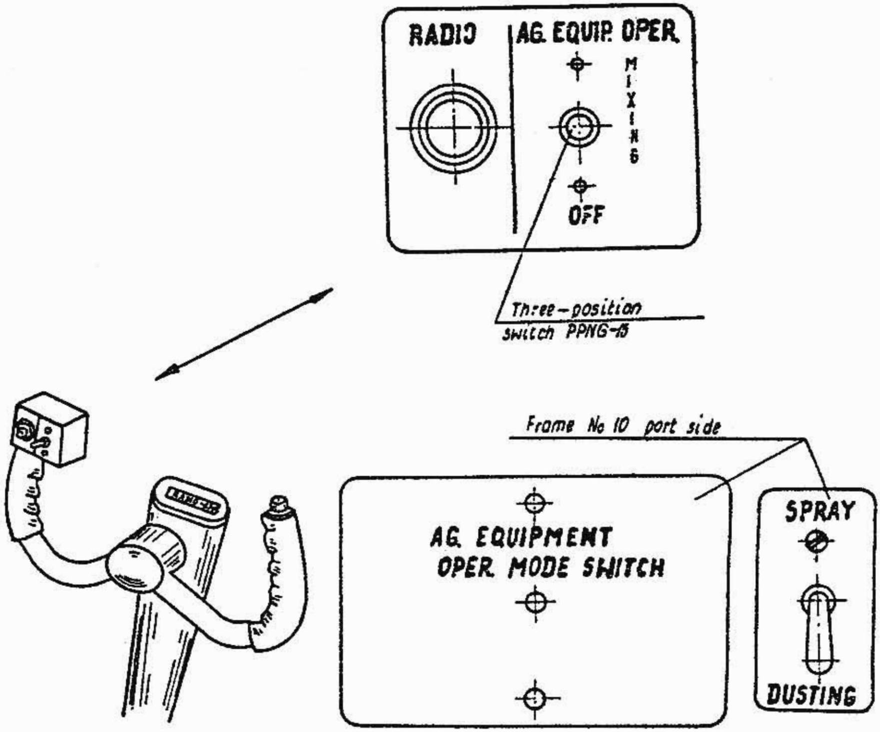


Fig. 4.16. Agricultural Equipment Control

8. Tables of Approximate Flow Rates of Chemicals at Flight Speed of V = 160 km/h

It.	Type of spraying system	Equipment	Fluid flow-rate litres/s	Total time of hopper emptying /in sec/
1	Spray system Sz7628-215 /with nozzles No. 4/	With shut-off valves	Not less than 12	112
		Without shut-off valves	Not less than 16,5	82
2	Spray system with ejector /with nozzles No.4/	With shut-off valves	Not less than 12	112
		Without shut-off valves	Not less than 16,5	82
3	Spray system with suction tanks	With nozzles of No.1	Not more than 2,5	540
		With nozzles of No. 10	Not less than 12,3	180

The spraying may be carried out with nozzles of dimensions: 1,2x5,5 mm, 2x5,5 mm, 3x5,5 mm, 4x5,5 mm, 5x5,5 mm marked sequentially with numbers 1 to 5. Besides, valves E20 may be used with caps E23. On airplanes released from Manufacturer's Works the nozzles No.4 are installed while the other ones are given over in a set with spare parts.

Nozzles with numbers subsequently lowered by one reduce each time the flow rate by l/s in relation to previous value. The flow rate of the liquid may also be reduced by using nozzles Sz7609-403 /with holes 1x1 mm/ as well as by installing glands Sz7609-537 of appropriate dimensions into square connection of distributing pipe of spraying system and by using "blind" nozzles /without holes/ installed on subwing pipes e.g. in every second hole /maximum/.

wsk -342-82 3000 szt. ew. 158-9:81

In case of installing the E-20 valves and E-23 caps /added 1:1 to spare set/ the flow rate of sprayed liquid must be not higher than 16 l/s.

The width of uniformly sprayed swath at an altitude of 10÷15 and at flight speed of 1550-160 km/h is 60 m.

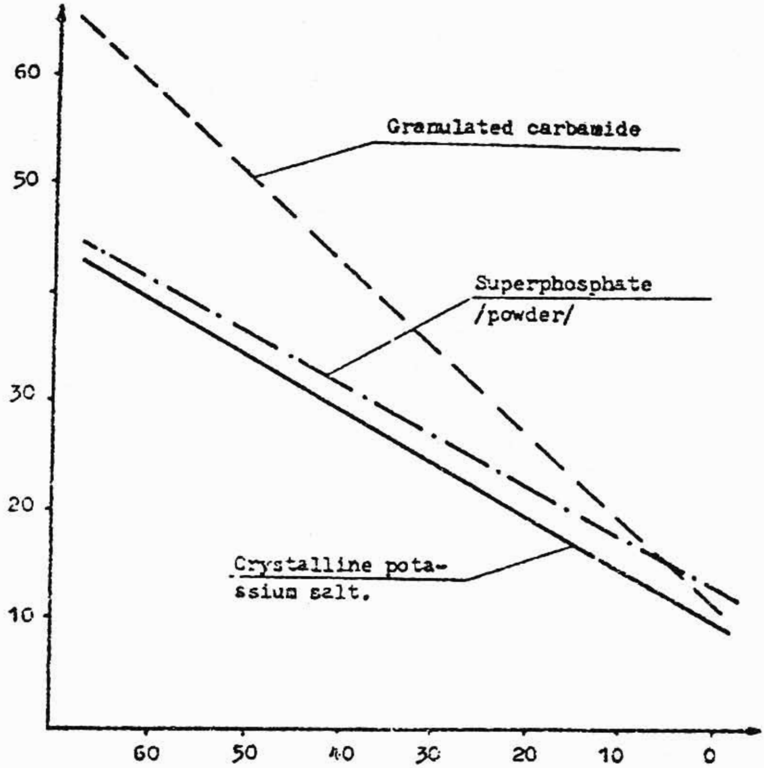
CAUTION: While using the spraying system suction tanks/on subwing pipes/ and installing the nozzle No.1 into the tee pipe it is recommended te blank every second spray nozzle with "blind" nozzle Sz7609-402-6 on subwing pipes.

B. Dry Chemicals

The table and diagram specify the approximate average flow rates per seconds for individual fertilizers with various degrees of opening the closing throat shutters.

The actual flow rates per second of the chemicals are to be determined practically during operation while taking into account the type of substance, humidity and granulation as well as other individual characteristics of chemicals used.

Specifications of chemicals	Position of adjusting screw end							
	0	10	20	30	40	50	60	max. approx. 66
1	2	3	4	5	6	7	8	9
Granulated carbamide	13	19	27	34	42	50	58	64
Potasium salt crystalline	11	15	19	24	29	34	39	42
Superphosphate, powder	14	18	22	27	27	36	41	44



Output versus adjustment position.

9. Safety Rules

The airplane crew must observe safety rules resulting from specific conditions of agricultural operations and in particular:

- do not dump the chemicals from the hopper anywhere but on strictly determined terrain covered by agricultural action;
- keep appropriate altitudes necessary in respect of flight safety and operation efficiency;
- close the door and windows of the cockpit when chemicals are being loaded into airplane;
- supply fresh air into cockpit during the flight by switching the ventilation system and shifting the cockpit window panes, if necessary.

The chemicals used in agriculture for dusting or spraying by An-2 airplanes are, as a rule, poisons for humans.
During preparatory operations /filling airplane with chemicals/ the airplane surrounding air and air inside contain often toxic dust in concentrations exceeding the acceptable values. The taxic chemicals may get in touch with clothes, shoes and bare parts of the body.
When performing the operations of dusting and/or spraying with the toxic substances the airplane crew is forbidden to smoke, eat or keep foodstuffs in the cockpit as well as in pockets of their working cloths.
After ending the work the body must be washed with warm water and soap /hands and face must be washed very throughly, and mouth is to be flushed with clean water/.

Symptoms of Chronic Intoxication

Constant overall headache, sleep disturbances, quick tiring, nervousness, weakening of memory.

Symptoms of Acute Intoxication

Burning in the mouth and along the alimentary canal, sore throat, salivation, accessive excitability, feeling of warmth, acute headache, difficulty in breathing, vomiting,diarrhoea, stomach colic, motion coordinating disturbances.

First Help

Remove the sick from toxic environment, cause him to vomit or give him vomitories, observe pulse and breath. Call the doctor.

SECTION 5–00
EMERGENCY SITUATIONS

SECTION 5-00

EMERGENCY SITUATIONS

wsk –342-82 3000 szt. ew. 158-9.81

EMERGENCY SITUATIONS

CONTENTS

SECTION 5

EMERGENCY SITUATIONS

1. Engine Failure During Take-off

/1/ When engine suffered failure during take-off, the airplane has a tendency to incline towards the nose. Immediate and decisive action of the pilot is necessary to level the airplane in time at low altitude before touch down.

/2/ Should the engine fail during take-off, the safe landing forward is possible, depending on speed and on the moment of engine failure, on those airfields and landing fields which ensure the following distances from the beginning of take-off:

Airplane speed at the moment of engine failure km/h	Landing speed km/h	Distance from the begining of take-off m
Take-off with flaps retracted at a rated power of the engine		
110	110	700
Take-off with flaps lowered to 30 deg at the rated power of the engine		
80	80	430

The values given above correspond to windless weather conditions of international standard atmoshpere for the airplane having the take off weight of 5250 kg while using the recommended techniques of take-off and normal braked landing run.

/3/ Should the engine fail during take-off from landing field which dimensions are not sufficient for landing forward, the touch-down shall take place beyond the limits of the used part of landing field. In such case slight deviation from take-off direction is allowed to avoid obstacles. Emergency landing is to be carried out.

2. Engine Failure after Take-off

/1/ Should engine failure take place after take-off but before performing the first turn at an altitude of 100 m the return to the landing field is impossible. In such case the direction of emergency landing is to be chosen taking into account the position of obstacles in take-off direction. The range of gliding flight from an altitude of 100 m with engine switched off is 800 m from a speed of 130 km/h in quiet air.

/2/ If engine failure happened at the moment of finishing the first turn /an altitude of 120 to 130 m/ a landing on landing field is to be carried out by immediate taking a turn of 90° with a bank of 30 deg and a speed of 155 km/h toward the landing place.
While taking a turn the airplane looses about 60 m of its altitude. Calculation for landing is to be corrected by lowering flaps.
Gliding flight with flaps lowered to 30 deg is to be carried out at a speed of 120-125 km/h with subsequent flattening-out as usual.

CAUTION: The method of carrying out the emergency landing is described in the further part of this section.

/3/ Engine failure and engine re-starting in flight
Engine re-starting in case of its failure during flight is easy to do but only possible when the cause of this failure has been cleared. Amoung the causes which may be cleared during flight, and which may be counteracted at least provisionally, are the following:

A. No fuel flow to engine resulting from:

/1/ Minimum, improper moving /closing/ the fuel valve.

/2/ Sucking of air by fuel pump. This defect may happen when there is very little fuel in tanks and violent evolutions are performed at the same time.

/3/ Flight with fuel valve shifted to one group of tanks and full emptying of fuel from that group.

/4/ Mechanical impurities in fuel system /filters/.

/5/ Fuel pump damage.

The characteristic feature of a/m defects is the total or partical fuel pressure drop in the system.

B. Incorrect mixture radio due to its excessive leaning by altitude correction lever.

C. No air flow to carburetor due to icing of air intake.

D. Re-starting Engine in Flight.

In all a/m instances of defects in flight the propeller contimues to turn, after engine ceased to operate, /due to autorotation/ all through the range of speed down to and including stall speed. The efficiency and speed of resuming normal engine operation will be dependent only on the efficiency and speed of clearing the cause of engine operation break.
To resume normal operation of the engine the crew must do the following operations:

/1/ Ensure flight speed of 150-160 km/h.

/2/ Adjust acceleration lever to a position as for starting on the ground. Do not switch off the magnetos and do not change position of shut-off valve.

/3/ If the indicator indicates lack of fuel pressure or its drop:

- check position of fuel valve and set it to "OPEN TANKS";
- use hand pump to create fuel pressure of 25 to 35 kPa /0,25 to 0,35 kgf/cm^2/ in the system.

/4/ If mixture leaning was used - the altitude corrector lever is to be shifted to extreme rear position corresponding to full enrichment of the mixture.

/5/ If the flight was carried out under conditions conducive to icing full heating of air entering carburetor is to be switched on.
After doing this operations the engine shall start operating.

CAUTION! In case of longer lasting flight with engine inoperative the oiling up of ignition plugs may take place. In such a case the starting may be facilitated in addition to operations as above - by switching on the ignition and pressing for a few seconds the handle of starter /to get stronger sparking on ignition plugs and a delayed ignition/.

4. Emergency Landing

Emergency landing is to be carried out in cases when the possibility of continuing the flight is excluded /break in engine operation, fire in flight and the like/. During emergency landing the piloting of the airplane and control of instruments in cockpit are to be performed personally by the chief commander.
The second member of the crew - after decision about emergency landing has been taken by the chief commander - observes constantly the right side towards the direction of gliding flight to warn the commander about any obstacles, help him in choose the place for landing and in determining the direction

of wind as well as transmits by radio a report about the place and time of emergency landing.

In case of emergency landing the airplane commander is obliged to:

- chose the place of landing;
- switch off fuel supply and magnetos and lower the flaps to 39.5 deg.

The touch down is to be carried out with mushing at a speed of 80–85 km/h. While landing onto the forest choose the low / young / and thick trees. When landing onto marsh land choose surfaces covered with bushes and bulrush. The calculation for landing is to be carried out with overshoot while loosing the excessive speed by lowering flaps or sliding.

5. Behaviour of Crew in Various Dangerous Situations During Flight

A. Engine Fire During Flight

Should engine fire be noticed during flight, the chief commander is obliged to switch off immediately the engine fuel supply while shifting the shut-off lever to "STOP" position and fuel valve to position "FUEL CUT OFF"· to switch off magnetos and converter, to close the engine cowl flaps, to tear off leaden seal from protecting cap and press the push button with description "FIRE"· and to emergency land.

B. Fire on Airplane Board During Flight

In case of fire on board of airplane during flight the crew must first of all determine its source and then take measures to put fire down without opening the dome windows or entrance door.

/a/ Close ventilation and switch off heating /if it was on/.

/b/ Put the fire down with hand fire extinguishers available on board in cockpit and in cargo-passenger cabin.

/c/ If the focus of fire is in an easily accessible open place - it is to be covered with covers, blankets or clothes to tramp out the fire.

/d/ If the source of fire endangers the cables of the electric system, the power supply is to be cut off by switching off the battery and converter.

CAUTION! 1.The duty of quick and efficient extinguishing of fire on board of airplane lies on the second member of the crew /2nd pilot, flight engineer or navigator - depending on the composition of the crew/.
The chief commander /1st pilot/ remains at the controls and prepares for emergency landing in case the extinguishing attempt proves unsuccessful.

2.In particular situations of fire on board the airplane, not covered by this manual the procedure to be taken is up to the chief commander considering first of all the safety of the crew, passengers and third persons.

C. Inefficiency of Fuel Supply System

/1/ Complete drop of fuel pressure and break in engine operation - proceed in accordance with para 3. /Engine failure and engine re-starting in flight/ while preparing for emergency landing. Emergency land if engine will not re-start.

/2/ Complete drop of fuel pressure at normal engine operation - leaks in the system or seizures in pump valve - land on the nearest accessory landing field.

/3/ Drop in fuel pressure by about 10 hPa /0.1 kgf/cm^2/ due to impurities in the insert of 12TF29-1 fine filter.

- in case of unstable engine operation, keep fuel pressure with hand pump and land on the nearest accessory landing field.

D. Inefficiency in Oil System

/1/ Complete or partial drop in oil pressure accompanied by propeller transition to high pitch: i.e. drop in engine speed and ustable operation with a tendency to stop.Emergency land!

/2/ Complete or partial drop in oil pressure while engine operation remains normal with no drop of speed - possible damage to pressure gauge or contamination of filter. Land on the nearest accessory landing field.

E. Engine Temperature Conditions

/1/ Increase of cylinder-head temperature above the acceptable value for horizontal flight /with open engine cowl flaps/ - a risk of engine seizure.
Land on the nearest accessory landing field while choosing the route enabling emergency landing.

/2/ Dramatic increase in oil temperature in horizontal flight with open oil cooler shutters - a risk of engine seizure. Land on the nearest accessory landing field while choosing the route enabling emergency landing.

/3/ Oil temperature increase and its upkeep above the value acceptable in horizontal flight with cooler shutters fully opened in winter - thickening of oil in the cooler.

If cooler heating attempts give no positive results, land on the nearest accessory landing field.

F. Smell of Gasoline with Simultaneous Gasoline Pressure Drop.

If gasoline smell appears in the cockpit with simultaneous gasoline pressure drop by less than 0.2 kgf/cm^2 the chief commander must make a decision about the necessity to emergency land onto a place chosen from the air while switching OFF the converter and all the units powered by it except for those specified in subsection "Converter inoperative" and carry out the landing.
Prior to landing, cut off fuel supply and shift fuel valve to position "FUEL OFF" as well as switch off magnetos and battery.
For emergency landing by night the battery is to be switched off only in the final phase of landing run.
In extreme cases, when no place appropriate for emergency landing is available, it is acceptable that gasoline pressure be maintained with hand pump and that flight be continued to the nearest place where landing will be feasible.

G. Converter Inoperative.

Converter failure is indicated by a red warning lamp "Converter inoperative". In such case, make sure that:

- converter is not loaded - use ammeter the pointer of which is to be at "0";
- battery is discharged - use voltammeter the pointer of which shall deviate to the right from "0".

On making sure that the converter does not operate, leave the following instruments switched on:

- all instruments for engine operation control;
- left artificial horizon AGK-47B and GPK-48;

- /VHO/ radio station for very short waves.

The loading required by a/m energy receivers is about 6.5 A. The remaining energy receivers are to be switched off and only switched on when it is vitally necessary.
In such a case two 12-A-30 batteries shall ensure the power supply for airplane board system for a flight lasting at least 2 hours.
To know the reserve of battery capacity the periodic inspection of its charging is to be carried out with the voltmeter.

H. Damage to Control Systems

/1/ Should one of the cables or tie-rods of airplane control system be torn the airplane commander is obliged to carry out the emergency landing.

/2/ If one of trimming tabs is excessively displaced /with no possibility of return/ the AZS unit of this trimming tab on central control desk is to be switched off immediately /to prevent further displacement of this trimming tab to extreme position/.

/3/ In case of excessive displacement of the trimming tab of the rudder or that of ailerons and appearance of considerable forces on control elements, reduce the indicated speed of the airplane to 140 km/h.

/4/ The airplane commander is to carry out following operations when faced by automatic displacement of elevator trimming tab to extreme position:

a/ diving

- lead the airplane to horizontal flight, do not allow any substantial loading and exceeding the maximum acceptable speed;

- keep indicated speed of 140 km/h and choose appropriate parameters of engine operation;

b/ Pitching-up

- when large forces appear on the flying controls, counter the pull up moment while not admitting the airplane to go into large angles of incidence or to exceed the minimum acceptable airspeed and keep the indicated speed of 135-140 km/h.

CAUTION: 1. When the trimming tab of the elevator is displaced in extreme position for "pitch up", the forces on flying controls are much higher than when displaced for diving.
2. If urgently necessary, the 2nd pilot helps in countering the pull-up moment on the order from airplane commander.

/5/ In flight with considerable displacement of any trimming tab the turns must be carried out with bank not more than 15 deg.

I. Break of Carrier Tape of Interwing Chamber

When the carrier tape broke during flight the airplane commander is obliged to determine flight conditions which do not cause vibration of the remaining tapes, reduce flight speed to 150 km/h and land on the nearest landing place while avoiding sudden turns.
If the flight takes place in conditions of turbulent air, land on the nearest landing field which ensures safe landing.
Breaking of supporting inter-wing tape is not a sufficient cause for immediate termination of flight.
In such a case do not permit airplane mushing while landing.

K. Vibrations of Engine, Interwing Chamber Tapes or Horizontal Stabilizer During Flight.

In case the vibrations of any of a/m elements occur during flight it should be striven to reduce vibrations by changing engine speed or flight speed. Depending on the amount of vibration the flight is to be continued to target airfield or to nearest accessory airfield.

