Yak 18T

Flight Operations Manual

Unofficial English Revision

Version 1.1

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Table of Contents

Introduction

This manual is to be used as a general guide for owners and pilots to understand and become familiar with Yak 18T Flight Operations. Flying acquaintances can also make use of it as an initial education prior to practical experience. This document is based on two versions of translated Russian flight operations manuals. They were brought together in this single document with diagrams and images where appropriate.

The main purpose of this guide is to present the reader with pertinent information, experiences and wisdom about the Yak 18T. If you have information that should be included in this manual, either identified as an obvious omission or as a useful enhancement, then kindly contact Alex Berry by email at alexberry@yak-aviation.com. This document is up for review by Yak 18T owners and pilots.

The Yak 18T aircraft was initially designed for training Aeroflot pilot cadets. It was purposely designed and manufactured as a robust but flexible 4-seat touring aircraft with the added bonus of aerobatic capabilities. In recent times, many of these aircraft have been brought back to life via a complete overhaul both mechanically and cosmetically, with custom paint schemes, up rated engines and executive leather interior being commons options. For these reasons, and many more, the Yak 18T is a serious contender for the discerning pilot who is seeking both aerobatic capability and, with extended fuel tanks, good touring capacity.

The 18T is worthy of all due consideration, especially when value for money is a key factor in the decision to purchase a recently overhauled aircraft. The 18T is considered a complex aircraft; it has a 360HP 9-Cylinder M-14P radial engine with both Retractable Gear and Variable Pitch Propeller, clearly not your average PA-28 or C172. The engine demands care and respect like any other engine, but it may be somewhat different to what you are used to, or what you trained in. However, do not let this dissuade until you have all the facts and have had a much closer look at this charismatic type.

Many modifications for the 18T are currently available. For example, the engine can be up rated to 400HP, the propeller can be exchanged for a 3-blade German MTV-9 240/250 (amongst others), inverted fuel and oil systems, extended wing tip and extended wing tanks can also be fitted. This manual does not however take into account the majority of these modifications – although we would be happy to incorporate these sections should they become available.

This manual contains instructions on Yak 18T piloting technique and general flight operations on the ground and in-flight. The checks in this guide also assume that only one person is present, the Pilot-in-Command (PIC).

Disclaimer

This flight operations manual is for guidance purposes only and has not been officially approved by Yakovlev or any other authority. It is not "a" or "the" definitive guide to Yak 18T Flight Operations and no claim is made to this effect. The originator of this document will not be held responsible for any action taken as a result of information presented herein.

Your support and assistance with the content and accuracy of this manual will no doubt aid all Yak 18T owners in continuing to conduct safe and informed flights.

Section 1 – Background Information

This section contains a brief background that was largely extracted from an article by A. Dugin (Smolensk) titled "YAK 18T. LIFE GOES ON".

1.1. Introduction

The 25th anniversary of the first Yak 18T take-off at the Smolensk Aircraft Manufacturing Plant was celebrated on May 25th, 1999. Today, the Yak 18T is the most popular general aviation aircraft in the Commonwealth Independent States (CIS) countries.

It is well-known to all aviators of the CIS countries, developed by the Yakovlev Design Bureau and followed the Yak-18U, Yak-18A, Yak-18P, Yak-18PM and Yak-18PS. The 18T was the final modification in the Yak-18 family. The two-seater basic aircraft Yak-18 (1946) was put into production in 1947-1955 at the Arsenyevsk and Kharkov Aircraft Manufacturing Plants as well as in China. 3,752 and 379 aircraft were built in the USSR and China respectively. The Yak-18U (1953) is an improved two-seater trainer. During the period of 1954-1957 960 Yak-18U were put out at Arsenyevsk Aircraft Manufacturing plant. The Yak-18-A (1957) was produced from 1957 till 1961 at Arsenyevsk Aircraft Manufacturing Plant (927 aircraft) and 1,796 planes were made in China. In 1961-1962, 125 aircraft were put out at Arsenyevsk Aircraft Manufacturing Plant. The Yak-18PM (1966) is aerobatic. In 1970-1972, 25 aircraft were produced in Arsenyevsk. The Yak-18PS (1970) is aerobatic too but there is no information about the number of aircraft produced (according to Russian Publishing Company Kodeks and KONVERSULT Consulting Company database).

1.2. Purpose

At first, the Yak 18T was designed to be multi-purpose. That's why the Ministry of Timber Industry and the Ministry of Public Health ordered 300 aircraft each (unfortunately their requests were not met). According to the USSR Council of Soviet Ministers (SOVMIN), the Yak 18T became a trainer for the Civil Aviation schools, so that the production program was intended only for the Ministry of Civil Aviation.

For ten years the Smolensk Aircraft Manufacturing Plant sent its output to Aktubinsk, Buguruslanovsk, Kirovograd, Krasnokutsk, and Sasovsk Civil Aviation schools. The Yak 18T's were not delivered to the DOSAAF (semi-military organisations) airclubs.

Only a "go-ahead" Ivanovsk airclub managed to get 10 aircraft. All-in-all 536 Yak 18T were produced in Smolensk for the period of 1973-1983, including experimental and prototypes. In 1974 an ambulance aircraft was built. Its purpose was to transport a patient on a stretcher with the escort of a doctor. But the series production of this configuration was not organized. Also, versions of an aircraft with ski and floating landing gears were being developed at the Yakovlev Design Bureau. But everything was in vain. Nothing came out of it.

The schools mastered the Yak 18T well while using it. All the shortcomings of the design were eliminated and improved according to 217 bulletins. But in 1988 according to the decree of the Ministry of Civil Aviation (MCA) of the USSR all the aircraft were taken out of operation and subjected to discarding, even though the aviation industry produced nothing comparable to replace the Yak 18T. Absolute nonsense! For example, in Kirovograd plant, a team of workers, having completed the up-dating according to the bulletins, as it had been planned, signed their names in the logbook of the aircraft, which next morning was carried away for good. All aircraft fleet was replaced by the An-2 at the schools.

The students had to study the nuts and bolts of training flights "in a Kamaz instead of Zhyguli" (which means dump truck and automobile respectively) was a witty remark of one of the pilot instructors. Part of the worn off Yak 18T was utilized. But after the interference of a newly created USSR Federation of Amateur Aviators, DOSAAF workers and motorcar enthusiasts were held to ransom aircraft for the depreciated cost. The nimblest managed to get the condemned for scrap-iron aircraft for 500…800 soviet roubles each or even for nothing. Thanks to such a decision more than 200 aircraft became privately owned property. As for the YAK 18T, it turned out to be the first popular General Aviation aircraft in the CIS countries. But, unfortunately, it is almost the only one up to the present day.

1.3. Collapse of the Iron Curtain

After the "iron curtain" collapsed, this aircraft attracted the attention of foreign countries. Apparently, the aircraft participation in widely advertised flights of the crews of the Russian Federation of Amateur Aviators to the USA and Australia boosted its popularity. The aircraft were taken abroad in different ways. That's why at the present time the habitat of the aircraft spread to various countries from Bulgaria to New Zealand.

In 1993, the Smolensk Aircraft Manufacturing Plant resumed Yak 18T production. Although the rigging was made afresh, the aircraft structure did not change. Outwardly the second-generation aircraft differs by symmetrical installation of two footboards (footboards of the first-generation aircraft were mounted only on the left side). Little changes also occurred in the equipment make-up. The ARK-9 was replaced by the ARK-15M.

The Ulyanovsk Civil Aircraft Academy (UCAA), the former Civil Aviation Centre of the Council of Mutual Economic Assistance, became the biggest customer of the second-generation aircraft. Having got their bearings, the UCAA supervisors made a decision to get involved in primary training and bought 15 Yak 18T in Smolensk. And here is the result: if other schools go on using the An-2 as a trainer, and have been handing over certificates about completing the theoretical course instead of pilot license, in Ulyanovsk the students fly as much as they are supposed to.

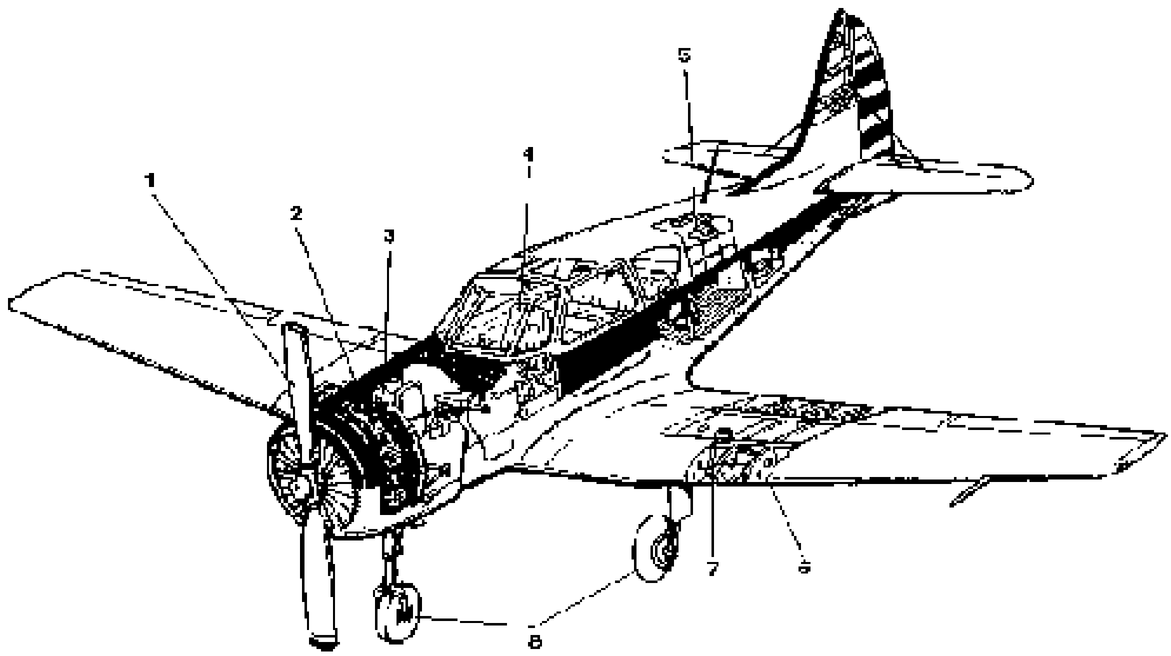
1.4. The Aircraft

The aircraft fuselage is mainly of riveted structure. Glue-welded joining of stringers and skin is used in the rear part. The wing is two-spar, cantilevers are mounted to the centre-section by the joint of the "lug-plug" type with four bolts each. The wing centre-section is made as a one-piece unit with a fuselage and the wingspan is 3.6m (11ft). That puts certain limitations on ground transportation. Along the whole span of the centre-section to the lower berth of the rear spar, the landing dashboard is hanging. The frame of the wing and tail unit is all-metal. Wing panels, ailerons, fin, stabilizer, elevator and rudder have aircraft cotton fabric ÀÌ-93 skin, which is called ‘percale’ in Russia, although these are different materials that can be used.

The cabin is four-seat. Along the cabin sides there are two car-type doors from 850 to 1250mm in size, equipped with an emergency fault mechanism that allows the doors to be jettisoned in an emergency. In the first row there are two armchairs, adjustable vertically and horizontally with the mechanism of shoulder belts tightening. There is a passenger couch in the second row. Behind it there is an upper baggage rack and under it is quite a substantial baggage compartment. The hatch of the baggage compartment is to the left side of the board of the fuselage. The hatch lid opens up. And when it is closed, it is held by a pintle lock. Access to the lock-knob is from the cabin side with a rack-back position of the couch.

There is a heating system, in which the outward air is heated from a heat exchanger of the engine exhaust and comes into the cabin. The system insures the windshield blower of the canopy. The air-cooling system ensures the cabin pressurization under the velocity head influence (air intakes are located on both sides of the fuselage and on the canopy upper frame). Left windshield is provided with an electric drive windshield wiper. The service ceiling is 5,520m (16,730 ft). But as oxygen system is not available on-board, it is not permitted to fly higher than 4,000m (13,120 ft) as it is stated later in this Flying Operations Manual (FOM).

The power plant consists of the M-14P engine and a variable-pitch propeller V530TA-D35 with an rpm governor R-2. It is completely identical to the propeller group of the Yak-52s, except for some little differences in engine mounting. The tricycle-equipped landing gear with the nose strut is retractable. The front strut wheel is castor. The main landing gear wheels have block brakes. All landing gears are of telescopic type with a oleo-pneumatic shock-strut (AMG-10 oil and nitrogen). The double action shock struts are used in the Yak 18T. They ensure overcoming of the unpaved runway roughness with a smaller loading for frame construction. The tire pressure is 3 kgpcm² (61lbpsq.ft). A skilled pilot can turn the aircraft around practically on one wheel. The turning radius equals the landing gear tread width. A parking brake system is provided for the Yak 18T. In the case of the main system failure, the emergency system can perform all the functions except for the M-14P start. The capacity of a main air system cylinder is 12l (3.2 gal), the emergency one is 3l (0.8 gal). During the flight the air system is recharged from the AK-50T compressor, mounted on the engine.



1. Propeller
2. M-14P engine
3. Oil tank
4. Pilot chair
5. Radio equipment
6. Landing light
7. Fuel tank
8. Retractable landing gear

The fuel (standard version) is distributed in two main tanks with the capacity of 95l (25 gal) each and in the service tank with the capacity of 3.5l (0.9 gal). The fuel is fed by gravity from the main tanks to a service tank, located in wing panels. The service tank is mounted lower than the main ones. The fuel is fed from the service tank, mounted on the engine by the 702K rotary pump. Before the engine start-up a fuel priming pump is used for priming its cylinders and the 702K fuel pump. The fuel to be used is B-91/115 gasoline, GOST (State All-

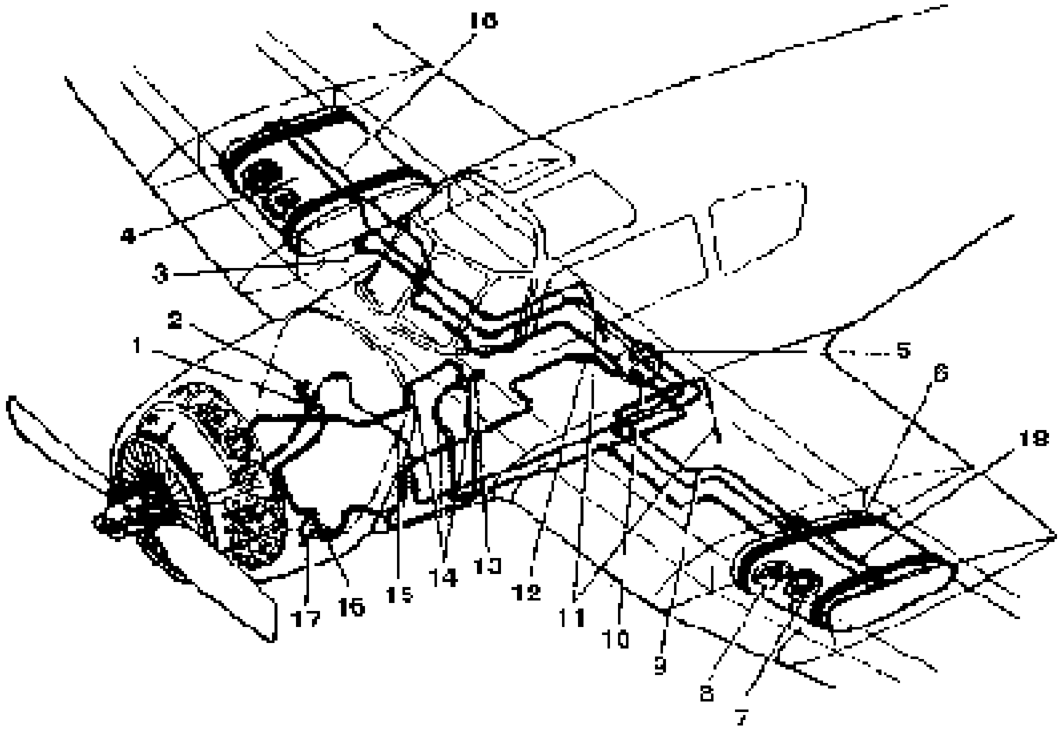
Union standard) is 1012-72. But Voronezh Mechanichal plant is going to use the automobile AI-92 gasoline for the M-14P operation in the nearest future.

The oil system ensures oiling and cooling of rubbing surfaces of the engine parts as well as the P-2 regulator pump. The MS-20 oil of GOST 21743-76 is used in it. The oil circulation in the system is forced by the MN-14 gear pump, mounted on the engine. The oil tank is mounted on frame No 0. Its capacity is 24 l (6.35 gal). The air-oil cooler 2281-2-0 of a tubular type is mounted on the right side of the center-section of the front spar. Its air intake is located in the wing leading edge flap. To make the engine start-up easy in winter the system of oil thinning by gasoline is provided.

The Yak 18T inherited the ability to perform a full complement of aerobatics from the early aircraft of the "T" family. There is only one point to pay attention to. The standard oil system design doesn't provide the engine oiling during the inverted flight. That's why the FOI forbids its performing. The fuel and oil consumption doesn't exceed 45 lph (12 galph) and 1 lph (0.26 galph) respectively at the second cruising regime.

Three power supply systems are used on the Yak 18T. They are: a direct-current of a voltage of 28V, an alternate single-phase current of a voltage of 115V with frequency of 400 Hz and alternate three-phase current of the voltage of 36V and frequency of 400 Hz. The primary system is a direct-current system with the GSR-3000M generator and the 20NKBN-25UZ storage battery. The sources of alternate current are the PO-250A (115V) and the PT-200Ts (36V) converters.