L. Flight During Storm

/1/ Should a storm be met during flight on predetermined track so that it cannot by bypassed the airplane commander is obliged to return to the nearest airfield. If you got into an area of intensive storm the chief commander is obliged to take all measures necessary to leave this area as soon as possible.

/2/ The crossing of storm front or going into the area of stormy clouds of local character is dangerous because of a risk of getting into an area of electric discharges. Besides, high turbulence of air in storm area causes sudden shocks of the airplane which may lead to its destruction.

/3/ If the airplane gets onto the ascending stream of air /which may take place in flights in mountainous terrain/ keep the recommended flight speed by reducing the manifold pressure without changing engine speed; when airplane gets into descending air stream engine power is to be increased to counteract the descent of the airplane. If airplane continues to descend the engine power is to be increased to rated value (of-n = 2100 RPM), MP = 1197 hPa (900 mmHg) and flight speed reduced to 150 km/h to increase the rate of climb.

M. Emergency Bailing Out of Airplane in Flight.

Should mandatory need arise for emergency parachute jump the airplane crew is obliged to do the following:

/1/ Direct airplane towards uninhabited terrain.

/2/ Cut off fuel supply to engine and switch off magnetos.

/3/ Determine /if possible/ the conditions of horizontal flight at a speed of 120 to 140 km/h.

/4/ Perform a rescue jump through the door of cargo cabin.

CAUTION: Conditions in which the crew has the right to leave the airplane are specified in separate rules.

N. Leaving Airplane Through Emergency Exit

If the cockpit door and cargo cabin door /of the airplane/ are blocked in case of emergency landing the airplane may be left through emergency exit in the upper part of the dome.

The opening of emergency exit takes place by pulling toward yourself the levers positioned on the central push rod of the dome cover. On releasing the cover from supports on the dome it is to be thrown away and the airplane is to be left through the free space.

O. Replacement of Fuses and Electric Bulbs During Flight.

Fuses of type SP (SP-1, SP-2 and SP-5) serving to protect the circuits of alternating current of a voltage of 36V and 115 V are to be found in the box "RK $\frac{36}{115}$ which is installed on the wall of the fuselage in cargo cabin above the floor near frame No.5 at the right side.

The box contains the following fuses:

- for PO-500 working converter /SP-5/;
- for PO-500 reserve converter /SP-5/;
- for WF-150 voltmeter /SP-1/;
- for MRP-56P unit /SP-1/;
- for ARK-9 radiocompass /SP-1/;
- for RW-UM radioaltimeter /SP-2/;
- for AGK-47B artificial horizon /SP-1/;
- for GIK-1 gyroscopic compass /SP-5/.

On the inside of the box cover there are spare fuses three of each SP-1, SP-2 and SP-5.

Should voltage be missing in any of a/m circuits the fuse is to be checked if not burned out and, if that is the case, replaced by a new one.

If the replacement takes place during flight when power supply busses are under voltage, caution is to be exercised.

Should any of the following electric bulbs become burned:

UPO	in UPO-4 light
SM-15	in KLS-39 light
SM-30	in KLSRK-45 light
SM-39	in SLM-61 light

they are to be replaced by new ones.

The spare electric bulbs are in the central switchboard /CRS/ installed on the left wall of the fuselage near the frame No. 5 above the floor of cargo-passenger cabin.

P. Using Filings-Signalling Filter

Intermittent flashing or continuous lighting of the light on left instrument panel with a caption "Filings Present" - pay special attention to oil temperature and pressure.

If oil temperature rises or oil pressure drops with accompanying flashes or continued lighting of the lamp - land on the nearest landing field while choosing a track which enables emergency landing.

SECTION 6–00
TABLES AND DIAGRAMS

TABLES AND DIAGRAMS

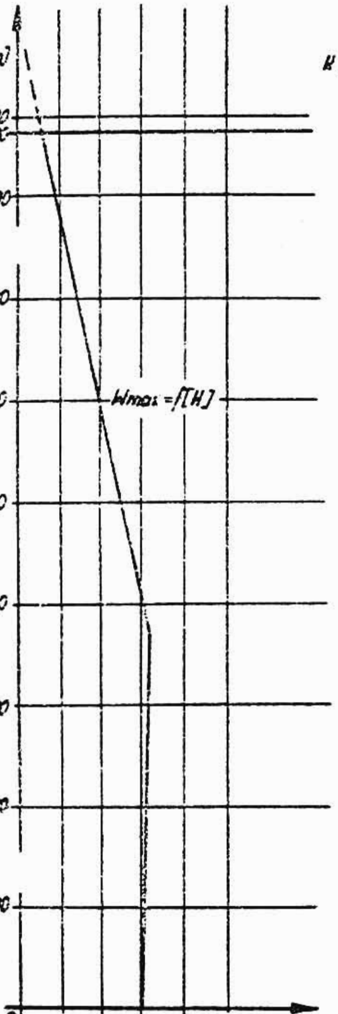
CONTENTS

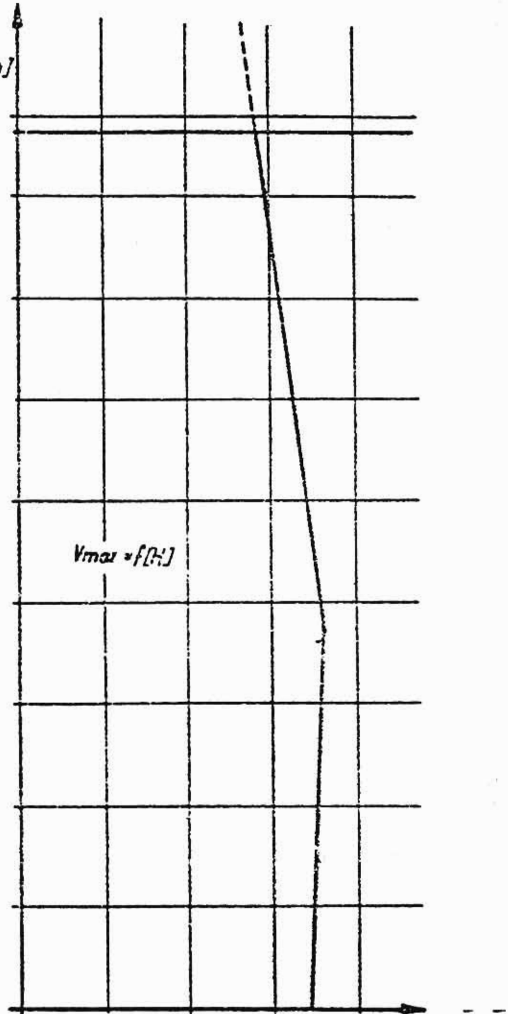
S E C T I O N 6

TABLES AND DIAGRAMS

Diagram 1

Diagram 2





Q = 5250 kg
Fig.6.1.Diagram No.1 Climbing Speed Versus Altitude

C.G. position – 24% m.a.c
Diagram No.2. Maximum Speed Versus Altitude.

wsk –342-82 3000 zzl. ew. 158-9:81

Diagram No 3

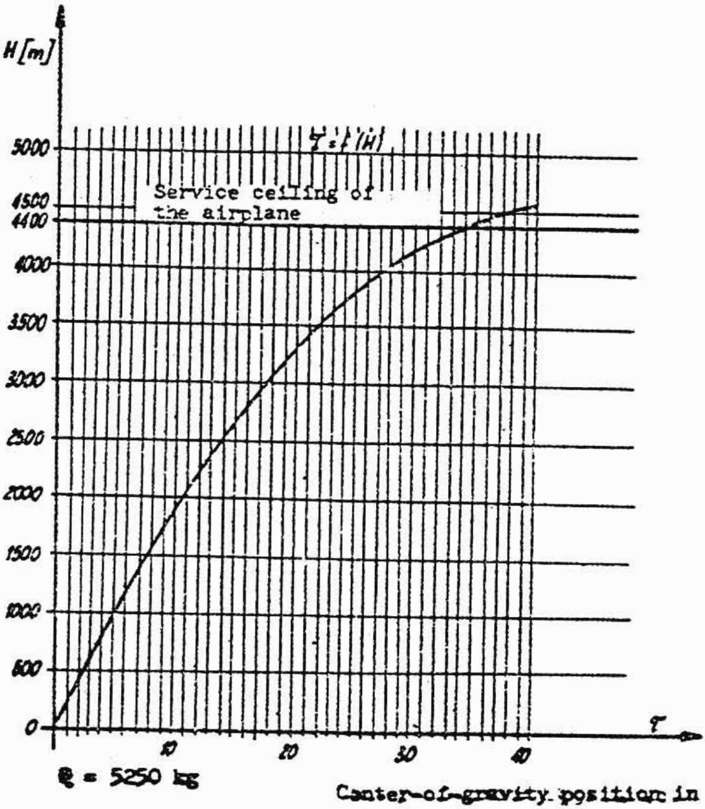
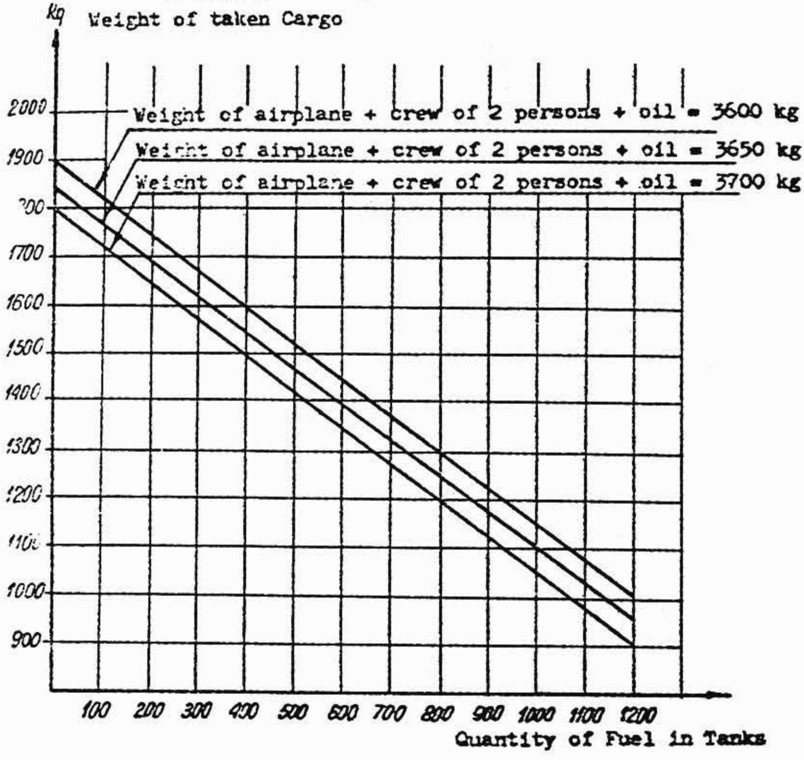


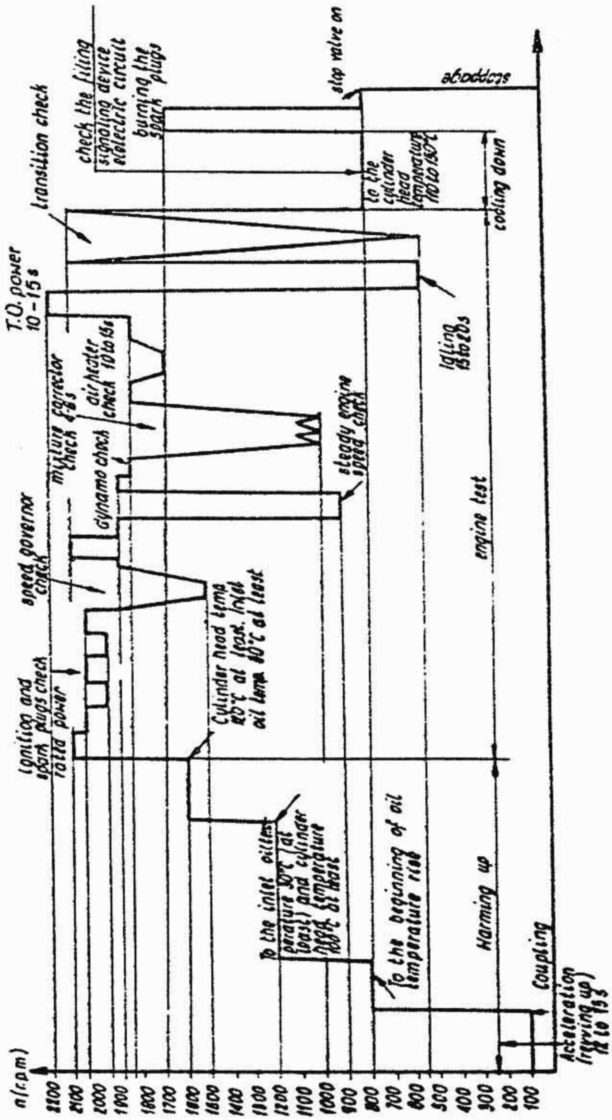
Diagram of climbing time versus altitude

Diagram of Taken Cargo in Relation to Quantity of fuel in Tanks.



CAUTION: Data accepted for the diagram of taken load: crew 160 kg and oil 75 kg total weight Q_c = 5500 kg

wzk -342-82 3000 szt. ew. 158-T.81



ASz-62IR Engine Performance Test Diagram.

Name and designation of airplane	Empty weight Q_W /kg/						Center of gravity of empty airplane x /%MAC/						Signature and Date					
Agricultural version of the airplane An-2R	New	Overhauled					New	Overhauled										
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Version with dusting system																		
Version with spraying system																		
Transport version																		
Airplane in cargo transport version or cargo-passenger version /An-2T, An-2TP/, transport-parachute version /An-2TP/, passenger version /An-2P/																		

Extract from Airplane Weighing Sheet.

SECTION 7–00
SUPLEMENTS

SECTION 7-00

SUPLEMENTS

wsk -342-82 3000 szt. ow. 158-9:81

S U P P L E M E N T S

CONTENTS

2

SUPPLEMENT No. 1

LIST OF ABBREVIATIONS AND DESIGNATIONS

G - **Mass**

G_w - **Mass** of empty airplane with additional equipment adapted for performing the assigned task **/empty mass/**

G_c - **Mass** of airplane ready to perform assigned task **/All-up mass/**

SC - Center of gravity

SCA /MAC/ - Mean aerodynamic chord

X - Position of center of gravity

V_e - Equivalent speed

V - True speed

V_p - Instrument speed

V_{pp} - Corrected instrument speed

V_w - Speed along the track for best rate of climb

n - Engine speed

m - Overload factor

P_k - Pressure in carburetor suction [illegible]

H - Altitudes according to standard atmosphere

Ap. ROLN.	– Agricultural equipment
D	– Dose of chemicals
$H_{min.}$	– Minimum altitude
LEW.	– Left
PRAW.	– Right
MAW /ISA/	– International standard atmosphere
OPRYSK	– Spraying
OPYL.	– Dusting
P	– Pressure of chemicals
S	– Working swath width
q	– Flow rate of chemicals
$t_{otocz.}$	– Ambient temperature
$\delta_{kl.}$	– Flap displacement angle
WYL.	– Switched OFF

② SUPPLEMENT No. 2

CONVERTION TABLE

PARAMETER	UNIT OF MEASURE		CONVERTION RATIO
	NAME	DESIGNATION	
PRESSURE	pascal	Pa	1Pa = 1N : /1 m²/
	kilogram force per square centimeter	kgf/cm²	1 kgf/cm² = 98066.5 Pa
	milimeters of mercury column	mmHg	1 mmHg = 133.322 Pa
POWER	wat	W	1W = 1J : /1s/
	horse power	KM /HP metric/	1KM=735.49875 W

CAUTION: This manual presents parameters in SI and in metric system of units.

wsk –342-82 3ooo szt. ew. 158-9.81

SUPPLEMENT No. 3

SUPPLEMENT TO THE FLIGHT MANUAL FOR An-2 AIRCRAFT POWERED BY ASz-62IR ENGINE, An-2 TP VERSION ADAPTED FOR TRANSPORTATION OF PATIENTS

Airplane: 1G211-01, 1G211-02
1G214-06, 1G214-07

SECTION 1-00

B. Cargo-passenger cabin

The cargo-passenger cabin of An-2TP airplane adapted for carrying patients is modified in comparison with the serial airplane in transport-passenger version.
Due to those modifications as well as additional equipmant installed on the airplane it may be utilized in the following basic versions:

- version 1 – the airplane is equipped with 6 /six/ stretchers grouped by three at each wall, 1 /one/ seat mounted on the cabin starboard at the frame No. 15;
- version II– the airplane is adapted for transportation of 7 /seven/ passengers in comfortable seats.
- compound version – the passenger seats mounted on the cabin one wall and the stretchers on the second wall.

For transportation of patients, till the special stretchers will be done, the standard stretchers with standard attachment /i.e. cables and brackets on both cabin walls/ are used.

The special stretchers are attached by means of racks and brackets which may be quickly installed or removed.
The special stretchers are quickly installed on the airplane and protected against their displacement by means of blocking.

Additional equipment for carrying patients consists of: holders for drip installed on the ceiling, bracket on frame No 5 for fixing two oxygen cylinders of 5 l capacity each, downcast ventilators installed between stretchers.
To establish contact between cabin personnel and crew the SPU-7 caller's box is used.
It is mounted nearby the seat at frame No 15.
At airplane standstill in order to change the air in passenger cabin the ventilating system should be actuated.
In order to switch on the fans installed in underwing containers put the change-over switch situated on the L.H. panel into the position "WŁĄCZ" / ON /.
The fans force the air into ventilating collectors installed on both cabin sides.
The containers are mounted on the airplane instead of air scoops /see, Fig. 1.8. position No 7/.
The passenger cabin is additionally furnished with hot air collectors.
Hot air consumption may be individually controlled by means of collector shutters.
Air heating system is shown in Fig. 7.1.
In order to facilitate the passengers entrance and exit the airplane is equipped with the special entrance stairs with handrails.

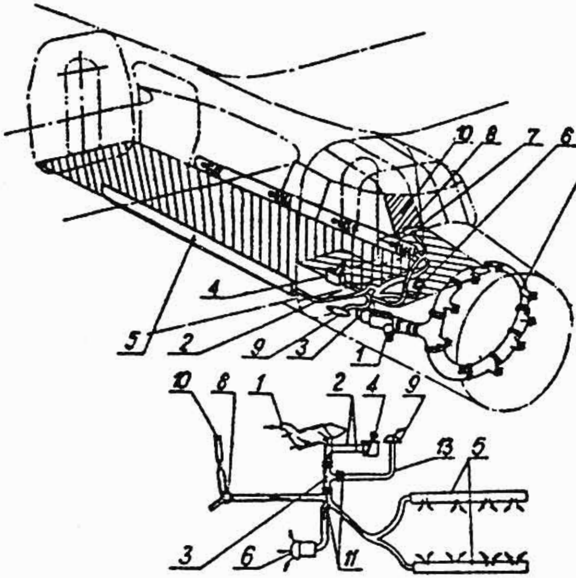


Fig. 7.1. Cabin heating system

1-air intake
2-shutter control cables
3-distributor
4-distributor control lever
5-passenger cabin heating collector
6-cockpit heating valve
7-collector
8-windshield heating valve
9-hot air outlet
10-heated windshield
11-throttles
12-exhaust manifold
13-pipe

wsk -342-82 3000 szt. ow. 158-9.81

SECTION 4-00

NORMAL PROCEDURES

D. Airplane loading

Empty airplane mass and its center of gravity with seats and stretchers mounted on the airplane are given on page 7-00/9.

Considering, that the center of gravity at full amount of fuel, crew and patients together with medical staff does not exceed 30,5 % MAC it is sufficient to sum up the mass of airplane loaded for take-off.

If the passenger from 1st seat passes to the lavatory the center of gravity will not exceed 32 % MAC.

WARNING! The passengers are not allowed to stand in the lavatory at take-off and landing.

EXTRACT FROM AIRPLANE WEIGHING SHEET

Name and designation of airplane	Empty mass of airplane Q_w /kg/ ж						Center of gravity of empty airplane X /% MAC/						Signature and data					
	New	Overhauled					New	Overhauled										
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Airplane in transport-passenger version An-2TP adapted for transportation of patients																		
Airplane equipped with 7 seats																		
Airplane equipped with 6 stretchers and 1 seat																		
Airplane equipped with 4 seats on cabin starboard and 3 pairs of stretchers on cabin portside																		

ж Empty airplane mass consists of the following equipment:
Batteries 2 pos
Cushion for pilot seats 2 pos
Signal pistol and 12 signal rockets
Underwing containers with fans 2 pos
Oxygen cylinders 5 l each 2 pos
Stretcher fixing units

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SUPPLEMENT No. 4

to the Flight Manual for the An-2 aircraft powered by ASz-62IR engine being equipped with the "BAKŁAN-5" transceiver.

"BAKŁAN-5" transceiver operation

1. Switching the transceiver into operation.
   a/ Before switching the transceiver into operation set the PSz /ПШ/ switch situated on the "BAKŁAN-5" remote - control panel to bottom position /OFF/ /ВЫКЛ./
   b/ Put the operation mode switch to position UKR /УКР/ and turn the general volume control /ОБЩАЯ / to obtain max. volume on the SPU intercom caller's box.
   c/ Switch on the transceiver supply by means of AZS-5 with the inscription UKF situated on the central instrument panel. After 1 minute since the moment of its switching on the "BAKŁAN-5" transceiver will be ready to work.
   d/ Adjust the volume by means of volume control situated on the SPU control panel.
2. Switching the transceiver to desired communication channel. Select the desired frequency using two knobs situated on the transceiver remote control panel /Fig. 7.2/.
3. Change from reception to transmission. In order to pass from reception to transmission press the push-button "RADIO" on the left or right control wheel as appripriate depending on which place the talk will be carried from.
   Passing from transmission to reception is established after release of the push-button.

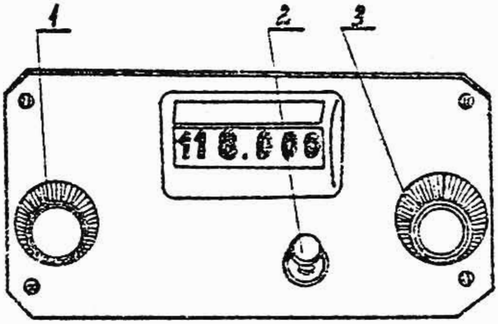

Fig. 7.2. "BAKLAN-5" transceiver control panel

1,3-frequency knobs /selectors/;
2-squelch suppressor change-over switch.

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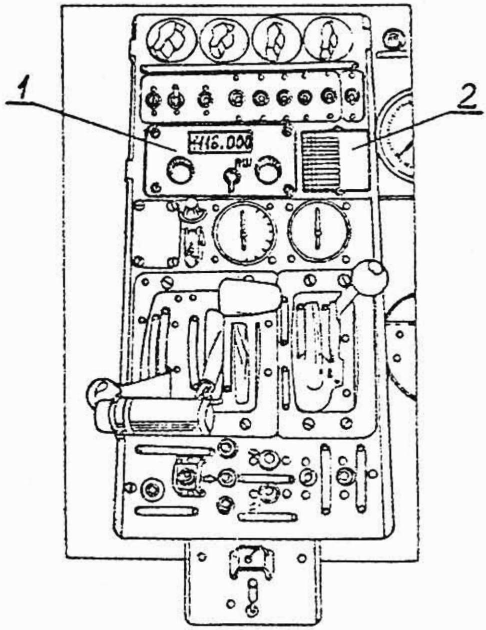

Fig. 7.3. Central Console

1-"Bakłan-5" radio station control panel

2-Frequency display

SUPPLEMENT No 5

Supplement to the Flight Manual for An-2 aircraft powered by ASz-62IR; An-2R /agricultural version adapted for transportation of passengers

GENERAL

Tis Supplement is aimed at informing the ground and flight staff about service conditions of An-2 aircraft in agricultural version, being equipped with additional equipment /described further on/ for transportation of 12 passengers in more comfortable conditions.

CHAPTER 1-00

6. CABINS

B. Cargo-passenger cabin

Owing to additional equipment and different modifications introduced to cabin it may be used for transportation of passengers /besides its main functions, i.e. for agricultural, transport-paratroop and sanitary tasks/.
Owing to these modifications a considerable gain in travel comfort and cabin features as compared with the aircraft in agricultural, transport-paratroop and even transport-passengers version, has been also achieved.
The cabin in passenger version contains:
- twelve soft seats installed in flight direction in 4 rows, 3 seats in each row. The seat backrest is of reclining type and automatically returns to its initial position;

- decorative upholstery of cabin walls, ceiling, frames No 5 and 15;
- emergency /escape/ hatch built in the cabin starboard between frames No 10 and 12. It is intended to enable the passengers to abandon the aircraft in case when it is impossible or difficult to leave it through the door;
- audible signalling system to call the crew memebers. It consists of the SEZ-2-45 bell installed in the cockpit and four call-push-buttons 204 K installed on frames No 7 and 10 on both fuselage sides nearby the seats, as well as lamps disposed on cabin ceiling;

In consequence of installation of emergency hatch, the aircraft in sanitary version can be equipped with four stretchers only /not six as in serial An-2R/; 3 stretchers - on the aircraft port side and 1 - on its starboard.
In order to enable the passengers entrance and exit, the entrance stairs are used, just as in An-2TP version.
In flight, the stairs are fixed to the frame No 15 on the aircraft starboard.

7. Aircraft systems

A. Pneumatic system

The aircraft is additionally equipped with pneumatic system arranged for dual control of wheel braking.
The dual control allows the instructor to teach the trainee the way of braking the aircraft and even to completely assume personel control of the braking operation.

CHAPTER 1-20 AIRCRAFT EQUIPMENT

1. Flight, navigational and radio equipment

The aircraft has been additionally equipped with the reserve

ultra-short waves /USW/ transceiver RS 6102.
This transceiver is set up on the right instrument panel.
Actuation and servicing of the transceiver are described in section 4-20.

Section 4-00 NORMAL PROCEDURES

Aircraft loading

In the passenger-transport version of the aircraft the transport of 12 passengers with their personal luggage is permissible.
The center of gravity of loaded airplane must be determined each time before the flight on the basis of center-of-gravity determination diagram and loading example.
Empty aircraft mass and center of gravity position are given in the Extract from airplane weighing sheet on page No 21.
The way of determining the center of gravity position from diagram and by static-moment method is given in Flight Manual on page 4-00/23.
Loading example:

- empty airplane with center of gravity at 21,95% MAC /as an instance/	3505
- passengers / 12 x 75 /	900
- crew	160
- oil	50
- fuel	885
Airplane loaded for take-off	5500 kg

Center of gravity acc. to diagram is 30.7 % MAC

WARNING! THe passengers are not allowed to stand in the lavatory and near the emergency hatch at take-off, climb and landing.

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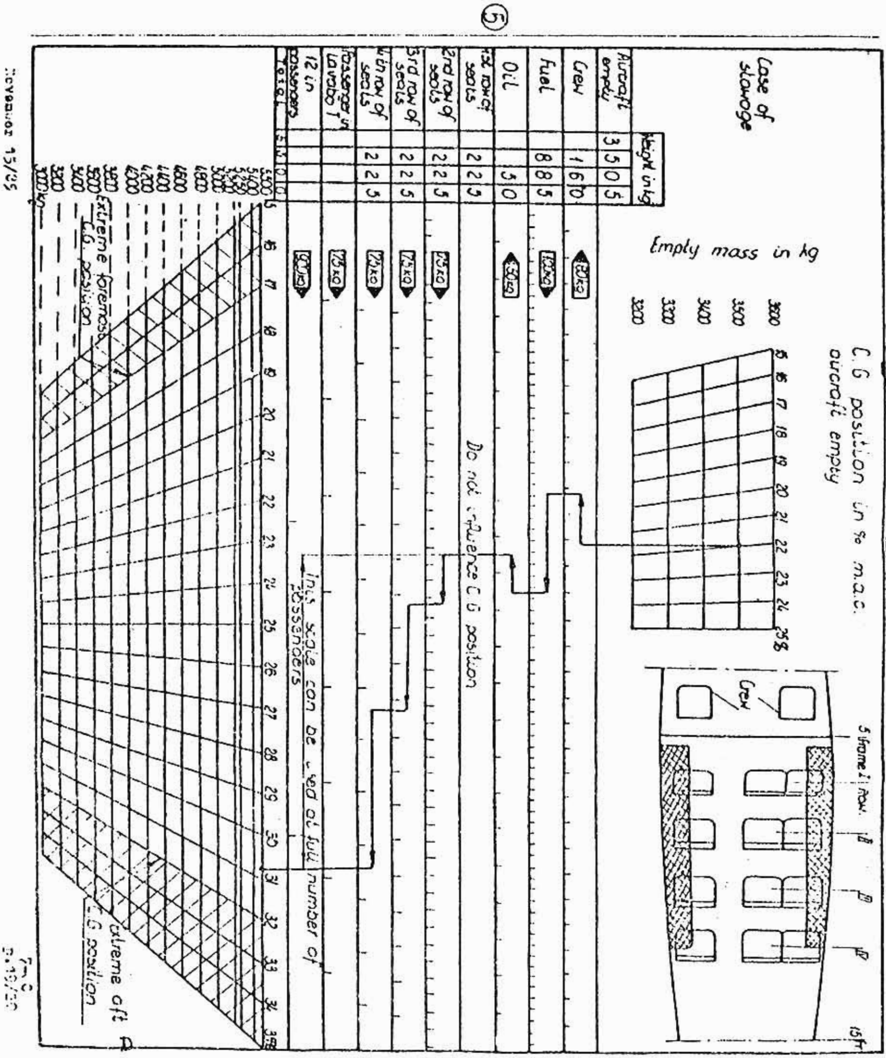

Diagram for Determining Position of Center of Gravity.

(5)

Name and designation of aircraft	Empty mass Q_w /kgs/ *						Center of gravity of empty airplane x / % MAC /						Signature and data					
Aircraft in agricultural version An-2R	New	Overhauled					New	Overhauled										
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Version with dusting system																		
Version with spraying system																		
Transport-paratroop version																		
Passenger version																		

Extract from Airplane weighing sheet

*/ Empty airplane mass includes the equipment given in the table on page 7-00/22

Item	Name of equipment /unit/	Drawing number, type	Amount	Aircraft version		
				agricultural	transport	passenger
1	2	3	4	5	6	7
1	Batteries	12A30	2	x	x	x
2	Cushion for pilots seats		2	x	x	x
3	Signal pistol and 12 signal rockets		set	x	x	x
4	Cargo mounting cords /in a floor imbedded box/		9	-	x	-
5	Cargo mounting clamps		17	-	x	-
6	Carpet	MP1000-0	1	-	-	x
7	Step	MP1375-0	1	-	-	x
8	Step	serial An-2R	1	x	x	-
9	Hand-rail	MTP0450-20	1	-	x	x
10	Cargo-passenger cabin ventilating system					
	a/ venting collectors		L+R	-	x	x
	b/ exhaust fan with pipes	DW-201	1	x	-	-
11	Floor panels	MSzJ0402-100	1	-	x	x
12	Floor panels	MSzJ0402-150	1	x	-	-
13	Droping ropes	MSz0415-0	1 set	-	x	-
14	Cargo-passenger cabin decorative upholstery	just as for An-2TP	1 set	-	x	x
15	Decorative upholstery of 5 and 15 frames		-	x	x	x
16	Passenger seats with belts	MP12-10-0	12	-	-	x

1	2	3	4	5	6	7
17	Angle bars and passenger seats fixing units	MP1360-0	1 set	-	-	x
18	Side passenger seats with belts	TP0418-0	12	-	x	-
19	Cushions	MTP0450-230-1	12	-	x	-
20	Radio equipment ARK-9 - receiver, frame antenna, feeder	- -	-	-	x	x
21	Dusting and sprying equipment /acc. to WTSz-O-II/	- -	-	x	-	-
22	Cockpit door /frame No 5/	MTP0105	1	x	x	-

SUPPLEMENT No. 6

SUPPLEMENT TO THE FLIGHT MANUAL FOR THE An-2 AIRCRAFT POWERED BY ASz-62IR / AIRPLANE 1G220-26÷31/ PERTAINING TO AMOUNT OF TRANSPORTED PASSENGERS OR PARACHUTISTS.

CHAPTER 4-00

Aircraft stowage

The aircraft can carry 11 passengers or parachutists.
/The seat No. 1 is not mounted on the aircrfat/.
The C.G. position of the stowed aircraft shall be determined on base of the diagram with the exception of the passenger on first seat.
The seats arrangement is showed in Fig. No. 7.2.

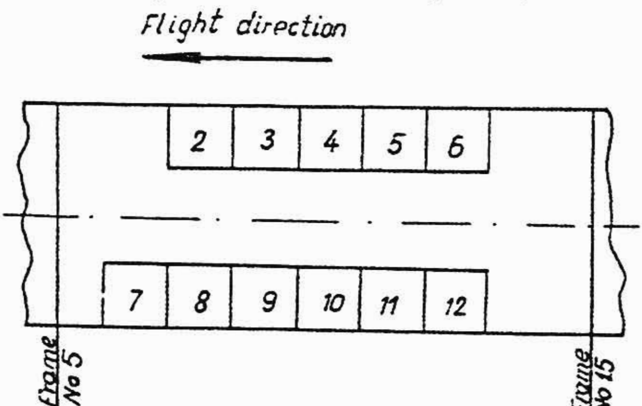

Fig. 7.2. Seats arrangement

SUPPLEMENT No 7

SUPPLEMENT TO THE FLIGHT MANUAL FOR An-2 AIRCRAFT POWERED BY ASz-62IR ENGINE AND EQUIPPED WITH A NEW TAIL WHEEL

Mandatory from 1G224-01 airplane

GENERAL

This Supplement is aimed at informing the service and flight personnel of changes conc. the An-2 tail wheel replacement by another one.

STATEMENT OF MODIFICATIONS

From 1G224-01 airplane, instead of the tail wheel made of AK-6 forging furnished with the blocking system to block the tail wheel in neutral position, the tail wheel made of welded elements without blocking system is used.
The new tail wheel is set up into neutral position at take-off and landing by means of cam system.
In consequence of the a.m. the following units are not installed on the airplane:

1. Air hoist and electro-pneumatic valve 694700M of pneumatic system;
2. AZS-5 and SLM-61 signalling lamp on instrument panel central plate /items 1 and 3 on page 1-20/6/

UTILIZATION

If you carry out works per "Control list" before take-off and landing do not perform procedures conc. the inspection of tail wheel blocking mechanism.

S U P P L E M E N T No 8

SUPPLEMENT TO THE FLIGHT MANUAL FOR AN-2 AIRCRAFT POWERED BY ASZ-62IR ENGINE, RESULTING FROM INSTALLATION OF SLATS DISPLACEMENT LIGHT SIGNALLING

Mandatory from 1G214-09 airplane, on special request

DESCRIPTION OF MODIFICATIONS

From 1G214-09 airplane the light signalling of slats displacement is installed, on special request of the Users.
The light signalling is switched on by means of AZS-2, situated on instrument panel central plate. Close to it, the lamp with red filter is mounted. The lamp is alight at full displacement of both slats.

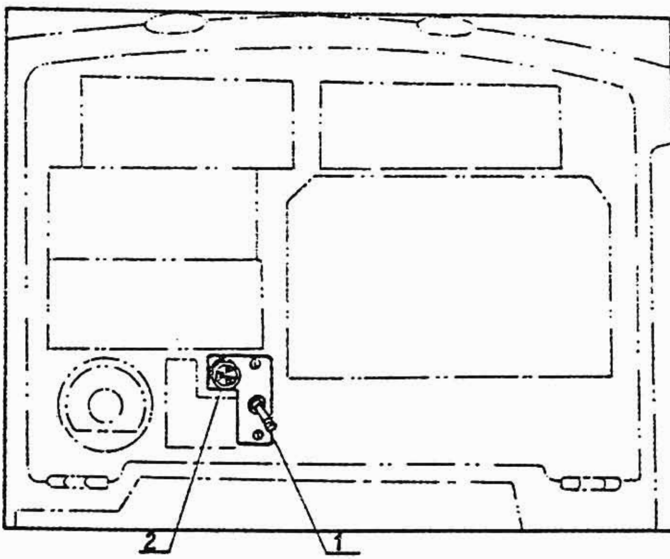

Fig. 7.3. Instrument panel central plate
1-AZS-2 for sygnalling of slat displacement
2-Signalling lamp of slats displacepent

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S U P P L E M E N T No 9

SUPPLEMENT TO THE FLIGHT MANUAL FOR An-2 AIRCRAFT POWERED BY ASZ-62IR ENGINE RESULTING FROM INSTALLATION OF SLATS DISPLACEMENT LIGHT SIGNALLING AND IN - STALLATION OF LAMPS WITH INSCRIPTIONS "EXIT" AND "EMERGENCY EXIT".

Mandatory for 1G222-37 airplane (identity mark YU-BOP) on special request.

On User's special request on 1G222-37 airplane the light signalling of slats displacement and the lamp with inscription "EXIT" above passenger door and the lamp with inscription "EMERGENCY EXIT" above emergency hatch are installed.
The lamp signalling slats displacement is installed on L.H. instrument panel (Fig.7.4) and AZS-2 for switching on the supply of signalling circuit is installed on L.H. control desk (Fig.7.5).
The lamp "EXIT" is switched on by means of AZS-5 situated on instrument panel central plate with inscription "AZS for lighting siren behind instrument panel..."
The lamp of emergency exit is switched on by means of AZS-2 situated on L.H. control desk with inscription "EMERGENCY EXIT" (Fig.7.5)

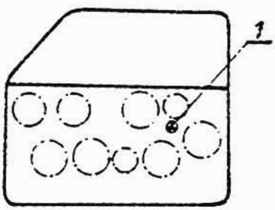


Fig.7.4.
L.H. instrument panel
1-lamp for signallig slats displacement

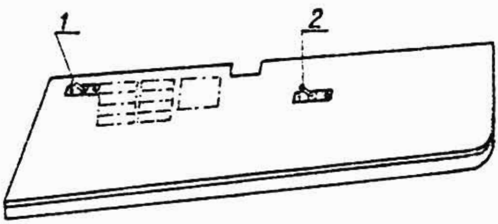


Fig 7.5.
L.H.control desk
1-AZS-2 for emergency exit lamp
2-AZS-2 for slats displacement signalling

SUPPLEMENT No. 10

SUPPLEMENT TO FLIGHT MANUAL OF THE AN-2 AIRPLANE POWERED BY THE ASz62IR ENGINE RELATING TO THE OPERATION OF THE FOLLOWING RADIO-NAVIGATIONAL EQUIPMENT:

- AR 3201 VHF TRANSCEIVER
- AR 3202 VHF TRANSCEIVER
- KR 87 AUTOMATIC DIRECTION FINDER
- ATC-2000 TRANSPONDER WITH ENCODING ALTIMETER

AND OPERATION OF THE AIRPLANE WITH 12 FORWARD FACING PASSENGER SEATS.

Effectivity - 1G224-13 and up.

1. AR3201 Transceiver Operating Instructions

WARNING: Do NOT switch on the transceiver during engine starting or shutdown.

Before switching ON the transceiver first switch ON the airplane electrical system and the AZS-5 located on the central panel under the inscription "COM I" and put the mode selector located on the SPU-7 box to the position "UKR".

/1/ Switching ON

- position the switch 7 (fig.1) to "ON"; after a few seconds the digit 188,88 will appear in the display; then the emergency frequency digit 121.500 will be automatically displayed when the channel selector 6 is in the position "A".
  In the channel selector positions from 1 thru 4 the pre-stored channel frequencies will be displayed.
- if a frequency other than the pre-stored ones (formely fed into the memory) must be chosen position the switch 6 to "A" and set the desired frequency using the knobs 4 and 5.

/2/ Communication with ground radiostation.

- select the frequency of the desired radiostation
- set the volume adjustment knob (Fig.1) to a median position
- press the button "RADIO" on right or left control wheel and call the ground radiostation. Change-over from transmission to reception takes place upon releasing the button.
  If the signals received are weak or noise is heard position the switch 7 /ON/OFF/ to "SQL".

Storing /programming/ frequencies /feeding into transceiver memory/

- position the channel selector /6/ to "A"
- select the desired frequency using the knobs 4 and 5
- position the channel selector to any memory store channel number /from 1 to 4/
- press in the STORE button /2/

NOTE: When cancelling or changing stored frequency in any channel proceed in an analogical manner.