1.5. The Fuel System

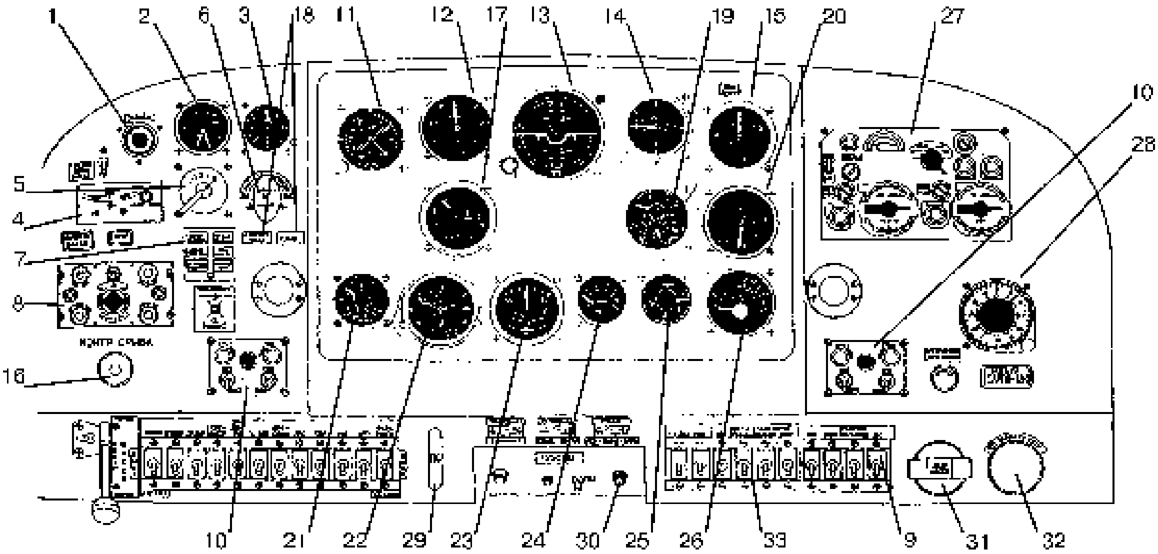


1 - oil dilution valve	10 - fuel drain valve
2 - P-1B fuel pressure transmitter	11 - vent pipe
3 - oil feed pipe	12 - check valve
4 - main fuel tank	13 - 740400 hand primer pump
5 - service tank	14 - fill hoses
6 - main fuel tank	15 - bypass pipeline

7 - filler
8 - fuel quantity transmitter
9 - overflow and vent line
16 - fuel fire shut-off valve
17 - fuel filter
18 - overflow and vent line of a service tank

The standard complete set of aircraft instrumentation consists of the GMK-1AE compass system (CS), the AGD-1K gyro horizon, the EUP-53U turn indicator, the UC-450K airspeed indicator, the VD-10K altimeter, the VR-10MK VSI rate-of-climb indicator, the AM-10K accelerometer, the AchC-1 aircraft clock, the KI-13K magnetic compass, the SSKUA-1 angle-of-attack warning system.

1.6. The Control Panel



1 - engine start button	12 - US-450 speed indicator	23 - EUP-53U indicator
2 - 2M-80 air system gauge	13 - 1122-B horizon indicator	24 - TUE-48 temperature indicator
3 - AM-1OK accelerometer	14 - VR-1MK rate-of climb indicator	25 - TTsT-1 temperature indicator
4 - landing gear warning light	15 - MV-1bV pressure vacuum gauge	26 - SBES-2077B fuel quantity indicator
5 - PM1-1 magneto switch	16 - ground break-down control button	27 - ARK-15 control panel
6 - hand primer pump product No 740400	17 - VD-1OK altimeter	28 - KM-8 compensator
7 - T6-U2 signal panel	18 - SSLUA-1 system indicators	29 - fuel emergency shut-off cock handle
8 - GMK-1AE control panel	19 - UKZ-1 indicator	30 - Baklan-5 control desk
9 -	20 - PTE-1 tachometer indicator	31 - landing gear emergency release cock
10 - SPU-9 control panel	21 - VA-Z voltammeter	32 - electrical system charging cock
11 - YGR-4UK indicator	22 - AchS-1K clock	33 - AZRGK-2 break-down signalling

The radio equipment consists of the Baklan-5 radio compass and the MRP-56P station and the SPU-9 intercom. The radio navigational equipment includes the ARK-15M automatic marker receiver.

The RV-5 low-altitude radio altimeter and the Os-1 device for automatic landing were additionally installed on five aircraft for Kirovograd flying school some years ago. But Soviet GPS for the Yak 18T was unclaimed. So the aircraft of such a complete set haven't been produced any more.

For the night flights and in conditions of low visibility the red highlight of the dashboard and the control panel is provided. Besides the navigation lights and the MSL-3 signal beacon, the exterior lighting equipment includes the LFSM 28-200-landing/taxi light.

Section 2 - Technical Information

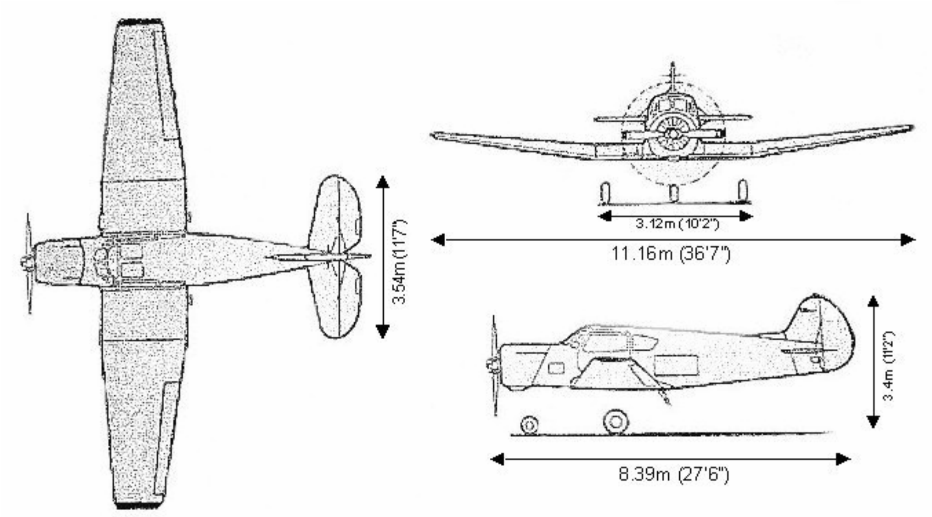
This section contains some technical information about the performance, dimensional characteristics and standard equipment of the Yak 18T.

2.1 Performance

Engine	360HP, M-14P
Engine starting system	Pneumatic
Cylinders	9, Radial, Star-type/single layer
Cubic capacity	10 litres (1.1l per cylinder)
Cooling system	Air
Weight (dry)	214kgs ±2%, 471lbs ±2%
Max engine speed	101%
Empty weight	2,728lbs, 1,240kg
Gross weight	3,630lbs, 1,650kg
Average cruise	200km/h, 108kts, 124mph
Top speed (sea level)	262km/h, 141kts, 162mph
Max. IAS (straight and level flight)	300km/h, 162kts, 186mph
Max. IAS (straight and level flight with bumpiness)	360km/h, 194kts, 224mph
Max. IAS (in a dive)	460km/h, 248kts, 285mph
Range, 193litres (std. no reserve)	760km, 470miles, 3hrs 45mins
Range, 193litres (+30mins reserve)	660km, 410miles, 3hrs 15mins
Range, 193litres (+45div. + 30mins reserve)	510km, 315miles, 2hrs 30mins
Range, 320litres (ext. no reserve)	1,250km, 775miles, 6 hrs 20mins
Range, 320litres (+30mins reserve)	1,150km, 714miles, 5 hrs 50mins
Range, 320litres (+45div. + 30mins reserve)	1,000km, 620miles, 5 hrs 5mins
Ground run	1,221ft, 370m
Ground roll	1,155ft-1,551ft, 350m-470m
Service ceiling (with supplemental oxygen)	16,400ft, 5,000m
Service ceiling (without supplemental oxygen)	13,120ft, 4,000m

The ranges above are based on an approximate average burn rate of 50 litres per hour of flight at 200km/h i.e. Cruise I. Monitor the fuel burn rate of your particular aircraft against these figures (it may be more or slightly less) and always err on the side of caution. Also note the additional ground run and roll distances based on take-off weight, fuel load, C of G, runway slope, icing conditions etc. Never conduct flights purely based on the figures stated above.

2.2 Dimensional Characteristics of the Yak 18T



2.2.1 General Data

Length	8.39m ±1.6cm (27'6")
Height	3.4m (11'1")
LG wheel track	3.12m ±2cm (10'2")
LG wheel base at rest	195.5cm ±0.6cm
Tyre size (braked wheel tyres of main undercarriage legs)	50*15cm
Tyre size (nose undercarriage leg)	40*15cm
Distance from tip of propeller blade to the ground (at parking position with compressed shock struts and wheel tires)	16cm
Pitch angle at rest	2°

2.2.2 Wing

Section	Klark YH
Area, Span	18.8m², 11.16m (36'7")
Length of mean aerodynamic chord	1.74m (5'8")
Aspect ratio	6.6
Dihedral (along ¼ chord line)	7°20'
Angle of wing setting	2°
Ailerons area	1.92m²
Aileron deflection (up/down)	22°-1° / 15°-1°
Landing split flap area	1.6m2
Deflection angle of the landing split flap	50° +3° / -1°30'

2.2.3 Horizontal Tail

Area	3.185m²
Span	3.54m (11'7")
Elevator area (incl. trim tab)	1.235m²
Dihedral	0°
Elevator deflection (up/down)	25° -1°30' / 25° -1°30'
Elevator trimmer deflection (up/down)	20° +3°40' / 20° -1°15'

2.2.4 Vertical Tail

Area	1.7m²
Rudder area	0.982m²
Rudder deflection (left/right)	27°-1° / 27°-1°

2.2.5 Engine Conditions

Engine Condition	Power nr. Ground (HP)	Crankshaft Speed	Supercharger pressure, mm mercury column	Specific fuel consumption g/l, s.hr
Take-off regime	360-2% (reduced)	99-4% ground 99+1-2% air	Po+125±15	285-315
Nominal I	290-2% (reduced)	82%-84%	Po+95±15	280-310
Nominal II	240-2% (reduced)	70%	Po+75±15	265-300
Cruise I	0.75 of the measured power at Nominal II	64%	735±15 (absolute)	210-230
Cruise II	0.6 of the measured power at Nominal II	59%	670±15 (absolute)	215-235
Idling		≤ 26%		

1. Higher power limit and boost pressure behind the supercharger at take-off, Nominal I and II is not limited
2. 99.4% of the crankshaft rotational speed corresponds to 2900rpm
3. Time of continuous engine operation in the take-off regime must not exceed 5mins at peak rpm conditions are 1min at rest conditions

Maximum engine speed (rpm)	101%
Idling (26%) to take-off regime engine acceleration capacity at V=0, H=0 does not exceed	3 seconds
Maximum over-speeding at acceleration application in flight (duration **does not exceed 1 second** and time during service life – 30 minutes)	109%

2.3 Fuel Specification and Octane Number

Petrol	B-91/115
Gost	1012-72 (octane number ≥ 91)

2.4 Carburettor

Symbol	AK-14P
Type	Pressure carburettor, without float
Inlet temperature	+10°C - +45°C

2.5 Fuel Pressure in front of Carburettor

At operating conditions	0.2-0.5 kgf/cm²
At minimum rpm at least	0.15 kgf/cm²

2.6 Petrol Pump

Symbol	702 ML
Type	Lobe rotary pump
Number per engine	1

2.7 Fine Filter

Symbol	8D 2.966.064
Type	Sump, gravity filter
Filtration fineness	36-40μm

2.8 Oil Grade

For flight and winter ops.	MC-20 or MK-22 (Gost 10103-49)

2.9 Oil Consumption

At Cruise I (g/l sec/hr)	≤ 8 (during 1st overhaul)

2.10 Oil Pressure

At operating conditions	4-6 kgf/cm²
At minimum rpm (in the main line)	≥1 kgf/cm²

(Measured through a special pipe connection at the oil pump)

2.11 Oil Inlet Temperature

Recommended	50°C - 65°C
Minimum permissible	40°C
Maximum during long term operations	75°C
Maximum temperature in first 15mins operation	85°C

2.12 Cylinder Head Temperature

Recommended	140°C - 190°C
Minimum permissible for engine normal operation	120°C
Minimum for continuous operation	140°C
Maximum for continuous operation	220°C

2.13 Magnetos

Symbol	M9-25M
Type	Four-spark, shielded
Number **in the** engine	2

2.14 Spark Plugs

Symbol	CD-49CMM
Number per cylinder	2
Ignition sequence	1-3-5-7-9-2-4-6-8

2.15 Propeller

Symbol	V530TA-D35
Type	Variable-pitch tractor
Action	Direct
Direction of action	Left
Diameter	2.4m (7'10")
Blades	2
Minimum blade angle at 1000mm radius	14°30'±10'
Maximum blade angle at 1000mm radius	14°30'±10'
Range of blade rotation	20°±40'
Weight	40kg+2% (88lbs+2%)

2.16 Main Flight Performance at Standard Conditions

Maximum indicated horizontal airspeed	262km/h, 141kts 162mph
Maximum service ceiling	13,120ft, 4,000m

As standard oxygen equipment is not available in the aircraft, flights at altitudes above 4,000m (13,120ft) are **PROHIBITED**. In order to avoid the engine overheating, the climb to 3,000m (9,900ft) should be made at Nominal II (70%) conditions -

- V(limit) = 170km/h (91kts) at ambient temperature near the ground up to +20°C
- V(limit) = 180km/h (97kts) at ambient temperature near the ground over +20°C

Climb from 3000m and higher is allowed to be performed at Nominal I conditions V(limit) = 165km/h (89kts). Time to climb to an extreme high altitude is ≤35 minutes.

2.17 Airfield Performance

Take-off Weight	Rotation Speed	Take-off Run	Take-off Distance to 10m (33ft)	Length of Aborted Flight	Touch-down Velocity with Flap	Landing Run	Landing Distance from 15m (50ft)
At mean conventional bearing power of soil 8-9 kgf/cm²							
1,650kg	135km/h	370m	670m	850m	130km/h	470m	790m
1,510kg	125km/h	265m	540m	650m	120km/h	390m	690m
3,637lbs	73kts	1,214ft	2,198ft	2,789ft	70kts	1,542ft	2,592ft
3,329lbs	67kts	870ft	1,772ft	2,132ft	65kts	1,279ft	2,264ft
At mean conventional bearing power of soil 4-5 kgf/cm²							
1,650kg	125km/h	500m	920m	700m	125km/h	350m	650m
1,510kg	120km/h	455m	830m	-	124km/h	350m	610m
3,637lbs	67kts	1,640ft	3,018ft	2,297ft	67kts	1,148ft	2,132ft
3,329lbs	65kts	1,493ft	2,723ft	-	67kts	1,148ft	2,001ft

Landing without the extended split flap is permitted in the following cases:

- at headwind speed of less than 10m/s (19kts/22mph)
- at crosswind
- in case of faulty flap extension mechanism
- in the cases where the pilot possesses adequate skill
- in the case of aircraft ditching

Section 3 – Operational Limitations

3.1. Flying Limitations

Maximum allowable indicated airspeed at diving	300km/h	162kts
Maximum allowable indicated airspeed at turbulence (210-250km/h recommended)	300km/h	162kts
Maximum allowable indicated airspeed for undercarriage and flap extension	200km/h	108kts
Indicated stalling airspeed at braking with flying weight of 1570kg – 1620kg when the engine is at idling conditions		
Clean:	120-123km/h	64-66kts
Flap extended:	112-114km/h	60-61kts
Nominal I Clean:	102-105km/h	55-56kts
Take-off regime (gear down/flap):	97km/h	52kts

3.2. Operational Loading

At take-off weight of 1,500kg	+6.4 / -3.2
At take-off weight of 1,650kg	+5 / -2.5

3.3. Crosswind Components

Maximum permissible headwind velocity at take-off and landing	15m/s (29kts/33mph)
Maximum allowable crosswind speed at 90° runway angle at take-off	12m/s (23kts/26mph)
Maximum allowable crosswind speed at 90° runway angle at landing	10m/s (19kts/22mph)
Maximum allowable headwind speed when landing without the extended split flap	10m/s (19kts/22mph)

3.4. Weight and Balance Data

	Versions	
	Trainer version	Initial training
Take-off Weight	1,650kg (3,638lbs)	1,510kg (3,329lbs)
Total load	438kg (966lbs)	303kg (668lbs)
Fuel	100kg (220lbs)	100kg (220lbs)
Equipment	338kg (745lbs)	203kg (447lbs)
Crew – including:		
Pilot (1/2 persons)	80kg (176lbs)	185kg (408lbs)
Cadets (3 persons)	240kg (529lbs)	-
Equipment without crew:		
Seat cushions	5	-
Parachutes	-	25
Oil	18	18
Aircraft empty weight	1,217kg (2,683lbs)	1,217kg (2,683lbs)
Centre-of-gravity (c.g.) position, %MAC (mean aerodynamic chord)		
- At take-off, RG retracted	24.5	19.5
- At landing, RG extended with 10% fuel and 50% oil	23.4	17.8
- Empty, RG extended	18.5	18.5
- Permissible CG position range, %MAC	13.0-26.0	13.0-20.5

1. Aircraft empty weight allowance is ±1%
2. Empty aircraft c.g. position tolerance is ±1% (MAC – mean aerodynamic chord)
3. The undercarriage extension displaces the centre-of-gravity forwards by 0.5%-0.7% MAC
4. In the initial training version, the crew weight includes two parachutes C-4. Assumed weight of the parachute is 12.5kg
5. One of every five mass-production aircrafts feature the wiring and attachment fittings for the OSB-1 and PB-5 radio stations. When these stations are installed, the mass of the

aircraft becomes increased by 10kg and the CG position of the aircraft becomes displaced 0.5-0.6 %MAC aft ward. The OSB-1 and PB-5 stations are installed only in the advanced training version aircrafts. In this case the take-off mass of the empty aircraft is increased by 25kg. The CG position of the aircraft shits 1.6-2.3 %MAC aft ward. For aircrafts not equipped with SARPP-12K flight data recorder the mass of the aircraft decreases by 10kg and the CG position of the aircraft shits 0.3-0.5 %MAC forward.

3.5. Other Limitations

- Due to the fact that the aircraft does not feature regular oxygen equipment, flights at altitudes more than 4,000m are **prohibited**

- In the trainer version, the number of the crewmembers should not exceed four persons

- As parachutes are not employed in the trainer version, **it is PROHIBITED** to make aerobatic manoeuvres. However, in the initial training version with a crew of two persons equipped with emergency parachutes, all elementary and advanced manoeuvres can be performed

- Prolonged inverted flight and return (backward) flying is **strictly PROHIBITED**

- Night training flights from non-lighted runways is **prohibited**

- Take-off is **prohibited** if the quantity of available fuel is less than 60litres. In the case of illumination of the RESERVE 30litres (Oct. 30l) light annunciator the aircraft is allowed to fly not more than 40-45mins. Flights in the circuit should be performed with LG extended. The minimum sub-soil strength for taxiways and runway is 4 kgf/cm²

Section 4 - Pre-flight Inspection

A quick review of your logbook will make it obvious how long ago it was that you flew in a Yak 18T. Whether you are the sole owner or a shareholder, you should always treat the aircraft with critical and suspect eyes. Whether you were the last to fly just yesterday or not, always perform an unrushed formal pre-flight inspection. The number of AAIB reports indicating inadequate pre-flights is *unnecessary* and *avoidable*. It takes 15-30minutes to do a good pre-flight; the best advice is to know what to look for and **CHECK PROPERLY**.

The following suggested pre-flight inspection is targeted at the pilot who is travelling alone – hence the structure of the checks and the engine starting procedures. The process of conducting the pre-flight inspection for those with willing and able assistance will no doubt be improved. In any case, it is recommended that you take full responsibility for all of the checks, allocating only insignificant tasks to others until you are convinced of their competence.

4.1. Preliminary Pre-Flight Actions

The following steps should be carried out prior to beginning the inspection, make sure that all covers and protective caps i.e. pitot cover, propeller cover, oil cooler stop, cockpit cover, aileron and rudder gust tabs are removed.

1. at dusty aerodromes the parking area of the aircraft must be **HOSED**
2. **REMOVE** any wing and tail tie-downs
3. in winter make sure that the aircraft is **CLEANED** from snow, ice and frost
4. if parked on grass, **REMOVE** any mud and grass from the undercarriage – also, check for unwanted items in the undercarriage recesses
5. **REMOVE** any items (typically grass and hay) located in the oil-cooling unit at the front of the starboard wing near the cowling
6. **LEAVE** the chocks under the main wheels and ensure that fire extinguishing aids are close to the aircraft in the event of a fire
7. **CHECK** that there are no **PEOPLE, SUBJECTS or VEHICLES NEARBY** capable of obstructing the propeller

Ensure that all precautions are taken to prevent against spontaneous folding of the undercarriage, the engine occasional start, cut-in of individual electric units and extension of the split flap. For this purpose check the following –

8. **SWITCH** the BATTERY-GROUND SUPPLY to the **OFF** position
9. **ENSURE** that all switches and cut-outs on the panel are switched **OFF**
10. **CHECK** that the magneto switch is **SET** to **0** position **OFF**
11. **CHECK** that the undercarriage lever is in the **DOWN** position and locked with a detent. If no detent is available, advise all assistants and passengers of the importance not to touch this lever
12. **ENSURE** that the flap lever is in the **NEUTRAL** position
13. in winter time, check that the gills are **CLOSED** (remember to check visually that the gills are actually closed when you think they are)
14. **ENSURE** that the oil cooler is **CLOSED** (remember to check visually that the oil cooler shutter is closed when you think it is)
15. **CHECK** that the carburettor heat is **OFF**

While in the cockpit, it is advisable to do a quick instrument check of the fuel contents –

16. **SWITCH** the BATTERY-GROUND SUPPLY to the **ON** position

17. **SWITCH** the ENGINE INSTRUMENTS to the **ON** position
18. **NOTE** the reading of **BOTH** tanks from the fuel contents gauge
19. **SELECT** and hold the switch for the **LEFT** fuel tank contents and wait for the gauge to stabilise and note the reading
20. **SELECT** and hold the switch for the **RIGHT** fuel tank contents and wait for the gauge to stabilise and note the reading
21. **COMPARE** the individual readings with the total fuel contents and that of the expected contents (i.e. as stated in the engine log book)
22. unless full-fuel is required, avoid deciding on this basis if the aircraft needs additional fuel until you have **VISUALLY** checked the contents of each tank, just in case the gauges are inaccurate
23. **SWITCH** the circuit breaker ENGINE INSTRUMENTS to the **OFF** position
24. **SWITCH** the circuit breaker BATTERY-GROUND SUPPLY to the **OFF** position
25. if additional fuel is required then inform the ground staff now
26. **NOTE**: all switches should be **OFF**

It is now advisable to perform a very quick check of the ANE (air navigation equipment). To do this, perform the following actions and remember that battery power is limited and will not last long; a quick check is all that is necessary to ensure that the lighting facilities function correctly -

27. **SWITCH** the BATTERY-GROUND SUPPLY to the **ON** position
28. **SWITCH** the ANE switches to the **ON** position
29. get out of the cockpit and **CHECK** the port side wing tip ANE light
30. move around to the front of the aircraft and **CHECK** the landing/navigation light on the port wing
31. while moving around to the starboard wing tip, **CHECK** the landing position lights on the front and main undercarriage
32. **CHECK** the starboard side wing tip ANE light
33. while moving to the rear, **CHECK** the anti-collision beacon
34. while moving to the port side, **CHECK** the rear tail ANE and then enter the cockpit
35. **SWITCH** the ANE switches to the **OFF** position
36. **SWITCH** the BATTERY-GROUND SUPPLY to the **OFF** position
37. **NOTE**: all switches should be **OFF**

4.2. Relevant Documentation

Before the equipment is inspected, the pilot-in-command must look through the flight **logbook** to check whether any reported **defects** (detected during previous flights) have been eliminated. It is **important** to get to know what kind of works/repairs have been performed on the aircraft by technical personnel.

If a group manages the aircraft then seek information about the **maintenance schedule** and if action needs taking – **ACT!** From this point on, you the pilot-in-command become responsible for the readiness of the aircraft for flight -

- ☐ **Have you got valid and appropriate Aviation Insurance?**
- ☐ **Do you have copies of your C of A and C of R with you?**
- ☐ **Do you need a Permit to Fly?**
- ☐ **Is it valid?**
- ☐ **Taking passengers?**

- ☐ **Are you ready to brief them?**
- ☐ **Have you got the prerequisite flying experience?**

CHECK!

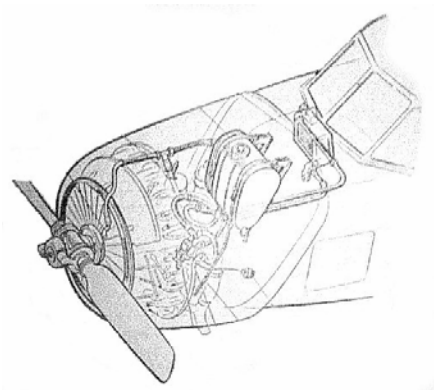
4.3. Performing the Inspection

4.3.1. Pre-flight Checks

Checking the Fuel and Oil

38. The amount and grade of the available fuel and oil must be **CHECKED** and **REPLENISHED** if necessary. The pilot-in-command must be sure that the fuel deposit is discharged and is free of mechanical additives and water and in wintertime ice crystals

Checking the Oil



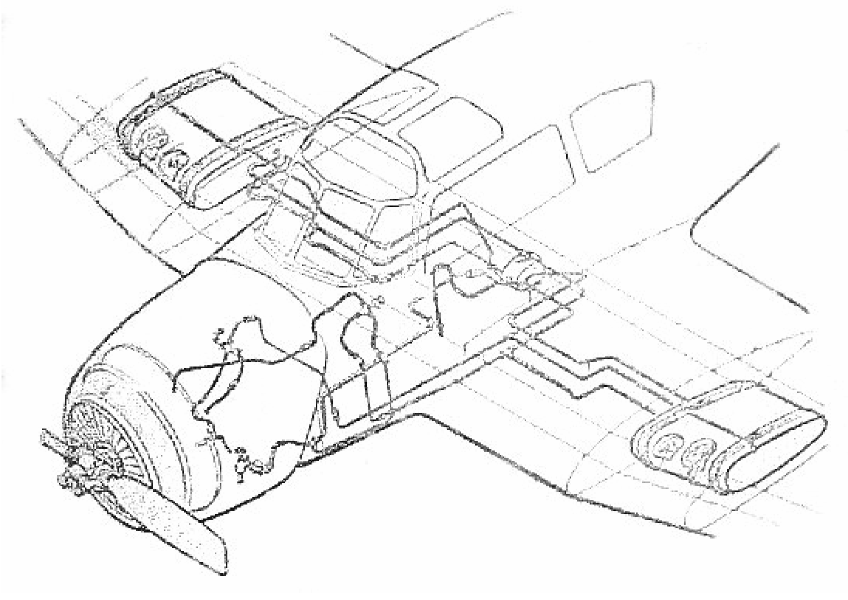
39. The oil contents are checked by the means of a dip-yoke attached to the oil cap on top of the cowling. First **CHECK** the oil by climbing on the starboard wing, edging forward avoiding the oil cooler until you can comfortably remove the oil filler cap without losing your footing. If you are quite a heavy individual or are uncomfortable with this approach, find some step-ladders and climb from either side of the cowling – it's safer this way
40. **REMOVE** the cap, undo, remove and check the dip-yoke and **ENSURE** that the oil contents are in the range of 12-14 litres for ordinary flight (>8litres for aerobatic flight). The standard oil level reading is 18 litres. The total oil tank volume is 30litres
41. **ADD** the correct grade of oil as required by using a funnel being careful not to spill the oil during the process
42. Once satisfied with the oil contents, ensure that you **REPLACE** the dip-yoke and cap correctly and **SECURELY**. **CHECK** that the dip-yoke cap is held tight under the edges of the oil filler tab and then tighten
43. When refitting the oil cap on top of the cowling, **ENSURE** that the cap is placed correctly and that the screw 'clicks' into place to fasten the cap correctly
44. **NOTE** the quantity of oil and the amount added in the engine log book

Checking the Fuel Deposit

45. To drain and **INSPECT** the fuel contents, move underneath the fuselage to identify the fuel drain cap (only 1 fuel drain on a Yak 18T). This is located aft of the cowling, just in front of the split flap
46. Carefully **UNSCREW** the locking screws and allow the fuel cap to open on its hinge. Note, use the right tool and avoid using excessive force when opening the cap as this will decrease the life of the screw heads
47. Use a reasonably large clear container (unlike the usual test-tube like drainers). **HOLD** the container beneath the drain and **PUSH** the release valve to allow the fuel contents to fill the container
48. **CHECK** that the fuel is free from mechanical admixtures, sediments, water, ice crystals and is of the correct colour (i.e. blue). It is quite normal to drain 200ml-300ml of fuel
49. If unsatisfied with the fuel contents, **RE-DRAIN** and **RE-CHECK**. If you are in doubt, err on the side of caution and seek additional advice – do not rely on hope. We all know that the carburettor can become blocked and hence stop the engine at a critical time
50. **REPLACE** the fuel cap and as before, carefully lock the securing screws in place without using excessive force

<u>Visual Fuel Inspection</u>

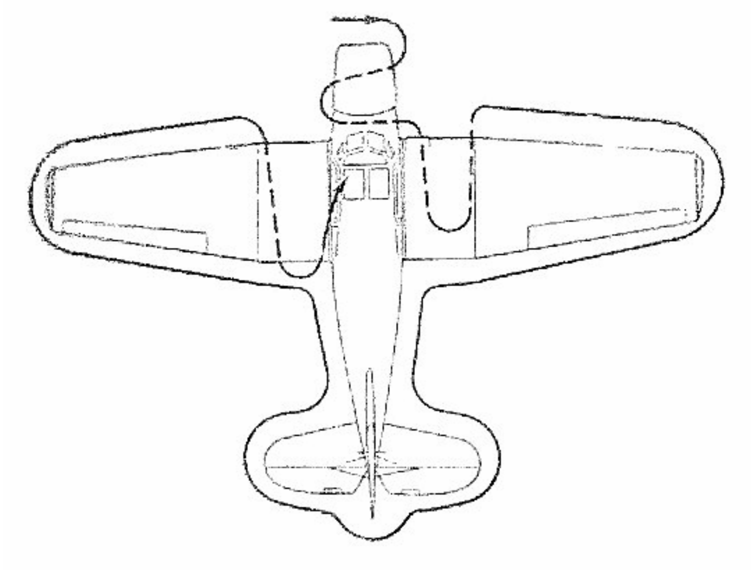
51. With a full tank reading, the fuel level in the tanks must be **BELOW** the edges of the tank fillers by at least 3cm. The total capacity of the fuel tanks is 193litres (more for those 18T's with extended wing or wing-tip tanks)
52. **REMOVE** the fuel cap and fuel lock on the port wing (similar to when checking the oil)



53. **REMOVE** the inner fuel filter and then use a fuel dip-yoke (if available, visually if not) to **MEASURE** the contents of the tank. Note: with extended wing tanks, it is not possible to gain an accurate measure of the tank contents by visual inspection due to the wing dihedral
54. **REPLACE** the fuel filter and lock and ensure it is correctly positioned and **SECURE** (similar to oil) even if you are awaiting additional fuel
55. **REPLACE** the fuel cap and lock the screws in the correct position

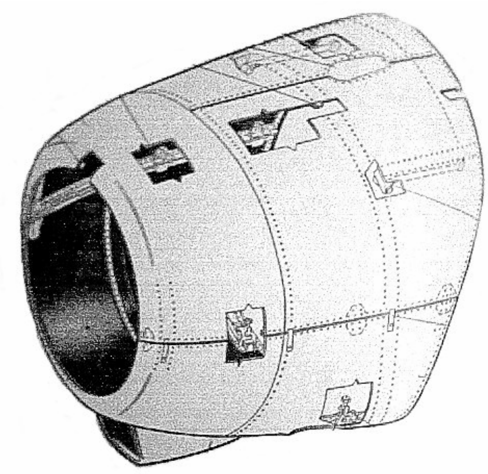
<u>Performing the Walk Around</u>

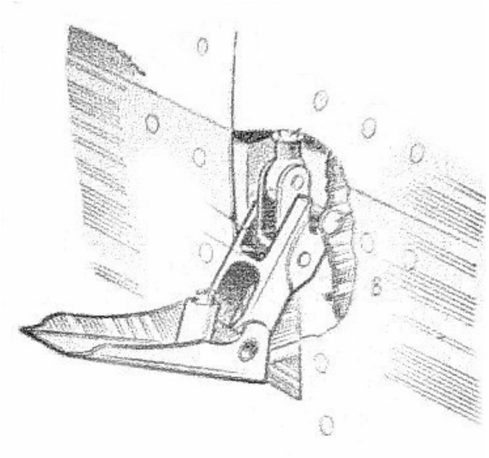
56. Perform the walk around **SLOWLY**; take your time. If you are in a rush, then think about the implications of missing something vital and then ask yourself what is more important? The diagram below suggests a route for the walk around. By all means design your own, but whatever you decide, ensure that the walk around covers everything that is vital and once you have adopted a route, stick to it and improve it. **AVOID** the complacent 'quick-random-check' syndrome.