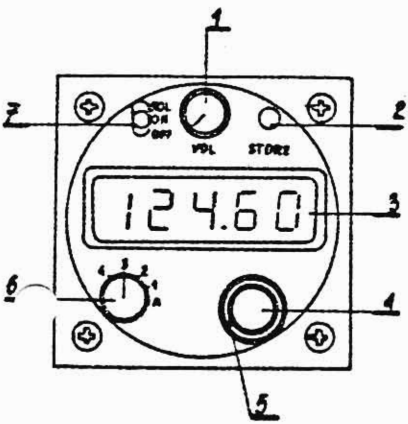


Fig.1. AR3201 transceiver front panel.

1-Volume adjustment knob /potentiometer/
2-Store button
3-Frequency display
4-kHz frequency programming knob
5-MHz frequency programming knob
6-Memory store channel selector
7-Transceiver ON/OFF and SQUELCH switch

The transceiver location on the airplane is shown in Fig.no.2.

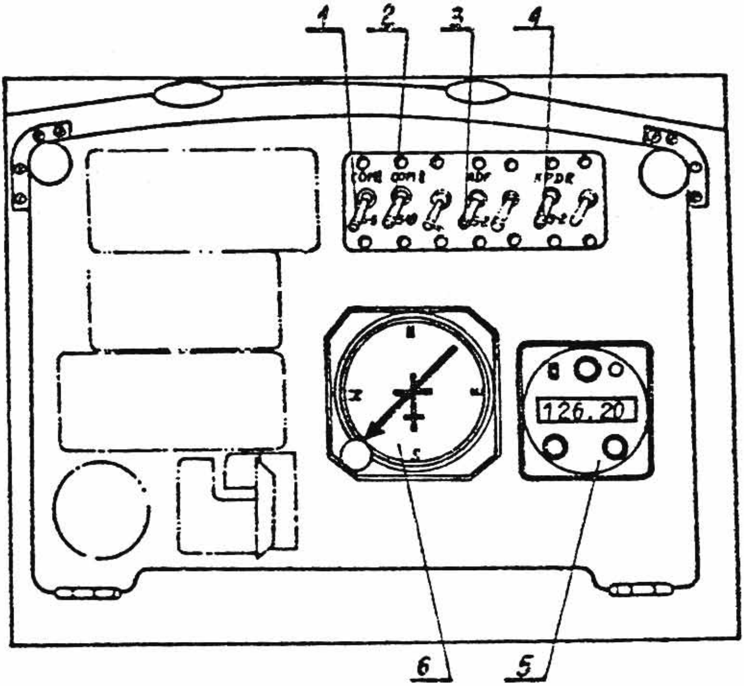


Fig. 2. Central instrument panel.

1- AR 3201 transceiver AZS switch
2- AR 3202 transceiver AZS switch
3- KR 87 automatic direction finder AZS switch
4- ATC-2000 transponder AZS switch
5- AR 3201 transceiver
6- KI 227 automatic direction finder indicator

2. AR 3202 TRANSCEIVER OPERATING INSTRUCTIONS.

WARNING : Do NOT switch on the transceiver during engine starting or shutdown.

B Before switching ON the transceiver first switch ON the airplane electrical curcuit and the AZS located on the central instrument panel under the inscription "COM II" and put the mode selector switch located on the SPU-7 box to the position "CP",

/1/ Transceiver switching ON and self-test /autocontrol/

- put the ON/OFF 9 switch (Fig.3) to ON /pressed/; the most recently selected channel frequencies will apper in the active /1/ and preset /3/ frequency displays

  NOTES : 1. If the memory back-up battery has failed, the channel frequency 126.000 MHz will appear in the active frequency display.

  2. If the channel frequency flashes ON and OFF in the display alternately with a row of dashes, this means that the transceivar cannot be operated in this frequency; use the knobs 4 and 5 /Fig.3/ to select another channel frequency.

- press the TEST button. The digits 188.88 should flash ON and OFF in both LCDs.
  If the transceiver is functioning properly the green indicator lamp will light up and a 1000 Hz tone should be audible in the headset.

/2/ Transmission and reception

- using the knobs 4 and 5 select the frequency of the local ground station
- set the volume control knob 10 so that the marking points in the display window are aligned.
- press in the button "RADIO" on the right or left control wheel and call the ground station.

  NOTES: 1. If the green indicator lamp is lit this means that the transmitter is operating properly.

  2. If the red indicator lamp is lit this means that the transmitter output is mismatched.

- switch OFF the squelch function 8 /depress SQL button/
- when the ground station answers, using the volume control knob adjust the correct volume for reception
- switch ON the squelch function 8 /release SQL button/

/3/ Setting the preset /standby/ frequency

- using the button 6 /Fig.3/ switch ON the preset display /both the active and the preset /programmed/ frequencies are displayed/.
- use the knobs 4 and 5 to select the desired frequency in the programmed /standby/ frequency display.

/4/ Swapping frequencies in the LCD's

- with the button 6 switch ON the preset /standby/ frequency display
- press the button 2 /Fig.3/ for a short time; this causes the active and preset frequencies to be exchanged for one another.
- To reverse the prodedure press the button 2 once again.

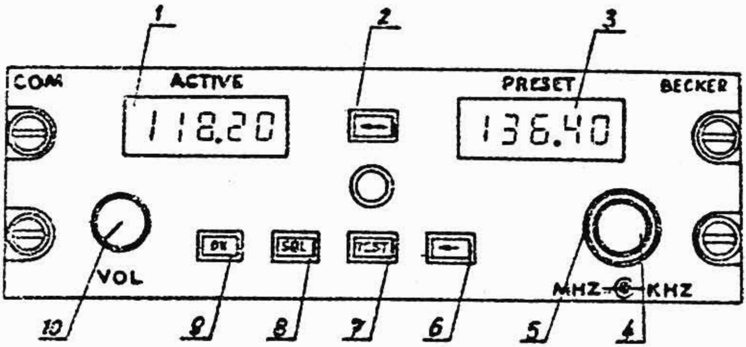


Fig. 3. AR 3202 transceiver,

1- Active frequency display
2- Transfer button /swapping active to preset frequency and vice versa/
3- Preset frequency display
4- KHz frequency adjustment knob
5- MHz frequency adjustment knob
6- active/preset frequency selector button
7- test button
8- squelch button
9- ON/OFF
10- volume control knob /potentiometer/

The AR 3202 transceiver location is shown in Fig.4.

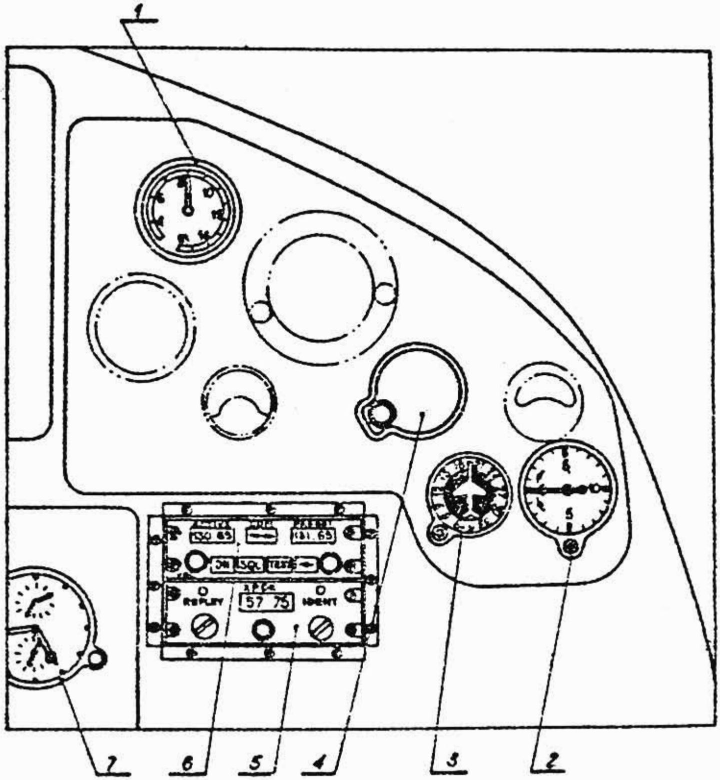


Fig. 4. RH instrument panel.

1- MW-16U pressure gauge
2- WR-10U rate-of-climb indicator
3- UK-3 indicator /GIK-1 kit/
4- Encoding altimeter
5- ATC-2000 transponder
6- AR 3202 transceiver
7- ACzS-1 time clock

3. KR 87 AUTOMATIC DIRECTION FINDER OPERATING INSTRUCTIONS

WARNING : Do NOT turn on the ADF during engine starting and shutdown.

/1/ Switching ON

- switch ON the AZS located on the central instrument panel under the inscription "ADF"
- position the mode selector switch located on the SPU-7 placard to "PK-1"
- rotate the knob 4 /Fig.5/ clockwise past the detent

  NOTE : This knob is also used to adjust the volume.

/2/ Operating modes

The KR 87 Automatic Direction Finder has two operational modes.

- In the ANT /antenna/ mode /ADF button (9) out/ the loop antenna is disabled and the unit simply acts as a receiver The KI 227 (Fig.7) indicator needle will remain parked at the 90° relative position and the "ANT" message on the left side of the display will be lighted
  This mode is used for station identification.
  For easier identification of the stations a beat frequency oscillator /BFO/ function is provided.
  Pushing the BFO switch (8) will cause a 1000 Hz tone to be heard whenever there is a radio carrier signal present at the selected frequency. If will also light the "BFO" message in the center of the display.
- With the ADF button depressed, the unit is placed into the ADF mode and loop antenna is enabled.
  The "ADF" message on the left side of the display will be lighted and the indicator needle will point to the relative bearing of the selected station.

In order to tell if there is a sufficient signal for navigational purposes, the pilot can place the KR 87 back into the ANT mode, parking the indicator needle at 90°
When the unit is then switched to the ~~ADF mode~~, the needle should slew to the station bearing in a positive manner, without excessive sluggishness, wavering, or reversals.

/3/ Frequency control.

A. Active frequency - is the frequency to which the ADF is tuned.
It is displayed in the left hand window. It may to changed with the concentric knobs 3 when either time mode /flight timer or elapsed timer/ is being displayed in the right hend window.
The small knob is used to set the 1's digit and the 10's digit. Turing the large knob changes to 100's digit and 1000's digit.

B. Standby frequency

The standby frequency is displayed in the right hand window when the "FRQ" message is lighted.
It may be changed, with the knobs /3/ in a manner similar to thet explained above for the active frequency.
If not being displayed the standby frequency may be called to the window by pressing the "FRQ" button /7/.
Pressing this button when the standby frequency is displayed causes the current standby and active frequencies to be exchanged.

/4/ Timer

A. Flight timer

The flight timer is displayed in the right hand window when the "FLT" message is lit.

B. Elapsed timer

This timer has two modes: count up and count down.
When power is applied it is in the count up mode starting at zero.
If elapsed time /"ET"/ is currently displayed pressing the "FLT/ET" button 6 will cause the flight timer to be displayed. Pressing this button again will exchange the two timers in the display. If the standby frequency is displayed, pressing the "FLT/ET" button 6 will cause the timer which was last displayed to reappear in the window.

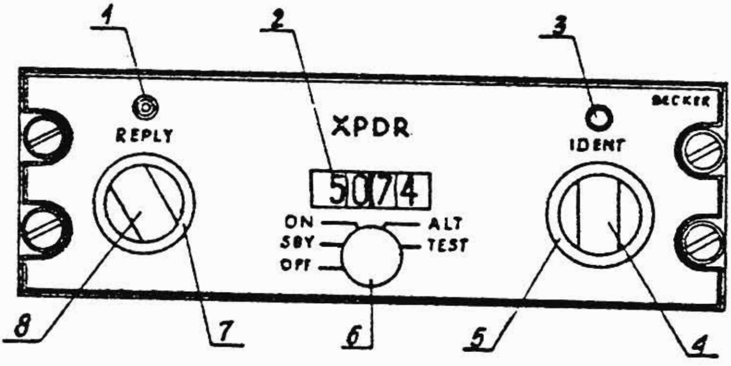


Fig. 5. Automatic Direction Finder.

1- Active frequency; 2- Standby frequency or timer; 3- Concentric frequency tuning or time setting knobs; 4- ON/OFF and volume control knob; 5- Timer set/reset button; 6- Flight timer /elapse timer button; 7- Frequency display button; 8,9- Mode selector buttons.

The KR 87 ADF mounting location is shown in Fig,6

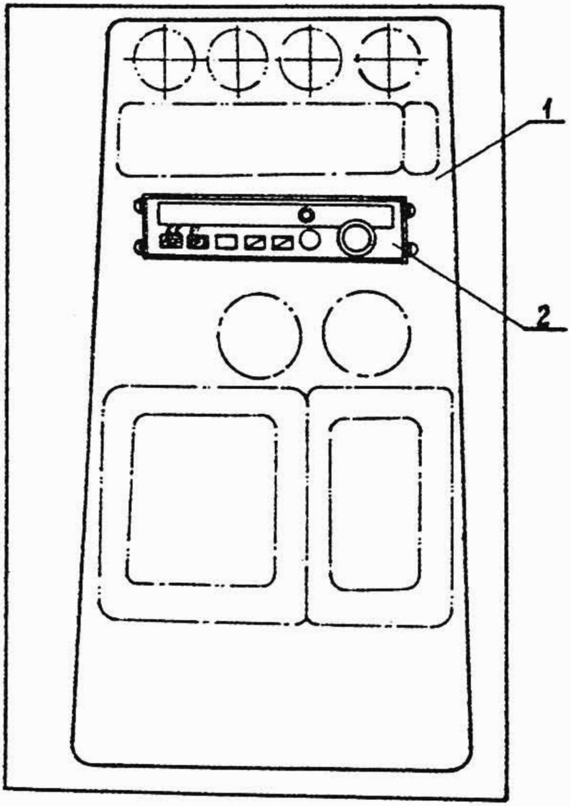


Fig. 6. Central console

1- Console
2- KR 87 Automatic Direction Finder

The KI 227 Automatic Direction Finder indicator mounting location is shown in Fig. 2

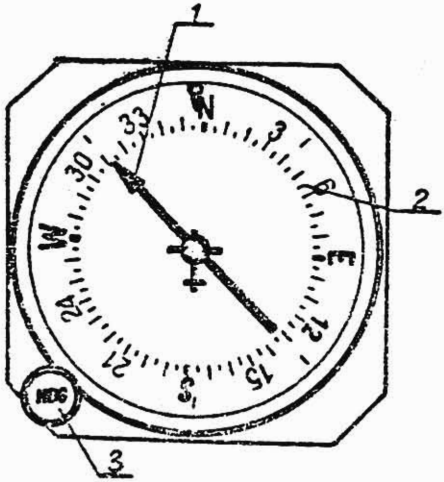


Fig. 7. KI 227 ADF indicator

1- Bearing pointer

2- Compas card

3- Heading knob

4. ATC 2000 TRANSPONDER OPERATING INSTRUCTIONS

WARNING : 1. Do NOT switch on the transponder during engine starting or shutdown.

2. Before switching On the transponder first switch ON the airplane electrical system.

/1/ Switching ON

- move the mode selector switch 6 /Fig.8/ from the position "OFF" to the position "SBY" for the period of 60 seconds.
- move the mode selector switch 6 /after 60 seconds since switching ON/ past detent to the position "TEST"/ In this position the lamp "REPLY" 1 should be lit/.

/2/ Operation in mode A

- activate the transponder only on request of the Air Trafic Control /ATC/.
  To provide for instant readiness of the transponder for operation during the whole flight the mode selector 6 should remain in the "SBY" /standby/ position.
- using the four coding switches 4,5,7,8 set the code required by the Air Trafic Control. Two-digit codes should be located in the first two windows of the display.

WARNING :

a/ move coding switches only when the mode selector switch 6 is in the "SBY" /standby/ position.

b/ do NOT operate transponder at codes 76 and 77 as these are reserved for emergency situations.

c/ do NOT use transponder at the code 0000 because then only frame impulses are transmitted which is not sufficient for ground station identification of the airplane.

- position the mode selector switch 6 to ON only on request of the Air Trafic Control - the transponder responds then to the interrogation of the "A" type which is signalled by lighting of the lamp "REPLY"
- press the "IDENT" button 3 for a short time only on request of the Air Trafic Control - this causes quick identification of the airplane by the ground radar system,

/3/ Mode "A" operation and mode "C" operation

- position the mode selector switch 6 to "ALT" only on request of the Air Trafic Control - in this position the transponder apart from the code transmits also the airplane flight altitude.
- On request of Air Trafic Control the pilot presses the "IDENT" button on the transponder to initiate a special identification pulse instantly identifying the airplane on the radar screen.

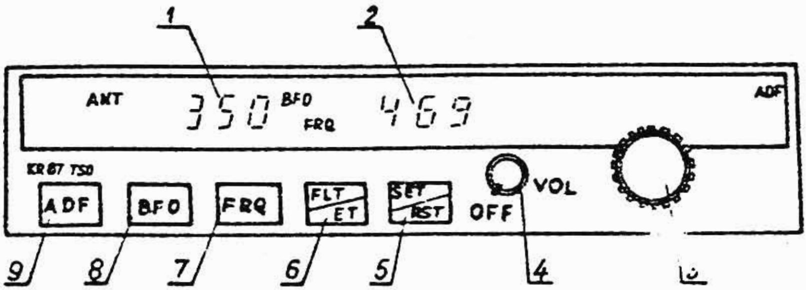


Fig. 8. ATC 2000 transponder face panel

1- reply lamp

2- code display

3- identification button

4,5,7,8 - coding switches

6- mode selector switch

The transponder, encoding altimeter, ACzS-1 time clock, MW-16U pressure gauge, UK-3 indicator, WR-10U rate-of-climb indicator mounting locations are shown in Fig.No. 4.

Fig. No. 9 shows the mounting location of the KPP-MSz receiver of the KUSR-MP-2 navigation system.

NOTE : Detailed description of the design, operation and maintenance of the AR-3201, AR-3202, KR 87 and ATC 2000 units is given in the documentation furnished by the manufactures with the units.

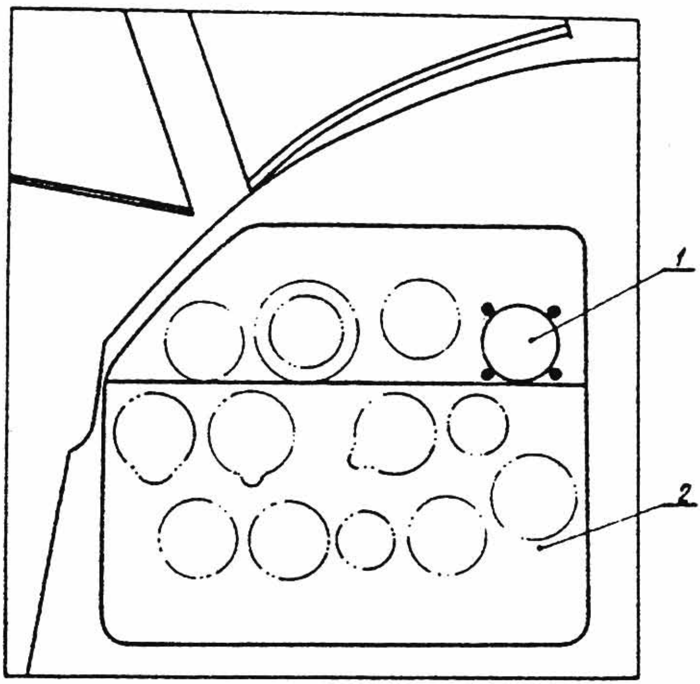


Fig. 9. Left hand instrument panel.

1- KPP-MSz nav.receiver of the KURS-MP-2 system

2- Panel

5. TRANSPORT-PASSENGER CABIN

The transport-passenger cabin provides for mounting of 12 forward facing passenger seats after dismounting side seats.
When transporting passengers in forward facing seats proceed as follows

a/ determine the center of gravity position on the basis of the chart given in section 7 on pages 19/20 of this manual.

b/ to facilitate the entry of the crew into cockpit it is recommended to remove the cockpit door or dismount the middle seat in the first row and carry only 11 passengers.

c/ the center of gravity position of the empty airplane with 12 seats is given in section 7.00, page 50.

EXTRACT FROM THE AIRPLANE WEIGHING Sh.