Perform the external inspection of the aircraft with the following checks –

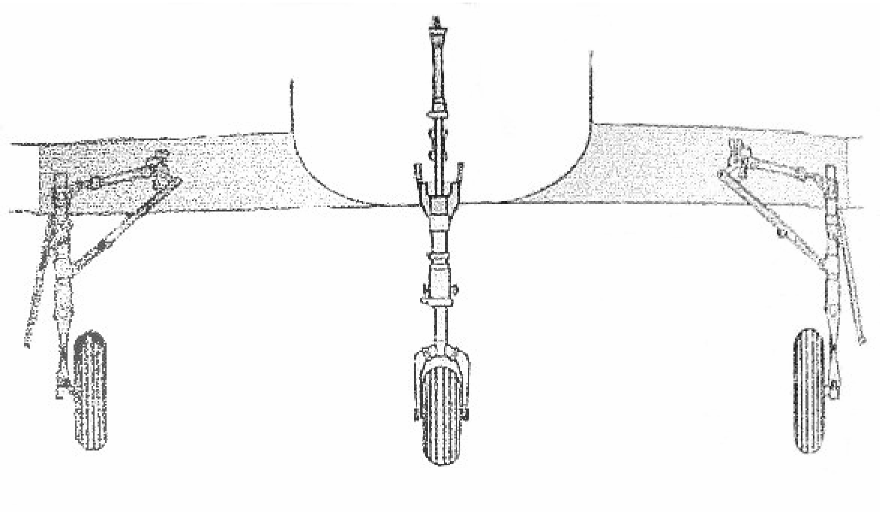
57. **CHECK** that the air valve inside the port-side cowling has been released and that no air is present by opening the valve. Do not over tighten this value
58. **CHECK** the engine cowling to make sure that no damage is present and that the cowl fasteners and cover plates are shut and secured correctly (slits of the fasteners should coincide with marks on the cowling)



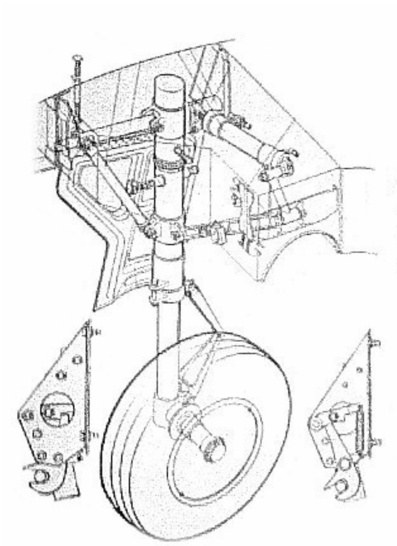


59. **CHECK** the spinner/hub, ensure that all of the screws are secure, especially on either side of the propeller blades where they meet the spinner
60. **CHECK** the propeller blades and the blade counterweights for stone chips on the reverse side and other damage and cracks

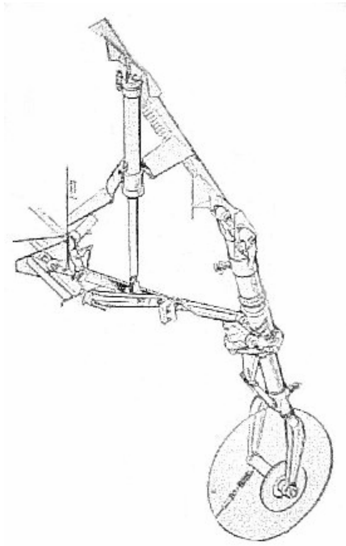
61. **CHECK** propeller blade setting according to setting marks
62. **CHECK** for leakage of petrol and oil
63. **CHECK** the undercarriage and fixture of the undercarriage extension signal lights, be sure that the tyre casing of the nose undercarriage leg is not damaged, the tyre pressure is a standard one (15-20mm tyre deflection), the damper conditions is proper (no mixture leakage) and camber of the shock-absorber strut is normal, a visible portion of the stem should de equal to 173-187mm
64. **CHECK** whether tyre casings of the main undercarriage legs, grounding springs and signal lights fixtures of the undercarriage lowering are proper, the tyre pressure is standard (25-30mm deflection) and the sag of the shock-absorber struts is equal, the visible portion of the stem should be 204-234mm



Main Undercarriage

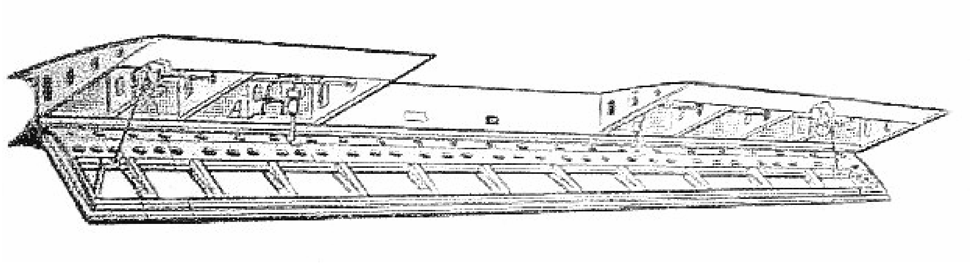


Example Undercarriage

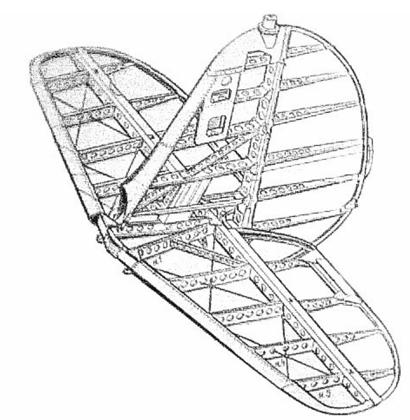


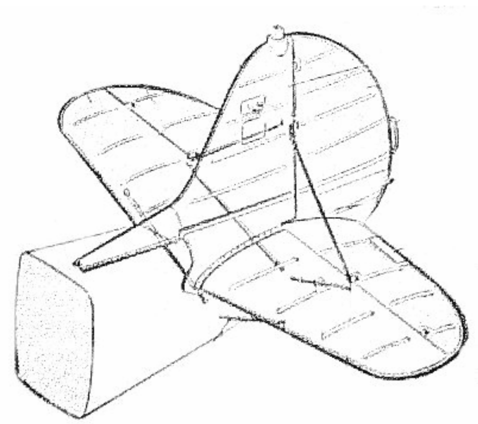
Front Undercarriage

65. **CHECK** the centre-wing section from below
66. unlike the diagram below, make sure that the landing split flap is raised and fits **TIGHTLY** and that no fuel or oil leakage is present



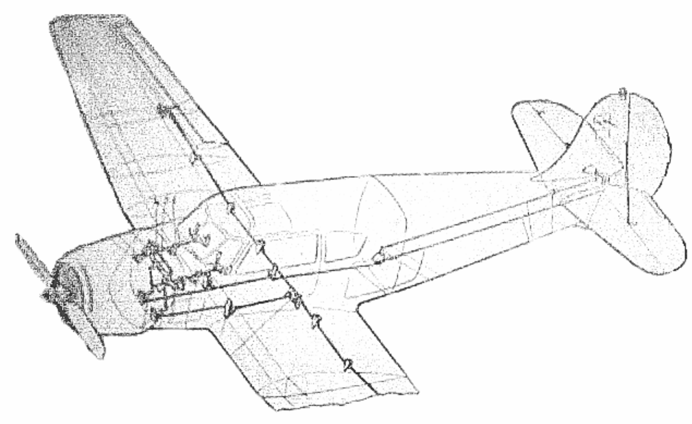
67. **CHECK** the starboard wing and look for damage of the wing skin and fillets
68. **CHECK** the state of the air intake, oil cooler and cells
69. **CHECK** for oil leakage and the proper condition of the extended undercarriage position indicator and state and fastening of the position lights
70. **CHECK** that the ailerons are good and joint couplings are proper, and that the clamps are taken off and the aileron can be freely deflected
71. at ambient temperatures of less than -5°C, **CHECK** whether a shutter is installed on the radiator cells
72. **CHECK** the starboard side of the fuselage, ensure that the cabin glazing, fuselage skin and radio station aerial are not damaged. Also check that the security of attachment to the fuselage is proper
73. **CHECK** along the top of the fuselage to the point where the tail fin joins the fuselage, looking for signs of stress and any disfiguration or panel movement
74. **INSPECT** the tail unit for external defects
75. **ENSURE** that the horizontal and vertical stabilisers and their fillets are free from mechanical damage
76. **CHECK** that the hinge joints of the elevator and rudder are serviceable and are properly greased, see whether cramps are proper
77. **CHECK** fastening of bracing struts, case of the elevator and rudder deflection
78. **CHECK** the elevator trimmer is operational by winding it lock-to-lock and then **SET** it back to the **NEUTRAL** position. It is possible for the elevator trimmer wire to come off of its spindle. If you anticipate that this is the case during the winding, cease to test the trimmer as this will only make the corrective action more difficult
79. **CHECK** that the flashing anti-collision beacon and tail position lights are not defective





80. **INSPECT** the port side of the fuselage, **CHECK** its skin, see whether the locks of the luggage compartment and board hatches are closed, secure and fastened to the fuselage. The luggage compartment lock is renowned for looking locked but not actually being locked – check this is not the case by firmly pushing the luggage compartment from the inside behind the rear seat

81. **CHECK** the radio-altimeter aerial, radio compass and marker aerials are not damaged
82. **CHECK** state of glazing, the cabin door and door hinges. Water has been known to creep down into the slim cabin door pockets. If this is the case, remove the water before continuing
83. **CHECK** the port wing, check the state of the wing skin and presence of fillets, condition of an aileron and joint couplings. See whether cramps are withdrawn and the fastening is proper
84. **INSPECT** the state of pitot-static tube PST, see whether the pitot cover is removed and the undercarriage extended position indicator is sound and that the landing light is not damaged

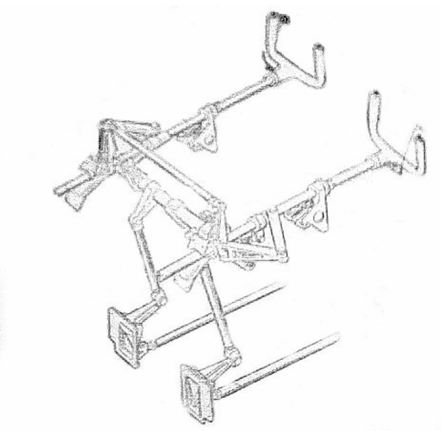
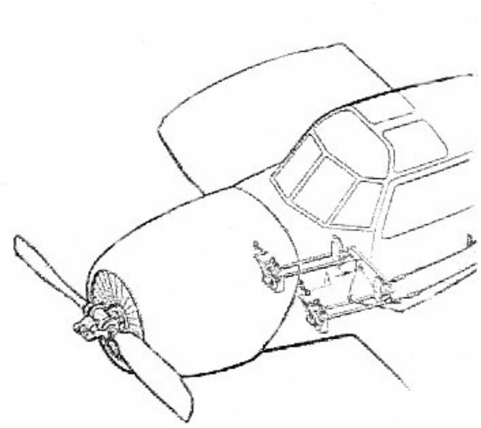


The pilot should check the following prior to entering the cockpit -

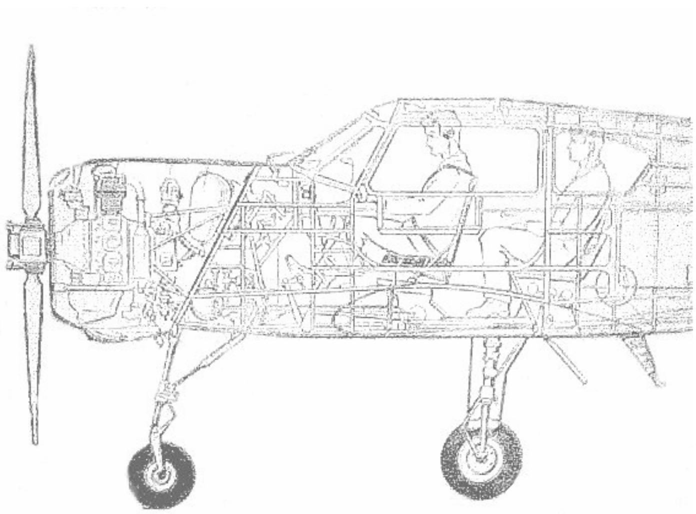
85. that the cockpit is **FREE** from foreign objects, the seats are **INTACT** and mechanisms of the door latches are **PROPER**. The door locks can become difficult to close properly **RESOLVE** before you get to the point of doing your power checks
86. the state of the **SAFETY HARNESSES** and the mechanism of fitting the shoulder straps is secure and operational
87. the presence of **PARACHUTES** in both front seat pans, checking that the parachutes have been repacked according to regulations (4 if carrying passengers, remembering weight and balance checks)
88. the presence of **LIFE-JACKETS** in both front seat pans if crossing water (4 if carrying passengers)
89. the presence of a **LIFE-RAFT** on the rear shelf or on an appropriate seat if crossing water
90. **CLEANLINESS** and the condition of the glass cockpit windows being intact. Clean both inside and outside if necessary
91. if passengers are to be carried, the pilot may now allow them to the enter the cockpit, providing them with clear instructions as to what to do to install themselves and fasten the **RESTRAINTS**, **LIFE-JACKETS** and **PARACHUTES** where appropriate
92. the pilot must then **CHECK** that all passenger restraints are correct and that no items are trapped outside when the cabin door when it is closed
93. the pilot is now obliged to provide the first part of the pre-flight **PASSENGER BRIEFING,** giving the passengers plenty of time to understand and question the talking procedure, take-off, enroute and landing processes, exit procedures and priority and noises to expect. If appropriate, ask one or more of your passengers some questions too and ask them to keep a good look out to the port or starboard side/s

After entering the cockpit, the pilot should proceed as follows –

94. **PUT** feet on the rudder pedals under the pedal belts and, if necessary, **ADJUST** the seat so as to be able to fully deflect the rudder pedals and the yoke to their full extent
95. **CHECK** to be sure of easy and positive action of the yokes and rudder pedals and of the correctness of the controls and ailerons for **FULL AND FREE** deflection

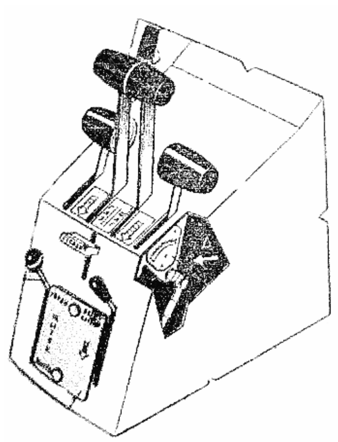



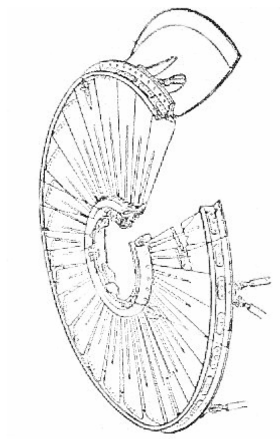
96. **CHECK** whether the parachute spring hook is attached to the pull ring on the seat pan
97. **CHECK** to ensure that the seat harness release is intact
98. **FASTEN** waist and shoulder straps and press yourself to the seat back and tighten waist straps in the buckles. By means of a handle of the tightening mechanism retract and lock the shoulder straps and then tighten the buckles – ensure that you can still **REACH** all necessary instruments
99. **CONNECT** the radio communications headsets
100. **CHECK** whether the cockpit's doors are closed and properly clamped in the locked position with by the latch and the lock
101. **CHECK** for the proper state of the flight and navigation instruments as well as other instruments, **SET** the altimeter pointer to zero and check whether the altimeter barometric pressure corresponds to the actual value at the aerodrome level pressure at a given moment (with a difference of not more than +1.5mm of Hg.)
102. **CHECK** clock reading, wind it up and **SET** the correct time and reset the counter



Check the engine controls –

103. **CHECK** the motion of the thrust lever from idle to fully open
104. **CHECK** the action of the pitch control lever
105. **CHECK** that the carburettor heat control lever can be easily moved (after checking stop heating by placing the lever fully upwards)
106. **CHECK** the opening and closing of the cowling gills and radiator shutters, **ENSURE** that the control wiring does not jam and that the cowling gills and radiator shutters are closed and open when you expect them to be – **CHECK VISUALLY**: do not expect that everything is fine just because the control levers feel normal. If the gills are not opening and closing freely, then it is possible to loosen the equipment by squirting aviation lubricant in the cowling joints on the front of the cowling, being careful not to disconnect the small springs connected to some of the gills





107. **ENSURE** that the **FUEL SHUT-OFF VALVE** is pushed as far forward as it will go. i.e. fuel is not cut off

108. Now **OPEN** the air system valve by turning it fully to the left and –

   a. **CHECK** air pressure in the main and emergency cylinders which must be 50 ±5 kgf/m²
   b. **PROPER** functioning of the landing split flap-operating mechanism (its extension and retraction) and **CHECK** the proper state of the warning light. To do this, move the flap lever to the position **RETRACT** (counter pressure is to be created) and then to the **EXTEND** position and control the flap extension by means of a red indicator FLAP EXTENSION on the panel which will **LIGHT UP** at this moment. Then **RETRACT** the flap, to do it **SET** the flap lever to the position **RETRACT** and on making sure it has been retracted from a red indicator light **FLAP EXTENSION** which will go **OUT** on the panel, place the flap lever in the **NEUTRAL** position.

   c. **NOTE:** if the air pressure is low, you may omit this step for now, until the engine is operational and the air pressure is being recharged

109. **CHECK** air-tightness of the braking system, fully apply the brakes and **ENSURE** that no noise or hissing of air can be heard. Leave the brakes in the **ON** position and continue the checks in the next section 5.1 Start Preparation

Section 5 – Engine Start Preparation

The following text provides an overview of Hydraulic shock – if you have not read it before, you are urged to read it entirely before continuing. If you have read it before, it is still worth reading it as a reminder.

5.1. Hydraulic Lock/Shock Avoidance

This section kindly provided courtesy of Richard Goode Aerobatics (www.russianaeros.com)

The importance of preventing hydraulic lock can never be underestimated. The consequences are at best expensive, at worst – **catastrophic!** One fatal accident was caused by hydraulic lock, leading to total engine failure and a subsequent stall/spin.

5.2. What is Hydraulic Lock/Shock?

In the normal functioning of the internal combustion engine, the piston moves towards the top of the combustion chamber. (To avoid confusion we should realise that we are talking about the lower three cylinders on the M-14P, and therefore this is effectively at the bottom, at least in relation to the ground!) If, however, a proportion of the combustion chamber is filled with a liquid – in this case oil, which is incompressible - something must give. If the engine is turning with any degree of inertia – even being pushed through by the air-starter (although hand pulling cannot cause problems), the weakest part of the entire assembly is the connecting rod.

Thus, when we attempt to start an engine with oil in the bottom of the combustion chamber, and it certainly doesn't need to be full, this will initially increase the compression and, at its extreme, simply results in the piston being unable to progress further, hence the connecting rod bending and shortening.

If you have any doubts about oil descending in these engines, you only have to see the amount of smoke following a start-up to realise that every engine has a fair amount of oil in the cylinders – but we of course are talking about more than that. A fundamental cause is that the pistons are made from an aluminium alloy to a very high coefficient of expansion. This means that, as it heats up, it expands to a much larger size and, in order to tolerate this, when cold it is quite significantly smaller than the piston bore, allowing oil in the engine to drain past the pistons, through the piston rings, and then down into the bottom three cylinders.

The other issue is that the M-14P has a dry sump, i.e. a separate oil tank, from which oil is sucked to feed the engine, and to which it is returned by the scavenge pump. Normally a valve prevents oil from the tank, which is of course higher than the engine, descending into the engine unless the oil pump is turning. However, this can become stuck, even by a small piece of dirt, and particularly over a period of time the entire contents of the oil tank can migrate into the engine and, inevitably, will end up in the lowest place – the lower cylinders.

5.3. The Consequences

Once the connecting rod has bent, it is inevitable that it will ultimately break, although amazingly engines often continue to run with a bent connecting rod for a number of hours. In the shorter term however, the bottom piston ring (of course, with inverted cylinders, the one furthest away from the ground), comes very close to the end of the cylinder at the bottom of its stroke, i.e. geographical top). With a bent connecting rod it is quite likely that the final oil-control piston ring will jump out of the cylinder. Then of course, when the piston is forced back into the cylinder, the piston ring will break, which initially will lead to high oil consumption, and almost inevitably to pieces of the ring being found in the front oil-filter, with an indication also from the chips-in-oil. If nothing is done at this stage, the connecting rod will break.

The consequences of this can be truly dramatic, in one case the main crankcase bolts shot forward not only through the gills (quite easily), but also right through the passing propeller blade!

It is also quite likely that mechanical mayhem on this scale could cause the engine to seize totally, and if this happens suddenly it will very likely tear itself out of the frame, with a consequent problem of a quite serious shift of C of G to the rear.

5.4. What can be done?

The obvious answer is to not start the engine with oil in the bottom cylinders. What one should realise, however, is that there is oil not only in the cylinders, but also in the three bottom intake-tubes. An examination of the engine will show you that a tail-wheeled aircraft (e.g. Yak-50 or Sukhoi) will have a much higher tendency to collect oil in these tubes than a nose-wheeled aircraft.

For this reason those owners who think that merely by turning the propeller through 20 or whatever blades before starting, they are totally avoiding hydraulic lock are deluding themselves. Certainly this will dislodge oil already in the cylinders, but it will do nothing to remove the oil in the intake tubes, which immediately after starting, is sucked into the engine, then possibly causing hydraulic lock.

For this reason the designers put drain plugs in the three bottom cylinders, as well as thoughtfully providing a special spanner with which to remove these plugs. The problem with this is that it does take some time to remove the lower engine cowl and drain these intake tubes. However, you ignore this at your peril.

Thus, for the original operators of these aircraft, as soon as an aircraft had not been used for a day or so, it was absolutely routine to undo the cowls and drain oil out of these intake tubes. Few of us however have our trained mechanic to do this before flying, and all too often it is neglected.

A final way of minimising the problem is to ensure that every engine is run for at least 30 seconds at 60% before shutting down (remembering of course that the engine should not be shut down at above 1500 cylinder head temperature), which will scavenge excess oil from the engine into the oil tank, as well as get rid of oil in the supercharger, which is after all, the oil that ultimately drains into the intake tubes.

5.5. Other Solutions

Given the reluctance of the average pilot in the West to spend more than a couple of minutes with an aircraft before flying, it is inevitable that people have been thinking of ways of banishing hydraulic lock.

Sergio Dallan method	Sergio Dallan, an Italian Sukhoi owner and an exceptional engineer, pondered the problem at length, and his solution comes in two parts: i) A master oil-tap at the bottom of the oil tank, which is (thankfully) connected to a warning light and an external visual signal, whereby after flight the oil supply is switched off and therefore cannot drain out of the oil tank. Hopefully of course the oil is switched on again before starting. ii) A clear window on the gearbox inspection plate enabling the propeller to be turned after shutting down to the position whereby the crankshaft throw is in its highest position. In this way oil cannot drain through the crankshaft and then slowly leak out of the big-end bearings and then into the lower cylinders.

	The system is good, but is not cheap (US$1,000), as well as taking a day and a half to install, and the slight possibility arising of starting with the oil still switched off.
Manifold drains	The next obvious way of combating the problem is a system whereby pipes are attached in the three lower manifold drain plugs, which then either go to individual drains or, more commonly, collect together into one larger pipe, and then into a fuel-drain type tap, which is opened after flight - oil slowly trickles through it, and before flight it is shut. This is an excellent system, although most of the systems I have seen incorporate small-bore pipes, which certainly would not allow oil in sufficient quantities to pass through when cold. There is also the need to shut the drain tap before the next flight.
Vedeneyev System	Vedeneyev are of course the original designers of the engine, and they have developed an ingenious, and fully automatic system whereby, after shutdown, oil drains from the three lower intake tubes into a container fitted to the bottom of the engine, which, on start up, is sucked slowly into the supercharger, and then into the cylinders and burnt. This system has the advantage of being totally automatic, as well as providing extra lubrication around the engine during the critical start-up period. Prototypes of it are now flying successfully, and it is hoped that the system can be offered on a commercial basis within a few months. Again however it is not a simple modification and the existing oil sump, i.e. the large green part of the engine you see projecting from between the lower cylinders, needs to be removed and machined.

5.6. Conclusion

Check that the engine was previously run for at least 30 seconds at 60% before being shutting down. Turn the engine thoroughly through before every start and notice any oil coming out of the exhausts – even if you have only left the aircraft for half an hour (being aware of the engine temperature before turning is important to avoid it starting by itself). Drain the intake tubes if you have left the aircraft for more than a day, or fit one of the systems above which will drain them for you. If you have failed to start the engine after the second attempt and engine priming was conducted, then pull through the propeller to remove any excess fuel from the cylinders.

Section 6 – Engine Start

At ambient temperatures of +5°C or less, the engine must be warmed-up from an airfield heater, to a cylinder head temperature of at least 30°C. In this case, it should be quite easy to turn the engine propeller through by hand.

If the ambient temperature is between +5°C-10°C and if the oil in the engine and oil system is diluted with petrol then the engine can be started having not been warmed-up. The engine can either be started from the aircraft accumulator or from the airfield power source.

CAUTION

- **DO NOT** turn the propeller when the engine is hot i.e. > 100°C (lower to be safer)
- **DO NOT** fill petrol up above the amount specified, as it can wash oil off the cylinder walls and cause a score of the pistons or can be accumulated in the bottom cylinders and also contribute to a hydraulic shock
- **DO NOT** fill the petrol up through exhaust branch pipes and spark-plug ports

6.1. Prior to Starting the Engine

- **CHECK** that the propeller pitch lever is placed in the **FINE PITCH** position
- **SET** the thrust lever to the position corresponding to **1/3**rd of fully open equivalent to approx. 28-38% engine rpm
- **ENSURE** that the fuel cut-off valve is in the open position i.e. **FULLY FORWARD**
- at ambient temperatures below zero, **SET** the carburettor heat control lever (adjusts air getting into the carburettor) to the **ON** position (i.e. fully downwards)

6.2. Avoiding Hydraulic Shock

- **CHECK** that the engine was shutdown using the correct procedure i.e. run at **60%** for at least 30 seconds at the correct temperature setting – if not, it is advisable to drain the bottom three cylinders for hydraulic shock avoidance
- **TURN** the propeller through until the oil that may drip from the exhausts ceases completely. This may take several revolutions
- Now **WAIT** for the oil to stop dripping completely and then turn the propeller through a few more times looking for signs of further oil expulsion from the cylinders and repeat if necessary

6.3. Engine Priming

- **TURN** propeller (3-4 revolutions); during the propeller turning, **SET** the primer MOTOR PRIMING to the CYLINDER position and fill up 2-3 primers of petrol into the engine cylinders in summer and 3-5 primers in winter time.
- **GOOD ADVICE**, but this is a tad difficult if you are on your own! Prime the cylinder, turn the propeller, prime the cylinder, turn the propeller, prime the cylinder and turn the propeller. Laborious but necessary and "Yes", you do need to get in and out of the cockpit each time. Also, if you are on wet and muddy ground, you need to think about cabin cleanliness too
- Now **SET** the MOTOR PRIMING primer to the FUEL LINE position and **GENERATE** the fuel pressure in front of the carburettor to 0.2 to 0.5 kgf/cm^2
- **NOTE**: this pressure will drop with time and may need to be restored prior to start – **DO NOT** over prime more than 0.5kgf/cm^2
- upon completion, **SET** the primer back to the CYLINDER position ready to provide additional fuel into the cylinders upon starting (i.e. the primer should be pulled out)

6.4. Engine Starting

To start the engine, the pilot should proceed as follows -

- have a good look round and check for any **PEOPLE**, **ANIMALS** or **VEHICLES** that may have unexpectedly approached the aircraft
- even if your aircraft does not have the small windows at the front of the cockpit, it is still advisable to open the cockpit door, look around and announce loudly **"CLEAR OF PROPELLER"** and listen carefully for any response
- once happy, close the cabin door and fit your safety harness securely
- **SWITCH** the BATTERY-GROUND SUPPLY to the **ON** position
- **SWITCH** the circuit breakers IGNITION, UNDERCARRIAGE WARNING, ENGINE INSTRUMENTS, ELECTRIC TURN INDICATOR and GYRO-HORIZON to the **ON** positions
- **TURN** the start button-casing counter clockwise until the red mark is pointing north. The starter button is now live and the engine is now ready to be started
- **LOOK AROUND AGAIN** for any **PEOPLE**, **ANIMALS** or **VEHICLES**
- **PRESS** the **START** button as far as it will go. Duration of a continuous depression should not exceed 3 seconds
- after the propeller has been turned through 3-5 turns, switch the **MAGNETOS ON** by setting the switch to **1+2** position. To provide a more successful start of the engine after the first flashes, feed additional fuel into the cylinders with the help of the primer (which was intentionally left out in the previous steps)
- **DURING** start, if flashes appear in the cylinders, it is allowed to continue the engine starting procedure by displacing the thrust lever forwards and backwards in the range of revolutions, corresponding to **28%-60%**, a throttle retard and accelerate rate is 2-3 seconds
- after **STABLE ENGINE OPERATION** has been obtained, **RELEASE** the start button and **SET** the thrust lever to the position corresponding to **38%-41%**, while simultaneously observing the oil pressure and the pressure gauge readings
- after the engine start, **LOCK** the priming pump handle by setting it to the centre position. **MOVE** the start button clockwise to the locked position, cut in the generator and warm-up the engine
- If the engine fails to be started after two attempts, stop the starting and identify the reason

CAUTION

- Prior to re-starting, observing all precautions (e.g. engine temperature) pull the propeller through manually by 4-8 full revolutions to remove fuel and oil from the cylinders which has remained there after a previous start (if it was performed with priming) in order to avoid hydraulic shock
- If during 15-20 seconds after the engine has been started, **OIL PRESSURE** does not reach a value of 1.0 kgf/cm2, **SHUTDOWN** the engine and locate the cause

Now that the engine has started, pay particular and frequent attention to the engine and oil temperatures and pressures and **CHECK** the following –

- that the undercarriage warning (three green indicators) lights come on, and check the proper state of red lights by pressing the test button

- that the elevator trimmer control (when the trimmer is in the **NEUTRAL** position, a yellow/green indicator light **TRIM NEUTRAL** on the panel is **ON**

- the state of electric instruments

(check whether the pointers are **SET** to their initial down positions)

- the serviceability of the fuel level indicator, the total amount of fuel in the tanks and fuel amount in the left and right tanks separately

- note the amount of fuel that was added (if any) and compare against what is now indicated
- the voltage of the airborne accumulator under load, to do it cut in the ANE (AHO) circuit breaker on the panel for 10-15 seconds, press the voltmeter button-voltage value should be at least 24V and is likely to stabilise at 27V-29V. The image obviously shows 0

- prepare and check the flight-control and navigation equipment and the radio instruments of the aircraft as well as the interior cabin lighting facility, if night flights are to be performed



6.5. Engine Warm-up

- Warm-up the engine at the crankshaft speeds of **41%-48%** until the oil temperature at the engine inlet is increased. As fast as the oil temperature increases, accelerate the engine up to **44%-48%** in summer and **51%** in winter time and perform the engine warm-up at these conditions until temperature of at least **120°C** of the cylinder heads is reached and the oil temperature not less than **40°C** at the engine inlet is obtained

- The engine is considered to be warmed-up, if the temperature of the cylinder heads is not less than **120°C**, the oil temperature across the engine inlet is not below **40°C** and the temperature of air getting into the carburettor is not less than **+10°C**
- Once satisfied with the raising oil pressure and temperature, during the remaining period of the engine warm-up, proceed with the provision of the second half of your passenger **BRIEFING**
- After the engine has been warmed-up, **ALTER** the propeller **PITCH** by moving it twice from fine to coarse i.e. high to low
- With the help of the thrust lever **DECELERATE** the engine to minimum rpm
- **CHECK** again to ensure, that the cockpit doors are safely enclosed and locked with the catch
- **UNLOCK** the undercarriage lever by moving the latch to the left
- **SET** rudder pedals and the yoke to the **NEUTRAL** position

6.6. Taxiing to the holding point

- **REQUEST** ATC taxi clearance to the hold. Upon clearance, have a good **LOOK** around and **RELEASE** the brakes

After having received taxi-clearance, the pilot must proceed as follows –

- **APPLY** the brakes and accelerate the engine up to **64%-68%.** At this speed the aircraft should be **HELD** on the brakes and in position
- During taxi, perform the differential brake checks but do this **SPARINGLY**. The braking system of the Yak 18T can **OVERHEAT** with a prolonged application of the braking mechanism, thus resulting in a complete brake failure on one or both sides of the system. However, it must be noted that one can taxi reasonably well **WITH MINIMUM BRAKE USE**
- **DECELERATE** the engine to minimum rpm and ensure that no obstacles in the taxiing direction are present, release the brakes and accelerate the engine smoothly to the extent **SUFFICIENT** for the aircraft to start motion and proceed taxiing. At night and if visibility is poor or reduced at day time, switch on lower beam and, if required, the upper beam of the land/taxi lamp
- Time of the land/taxi lamp switching-on should not exceed 5 minutes. During taxiing, hold the yoke in the **NEUTRAL** position, use brakes smoothly and as short duration pulses. Note: it may be necessary to deflect the yoke
- The speed of taxiing on a natural surfaced runway should not exceed **15km/h**, on a concrete runway not more than **30km/h**
- Perform taxiing at a slow speed, observing maximum care if the ground is slush-covered or rough, the terrain is unknown and obstacles are present nearby. If taxiing on grass, beware that uneven ground can push the nose wheel into the air, sometimes quite high, so taxi at what you might think to be too slow a speed on all suspected uneven ground
- During taxiing at low engine crankshaft speeds, it is advisable to switch off the maximum number of the power consumers except for the radio station, flashing beacon and ANE

and at night - to avoid discharging of the airborne accumulator due to prolonged taxiing which is not sufficient enough to charge the accumulator

6.7. Engine Run-up

- Carry out the engine checks with the cowling gills and the radiator shutter **CLOSED**. Prior to acceleration, **SET** the controls to the **NEUTRAL** position and **BRAKE** the wheels

- Run-up the engine to **Nominal II**, by pushing the throttle lever fully forwards and by increasing the propeller pitch simultaneously. In so doing, the readings of the engine control instruments should be as follows –

Crankshaft speed	70%
Supercharger pressure (boost pressure)	Po+75±15mm of Hg
Oil pressure	4-6 kgf/cm²
Petrol pressure	0.2-0.5 kgf/cm²
Oil temperature at the engine inlet	40-75°C
Cylinder head temperature	≤ 190°C
Carburettor inlet air temperature	≥ +10°C

- The engine must run steadily and without shaking or abnormal vibration. To avoid engine overheating as a result of insufficient airflow, the engine should **NOT** be operated continuously on the ground at the **Nominal Rating** conditions.

CHECK the correct functioning of the magnetos and spark plugs –

- **SET** the propeller to the **FINE PITCH** position
- **USING** the thrust lever **SET** a speed of **64%-70%**
- **SWITCH** one magneto off for 15-20 seconds and compare the drop in rpm with the previous setting
- **SWITCH** both magnetos **ON** for 20-30 seconds (usually much quicker), until the initial speed is recovered
- **SWITCH** the second magneto **OFF** and compare the drop in rpm with the previous setting and note the difference in drops between both magneto checks
- **SWITCH** both magnetos **ON**
- The engine crankshaft speed (rpm) drop when one magneto is operating should not exceed **3%**
- If the drop does exceed 3%, repeat the procedure until normal operation is achieved. If after prolonged magneto tests a drop is still found to be more than 3%, one is advised to shutdown the engine and seek further advice
- **APPLY** carburettor heat and **CHECK** for a drop in engine rpm

CHECK the correct operation of the generator –

- **SET** the engine conditions to **IDLING**
- using the thrust lever **SET** the crankshaft speed to **57%-58%**
- from extinguishing the **GENERATOR FAILURE** light, make sure that the generator has been connected to the aircraft electrical wiring system
- **CHECK** the voltage being produced by the aircraft through the electrical wiring system via the voltmeter by pushing the voltage check button, its reading must be **27V-29V**
- **SWITCH ON** the power consumers required for the flight - converter, radio altimeter, radio compass, intercom system, VHF radio station, gyro-horizon inverted, compass system, gyro-horizon and the flashing beacon and for night flights, the air navigation equipment and the landing/taxi light

CHECK for the correct functioning of the propeller and rpm governor. To do this, proceed as follows –

- using the thrust lever **SET** a speed of **70%** with the propeller's position **SET** to **FINE PITCH**
- **SHIFT** the propeller pitch lever to the **COARSE PITCH** position (fully backwards), in this case the crankshaft speed will be reduced to approximately **53%**
- **SHIFT** the propeller pitch lever to the **FINE PITCH** position (fully forwards), the crankshaft speed will increase up to the initial value of **70%.** Notice a short-term oil pressure drop at the engine inlet. Up to 2 kgf/cm² is allowed with a subsequent recovery during 8-11 seconds

CHECK for the correct operation of the propeller and rpm governor at the equilibrium speeds, for this purpose proceed as follows –

- using the thrust lever **SET** a speed of **70%** with the propeller **SET** to a **FINE PITCH** position
- using the propeller pitch lever **SET** a speed of **64%**
- by **MOVING** the thrust lever smoothly back and forth but not against the stop, make sure that the engine crankshaft speed remains **UNCHANGED**
- the engine speed can be increased or decreased by 2-4% respectively via an abrupt forwards and backwards motion of the thrust lever. It's equilibrium rpm will then be restored in 2-3 seconds.