Airplane description and designation	Empty weight Q_M /kg/*/						Empty C.G.position x /% MAC/						Signature and date					
A/c in transport-parachute drop version An-2TD	New	After overhaul					New	After overhaul										
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Transport-parachute drop variant *) including KURS-MP-2	/*						/*											
Passenger variant (12 forward facing seats) *) including kurs-MP-2	/*						/*											

*/ The following equipment is included in the empty airplane weight :

<u>For transport - parachute drop variant</u>

Batteries	2 pcs
Pilot seat cushions	2 pcs
Flare pistol with 12 flares	kit
Cargo attachment cables /in box in floor/	9 pcs
Cargo attachment clamp	17 pcs

<u>For passenger variant</u>

Batteries	2 pcs
Pilot seat cushions	2 pcs
Flare pistol with 12 flares	kit
Passenger seats	12 pcs

SUPPLEMENT No. 11

to the flight manual of the An-2 airplane powered by the ASz-62IR engine referring to the operation of the R-842 long range transceiver.

R-842 long range transceiver operating instructions.

Operate the transceiver using the remote control console /Fig.2/ located on the RH instrument panel.
To prepare the transceiver for reception proceed as follows :

/1/ Turn ON the transceiver using the AZS-10 switch with the inscription "KF" located on the central instrument panel and position the mode selector switch located on the SPU-7 console to "SR".

/a/ Put the channel selector /1/ to position corresponding to the working channel.

/b/ Put the mode selector switch /3/ to the position "RRG" when close correspondents are communicating and to the position "ARG" when far away correspondents are communicating.

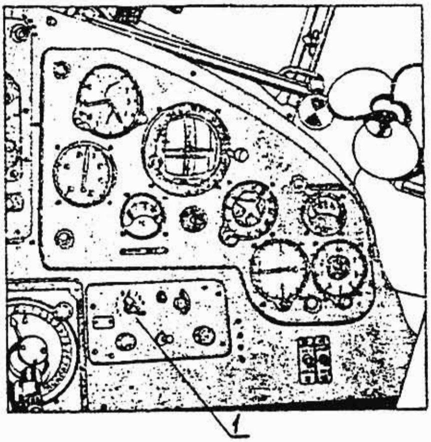


Fig. 1. RH instrument panel.
1- R-842 transceiver control console.

/c/ Put the "VOLUME" control knob /4/ to a median position and while receiving signals adjust the volume level as necessary. Change-over from reception to transmission takes place upon depressing the transmission button located on the control wheel. Adjust the self-listening signal volume level with the self-listening volume control knob /6/, pronouncing loudly to the microphone to vowel "A". During long distance communication turn ON the switch "DGR.MOD" //5/.

NOTE: To ensure stable communication select the following range of frequencies :
- for distances up to 80 km 2 - 3.5 MHz
- for distances from 120 through 500 km 3.5 - 6 MHz.
- for distances from 500 through 1000 km 6 - 8 MHz

At the distance of 80-120 km there is a zone of unstable communication.

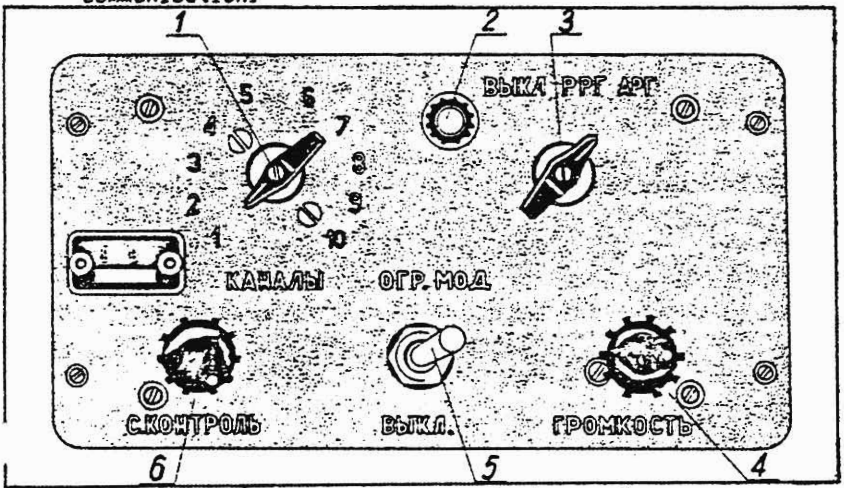


Fig. 2. R-842 transceiver control console.

1-Channel selector; 2-Light "ready for operation"; 3-Mode selector switch; 4-Receiver volume control potentiometer; 5-Modulation limiter switch; 6 - Self-listening volume control potentiometer.

SUPPLEMENT No. 12

Supplement to the Flight Manual of the An-2 airplane powered by the ASz-62IR engine relating to the operation of the KX 175B comm transceiver and KI208 nav receiver.

Effective on serial number 1G228-25 and up.

Upon mounting of the KX 175B comm transceiver on the airplane the following mode selector switch positions on the SPU caller's box correspond to the following installations

- "UKR" position - KX 175B is activated
- "RK-1" position - ARK-9 is activated
- "SR" position - RS6102 /standby/ is activated

1. KX175B comm transceiver operation.

/1/ Switch on the comm transceiver.

/a/ Connect the kit - headphone - microphone,

/b/ Switch ON supply from the board battery,

/c/ Switch on the circuit breaker AZS-5 /located on the central panel/ with the inscription COMM I and move the operation mode switch to UKR /YKP/,

/d/ Move the switch located on the central panel to "ON" or "TEST".

NOTE : In position "ON" - noise suppessor OFF.

In position "TEST" - noise suppressor OFF.

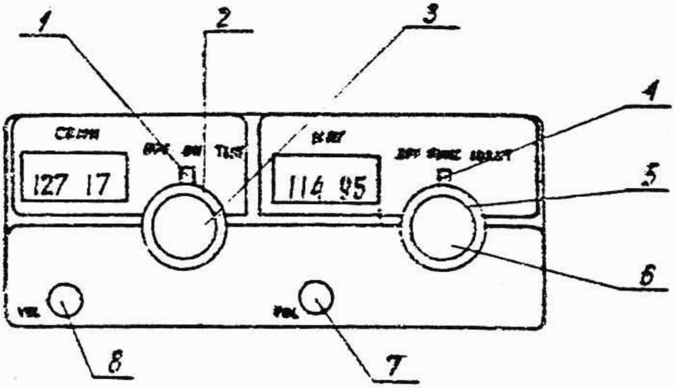


Fig.1. KX175B transceiver control panel

1- COMM change-over switch, 2- COMM MHz frequency selector, 3- COMM kHz frequency selector, 4- NAV change-over switch, 5- NAV MHz frequency selector, 6- NAV kHz frequency selector 7- NAV volume, 8- COMM volume.

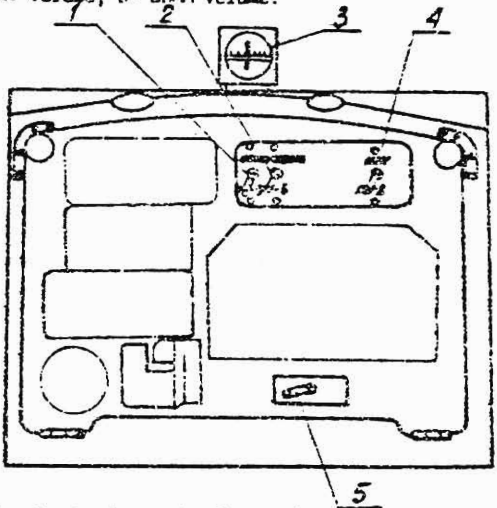


Fig.2. Central part of the instrument panel

1- Automatic circuit breaker AZS for KX175B transceiver
2- Automatic circuit breaker AZS for RS6102 transceiver (standby)
3- Direction indicator GPK-48, 4- Automatic circuit breaker AZS for navigation indicator. 5- Automatic circuit breaker AZS for MSL-3 anticollision lights.

§/e/ Using the larger COMM knob set the COARSE FREQUENCY (first three digits in MHz display),

/f/ Using the smaller COMM knob set the fine frequency (remaining two digits in MHz display)

2. KI208 VOR/LOC NAV receiver operation

/a/ Switch ON power supply from the board battery.

/b/ Switch the receiver on by moving the switch at the inscription NAV to "VOICE" or "IDENT".

NOTE : In position "VOICE" - signal reception without identification tone.
In position "IDENT" - signal reception with identification tone.

Set the frequency with NAV knobs.

The KI-208 direction indicator has a dial with angular scale which may be dialed with the OBS knob to the desired course. The VOR/LOC course indicator pointer indicates the direction and deviation from the selected course.
If the receiver is damaged or false VOR signal appears, a well visible flag appears on the indicator under the deviation pointer.

CAUTION : BEFORE STARTING ENGINE MAKE SURE THAT ALL RADIO EQUIPMENT IS OFF.

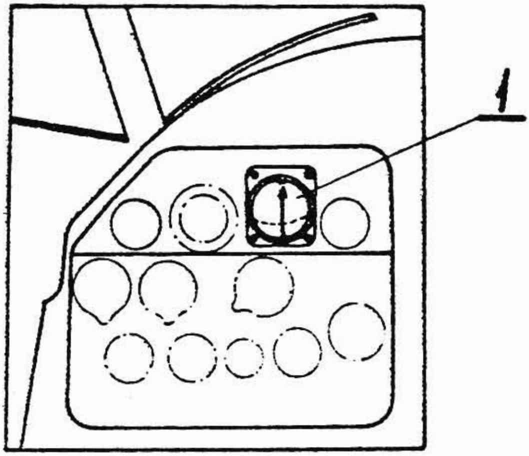


Fig.3. L.H.part of the instrument panel

1- KI208 Navigation indicator

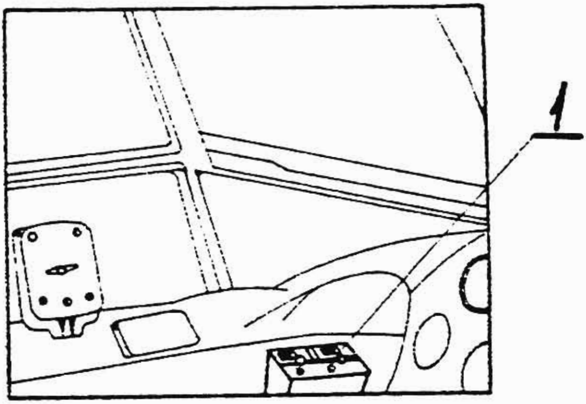


Fig.4. View of Left Upper Part of Cockpit

1- KX175 B transceiver

SUPPLEMENT No 13

TO An-2 AIRPLANE FLIGHT MANUAL WITH ASz-62IR ENGINE CONCERNING THE OPERATION OF KT-76A TRANSPONDER AND KEA-130 ENCODING ALTIMETER.

Effectivity: 1G214-09 a/c and up

1. General description.

The KING KT-76A transponder is a radar beacan equipment designed to fulfill the role of the airborne beacon under the requirements of the Air Traffic Control Radar Beacon System /ATCRBS/.

The KT-76A transponder is capable of locating the user through the air traffic controller.
Range and azimuth are established on the basis of the response sent by the transponder's pulsed transmitter to a toutine interrogation from the ground radar station.

The transponder reply is a set of pulses selected in number and positioned in time, one with respect to the other /not entirely unlike telegraphy/. Information is conveyed to the ground in this way.
An identity code number, selected at the front panel by the pilot is transmitted as a Mode A reply.

Mode C, altitude reporting, is an additional capability of the transponder. In order to convey altitude information, the transponder must be used in conjunction with a reporting altimeter KEA 130 and operated in "ALT" mode.

An beacon system is S.P.I. (Special Pulse, Identification/. After pressing the ident button the transponder, when interrogated, will reply with a special pulse that will cause the special pip on the controller's display to "bloom" giving in effect immediate recognition.

2. Operation of transponder.

To turn ON the transponder set the "TRANSPONDER" switch situated on central control desk to the position "ON" /upper/ The transponder is actuated by rotating the function selector /1/ - Fig.1 from the "OFF" position to any other position.

NOTE: The KT-76A should be turned off during starting the aircraft engine.

After being turned ON there is a 45 second delay before the unit becomes functional. This is to enable the transmitter lamp warm up and stabilize.

The function switch will be usually set to the "STANDBY" position, however, any operative position will initiate the time delay turn on.

Any time the function switch is in the "ON" or "ALT" altitude position, the transponder becomes an active part of the beacon system. It is undesirable from a system view point that the transponder be operating /function selector in either of these positions/ on the ground, during taxiing or parking at a terminal with a co-located beacon interrogator.

Attention should be also paid to the code selected on the front panel. It should be in accordance with instructions for IFR flight or rules applicable to transponder utilization for VFR flight.

NOTE: Never activate the transponder with either Code 0000, 7700 or 7777 selected on the front panel
Code 7700 is reserved for emergencies.

During normal transponder operation, a flashing lamp is an indication of a transmitted reply.

...errogations are normally transmitted at 10-15 second intervals.

Lamp flashes within these intervals may be from hoise, a second or third interrogator search radar or from side lobes from interrogators without side lobe suppresion.

Function "ON" will be the customary mode of operation. When an encoding altimeter is part of the system, select the "ALT" function, if traffic controller requeets altitude reporting.

Function "ALT" permits the transponder to encode an altitude reply.

The IDENT feature is used at the request of the traffic controller. The IDENT button is depressed momentarily and then released. The memory holds the IDENT reply for at least one radar sweep to assure the proper reply. This memory also turns the reply lamp ON steady as an indication of the ident function.

The KEA 130 encoding altimeter mounted on RH instrument panel /Fig.4, p.7-00/39/ is fitted with a knob for altitude correction.

To turn OFF the transponder, reset the function selector to "OFF" position and switch OFF power supply by shifting the AZS-5 "TRANSPONDER" circuit-breaker to the lower position.

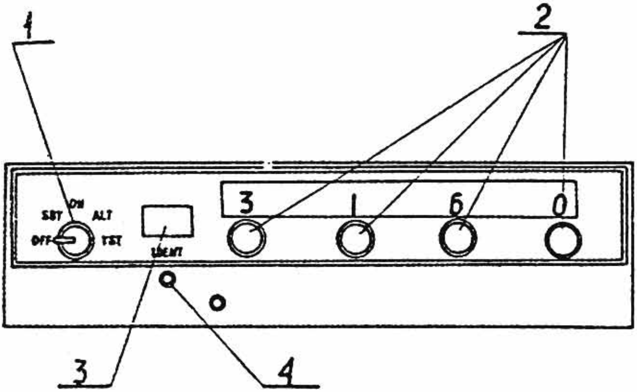


Fig. 1. Transponder controls.

1 - Function selector

2 - Code selector knots

3 - Reply lamp

4 - IDENT button

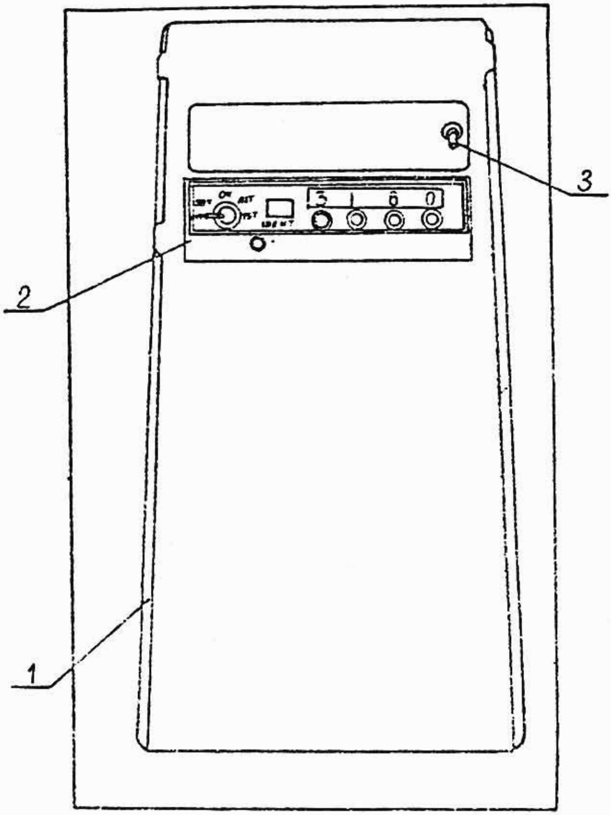


Fig. 2. Central control desk.

1 - Control desk
2 - KT-76A transponder front panel
3 - KT-76A transponder switch

SUPPLEMENT NO. 14

SUPPLEMENT TO FLIGHT MANUAL, FOR An-2 AIRCRAFT, POWERED WITH ASz62IR ENGINE, An-2P PASSENGER VERSION OF AIRCRAFT.

CHAPTER 1-00

GENERAL

An-2P passenger version of aircraft is designed to carry only passengers and their personal luggage. Flight in this version of aircraft is much more comfortable for passengers than in other versions due to modification of cargo cabin.
The whole cargo cabin is lined with decorative covering to make the interior more esthetic.
Noises from working engine are damped due to sound-aborbing isolation put under decorative covering.
On the starboard between frames 10 and 12 there is emergency exit for emergency leaving the aircraft, when the entrance door is locked.
There are 12 seats placed in flight direction.
Folding door to cockpit enables taking places by passengers in the first line of seats.
Fig. 1. Shows Lay-out of seats and remaining equipment.
Because of balence, there is only one storage battery on this version of aircraft installed in a container between frames No. 3 and 4 under cockpit floor.

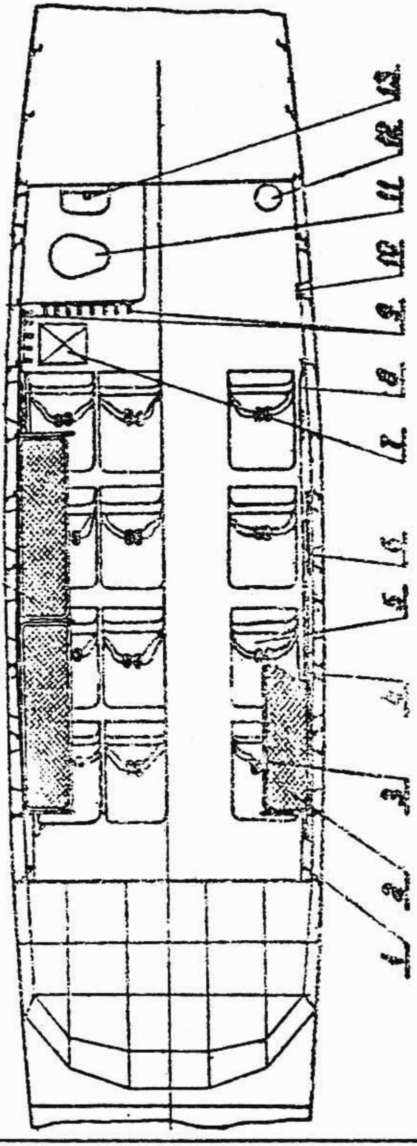


Fig. 1. Passenger cabin equipment.

1-decorative covering, 2-luggage shelf, 3-seat belts, 4-ventilation chamber, 5-seat, 6-curtains, 7-place for luggage, 8-heating collector, 9-hangers, 10-handrail, 11-toilet, 12-fireextinguisher, 13-lavatory.

Also because of this, on An-2P-passenger version of aircraft the following are not installed:
one IP-100 fuse, KM-200D contactor, TDE-210 transmitter mating with the other battery and two swiches to control batteries.

Remaining data - not changed.

C H A P T E R 2-00

OPERATING CONDITIONS AND LIMITATIONS

Not changed

C H A P T E R 3-00

AIRPLANE PERFORMANCE

Not changed

C H A P T E R 4-00

NORMAL PROCEDURES

D. Airplane loading.

The position of center of gravity of loaded airplane should be determined according to diagram in Chapter 7-00, p. 19/20 of this Manual.
The way of position determination of center of gravity is shown in Chapter 4-00, E. D.

Remaining data - not changed.