CHECK the engine during 20-30 seconds. To do this, perform the following procedures –

- **SET** the propeller control lever to the position **FINE PITCH** forwards to the fine-pitch stop (decrease the propeller pitch completely)
- **SHIFT** the thrust lever smoothly forwards against the stop

The readings of the engine control instruments must be as follows –

Crankshaft rational speed	95%-99%
Supercharger pressure	Po+125±15mm of Hg
Petrol pressure	0.2-0.5 kgf/cm²
Engine inlet oil temperature	40°C-75°C
Oil pressure	4-6 kgf/cm²
Cylinder head temperature	≤ 220°C
Carburettor inlet air temperature	≥ +10°C

CHECK the engine running at minimum speed (rpm) with the propeller **SET** at fine pitch and the thrust lever **SET** fully backwards. The engine should run steadily, the instruments readings must be as follows -

Engine speed (rpm)	≥ 26%
Oil pressure	≥ 1.0 kgf/cm²
Petrol pressure	≥ 0.15 kgf/cm²

To prevent the spark plugs from getting **FOULED**, the duration of the engine running at minimum rpm should **NOT EXCEED** 5 minutes. Also note that the low voltage generator light is expected to illuminate.

CHECK engine acceleration response. For 2-3 seconds put the thrust lever smoothly from the idling stop fully forwards against the stop, in this case the propeller pitch lever must be in the position **FINE PITCH**. Transition from the minimum speed (rpm) to the take-off regime should be performed smoothly during 3 seconds. To provide the normal acceleration response, the temperature of the cylinder heads should be at least **120°C** and the oil temperature at the engine inlet must be not less than **40°C**

NOTE: the pilot can **TEST** of the engine acceleration response in flight. This should be performed at an IAS of **160km/h**

Section 7 - Flying

7.1. Take-off Preparation

Prior to requesting clearance for take-off, hold the aircraft with the brakes **ON** and carry out the following checks –

- **CHECK** the proper state of the gyro-horizon. The aircraft is cleared for take-off only if the gyro-horizon is **OPERATIONAL** (i.e. actually operational for at least 3 minutes)
- **CHECK** that the compass reading **CORRESPONDS** to the take-off heading (when was the last time the compass was re-aligned?)
- **CHECK** that the landing split flap is **RETRACTED**
- **CHECK** propeller pitch is **SET** to the **FINE PITCH** position (i.e. fully forward)
- **CHECK** for full and free **DEFLECTION** of the yoke and rudder pedals
- **CHECK** elevator trim is **NEUTRAL** position (a yellow/green light **TRIM NEUTRAL** on the panel should be **ON**)
- **CHECK** that the cut-outs, switches and circuit breakers on the switch board required for the flying mission fulfilment are **ON**
- in case of possible carburettor icing or ice formation in winter, **SWITCH** the carburettor heat **ON**

LOOK around and on making sure that it is clear and that no unexpected aircraft are approaching, **REQUEST** a clearance for take-off.

7.2. Take-off and Climb

Upon receiving the appropriate form of take-off clearance, enter the runway and **TAXI** along a straight line 3-5m in order to **SET** the nose wheel straight and over the take-off line, holding the brakes **ON**.

Immediately place the engine into the **Nominal I** regime. Hold the aircraft with the brakes **ON** and check readings of the instruments controlling the engine operation. The instrument readings must be as follows –

- cylinder head temperature **140°C-190°C**
- recommended inlet engine oil temperature **50°C-65°C** (at least **40°C** and not over **75°C**) and fuel pressure **0.2-0.5 kgf/cm²**)
- oil pressure **4-6 kgf/cm²**
- the engine must run without undue **VIBRATION** or **SHAKING**
- **SWITCH ON** the warning indicator **DANGEROUS SPEED**

On making sure that the engine **OPERATES PROPERLY**, **CLEARANCE** has been given and **NO OBSTACLES** are present on the runway, you may **TAKE-OFF** by selecting the engine **TAKE-OFF** regime

- **SET** the **CLOCK** to the **ON** position
- **RELEASE** the **BRAKES** and by a smooth moving of the thrust lever **SET** it to the take-off regime, i.e. fully forward
- **DURING** the take-off run, keep the yoke in the **NEUTRAL** position, compensate for the turns that may be necessary by gradually deflecting the rudder
- when the IAS has reached **80-90km/h**, smoothly pull the yoke backwards in order to **RAISE** the nose wheel to the take-off position (10-15 cm off the ground) and hold

this position until the aircraft rotates naturally upon the increase in airspeed. **NOTE: DO NOT** raise the nose wheel too high. The aircraft typically **ROTATES** as follows –

- with take-off weight 1,650kg IAS of **135km/h**
- with take-off weight 1,500kg IAS of **125km/h**
- what have you calculated it to be, given your load?

- After rotation, **INCREASE** IAS to **160-170km/h** for a gradual climb. **NOTE**: just after rotation, with the airspeed rising, the aircraft tends to quickly increase the pitch-up angle, be ready to **COMPENSATE** for this with the trim

- You may have been trained to take-off in a different way, i.e. as above, but upon rotation, level the nose to the horizon at about 30ft, with the undercarriage still down, so as to gain the maximum amount of airspeed without climbing and then to perform the climb out upon sufficient IAS. If you **HAVE** been trained in this way then fine, if not, continue with the gradual climb approach. Do not attempt this approach **UNTIL** you have received **SUFFICIENT TYPE TRAINING**. Also be aware that this approach may infringe your local circuit procedures so **CHECK** first

- At an altitude of at least **10m (~35ft) RETRACT** the undercarriage. To do this, perform the following procedure –

  - **MOVE** the undercarriage lever to the **RETRACT/UP** position, take care **NOT** to retard the lever to the **NEUTRAL** position
  - **CHECK** that the undercarriage has **RETRACTED** by noting the illumination of the **RED** indicator lights on the undercarriage display panel
  - **CHECK** that the undercarriage has **RETRACTED** by noting that the port wing, cowling and starboard wing undercarriage indicator **SIGNALS** have lowered into the airframe
  - once **SATISFIED** that the lights and indicators are correct and that the undercarriage has been retracted, **SET** the undercarriage lever to the **NEUTRAL** position

By the time the undercarriage has been retracted and an altitude of ~300ft has been achieved, **ALTER** the engine conditions from the take-off regime to the **Nominal I** regime for the climb to circuit height –

- **ACHIEVE** a crankshaft rotational speed of **82%-84%** by first reducing the propeller pitch and then by reducing the throttle to achieve the desired rpm. This action is to be carried out swiftly

  The climb is to be performed –

  - at IAS of **170km/h** at ambient temperatures up to **+20°C**
  - at IAS of **180km/h** at ambient temperatures over **+20°C**

- carry out the usual **500ft CHECKS**

CAUTION

- **CONTINUOUS** engine running in the take-off regime is **NOT** to exceed **5 minutes**

7.3. Cross-Wind Take-Off

- The peculiar feature of this take-off is the necessity to **DEFLECT** the yoke into **WIND** from the very beginning of the take-off run

- This enables us to maintain a **UNIFORM** load on the main undercarriage wheels and to **PREVENT** banking during the take-off run
- A trend to the upwind turn should be **COMPENSATED** by sufficient rudder deflection
- As the speed increases and the aileron rolling power gets stronger, the yoke is gradually pulled to the **NEUTRAL** position so as to **PREVENT** the aircraft lifting on one wheel and placing undue stress on the other undercarriage leg
- When an IAS of **100km/h** has been achieved, as above, by a smooth pulling of the yoke backwards, lift the front wheel to take-off position. The crosswind take-off speed **MUST** be **5-10km/h HIGHER** than that of a usual take-off
- The direction after rotation and while climbing is kept by following your **PLANNED** flight course
- **NOTE**: observe the cross-wind limitations of this aircraft

7.4. Climbing

To prevent the engine from overheating, after you have achieved circuit height, perform the rest of the climb at the **Nominal II** regime with the engine **SET** at **70%** and IAS at –

- **170km/h** at ambient air temperature up to 20°C
- **180km/h** at ambient air temperature over +20°C

While climbing -

- **TAKE** the load off the yoke by using the trimmer and check readings of the engine instruments
- **CONSTANTLY** observe the engine temperatures and that they fall within the recommended limits -

Crankshaft rational speed	70% (Nominal I)
Petrol pressure	0.2-0.5 kgf/cm²
Engine inlet oil temperature	engine inlet oil temperature 50°C-65°C (maximum oil temperature 75°C, maximum allowable temperature during a long-term engine operation or not more than 15 minutes is 85°C)
Oil pressure	4-6 kgf/cm²
Cylinder head temperature	cylinder head temperature 140°C-190°C (maximum cylinder head temperature during continuous engine operation is 220°C)
Carburettor inlet air temperature	≥ +10°C

Climbing from 3000m can be performed in the **Nominal I** regime with an IAS of **165km/h**

7.5. Engine Overheating (During the Climb)

If, while climbing, the temperature regime of the engine **EXCEEDS** the permissible limits with the cowling gills and the radiator shutters fully **OPEN**, the pilot should **CEASE** to climb, level out and increase the flight speed to **REDUCE** the severity of the engine conditions.

To **DECELERATE** the engine, first reduce the boost pressure using the thrust lever and then **REDUCE** the engine speed rpm using the propeller pitch lever. If the measures taken do not result in the temperature reduction, the pilot should plan to **END THE FLIGHT** and **INFORM** ATC of the conditions and depending on the actual situation, land at the planned alternate airfield.

WARNINGS

- Deliberate flights into known icing conditions are **PROHIBITED**. If the aircraft enters into an icing zone, the pilot must **SWITCH** on the CARBURETTOR HEATING, CABIN HEATING, CLOCK and change direction and/or the flight altitude

- Training flights into cloud are **NOT** allowed. In the cases of inadvertent IMC, the pilot must level out by a smooth pulling of the yoke and continue to pilot the aircraft relying on the gyro-horizon and electrical turn indicator. The pilot must compare the readings of the –

  - gyro-horizon and electrical turn indicator and make sure that there is **NO** banking or turn
  - gyro-horizon and the VSI indicator and make sure that the aircraft is flying **HORIZONTALLY**

  The pilot should **CONTINUE** instrument flying and perform a **180°** turn using a maximum **15°** angle of bank and **SET** a descent of **2-3m/s** to break out of the clouds

- Flying **OVER 4000m** can be performed only if **OXYGEN** equipment is available on board

7.6. Horizontal Flight

When performing circuit flights (undercarriage up or down) it is advisable to maintain an IAS of **170-180km/h. CHECK** for normal engine running conditions during horizontal flight, these are the same for flight planning.

- After climbing to a specified level, **SET** the speed and engine boost pressure according to the engine regime selected. At normal conditions during horizontal flight, the engine instruments should read as follows –

Fuel pressure	0.2-0.5 kgf/cm²
Engine inlet oil temperature	50°C-65°C
Oil pressure	4-6 kgf/cm² 1.0kgf/cm² at minimum rpm
Cylinder head temperature	140°C-190°C
Carburettor inlet air temperature	≥ +10°C

- During warm weather, carburettor heat must be **SWITCHED OFF** as a high temperature of air coming into the carburettor causes a **DECREASE** in the engine **POWER** and therefore engine efficiency

- In all cases of horizontal flight in conditions of increased humidity with the air temperature becoming lower than +10°C, carburettor heating must be **SWITCHED ON**

- In-flight fuel consumption is to be monitored by using the fuel level indicators for both tanks and the clock. When the **RESIDUAL FUEL** red light on the panel is illuminated, it means that 30litres of fuel remains in the tanks, this amount will be sufficient for a **MAXIMUM OF** 40-45 minutes of flying. See below!

- Aircraft onwards of No.0604 have an improved emergency fuel capacity monitoring system that provides a separate remaining fuel warning in the main fuel tanks. When the remaining fuel reaches **15litres**, the fuel quantity low warning lights come on **FUEL RIGHT** or **FUEL LEFT. This applies to HA-YAV**

- Controlled changes to in-flight engine power is recommended as followings -

  a) to reduce power (conditions) -

  - **DECREASE** the boost pressure
  - **DECREASE** the engine crankshaft rotational speed to the specified one
  - **ADJUST** the boost pressure

  b) to increase power (conditions) –

- **INCREASE** the engine speed rpm to the specified one
- **INCREASE** the boost pressure

To **AVOID** oil thickening in the propeller hub cylinder during prolonged flight in steady conditions with low ambient air temperatures, it is necessary to shift the propeller pitch from a fine pitch to a coarse one at regular intervals (i.e. every 25-30 minutes) using the propeller pitch lever, changing the engine rpm within the 55%-67% limits.

One can monitor the correct operation of the Generator by checking the **GENERATURE FAILURE** red light on the annunciator panel or by using the voltage level tester on the voltmeter gauge.

7.7. Chips in Oil

In flight, if the **CHIPS IN OIL** red light illuminates on the annunciator panel, the pilot is obliged to **END THE FLIGHT IMMEDIATELY** and to **INTENSIFY** control of the aircraft.

SPECIAL attention should be paid to the oil pressure and temperature at the engine inlet. If the pressure drops or the oil temperature rises, **INFORM** ATC about it and land at the nearest aerodrome or on the nearest emergency landing ground.

It is **PROHIBITED** to perform any flight if the **CHIPS IN ENGINE** red light is illuminated before take-off. This problem must be eliminated before flight.

Section 8 – Aerobatic Flight Manoeuvres

The Yak 18T with M-14P can perform the following aerobatic and elementary flight manoeuvres. The crew will determine the flight plan and altitude for aerobatics in each specific case.

- Aircraft weight for aerobatics should not exceed 1,500kg, the number of crewmembers must not be more than 2 persons.

- While piloting, manoeuvre recovery must be terminated at a level not lower than 1000m. While performing aerobatics the g-load should not purposely exceed +3.5g to +4g.

- Prior to performing any elementary and advanced flying, trim the aircraft to an IAS of **180km/h** and **SET** the engine crankshaft speed of **70%,** i.e. Nominal II engine regime

- Perform a **FULL CHECK** of the engine instruments

- To **PREVENT** against the engine intolerable spin-up while performing elementary and advanced flying, do not exceed the speed over **300km/h** (see aircraft flying limitations)

- It is **PROHIBITED** to perform any aerobatic manoeuvre without the appropriate type-training

This aircraft is cleared to perform the following aerobatic manoeuvres –

- Steep turns: 45° and 60° of bank
- Figure Eight
- Combat Turn
- Diving
- Steep Climb/Zoom
- Spiral
- Slipping
- Barrel/Slow Roll
- Flick/Snap Roll
- Normal 360° loop
- Half-loop
- Half-roll
- Spins

8.1 Steep Turn: 45° of bank

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre

- Prior to entry into the 45° banked turn, **SET** the engine conditions to **70%** and an IAS of **180km/h**

- Then by a **SMOOTH** combined moving of the yoke and rudder pedals, put the aircraft into the banked turn. The angle of bank is specified by the nose-over position and the front portions of the aircraft canopy relative to the horizon. This position must be measured and controlled using the gyro-horizon

- The aircraft's entry into the steep banked turn is performed in the same way as the shallow turn. As the bank develops, gradually **INCREASE** the boost to stabilise and maintain the 45° bank

- When the specified bank and required angular velocity is achieved, **MAINTAIN** the bank by slightly deflecting the yoke to the side opposite to the turn and forwards, simultaneously

- By pulling the yoke counter-clockwise and by deflecting the rudder pedals, eliminate the tendency for the aircraft to increase its rotational speed **WITHOUT** performing any side slipping

- **CHECK** the correctness of the turn by using the slip indicator ball and the electrical turn indicator

- **25°-30°** prior to the specified ground reference point, begin the roll-out via a combined movement of the rudder pedals and the yoke in the opposite direction of the aircraft rotation

- Complete the turn recovery by slightly pushing the yoke forwards. When the aircraft stops its rotation and is pulled out of the roll, **SET** the yoke to the **NEUTRAL** position and recover straight and level flight

- The aircraft should be **STABLE** throughout the entire process of the steep turn and the pilot should be able to easily shift from one direction of steep turn to another

8.2 Steep Turn: 60° of bank

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre

- Prior to entry into the 60° banked turn, **SET** the engine conditions to **70%** and an IAS of **200km/h**

- Then by a **SMOOTH** combined movement of the yoke and rudder pedals, put the aircraft into the banked turn. The angle of bank is specified by the nose-over position and the front portions of the aircraft canopy relative to the horizon. This position must be measured and controlled using the gyro-horizon

- The aircraft's entry into the steep banked turn is performed in the same way as the shallow turn. As the bank increases, gradually enlarge the boost so as to provide it to a full extent at a bank of 45°-50°. When the 45° bank has been achieved and it continues to increase, pull the yoke slightly backwards and relax bearing against the rudder pedal, which has been deflected at the turn entry

- At a bank of 60° using proportional and coordinated pulling of the yoke and the rudder pedals, hold the aircraft in the turn. Using the yoke, maintain the rate of rotation and the bank using the rudder pedals to retain the normal position of the nose-over relative to the horizon.

- When the specified bank and required angular velocity is achieved, **MAINTAIN** the bank by slightly deflecting the yoke to the side opposite to the turn and forwards, simultaneously

- By pulling the yoke counter-clockwise and by deflecting the rudder pedals, eliminate the tendency for the aircraft to increase its rotational speed **WITHOUT** performing any side slipping

- **CHECK** the correctness of the turn by using the slip indicator ball and the electrical turn indicator

- In the course of the banked turn, pulling of the yoke backwards is not allowed because during such a pulling a slight shaking of the aircraft makes its appearance, when the yoke is pushed forwards the vibration comes to an end.

- The turn recovery should be initiated 30°-35° before the specified ground reference point by using coordinated motions of the yoke and pedals, deflecting them to the side opposite to the aircraft rotation, in so doing, move the yoke forward simultaneously

- Complete the turn recovery by slightly pushing the yoke forwards. When the aircraft stops its rotation and is pulled out of the roll, **SET** the yoke to the **NEUTRAL** position and recover straight and level flight

- The aircraft should be **STABLE** throughout the entire process of the steep turn and the pilot should be able to easily shift from one direction of steep turn to another

8.3 Figure Eight

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre

- A figure eight is clearly a combination of two steep **360°** turns in the opposite directions combined by a fast transition turn on crosswind leg to downwind leg

- It can be performed quite easily by following the procedure for the 45° or 60° steep turn. However, during the reversal procedure it is necessary to push the yoke slightly in order to hold the speed

- As the banking lessens at the first **360°** turn recovery, the engine boost should be decreased to 480-500mm of Hg and at the entry into the second **360°** turn, the boost becomes complete
- Performing the figure eight manoeuvre requires special attention and a very exact motion and co-ordination of the control surfaces

- Complete the figure eight manoeuvre recovery by slightly pushing the yoke forwards. When the aircraft stops its rotation and is pulled out of the roll, **SET** the yoke to the **NEUTRAL** position and recover straight and level flight

- The aircraft should be **STABLE** throughout the entire process of the manoeuvre and the pilot should be able to easily shift from one direction of steep turn to another

- A figure eight can be performed at either **45°** with an IAS of **180km/h** or at **60°** with an IAS of **200km/h**.

8.4 Combat Turn

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre. Special attention should be paid to the space above the aircraft

- **SET** the rpm to **70%**, provide a full boost and at a low speed decay increase the IAS to **280km/h**

- Then by a **SMOOTH** pulling of the yoke backwards, approach the nose-over to the horizon line

- Using a fast and coordinated moving of the yoke backwards and to the combat turn's side at a simultaneous motion of the rudder pedals in the same direction, perform the aircraft transition to spiral climb with the initial bank of **15°** to **20°** and acceleration of 3.5-4

- A rate of entry into chandelle must be such that after a **130°** turn the aircraft has a bank and a **50°** climb angle, and with a further turn this position should be held

- On having made a **150°** turn (**30°** before recovery reference point) by simultaneous moving of the yoke and rudder pedals towards the side opposite the turn, recover the aircraft so that the airspeed indicator reading at recovery is at least **150km/h**, simultaneously, by a slight deflecting of the yoke forwards, provide a nose-over position relative to the horizon just the same as at the horizontal flight

8.5 Diving

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre. Special attention should be paid to the space under the aircraft

- Perform entry into the dive from horizontal flight or from a turn at an IAS of **150km/h** allowing **NO NEGATIVE** load factors

- Diving can be performed with the throttle open or closed with an IAS of **NOT** more than **300km/h** at the recovery termination

- While diving, observe the engine temperature not allowing the temperature of the cylinder heads to drop **BELOW 120°C**

- The aircraft is to be recovered from a dive by a smooth pulling of the yoke backward

- Warning, the pilot will experience considerable g-loads with a fast pulling of the yoke at high diving speeds

- To **PREVENT** the IAS exceeding **300km/h** during the dive recovery, the dive recovery should be started with **40°-50°** descent angles with an IAS not more than **280km/h**

8.6 Steep Climb/Zoom

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre. Special attention should be paid to the space above the aircraft

- The steep climb/zoom is performed with a climb **ANGLE** up to **50°**

- Prior to entry into zoom, **SET** the engine crankshaft speed of **70%** (2050 rpm), provide a full boost and with a small descent increase the airspeed indicator reading up to **280km/h**

- Specify a value of the climb angle, fix it and roll from the position of the horizon using the gyro-horizon instrument

- Proceed with recovery at the IAS of **170km/hr.** For this purpose, by means of a simultaneous rolling into a turn and decreasing climb angle at a constant boost, level the aircraft out

- The levelling out must be terminated at airspeed indicator reading of **140km/h**

8.7 Spiral

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre. Special attention should be paid to the space under the aircraft

- Perform the spiral from the steady state glide conditions at IAS of **180km/h** with a **45°** roll at the engine **IDLING** conditions or under the conditions, providing the vertical descent velocity of **3-4 m/s**

- **BEFORE** entry into the spiral, **CHECK** the engine instruments and having **SET** the designated gliding speed using coordinated motions of the yoke and pedals, roll into a turn

- When the specified roll has been achieved by slight motions of the rudder pedals and the yoke towards the side opposite to the turn, **ELIMINATE** the tendency of the aircraft to increase its roll by increasing the angular rotational velocity and trajectory speed

- **HOLD** the bank value according to the nose-over position and the canopy nose sections relative to the horizon, control it by the turn and slip indicator and by the gyro-horizon instrument

- The pilots **ATTENTION** during the spiral must be distributed in the same way as during steep turns

- Temperature drop of the cylinder heads below **120°C** is not allowed. After spiral recovery **SET** the glide speed of **170km/h**

8.8 Slipping

- Slipping with retracted and extended flap is performed at an IAS of **170km/h**

- Prior to slipping, select a ground reference point for direction-keeping, **SET** up a glide at the IAS of **170km/h**

- Turn the aircraft away from the reference point by **10°-15°** and by a smooth moving of the yoke create a **BANK** up to **20°** towards slipping, holding the aircraft from a turn using the rudder pedal deflection to the side opposite to the roll

- While slipping, keep the flight direction using a reference point orientation, check the speed and keep it according to the nose-over position relative to the horizon and by using the speed indicator

- **CHECK** the designated bank by the aircraft inclination relative to the horizon and by the attitude indicator (gyro-horizon)

- **RECOVER** the aircraft from slipping by a simultaneous motion of the yoke towards the side opposite to the bank and slightly forward

- When the bank has decreased, place the rudder pedals **in the NEUTRAL** position and maintain a gliding speed of **170km/h**

- Dampen the residual aircraft **DRIFT** after slipping with a return bank. Do **NOT** allow the temperature of the cylinder heads to drop below 120°C while slipping

8.9 Slow/Barrel Rolls

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre

- To perform a slow controllable roll, **SET** the indicated airspeed of **230km/h**, the engine crankshaft speed equal to **70%** with a full boost

- Then impart a pitch-up angle of **10°-15°** and hold this position

- **INITIATE** a longitudinal rotation by smoothly deflecting the yoke in the direction of the roll. When **45°-50°** of bank has been achieved, proceed to pull the yoke being careful not to slow the rotation. This is necessary to **PREVENT** the aircraft from turning when upside-down and to **PREVENT** the nose from dropping below the horizon

- After having **PASSED** the inverted position, with an angle of bank of **40°-50°** before levelling out in order to hold the aircraft relative to the horizon. **INCREASE** depression on the rudder pedal for rotation and as the aircraft approaches the **20°-30°** banked attitude, hold the aircraft nose-over position within the horizon line by pulling the yoke backwards

- As soon as the aircraft approaches level flying attitude, **STOP** the rotation, **SET** the controls to recovery and then to the **NEUTRAL** position when rotation comes to an end. The aircraft X-rotation/roll should be a **UNIFORM** one

- Good rolls should be performed **WITHOUT** altitude loss. The procedure of making left and right rolls is the **SAME**

8.10 Flick/Snap Rolls

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre

- To perform a flick roll, **SET** the indicated airspeed of **190km/h** rpm **70%** and the engine boost 650-700mm of Hg.

- Impart a pitch-up angle of **10°-15°** to the aircraft and hold this position

- Then by means of a fast pedal deviation by 1/3rd of its motion towards the roll to be performed and by a slight pulling of the yoke and simultaneously deflecting it towards the deviated pedal, impart rolling to the aircraft

- The position the controls and the engine control lever is not changed during X-rotation/roll

- **20°-30°** before the aircraft levelling out, **SET** the controls for recovery

- After the **RECOVERY** to level attitude, **SET** the controls to the **NEUTRAL** position. The aircraft X-rotation/roll should be a **UNIFORM** one

- Rolls are performed actually **WITHOUT** altitude loss. The procedure of making left and right rolls is the **SAME**

8.11 Half-roll

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre

- Entry into a half-roll is carried out from horizontal flight at an IAS of **160km/h**

- **PRODUCE** a pitch-up angle of **10°** to **15°** and then by simultaneous motions of the yoke and rudder pedals towards the desired half-roll, impart a **ROTATION** to the aircraft about an axis with such a rate that the aircraft will be turned upside-down in **2-3 seconds**

- When the given position has been achieved, **PLACE** the rudder pedals in the **NEUTRAL** position and by using the yoke **STOP** the aircraft rotation

- **REMOVE** boost and by a smooth pulling of the yoke backwards make the aircraft go into a dive

- On achieving an IAS of **190-200km/h**, gradually recover from the dive in such way that the IAS is **240-250km/h** at the end of the dive recovery

- When performing the dive recovery, abrupt motions and excessive pulling of the yoke are **NOT** allowed as considerable g-loads will be produced

8.12 Normal Loop

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre. Special attention should be paid to the space under the aircraft

- Using full engine boost and a small descent, accelerate to an IAS of **280km/h** prior to loop entry

- With a **SMOOTH** pulling of the yoke backwards, proceed to making a normal loop with a g-load of **+3.5** to **+4g**

- To **PREVENT** bank and turn caused by gyroscopic effects and yoke reaction torque, **HOLD** the aircraft firm using the left rudder pedal

- When the angle of climb is increased by more than **20°-30°**, gradually **INCREASE** the rate of the yoke motion until the aircraft starts its transition to the upside-down position
- After this, **REDUCE** the pulling (pull forces) of the yoke. At the top-most point of the normal loop, the yoke is pulled **SLIGHTLY** just so as to provide nose-down pitching
- If signs of aircraft **INSTABLITY** are present at the top-most point of the loop, move the yoke slightly **FORWARD** with a subsequent pulling **BACKWARDS** to create the required stabilisation effect
- As soon as the aircraft passes the line of horizon, smoothly reduce the boost to the minimum value
- **WEAKEN** the depression exerted on the left rudder pedal and feel the aircraft's "pushing" over
- When the **VERTICAL** dive position is achieved, slightly PUSH the yoke forward in order to provide a smooth dive recovery **WITHOUT** an abrupt transition to large angles of attack
- When the diving IAS is **190-200km/h**, initiate the recovery to level flight in such a way as to obtain an IAS of **270-280km/h**

8.13 Half-Loop and Half-Roll

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre. Special attention should be paid to the space under the aircraft
- **PRIOR** to commencing this manoeuvre, achieve **HORIZONTAL** flight and select the intended recovery ground reference point
- Perform acceleration with full engine boost and a small descent. The initial indicated airspeed of the half-loop is **300km/h**
- When the designated speed has been **ACHIEVED**, perform the first half loop by pulling the yoke backwards more vigorously (i.e. with a g-load of +5g) than in the case of an inside loop
- Continue with the pull until a vertical angle of 60° has been achieved, then lower the g-load to about +3-4g
- On approaching the top point, with the aircraft in the inverted position and its nose-over does not reach the horizon line by 5°-10° (the IAS must be at least **150km/h**)
- Now **DEFLECT** the yoke and rudder pedal towards the desired side, turn the aircraft about its longitudinal axis by 180° to perform the half-roll
- **SET** the controls for recovery at **20°-30°** before recovering to level flight
- As soon as the aircraft's **LEVEL** attitude is achieved, **SET** the controls to the **NEUTRAL** position

- The IAS during the half-loop recovery must be **140km/h.** If the speed at the time of the half-roll is **NOT 140km/h**, then the half-roll is **NOT ALLOWED** to be performed. **TERMINATE** the manoeuvre **WITHOUT** making the second half-loop

8.14 Aircraft Behaviour at Large Angles of Attack and Stall

- Pilots are warned about the fact that the aircraft is approaching a **STALL** by an **AUDIBLE** signal in the headset and **LIGHT** signals (indication DANGEROUS SPEED on the annunciator panel) approximately **15 SECONDS** prior to the stall

- The character of the Yak 18T can be remarkably **DIFFERENT** to that of a C172. For example, a C172 experiences a relatively sharp nose drop after the stall has occurred. The 18T has been known to produce a negative VSI upon stall without any other visible or audible signals so **DO NOT RELY** on receiving a stall signal for the awareness of the aircraft stall. A good instrument **SCAN** and attitudinal awareness will help to highlight an imminent stall and **UNEXPECTED** negative VSI reading

- The warning detector is **SET** to the response indicated speed of **130km/h.** The warning indicator is cut-in by a toggle switch on the switchboard

- The aircraft controls retain their operational effectiveness at low flight speeds, up to the **POINT** of the actual stall

- Other symptoms at the point of stall include a nose down attitude with rolling either to the left or to the right side and a small shaking or buffeting

- By pushing the yoke **FORWARD**, the aircraft attitude will transition from the angle of incidence to one that is below the stall, but only once the speed **INCREASES**

- The indicated stalling speeds with n_y=1.0 are as follows –

  - in the cruise configuration at the engine conditions **IDLING** 120-123km/h
  - in the cruise configuration at the engine conditions **NOMINAL I** 102-105km/h
  - in the landing configuration at the engine conditions **IDLING** 112-114km/h
  - in the landing configuration at the engine conditions **TAKE-OFF** 97km/h

- Large speed values correspond to the aircraft's weight of **1,650 kg**, small ones to the aircraft's weight of **1,500kg**

- At **NOMINAL I** engine conditions, with a full pulling of the yoke after the stall, the aircraft will **ROLL** either to the left or to the right with a greater **VIGOUR** than at **IDLING** conditions

- During **360°** banked turns and spirals, while pulling the yoke **BACKWARDS**, the aircraft vigorously **DROPS** the nose with a simultaneous rising of the IAS an **INCREASE** in roll will also take place

- An even greater **INCREASE** will occur if dropping the nose at the time of stall, and more so, the higher the speed during the turn-spiral. In moving the yoke **FORWARD**, the aircraft makes a quick transition to a sub-critical angle-of-attack

- In this case, pre-stall warning of shaking or buffeting is **NOT** felt. However, at the time of the actual stall, a slight shaking or buffeting **APPEARS**

- The turn-spiral stalls with different engine conditions and c.g. positions **DO NOT** differ in their nature

- Given the right conditions when entering the stall, the 18T can be remarkably uneventful with the pilot noticing just an unexpectedly high negative VSI

Section 9 - Spins

Spins are **PROHIBITED** unless the pilot has received appropriate spin training on type. After such training and for continued training purposes, spins comprising of not more than **TWO TURNS** at a level of at least **3000m** may be performed -

- **BEFORE** entry into this manoeuvre, study the surrounding airspace to make sure that no other aircraft are flying in proximity of your aircraft, that you will remain clear of cloud, congested areas and that sufficient altitude is available should the manoeuvre is not successful. Select the necessary ground reference points for completing the manoeuvre. Special attention should be paid to the space under the aircraft

- With the aircraft in level flight with an IAS of **170km/h** and the crankshaft speed at **70%**, balance the aircraft using the elevator trimmer

- Select a ground **REFERENCE** point for recovery from the spin

- **CHECK** that the engine instruments read as follows –

Fuel pressure	0.2-0.5 kgf/cm²
Engine inlet oil temperature	50°C-65°C
Oil pressure	4-6 kgf/cm² 1.0kgf/cm² at minimum rpm
Cylinder head temperature	180°C-190°C
Carburettor inlet air temperature	≥ +10°C

9.1. Entry into spin

Entering into a spin at **LEVEL** flight conditions –

- **FULLY** remove the boost and smoothly pull the yoke backwards as the speed decreases. This will establish a pancaking regime. Now **CONTROL** the aircraft to stop a wing from dropping or stalling -

    - Entering a spin with the engine conditions higher than **IDLING** is **PROHIBITED**
    - Increasing rpm in a spin is also **PROHIBITED**

- When entering a spin, pay particular **ATTENTION** to –

    - the nose-over position relative to the horizon
    - the reading of the speed indicator
    - the readings of the variometer

- When the IAS of **125-120km/h** has been achieved, **DEFLECT** the rudder pedal fully towards the specified spin direction and as soon as the aircraft initiates a wing stall and starts to drop the nose, apply **FULL** back yoke. Motions of the controls when going into a spin must be **SMOOTH**. Entry into left and right spins is **EQUAL**

- During the spin, **HOLD** the controls in the positions that were used for the entry. The character of the spin must consist of a uniform rotation; the spinning is vigorous but performed **WITHOUT** shaking or jerks

- The aircraft spins with an angle of the longitudinal inclination to the horizon equal to **50°-60°** at the first turn, and **45°-50°** at the second one

- At the first 3-tum spins the angle of longitudinal inclination is gradually **DECREASED** and angular rotational velocity rises at a constant speed and acceleration (n_y=2). After 3-4 turns the aircraft spin becomes **STABLE** with slight rolling oscillations, constant speed and acceleration

- At the first 3 turns there is no actual **DIFFERENCE** between the left and the right spins. After 3-4 turns the **RIGHT SPIN IS MORE** sloping than the left. Rotation during both spins is accompanied with some aircraft stalling **VIBRATION** or **BUFFETING**

- While spinning, direct a glance towards the spin direction by **25°-30°** from the air aircraft X-axis and by **20°-30°** below horizon

9.2. Spin Recovery

To recover the aircraft from a spin, first –

- **DEFLECT** the rudder pedal towards the side opposite to the spin direction and after this in 2 seconds move the yoke forward beyond a **NEUTRAL** position by ¼-1/5th of motion

- **NOTE**: moving the yoke fully forward is not advisable, as this can result in dive angle increase, appearance of a negative load factor, rising of the indicated airspeeds and a **LOSS OF HEIGHT** during recovery

- As soon as the aircraft stops its rotation, immediately place the rudder pedals in the **NEUTRAL** position, increase the IAS to **160-170km/hr** and then by **SMOOTHLY** pulling the yoke backwards, recover the aircraft from the dive at such a rate that the IAS reading at the end of recovery is **220-240km/h**

- When the aircraft **APPROACHES** the horizon, increase the engine boost

- **During three turns of the spin the aircraft's HEIGHT LOSS in recovery is 740m (approx. 2,400ft)**

- The aircraft recovers from a spin (up to three turns) with a **LAG** not exceeding **ONE TURN**

- When recovering from a spin, always **DEFLECT** the rudder pedal **AGAINST** the spin **EARLIER** than the elevator. In case of the **REVERSE** sequence the aircraft can **FAIL** to recover

- **DEFLECTION** of ailerons within up to ½ pro-spin motion does **NOT** affect the spin nature. At a full pro-spin deflection the spin gets less stable and steeper; **DEFLECTION** of the ailerons by ½ of motion and fully against the spin, the latter becomes more **FLAT** in its nature

- Influence of the **AILERONS** on the spin nature is felt **MORE** at the **RIGHT** spin than at the left one

- While spinning, if the ailerons are **DEFLECTED** against the spin by **MISTAKE** and the aircraft **FAILS** to recover in two turns of lagging (after pulling the controls for recovery), proceed as follows -

    - apply pro-spin controls (at the right spin the rudder is fully to the right side, the yoke is pulled fully backwards, ailerons in the **NEUTRAL** position) check to insure that they are in **NEUTRAL**
    - make one turn with the pro-spin controls

- for getting the aircraft out of the spin, **DEFLECT** the rudder vigorously and **FULLY** against the spin and in 3 seconds after the rudder kick, move the yoke fully **FORWARD**. A **LAG**, when this is done, can be equal to **1-1.5** turn at the left spin and **2-2.5** turns at the right one (The **LAG** during spin recovery is counted from the moment the elevator is applied)
- the aircraft recovers in a dive that is almost vertical when the rotation comes to an end, **SET** pedals to the **NEUTRAL** position and at acceleration of 3-4 recover the aircraft from a dive not allowing the IAS to exceed by more than **300km/h**

9.3. Recovery from an Inverted Spin

The Yak 18T is **PROHIBITED** from inverted spin training and practice flights.