CHAPTER 5-00

EMERGENCY SITUATIONS

G. GENERATOR INOPERATIVE

The generator failure is indicated by zero position of the ammeter pointer and lighting of the generator failure warning lamp. When the generator is inoperative all operating electrical power receivers on aircraft are supplied from the battery.
One 12-A-30 battery with the minimum operational capacity of 75% rated value, e.i. 21 ampere-hours, provides power supply to all operating receivers, including windshield and PWD-6M pitot tube heating (overall load is about 100 A) for 5-6 minutes.
To extend the battery operational time, it is necessary to reduce the loading of the power network, e.i. to keep the required minimum of receivers, swiched on for a long time. The following power receivers should be swiched on:

- PWD-6M (3.5 A) heating (if necessary);
- "(0.6 A) fuel quantity gauge;
- EMI-3K engine unit gauge, TUE-48 (0.9 A) thermometer;
- GPK-47 artificial horizon, GPK-48 direction indicator of co-pilot (3.5 A), (if necessary);
- instrument panels, and cabin lighting (if necessary);
- navigation lights (if necessary);

Switch on the PO-500 (24 A) converter periodically for the possibly shortest time.
If above mentioned recommendations are met, the 12-A-30 battery provides power supply for the airplane, for 30-40 minutes of flight.

N. LEAVING AIRPLANE THROUGH EMERGENCY EXIT.

If the cockpit door and the cabin door of the airplane are blocked in case of an emergency landing, the airplane may be left through emergency exit in the upper part of the dome.
The opening of emergency exit takes place by pulling backward the levers positioned on the central push rod of the dome cover.
On releasing the cover from supports on the dome it is to be thrown away and the airplane is to be left through the free space.
Hatch on the starboard between frames No. 10 and 12 is an additional emergency exit.
It is opened by pulling backward the red lever positioned on the hatch cover.
On releasing the locks the hatch cover is to be taken inside the airplane, and the airplane is to be left through the free space.

Remaining data - not changed.

CHAPTER 6-00

TABLES AND DIAGRAMS

Not changed

S U P P L E M E N T No. 15

SUPPLEMENT TO FLIGHT MANUAL FOR AN-2 AIRCRAFT, POWERED WITH ASz-62IR ENGINE, AN-2TP TRANSPORT--PARACHUTE VERSION OF AIRCRAFT

CHAPTER 1-00

GENERAL DATA

Transport-parachute version of An-2 aircraft is a modification of transport version, that enables training of parachute jumpers. Basic parachute equipment of aircraft consists of:

- a line for catching the parachute rip cords,
- hatch in the floor (between frames No. 10 and 11) for navigating airplane and determining its position,
- light signalling of the flight direction,
- instrument panel for instructor on the port side of aircraft (time-clock, altimeter, airspeed indicator),
- subscriber box of SPU-7 intercom with longer chord of headset, installed on the port side of airplane.

Two handles are fixed to luggage compartment door and the threshold is levelled with rubber covered element to enable quick and safe leaving of aircraft.
The port side of fuselage from the outside, between frames No. 17 and 21 is covered with a sealing (of rubber consistence) of thickness of 2,5 mm to protect fuselage skin against damage by parachute rip cords.

Remaining data - not changed.

CHAPTER 2-00

OPERATING CONDITIONS AND LIMITATIONS

Not changed

CHAPTER 3-00

AIRPLANE PERFORMANCE

Not changed

CHAPTER 4-00

NORMAL PROCEDURES

Not changed

CHAPTER 5-00

EMERGENCY SITUATIONS

Not changed

CHAPTER 6-00

TABLES AND DIAGRAMS

Not changed

SUPPLEMENT No. 16

This supplement to the Flight Manual of the An-2 Airplane Equipped with the ASz-62IR Engine deals with the operation of the following radio-navigational equipment:

1. KX 165 basic COMM/NAV transceiver (COM 1 NAV 1).
2. KX 165 reserve COMM/NAV transceiver (COM 2 NAV 2).
3. KR 87 radio direction finder (ADF).
4. KT 79 transponder with KEA 129 encoding altimeter.
5. KN 62A distance measuring equipment (DME).
6. KRA 10A radio altimeter.
7. KCS 55A pictorial navigational system.

I. INTRODUCTION

The radio-navigational equipment installed in the airplane permits establishing of radio communication with ground and airborne stations as well as flight navigation of the airplane and landing under IFR and ILS conditions.
In addition the airplane is fitted with a response system (transponder).

WARNING: BEFORE ENGINE STARTING AND ITS STOPPING MAKE SURE THAT ALL THE RADIO NAVIGATIONAL EQUIPMENT IS OFF.

E. COMPONENTRY AND OPERATION

1. KX 165 COMM/NAV Transceiver - Basic (COM 1 NAV 1).

1.1. Componentry

The KX 165 kit consists of the following units:
- KX 165 comm/nav transceiver (Fig. 1);
- CI 175 antenna;
- CI 1125 coupler (common for both transceivers);
- VOR/LOC/65 CI 157P antenna (common for both transceivers);
- KI 525A indicator (included in KCS 55A kit, Fig. 5).

1.2. Switching ON

- switch ON the power supply to the audio selector with the AZS circuit breaker/switch (located on the central instrument panel switchboard under the inscription "AUDIO MKR");
- connect the earphones and microphone;
- switch ON the basic comm/nav transceiver AZS (circuit breaker) switch located under the inscription "COM 1 NAV 1" on the central instrument panel (Fig. 2);
- switch ON the comm/nav transceiver with the ON/OFF/VOL control;
- switch ON the basic transceiver COM 1 earphones and microphone on the audio selector panel (Fig. 7).

NOTE: It is not allowed to press both "PHONE" and "SPEAKER" buttons at the same time.

- check with the "TEST" button for noise in the earphones and its smooth suppression with the volume control;
- establish radio contact with a ground station and check the quality of communication;
- move the operation mode selector switch of the nav receiver from the "OFF" to the "VOL" position. While switching over, the VOR pointer and the warning flag on the KI 525A indicator should slightly move. With the audio

selector panel NAV 1 button pressed additional noise should be heard in the earphones, the intesity of which may be adjusted with the "VOL" control knob on the navigation receiver.

2. KX 165 COMM/NAV Transceiver - Reserve (COM 2 NAV 2).

2.1. Componentry

- KX 165 transceiver;
- KI 206 indicator;
- CI 175 antenna.

2.2. Switching ON and operation of the reserve comm/nav transceiver (COM 2 NAV 2) are analogical to those of the basic comm/nav transceiver (COM 1 NAV 1). The reserve navigational receiver (NAV 2) is connected to the KI 206 indicator.

3. KR 87 Radio Direction Finder

3.1. Componentry.

- KR 87 receiver (Fig. 5);
- KA 44B antenna;
- KI 227 indicators (2 psc).

3.2. Switching ON.

- put the automatic direction finder power supply AZS (circuit breaker) switch located on the central instrument panel under the inscription "ADF" and the "ADF" button on the live audio selector panel to the "ON" position;
- move the operation mode selector swich to the "ANT" position;
- tune to the selected radio beacon and check if the identification tone is clear;
- check if the ADF pointer has stopped in the parking position (90°);

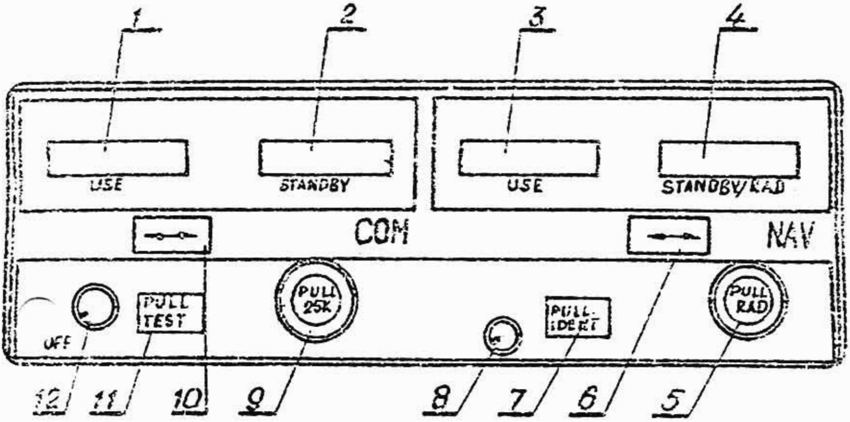


Fig. 1. KX 165 COMM/NAV Transceiver

1. Use frequency
2. Standby frequency
3. Use frequency.
4. Standby frequency or radial
5. NAV increment/decrement knobs and change-over knobs from standby frequency to radial
6, 10. Frequency selection buttons
7. Identification button
8. Audio volume control knob
9. COMM increment/decrement knob
11. TEST button
12. ON/OFF/VOL knob.

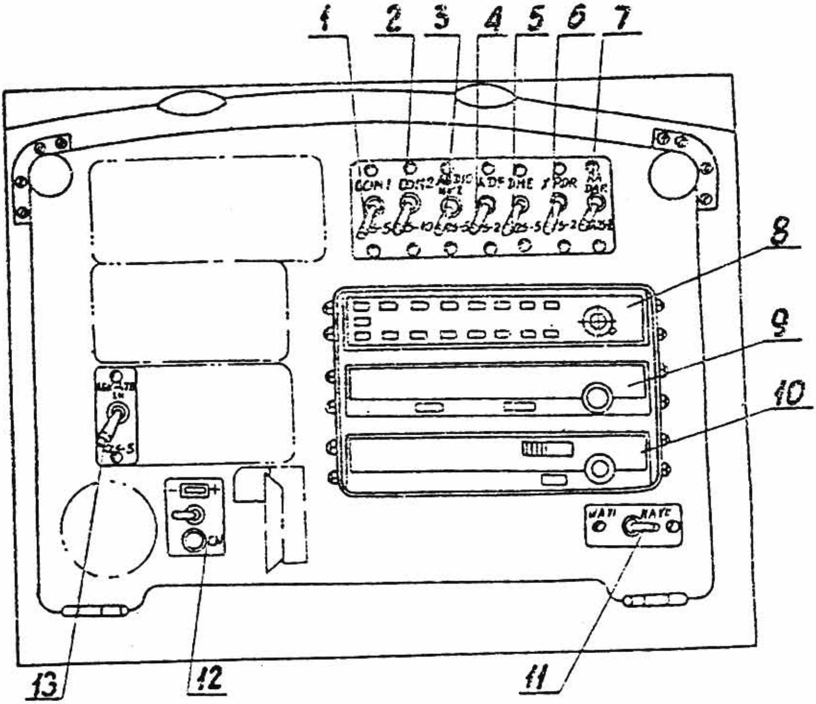


Fig.2. Central Instrument Panel.

1. AZS (circuit breaker) switch for basic comm/nav transceiver 1.
2. AZS (circuit breaker) switch for reserve comm/nav transceiver 2.
3. AZS (circuit breaker) switch for audio selector panel.
4. AZS (circuit breaker) switch for panel mounted switchboard and marker.
5. AZS (circuit breaker) switch for distance measuring equipment.
6. AZS (circuit breaker) switch for transponder.
7. AZS (circuit breaker) switch for radio altimeter.
8. Audio selector panel (switchboard).
9. Transponder.
10. Distance measuring equipment.
11. NAV 1 and NAV 2 change-over switch.
12. Gyrocompass slaving unit of KCS 55A system.
13. AZS for left artificial horizon.

- position the automatic direction finder switch to "ADF" and check that the pointer is directed towards the radio beacon.

If the results of the test are positive it means that the unit is operating properly and may be used for navigation.

4. KT 79 Transponder

4.1. Componentry:

- KT 79 transponder (Fig. 3);
- KA 60 antenna;
- KEA 129 encoding altimeter.

4.2. Switching ON

- before starting the engine check if the transponder operation mode selector switch (function switch) is in the "OFF" position;
- switch ON the power supply to the transponder with the AZS (circuit breaker) switch located on the central instrument panel under the inscription "XPDR";
- position the operation mode switch to "TST", after several seconds all the display segments should light up which is a proof of proper transponder operation.

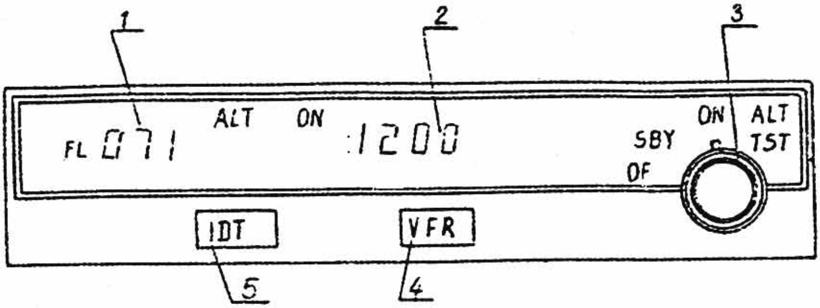


Fig. 3. KT 79 Transponder

1. Barometric flight height (in hunders of feet)
2. Code display
3. Function switch and code selector knob
4. VFR code button
5. Identification button

5. KN 62A Distance Measuring Equipment

5.1. Componentry:

- KN 62A distance measuring equipment (Fig. 4);
- KA 60 antenna.

5.2. Switching ON:

- put the AZS (circuit breaker) switch located on the central instrument panel under the inscription "DME" and the "DME" button located on the audio selector panel to the "ON" position;
- switch ON the power supply to the system with the "ON/OFF" switch;
- position the operation mode (function) switch to "FREQ."; the selected frequency should appear in the display;
- switch ON the navigation receivers;
- position the operation mode switch to "RMT";
- move the "NAV 1/NAV 2" switch located on the central instrument panel under the DME to the "NAV 1" position; digits or dashes should appear in the display;
- set the switch to the "NAV 2" position - the display should be similar.

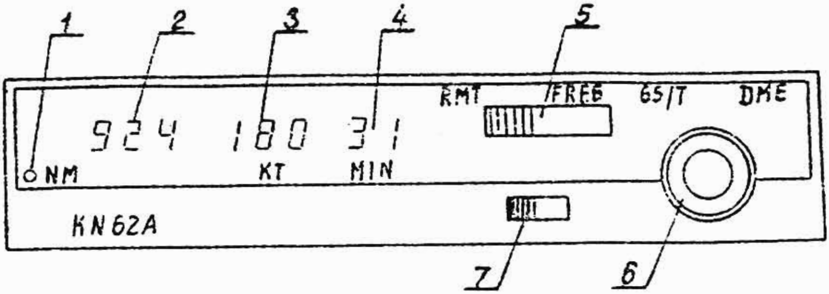


Fig. 4. KN 62 Distance Measuring Equipment

1. Photocell
2. Range
3. Ground speed
4. Time-to-station
5. Function switch
6. Tuning knob
7. ON/OFF switch.

6. KRA 10A Radio Altimeter

6.1. Componentry:

- KRA 10A radio altimeter;
- KA 131 antenna;
- KI 250 indicator.

6.2. Operation - switching and testing

- switch ON the power supply to the radio altimeter with the AZS (circuit breaker) switch located on the central instrument panel under the inscription "RADAR ALTIM" and to the audio selector panel with the switch located under the inscription "AUDIO MKR" (if it is not already on);
- position the "DH" marker to 20 feet;
- press the "DH" knob and hold it in the pressed position; the indicator should show 50±5 feet; the "DH" lamp should be OFF;
- holding the "DH" knob pressed, slowly move the knob clockwise until the "DH" marker indicates 50±5 feet; the "DH" lamp should light and 1 kHz audio signal should be heard in the earphones for two seconds;
- release the "DH" knob; the lamp should go out and the pointer should disappear from view (hide behind the scale mask).

NOTE: During take-off the audio signal should not be audible unless the "DH" marker is above 1500 feet. In the latter case a short signal is emitted when the pointer passes through the preset "DH" altitude.

7. KCS 55A Pictorial Navigation System

7.1. Componentry:

- KG 102A gyro-compass;
- KMT 112 transmitter;
- KA 51B slaving accessory;
- KI 525A indicator (Fig. 5).

7.2. Switching ON

- switch ON the power supply to the system with the AZS (circuit breaker) switch located on the central control desk (Fig. 6) under the inscription "KCS 55A"; after the gyro-compass motor has attained its normal working RPM the "HDG" warning flag, on the KI 525A indicator, should disappear from view;

- switch ON the KX 165 navigation receiver (NAV 1) and check if after the receiver is tuned to the "VOR" signal the NAV warning flag, on the KI 525A indicator, disappears from view and the central part of the pointer, on the KI 525A indicator, indicates the "VOR" course.

8. KMA 24 Audio Selector

8.1. Componentry:

- KMA 24 audio selector (Fig. 7);
- KA 26 antenna;
- AERO 2500 microphone-headset unit.

8.2. Switching ON

- apply the power to the unit with the AZS (circuit breaker) switch located on the central instrument panel under the inscription "AUDIO MKR";

- connect the first and the second microphone-headset units.

NOTE: The upper buttons are inoperative because the speaker is not installed in the airplane.

- move the operation mode selector to the "INT" position and check the communication between the 1-st pilot and the co--pilot;
- if the voice is not clearly audible adjust its volume with the the knob on the earphones.

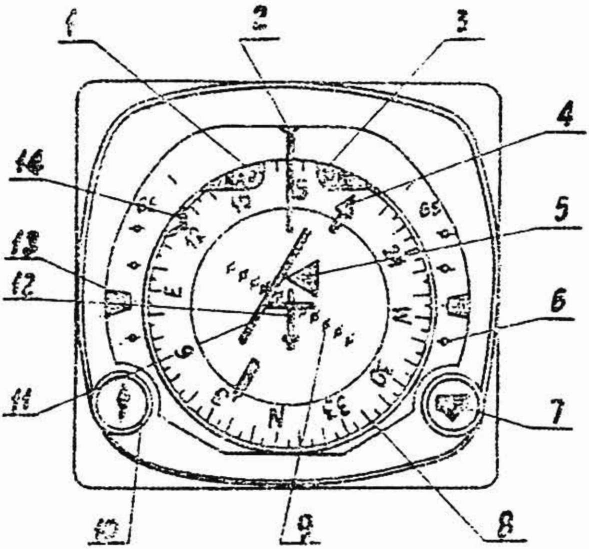


Fig. 5. KI 525A Indicator

1. NAV warning flag
2. Lubber line.
3. Heading warning flag
4. Selected course (VOR radial) pointer.
5. TO-FROM indicator.
6. Glideslope deviation scale.
7. Heading select knob.
8. Compass card
9. VOR/LOC deviation scale
10. Course select knob (VOR radial)
11. VOR/LOC lateral deviation bar
12. Symbolic aircraft
13. Glideslope pointers.
14. Heading select marker.

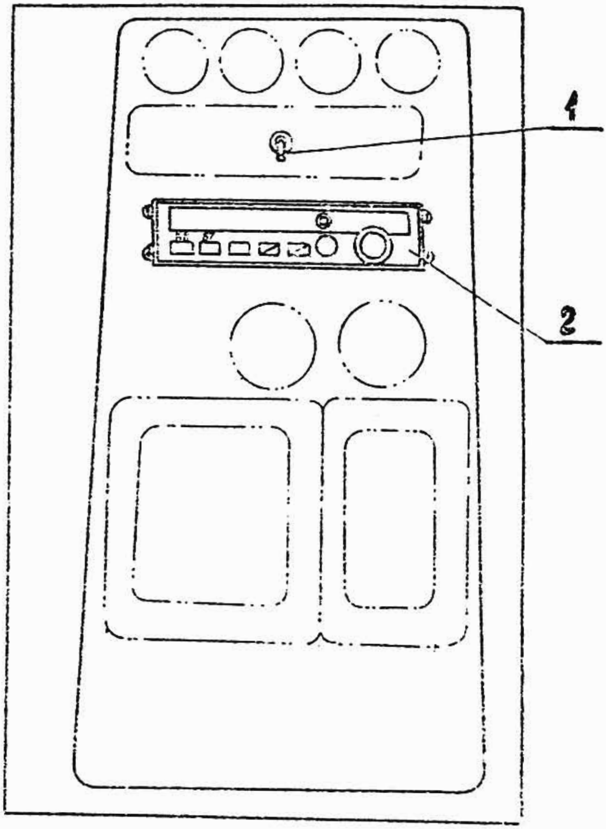


Fig. 6. Central control desk

1. .KCS 55A pictorial navigation system ON/OFF switch
2. KR 87 automatic direction finder (radio-compass)

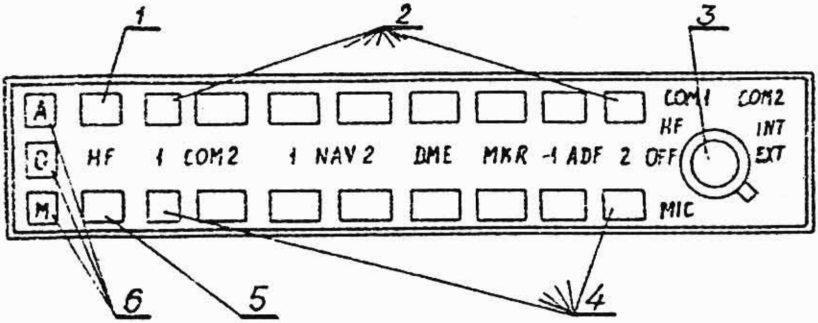


Fig. 8. KMA 24 Audio Selector Panel (Switchboard)

1. TEST button
2. Speaker buttons (inoperative)
3. Operation mode selector switch
4. Microphone- headset unit buttons.
5. Sensitivity button "SENS"
6. Marker lamps.

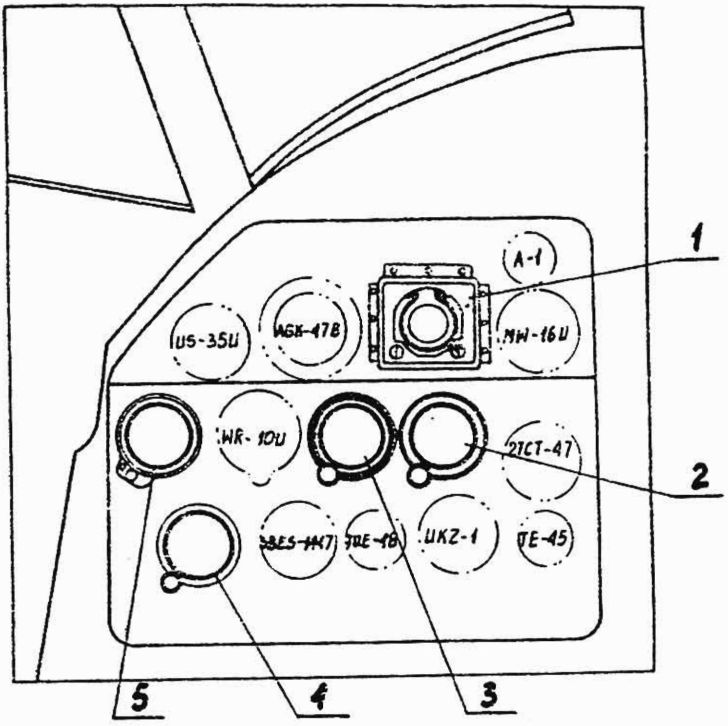


Fig. 8. Left Hand Instrument Panel

1. KI 525A indicator of KCS 55A gyrocompass.
2. KI 206 VOR indicator.
3. KI 227 indicator of KR 87 automatic direction finder.
4. KI 250 indicator of KRA 10A radio altimeter
5. KEA 129 encoding altimeter.

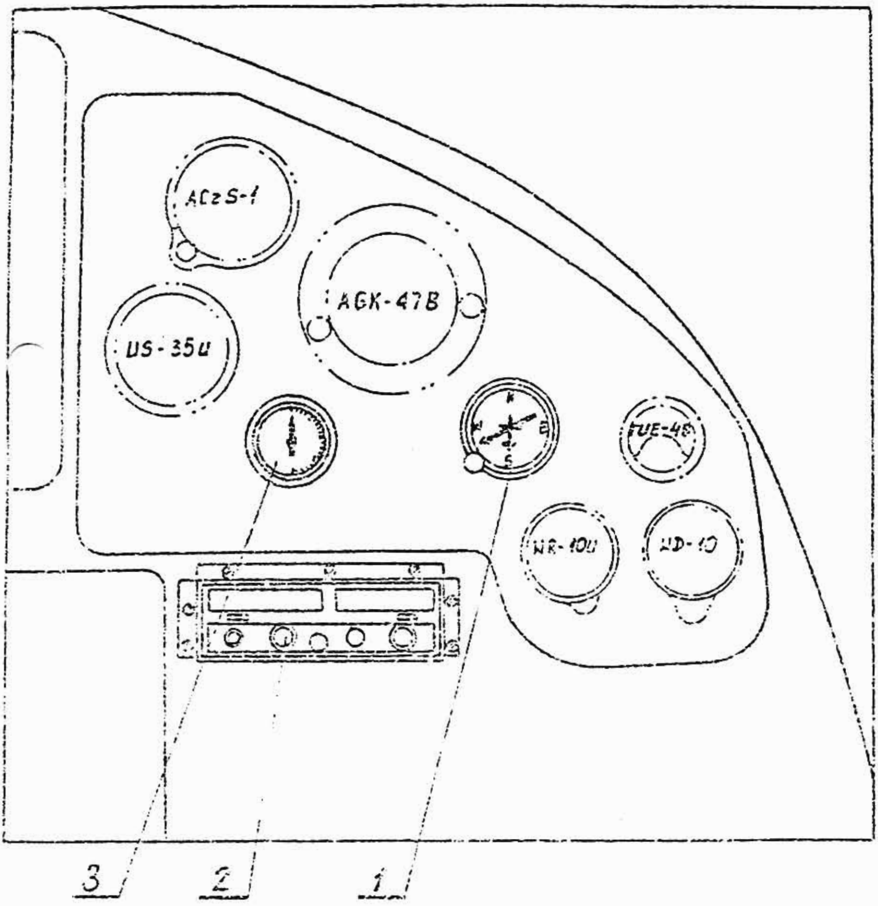


Fig. 5. Right Hand Instrument Panel.

1. KI 227 indicator of KR 87 automatic direction finder (radio compass).
2. KX 165 comm/nav transceiver.
3. Elevetor trim tab position indicator.

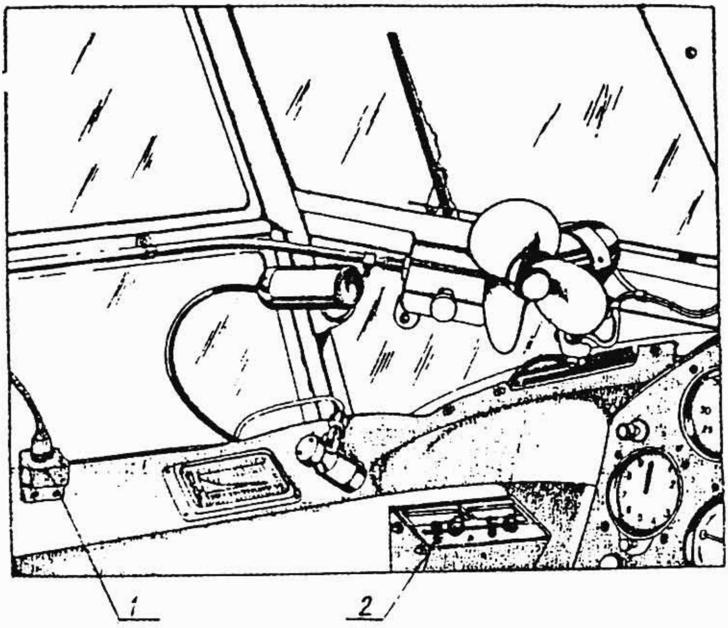


Fig. 10. View of Upper Left Cockpit.

1. Receptacles for connection of microphone-headset unit.
2. KX 165 comm/nav transceiver - basic.

SUPPLEMENT No.17

SUPPLEMENT TO AIRCRAFT FLIGHT MANUAL OF ASz-62IR ENGINE POWERED An-2 AIRPLANE REGARDING OPERATION OF An-2PK AIRCRAFT MODEL /WITH ENHANCED COMFORT PASSENGER CABIN/

Effectivity: on 1G238-51 and up

SECTION 1 - 10

8. Cargo - passenger cabin.

After having been modified the cargo-passenger cabin provides comfort flight conditions for passengers. Only six passenger seats are mounted in the cabin , four of them are arranged on cabin starboard while the remaining two ones - on its port side with a folding table located between them.
An additional equipment of cabin is a refreshment bar situated on Frame No.15.

SECTION 2 - 00

OPERATING CONDITIONS AND LIMITATIONS

No change

SECTION 3 - 00

AIRPLANE PERFORMANCE

No change

SECTION 4 - 00

NORMAL PROCEDURES

D. Aircraft loading.

Aircraft C.G. position shall be determined on the basis of chart attached hereto.
The C.G. position determination method is described under section 4-00, item D.
When the number of passengers is 6 (six) and one of them is in the toilet while the other one in the refreshment bar, the C.G. travel of loaded aircraft does not exceed 32%, which is depicted on the chart.

SECTION 5 - 00

EMERGENCY SITUATIONS

No change

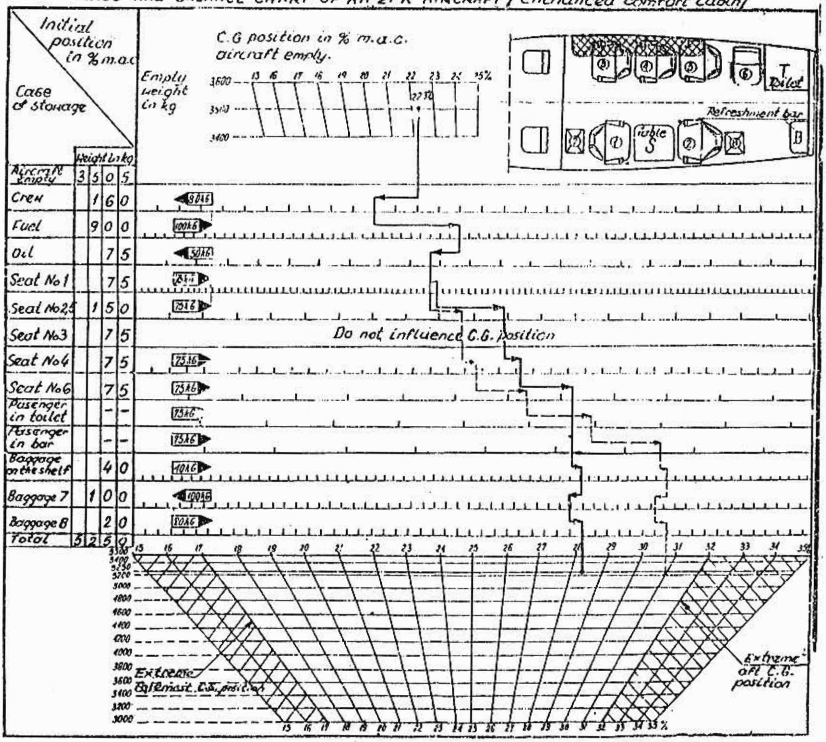
(The same as in the Supplement No.14 for An-2P version)

SECTION 6 - 00

TABLES AND DIAGRAMS

No change

MASS AND BALANCE CHART OF An-2PK AIRCRAFT /enchanced comfort cabin/



SUPPLEMENT No. 18

SUPPLEMENT TO THE ASz-62IR ENGINE POWERED AN-2 AIRCRAFT FLIGHT MANUAL REGARDING THE OPERATION OF AN-2TP /CARGO-PASSENGER VERSION/ AIRCRAFT WITH VARIABLE COMPLETION OF PASSENGER CABIN AND RADIO-NAVIGATIONAL EQUIPMENT.

Effective on the a/c S/N 1G234-02
1G238-24
1G238-25

SECTION 1-00

Subsection 1-00, it.6. Cabins.

B. Cargo-passenger cabin /it applies to the a/c: 1G238-24, 1G238-25/

To enhance esthetic appearance of the passenger cabin interior and to provide higher comfort of travelling there have been installed 12 forward facing passenger seats in place of the fold-type ones.
An additional equipment of the cabin constitutes the toilet with a wash-bowl and a water container located between the frames No's 13 and 15, while at the frame No.15 there is a coctail cabinet for offering refreshments during flights. Moreover, the passenger cabin floor has been lined with a carpet.

B. Cargo-passenger cabin /it refers to the a/c 1G234-02/

To extend aircraft operating capabilities, the passenger cabin has been additionally fitted with 12 forward facing seats and their attachment.
These seats can be installed upon removal of side seats arranged at the passenger cabin starboard and port side.

Subsection 1-20, it.1. Fight-navigational and radio equipment /re: 1G234-02 a/c/.

The aircraft is not equipped with the following units:

- MRP-56P Marker receiver
- ARK-9 Automatic Direction Finder
- A-037 Radio-altimeter.

In connection with this, the indicators, control panels and switches included in the a/m accessory assy have not been installed on control desks and instrument panels.

The remaining equipment is unchanged.

SECTION 2-00

OPERATING CONDITIONS AND LIMITATIONS

No change.

SECTION 3-00

AIRPLANE PERFORMANCE

No change.

SECTION 4-00

NORMAL PROCEDURES

D. Aircraft loading /re: 1G235-24, 1G236-25 a/c /.

The aircraft C.G. position is to be determined on the basis of the balance chart enclosed, as described under it. D, p.20, Section 4-00.

D. Aircraft loading /re: 1G234-02 a/c /.

The aircraft C.G. position shall be determined as follows :

- with side seats installed, according to it. D. "Airplane Loading", Section 4-00, p.20 and per C.G. position determination diagram, Section 4-00, pp. 25/26;
- with forward facing seats installed, according to Diagram for Determining C.G. Position, Section 7-00, pp. 19/20. The method of C.G. position determination is shown under Section 4-00, it.D, p.20.

The remaining text - no change.

SECTION 5-00

EMERGENCY SITUATIONS

No change.

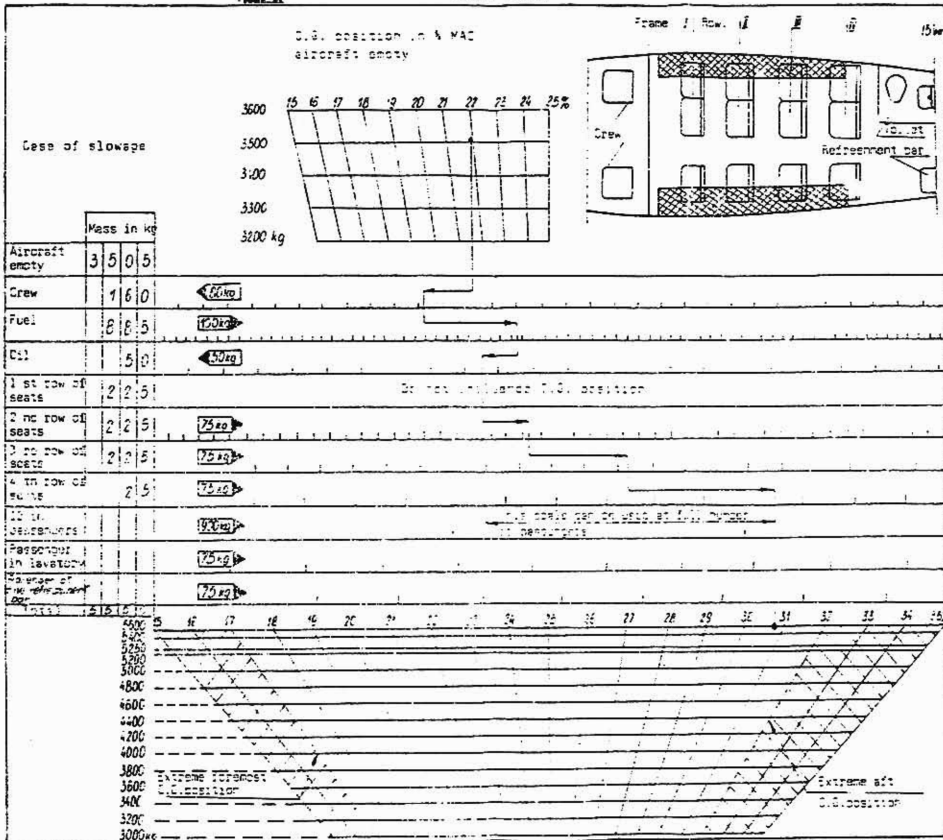
SECTION 6-00

TABLES AND DIAGRAMS

/re: 1G234-02 a/c /

Data regarding aircraft empty mass and balance to be entered in the "Extract from Aircraft Weighing Sheet" attached hereto.

The remaining tables and diagrams - unchanged.


C.G. position in % MAC
aircraft empty
Case of stowage
Mass in kg
Aircraft empty 3505
Crew 160
Fuel 885
Oil 50
1 st row of seats 225
2 nd row of seats 225
3 rd row of seats 225
4 th row of seats 225
Passenger in lavatory
Total
Frame
Row
Crew
Refreshment bar
Do not influence C.G. position
Extreme foremost C.G. position
Extreme aft C.G. position
3600
3500
3400
3300
3200 kg
3000 kg

Aircraft Version	Aircraft Empty Mass Q_w /kgs/*						C.G. of Empty Aircraft x /% MAC/						Signature and date					
Aircraft cargo-passenger version /An-2TP/	New	Overhauled					New	Overhauled										
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
Aircraft version with side seats installed																		
Aircraft version with forward facing seats installed																		

Extract from JG234-02 Aircraft Weighing Sheet

<u>NOTE</u>: Empty mass of the aircraft in particular versions includes the equipment specified in the table given in the Aircraft Weighing Sheet.

SUPPLEMENT No.19

SUPPLEMENT TO ASz-62IR ENGINE POWERED AN-2 AIRPLANE FLIGHT MANUAL CONCERNING An-2T, O VERSIONS, CHANGED COMPLETION OF COCKPIT, PASSENGER CABIN AND RADIO-NAVIGATIONAL EQUIPMENT.

Effective on a/c : 1G237 -31
1G237 -32

SECTION 1-00

GENERAL DATA

Subsection 1-10, it.6 Cabins

The cargo-passenger cabin is equipped with 11 fold-type seats to carry occupants or parachutists.
In the fuselage right wall, between frames No's 10 and 12, there is an emergency exit through which the occupants can leave the aircraft in case of emergency.
To attach and carry a personal luggage up to 40 kg there is a rack secured to the floor and airplane starboard as shown on Fig. 1.
The cargo attach fittings (33.pcs.) are screwed to the sockets in the floor.
Cargo is fastened with belts and straps (in case of large items of cargo) or by means of a cargo net.
The cargo attach belts (13 pcs.) are stored in the locker behind the door to the rear fuselage section.
Each belt can withstand load up to 1500 kg. The belt is shown on Fig.2. Fig 9 depicts typical exemplary attachment of minor cargo by means of a net.

it.7 - systems
para.B - fuel system
para.C - oil system

} lack of oil dilution system assemblies and components

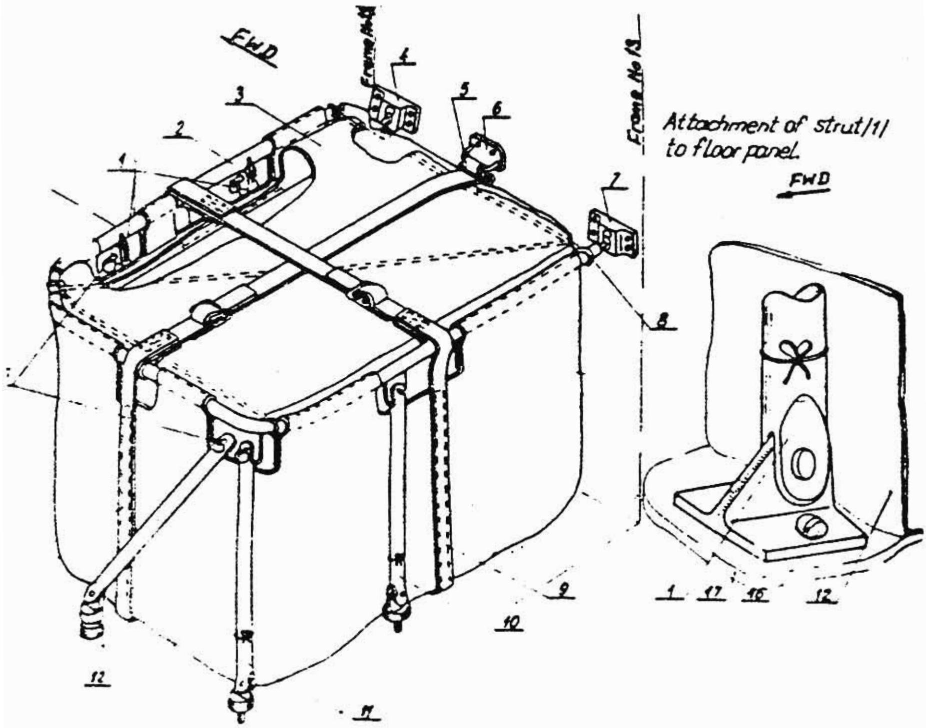


Fig. 1 Cargo Attachment Rack

1-Screwed down strut; 2-Frame; 3-Shield; 4,6,7-Brackets;
5-Buckle; 8-Hook; 9,14-Straps; 10,11,13-Screwed in struts;
12-Rack protective cover; 15-Pins; 16-Screw; 17-Floor panel.

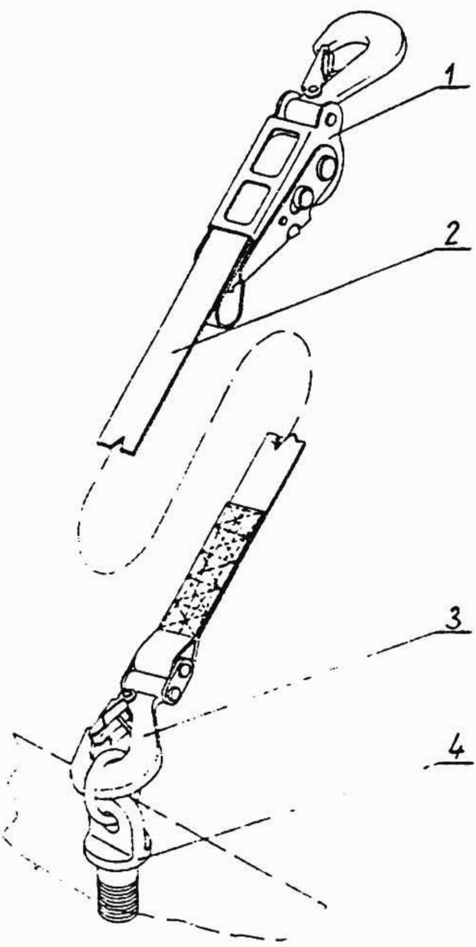


Fig. 2 Cargo attachment belt (Dwg. No. MSzB0422-100)

1 - Lock
2 - Strap
3 - Hook
4 - Fitting

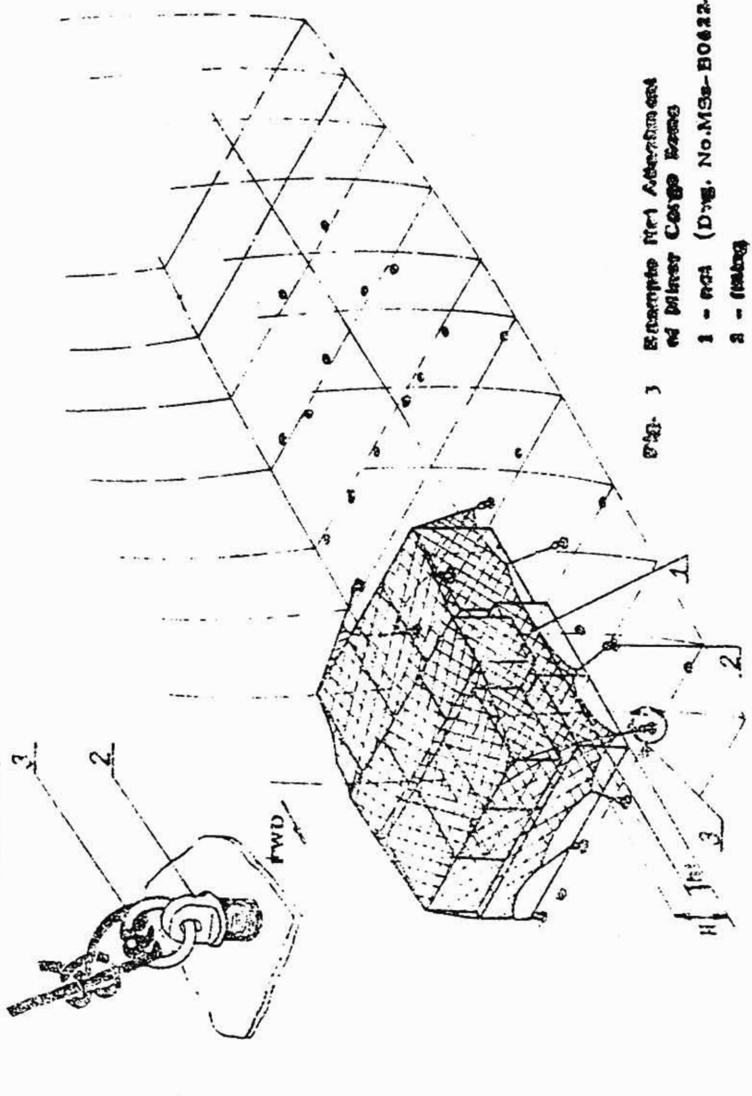


Fig. 3 Example Net Attachment of Minor Cargo Items

1 - net (Dwg. No.MSs-B0622-00)

2 - fitting

3 - strap

It is recommended that h_1 be $\frac{1}{2}$ H

SECTION 1-20

item.1 Radio and Flight - Navigational Equipment

1. The RW-UM radio altimeter has been installed in the aircraft instead of the A-037 mounted in lots.

2. The MRP-56P marker beacon has not been installed aboard.

3. The aircraft is adapted to provide the KT-76A transponder and ELT 10 emergency locator transmitter

NOTE :
1. The arrangement of flight-navigational equipment in the cockpit is shown on Fig's 4,5,6 and 7 herein.

2. The remaining equipment is unchanged.

Further contents - no change.

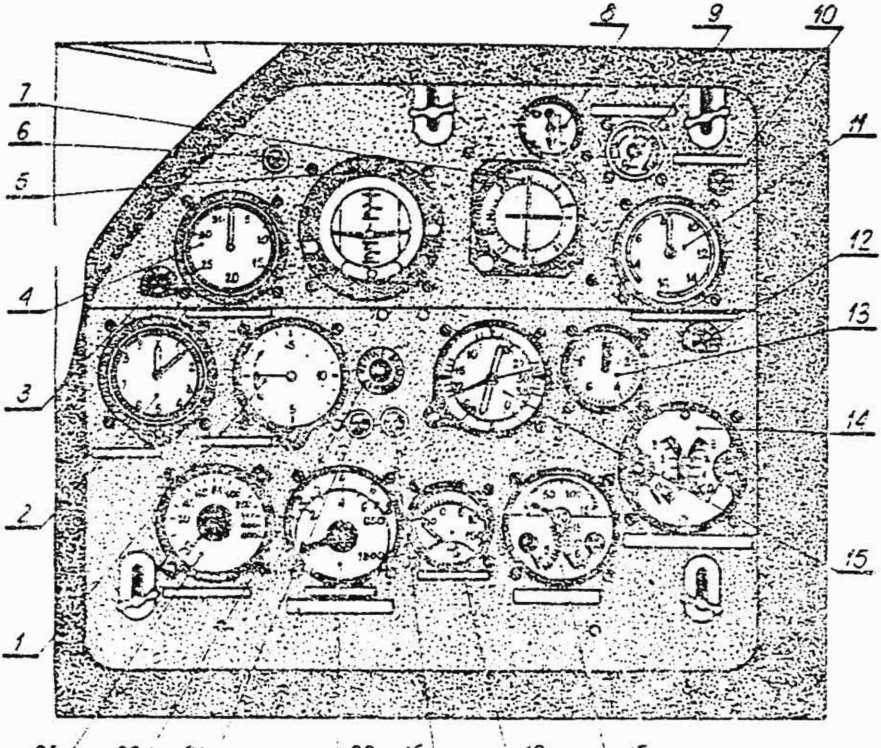


Fig. 4 Left Instrument Panel

Fig. 4 Left Instrument Panel

1 - Variometer;
2 - Altimeter;
3 - Dangerous altitude warning light;
4 - Airspeed indicator;
5 - Artificial horizon;
6 - Artificial horizon failure warning light;
7 - VOR/NAV indicator; (if installed)
8 - Elevator trim tab position indicator;
9 - Ammeter measuring generator current intensity;
10 - Generator operation indicator light;
11 - Manifold pressure gauge;
12 - Chip detector light (yellow);
13 - Tachometer indicator;
14 - Cylinder head temperature indicator;
15 - Gyrocompass indicator;
17 - Engine unit gauge;
18 - Mixture temp. indicator;
19 - Right tank group low fuel level warning light (yellow);
20 - Fuel gauge indicator;
21 - Left tank group low fuel level warning light (yellow);
22 - Compass slaving push-button;
23 - Radio-altimeter indicator.

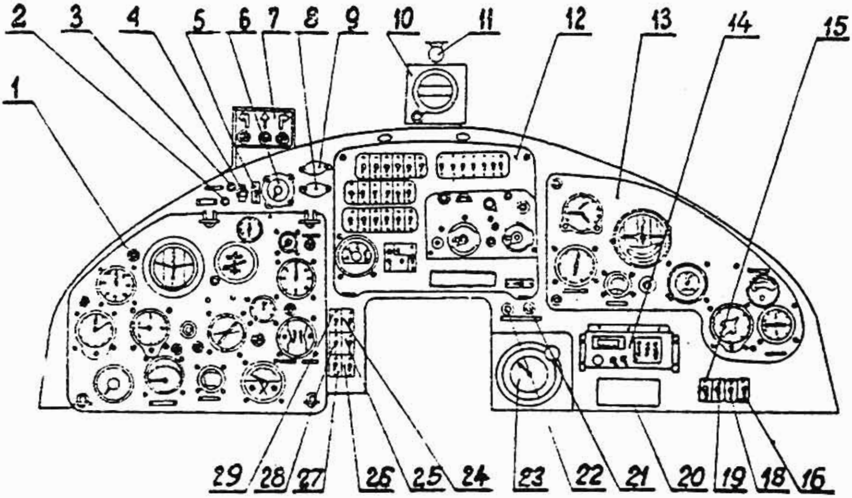


Fig. 5 . Instrument Panel

- LH instrument panel;
- Fire detector check light;
-- Engine fire detector light;
- Fire-extinguishing push-button;
- Start switch;
- Magneto switch;
- Flight direction indicator lights (if installed);
- Starter grip;
- Manual starter coupling grip;

0 - Gyroscopic direction indicator;
1 - Magnetic compass;
2 - Central instrument panel;
3 - instrument panel;
4 - VHF radio-etation (auxiliary);
5 - Flight direction indicator switch/ /circuit-breaker (if installed);

16 - Right fan switch;
*18 - Anti-collision light switch;
19 - Artificial horizon power failure warning test switch;
*20 - Limitations placard;
21 - Battery No. 2 check push-button } on An-2T and An-2TD versions only
22 - Battery No. 1 check push-button } on An-2T and An-2TD versions only
23 - ADF indicator;
24 - Right landing light switch;
25 - Taxi light switch;
26 - Lower identification light switch;
27 - Upper identification light switch;
28 - Navigation light switch;
29 - Left landing light switch;

* - if installed

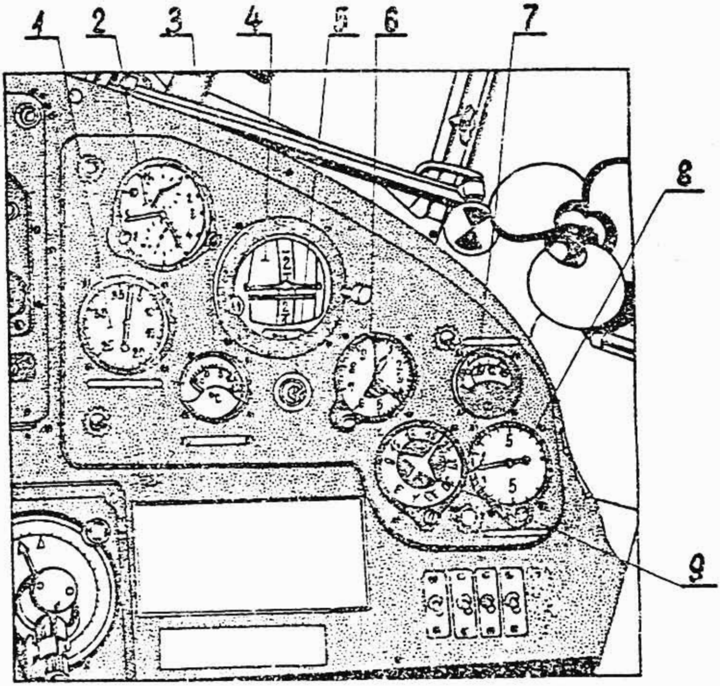


Fig. 6 . Right Instrument Panel

1 - Airspeed indicator;
2 - Hour clock;
3 - Ambient air temp. indicator;
4 - Artificial horizon;
5 - Compass slave push-button;
6 - Code altimeter; [illegible]
7 - Voltemeter measuring A.C. voltage;
8 - Variometer;
9 - Flight direction indicator from compass easy.

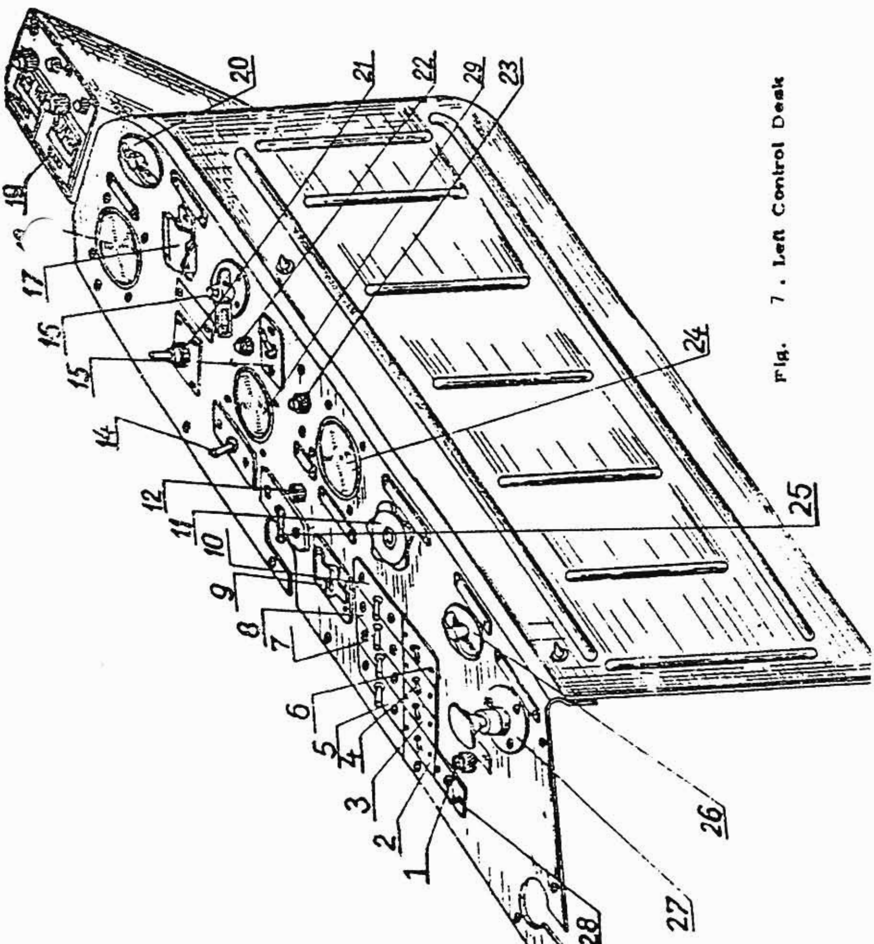


Fig. 7. Left Control Desk

Fig. 7. Left Control Desk

1 - Low fuel level warning check push-button;
2 - Wiper switch;
3 - Left windscreen wiper;
4 - Right windscreen wiper;
5 - Windscreen heating switch;
6 - Low fuel level aural warning switch;
7 - Side window panel heating switch;
8 - Central panel heating switch;
9 - Fire extinguishing system check switch;
10 - Left fan switch;
11 - Pneumatic system charging valve;
12 - Pitot tube heat indicator lamp;

14 - Passenger cabin lighting switch;
15 - Fuel gauge switch;
16 - Fuel tank selector;
17 - Fuel pump switch;
18 - Brake system pressure gauge;
19 - VHF radio-station;
20 - Radio-Altimeter assy switch;
21 - Emergency locator transmitter switch;
22 - Chip-detector check push-button.
23 - Pitot tube heat check push-button;
24 - Pneumatic main system pressure gauge;
25 - "NO SMOKING. FASTEN SEAT BELTS" indicator switch;
26 - Lateral panel light dimmer;
27 - Primer pump.
28 - "EMERGENCY EXIT" light switch;
29 - Rudder trim tab position indicator.

SECTION 2-00

OPERATING CONDITIONS AND LIMITATIONS

No change

SECTION 3-00

AIRPLANE PERFORMANCE

No change

SECTION 4-00

NORMAL PROCEDURES

SECTION 4-20

OPERATING RADIO-NAVIGATIONAL INSTRUMENTS DURING FLIGHT

5. Using Radio-altimeter RW-UM

(1) Set the altitude warning switch (on the left control desk) to an altitude you consider dangerous or the warning of which is needed during flight or landing.
If the altitude warning is not necessary the altitude switch is to be set to "OFF" position.

(2) Switch on the inverter with INVERTER MAIN switch located on central panel.

(3) Turn on the switch with an inscription RAD. ALT on the instrument panel. After switching on, an intermittent signal is audible in ear-phones for a period of 3-7 sec. (when altitude warning switch is on) and the light with the inscription "DANGEROUS ALTITUDE" on instrument panel light up and will remain ON until airplane climbs above this set altitude.
The pointer of altitude indicator must come to "0" with an accuracy of ±5 m.
In flight, whenever airplane flies below the altitude set by the altitude warning switch the sound signal shall become audiable in earphones and the "DANGER. ALTIT." light shall start to glow and remain "ON" as long as the plane is below this altitude.
If the altitude warning switch is set to "OFF" position the light is ON all the time. At this position of the switch during flight above 900 m the pointer of altimeter may deviate from extreme right position and show any altitude.

When the switch is set at any altitude the pointercomes comes to extreme right position when the airplane is above 600 m and remains there until the airplane descends below 600 m.

6. Switching the Receiver of MRP-56P Markers to Operation

Not applicable - the unit is not installed on the a/c

Instead, it.6 is added, which reads as follows :

6. PULSATORY - TYPE CONTROL OF TRIM TABS.

6.1. ELEVATOR TRIM TAB PULSATORY CONTROL

Elevator trim tab can be controlled either from a 3-position selector switch located on the left control wheel LH handle or from a switch located on the central control desk.
The switches are connected in parallel, and have three positions: central - "neutral" one, forward - "pitch-down", and aft "pitch up" (climb).
The switches incorporate an automatic return-to-neutral feature upon release from either forward or aft position.
When the "pitch-down" (forward) position is selected on either switch and held in this position for about 0,25 second, the elevator trim tab will be deflected upward by only about 0.5°.
With any other switch position change to follow, the current will flow through the tab deflection mechanism motor winding for only about 0,25 second.

For the tab deflection of more than 0.5° or the full one, switch the control several times from the neutral position as the tab deflection is obtained through 0.25 second pulses. To deflect the tab for "Climb", switch the control from neutral to "climb" (aft) position.

6.2 . PULSATORY CONTROL OF AILERON AND RUDDER TRIM TAB.

Aileron and rudder trim tabs may be controlled from three position selectors located on the central control desk. Both selectors have three positions: central - neutral, left - airplane bank and turn left, right - reversal. When left position is selected on both switches and held in this position for about 0.5 second, aileron and rudder trim tabs deflect by about 2.5° (aileron - down, rudder - right).

With any other switch position change to follow, the current will flow through the tab deflection mechanism motor winding for only about 0.6 second.
For the tab deflection of more than 2.5° or the full one, switch the control several times from the neutral position as the aileron and rudder tab deflection is obtained through 0.4 second pulses.
To deflect tabs in opposite direction, switch the control from neutral to right.

6.3 Rudder, elevator and ailerons trim tabs operation check:

(1) To check the proper operation of elevator and rudder trim tabs, apply several pulses (time switchings on) to each tab and notice if the arrows deflections at appropriate indicators are proper.
Check it from neutral position in both directions by about 5 pulses (switchings on).

(2) To check the aileron trim tab operation, deflect the left aileron down (to make if possible to observe the aileron from the cabin) and apply about 5 pulses (time switching on) to each unit in both directions, observing trim tab deflection.

NOTE

Trim tab neutral position is indicated by green lamps lighting on the central control desk.