- The aircraft's inverted spin is **STEEPER** than the normal spin. It is **NOT DIFFICULT** to **RECOVER**
- This is done with a full and vigorous rudder pedal **DEFLECTION** towards the side **OPPOSITE** to the spin direction
- With a subsequent 1-2 second **DELAY**, deviate the yoke **BACKWARDS** beyond the **NEUTRAL** position (by ¼-1/5th motion). The **LAG** experienced during recovery from the inverted spin is at **LEAST** 1 turn

9.4. Unintentional Snap or Fall into Spin

The spontaneous fall into a spin can **ONLY** occur as a result of **GROSS PILOTING ERRORS**.

While training or in flying practice it is **PROHIBITED** to perform a fall into a spin from **VERTICAL** manoeuvres (i.e. zoom, loop, half-loop and combat turn).

Inadvertent entry into a spin from a **360°** turn or spiral towards the side opposite to the bank is **PROHIBITED**.

- A spin **CAN** occur when making steep climbs, loops, half-loops and combat turns; usually when the yoke is pulled backwards and simultaneously the rudder (pedal) is fully deflected aside. With the controls in such as position the aircraft first rolls and then drops the nose and goes into a spin
- In **ALL** cases of a spontaneous fall into a spin, **REMOVE** the boost **IMMEDIATELY**
- **SET** the aileron to the **NEUTRAL** position and determine the spin direction
- **RECOVER** the aircraft from the spin by using one of the methods mentioned above
- During training, to teach manoeuvring in order to **CORRECT** "errors", an inadvertent entry into a spin is **ALLOWED** only from a descent turn (spiral) with the engine fully **UNBOOSTED**. To perform an inadvertent entry into the descent turn spin –
    - when the IAS is **150-170km/h** the aircraft is rolled into **50-60°** banked turn
    - during the turn, **PULL** the yoke backward and simultaneously **FULLY** deflect the rudder pedal (against the stop) **TOWARDS** the turn
    - the aircraft will vigorously **ENTER** into the spin

- after the second turn its spinning will be the same as during the spin entry at a minimum speed
- inadvertent entry into a spin from a **360°** turn or spiral can be performed at levels of at least **3000m**
- if the aircraft does not enter the spin but instead, makes a transition to an unstable deep spiral with a massive speeding up – it likely due to a pulling of the yoke and either movement of the rudder pedals to the **NEUTRAL** or fully deflected position and the yoke not fully pulled back

Section 10 - Landing

10.1. Descent and Landing Preparation

1. Perform a long descent in the range of operating altitudes with wheels down (flap is retracted) or with the flap extended (wheels-up) at the engine conditions –

    - Set the propeller to FINE PITCH, Pk = 300-340mm of Hg with preliminary heating of the cylinder head temperature not below 170°C, aircraft IAS must be 160-170km/h. Cylinder head temperature must be kept within 160°C-180°C limits by changing the boost or opening the gills, it is determined using the indicator. When the long-term descent is terminated, retract the undercarriage (flap) and fly according to the remaining flying mission

2. Approaching the airfield, check air pressure in the main and emergency networks of the pneumatic system (pressure must be 40-50 kgf/cm²), establish two-way radio communication with ATC and on receiving clearance to descend at the airspeed indicator reading of 170-180km/h, join circuit traffic at the initial approach altitude

3. Extend the undercarriage while downwind or during base to final at an indicated airspeed not exceeding 200km/h. To extend the undercarriage, proceed as follows –

    - **MOVE** the undercarriage lever latch to the left
    - **SHIFT** the undercarriage lever from the **NEUTRAL** position to **RETRACT** to create counter-pressure
    - **SHIFT** the undercarriage lever from the **RETRACT** position to **EXTEND** not retarding it to the neutral position
    - **CHECK** the undercarriage extension by the indicator lights and mechanical indicators (three green lights of the extended undercarriage position must be on, red lights will extinguish and mechanical indicators on the wings and cowling will be out completely)
    - **LOCK** the undercarriage lever with the help of the latch by shifting it to the right

Leave the undercarriage lever in the extend position till the aircraft taxiing in for landing and the engine shutdown.

10.2. Planning the approach

1. After undercarriage extension, maintain the indicated flying airspeed of 170-180km/h, check air pressure in the main pneumatic system and in case there is no pressure, change to the emergency system. Perform the turn onto base leg at horizontal level flight conditions with an IAS of 180km/h

2. After the turn onto base leg prior to the glide approach, check the engine temperature (in winter time the cylinder heads temperature cannot be less than 140°C), decrease the propeller pitch by shifting the propeller pitch lever fully forward and from the turn indicator reading make sure that the propeller pitch has been decreased completely

WARNING

Time of the engine continuous operation at rpm equal to 101% should not exceed 1 minute

3. Perform the base-leg to final turn at an IAS of at least 170km/h. Rollout of the turn must be terminated at a level of at least 150m (500ft)

4. Gliding between the turn onto base leg and turn to final must be carried out at the airspeed indicator reading of 170km/h

5. After rolling out of the turn to final, **SET** the gliding angle corresponding to the instrument speed of 150-170km/h, balance the aircraft with the help of the elevator trimmer, extend the landing split flap. For this purpose, shift the flap lever down against the stop; make sure that the flap has been extended from illumination of red indicator light FLAP EXTENDED located on the annunciator panel

6. After extension of the landing split flap, retain an IAS of 150-170km/h and at this speed perform gliding until the landing flare is initiated. It is advisable to make the approach glide, planning for a slight pulling

7. Carry out improving of the calculation with an appropriate adjustment to the engine boost, maintaining an IAS of at least 150km/h. Descent with the boost reduced must be completed prior to an altitude of 50m

8. If landing preparation and planning does not provide for a safe landing, adopt a go-around procedure. During the approach, the rate of descent is not allowed to be more than 5m/s (~17ft/s)

10.3. Going Around

1. It is possible to go around from any level, including from the flare-out height. If the pilot has taken the decision to go around, he must increase the boost up to the take-off regime by shifting the engine thrust lever to the fully-forward position during 1.5-2 seconds. When the indicated airspeed of 150km/h has been achieved, enter a climb gradually raising the IAS and at the altitude of at least 10m **retract the undercarriage** (switch the lamp on, if flying at night)

2. **At an altitude of at least 50m, retract the landing split flap**, **SET** the climb indicated speed of 160-170km/h and repeat approach

10.4. Landing

1. The landing flare is advisable to be started from the 5-6m altitude by a smooth moving of the yoke backwards and reducing the approach glide angle so as to approach the ground break-off at the altitude of 0.5-0.7m

2. Perform holding-off during the gradual descent of the aircraft. To do it, move the yoke smoothly backwards to provide a landing position for the aircraft such that the two-main wheels touchdown together from a height of 0.15-0.25m with the wings level and the nose wheel up

3. When the two-main wheels have touched down, hold the yoke's position from when the touchdown occurred. When the aircraft has decreased speed to 110km/h, lower the nose wheel and at a speed of 80km/h, proceed to braking

4. If during landing, there was no air pressure in the main pneumatic system, then after the aircraft has started a three-wheel stable landing run, open the emergency undercarriage extension lever EMERGENCY UNDERCARRIAGE and proceed to brake cautiously

5. When the run is over, clear the runway, retract the landing split flap, switch the unrequired power consumers off except for the light beacon and at night, air navigation equipment. On making sure that the brakes are proper, taxi to parking and shutdown the engine according to the advised procedure

10.5. Crosswind Landing

1. On the crosswind approach crab into the wind using a drift-correction angle

2. When landing, keep in mind that the aircraft in crosswind from the left has a settling tendency

3. After the two main wheels have touched down, move the rudder to obtain a coincidence between the axis of the aircraft and the runway centre line, then **SET** the rudder pedals to the **NEUTRAL** position and on lowering the nose wheel at a speed of 110km/h proceed to braking. Compensate the aircraft downwind side banking by aileron deflection

4. The touch down speed is 5-10km/h more than for usual flight

10.6. Engine Shutdown

1. Prior to the engine shutdown, switch-off the circuit breakers converter, radio altimeter, radio compass, intercommunication system, marker receiver, gyro-horizon inverter, compass system, gyro-horizon and radio station

2. Cool the engine, for this purpose –

    - **OPEN** the cowling gills and the oil radiator shutters fully
    - **DECELERATE** the engine crankshaft speed up to 28%-34% (a fine pitch of the propeller) and run at this condition until the cylinder head temperature is reduced to 140°C-150°C

If it is impossible to cool the cylinder heads up to 140°C-150°C, then engine stopping is allowed to be performed at the cylinder head temperature not over 170°C, in so doing, note the number of cut-outs with 170°C cylinder head temperature in the engine log sheet

3. After cooling the cylinder heads, carry out the engine stopping

CAUTION

Prior to the engine stopping, long-term idling is **PROHIBITED** as it causes the spark plugs to be fouled, the crankcase to be overfilled with oil and this in its turn can result in a hydraulic shock during a subsequent start

For the engine stopping, proceed as follows –

- **ACCELERATE** the engine up to 65%-68% with FINE PITCH of propeller during 20-30 seconds and let the spark plugs to burn-through
- **DECELERATE** the engine up to 28%-34% by the thrust lever
- **MAKE SURE** that the propeller pitch lever is **SET** to the position FINE PITCH
- **MOVE** the thrust level smoothly forwards against the stop (open fully the carburettor throttle butterfly)
- **SWITCH** the magneto off by setting the switch to 0 position

After stopping the engine, **SET** the thrust lever to the idle stop position IDLING (fully backwards) and close the fire valve.

SWITCH OFF the rest of the circuit breakers, switches and cut-outs on the switchboard.

CAUTION

The engine is **PROHIBITED** to be shutdown –

- directly from the cruise power settings and higher power settings

- by closing the fire valve with carburettor fuel usage (in order to avoid backfiring and fire)

After each flight, it is necessary to fill in a log sheet of the engine, making an appropriate entry about the engine operating time (including take-off regime) and the number of flights.

Section 11 - Special Cases in Flight

11.1. Pilot Actions in case of Engine Failure

- In case of an engine failure during take-off but before the aircraft rotates, immediately pull the thrust lever fully backwards and quickly apply the aircraft brakes and switch off the magnetos. If the pilot fails to pass around obstacles, then by braking one of the undercarriage wheels turn the aircraft so as to avoid a head-on impact. If the turn is not able to prevent against impact, close the fire valve, switch the battery off, jettison the door and retract the undercarriage

- In case of engine failure during a climb but before the turn onto the cross-wind leg, make a transition to a glide, switch the magneto, generator and battery off and land just in front of you. While holding-off, release the door. Change the landing direction if the straight-in landing is dangerous for the crew because of an impending head-on impact

- If the CHIPS IN ENGINE light is illuminated on the instrument panel (i.e. chip appearance in the engine oil system), check the oil temperature and pressure and the engine speed via the instruments. On making sure that the engine is operating properly, inform ATC about it and act according to his instructions, checking thoroughly the engine parameters. If one of the parameters does not correspond to the Operating Instruction, stop fulfilment of the mission, inform ATC about it and land at the nearest airfield

11.2. Pilot Actions in case of Pressure Drop

11.2.1. Engine Failure and the Primer

This section provided courtesy of Richard Goode Aerobatics (www.russianaeros.com)

Imagine that you are flying along, and then the engine begins to run roughly, or indeed begins to stop. It is unlikely to be electrical – i.e. a simultaneous failure of both magnetos; you haven't felt a huge amount of vibration and therefore the engine probably hasn't blown up; or the propeller fallen off, so quick thinking says that the problem is fuel. So what do you do?

Following an incident where a pilot did the wrong thing, a number of Yak pilots were asked what they would do. There is concern as to how few people know what they should do! Also, the correct answer to this does depend on understanding the use of the primer, which all too many pilots of Yaks only regard as the device for cold-starting the engine. In fact it serves as the emergency fuel pump, and indeed the aircraft will run on the primer alone, even if there has been a dramatic problem with the carburettor, or indeed even if the carburettor fails to work, as long as the primer is being pumped into 'cylinder' and air is at least getting into the engine from the carburettor.

In terms of what to do in an emergency such as this, important points are:

- First of all check the fuel pressure. If the fuel pressure has gone down, then there is a reasonable assumption that the fuel pump has failed

- In this case steady pumping on 'system' will bypass the fuel pump; supply fuel to the carburettor and keep the engine going. It might blister your hand, but you will have the breathing space to find somewhere to land

- If the fuel pressure is good, then it is a reasonable assumption that fuel is getting to the carburettor, and if you are ruling out total mechanical failure or failure of both magnetos, then the fault must be the carburettor

- In this case if the throttle is **SET** about half open, and then the engine primed on 'cylinder', but using frequent but short strokes, the engine will run reasonably well. Clearly long strokes will alternately drown and then starve the engine (I have not done this myself, but according to those who have, it is not too difficult to establish a position that keeps the engine running reasonably)

So remember what the primer does – on the 'system' side it is filling and pressuring the carburettor, and it doesn't matter how much is pumped in this way, since the excess will always return to the main fuel tank, but on the 'cylinder' side it is priming into the super-charger – i.e. effectively directly into the cylinders, and an excess on the ground will of course wash oil off the cylinder bores, or indeed cause a fire as excess fuel comes down through the carburettor or even out through the exhausts, while in the air the 'cylinder' primer can be a life saver with its ability to keep the engine going!

11.2.2. Pilot Actions in case of drop in Engine Oil Pressure

- If a drop in the oil pressure in the engine is detected, check the oil temperature. If the oil temperature rises, then land immediately in the terminal area and shutdown the engine

- If flying beyond the terminal area, land at an alternate airfield or select an appropriate landing field, and then after informing ATC, perform the landing

- In the case of a forced landing, adhere to the instructions given in the section on forced landing in this operations manual and if possible, any assistance offered by ATC

11.3. Pilot Actions in case of drop in Fuel Pressure and Non-Uniform Fuel Consumption

1. Signs of fuel pressure drop can be -
   - irregularities in engine operations, followed by a drop in engine rpm, some boost reduction and/or engine vibration or shaking
   - drop in fuel pressure as read on the fuel pressure gauge

2. In case of a fuel pressure drop, the pilot is obliged to -
   - inform ATC
   - turn the primer handle MOTOR PRIMING counter clockwise to the LINE position and start pumping petrol into the fuel system, checking the fuel pressure with the help of the pressure gauge
   - stop fulfilment of the mission and land the aircraft at the nearest alternate airfield or landing field
   - if the fuel pressure on the instrument is not recovered and the engine continues to run rough, move the primer to the CYLINDER position and start manual pumping, to achieve the best possible engine conditions
   - If fuel readings are low and differ significantly, bank 5°-7° towards the tank containing the least amount of fuel and continue flying until it is equal

11.4. Pilot Actions in case of Engine Vibration

If the pilot detects unusual aircraft vibration or shaking, proceed as follows –

- in all cases (with the exception of a drop in fuel pressure) pull the thrust lever fully backwards and adopt a gliding regime, **SET** the appropriate flight speed
- if the shaking or vibration does not cease after this action, smoothly move the thrust lever forwards and set up the engine conditions required for horizontal flight
- if after changing the conditions the symptoms still continue, then by using the thrust lever and the propeller pitch lever, select the rpm, at which the shaking will be minimised and land on your nearest airfield or alternate airfield in this flying regime, having delivered the preliminary radio message

11.5. Pilot Actions in case of Propeller Over-speeding

1. The main signs of propeller over-speeding are –

   - small engine vibrations
   - an unusual increase in crankshaft rotational speed
   - a significant change to the sound of the engine

2. If propeller over-speeding is detected during take-off, proceed as follows –

   - move the propeller pitch lever slightly backwards to increase the propeller pitch; - continue the flight not reducing boost
   - at an altitude of 5-10m retract the undercarriage
   - inform ATC
   - make a normal circuit flight and airfield landing

3. In case of propeller over-speeding during a dive, perform the following procedures –

   - remove the boost fully, increase the propeller pitch
   - recover the aircraft from the dive
   - stop the flying mission, inform ATC and perform a normal airfield landing

11.6. Pilot Actions in case of in-flight Fire

In case of an in-flight fire hazard, proceed as follows –

- close the fire valve, switch the magneto and circuit breaker IGNITION off
- if possible, deliver the appropriate radio message to ATC, informing them of your aircraft location
- transition to a gliding regime and, if required, use slipping in order to provide flame-out (i.e. starve the fire)
- if the airfield landing is impossible, select a landing field and perform an off-field forced landing
- perform the off-field landing on a forced-landing area only with the wheels up and the landing split flap extended
- in the initial training version, bail-out if the landing is impossible

11.7. Pilot Actions in case of Forced Landing

1. After the decision to perform an emergency landing has been made, deliver the appropriate MAY DAY call to ATC

2. In the case where the engine is inoperable, perform an airfield landing. During approach, ensure the flap and gear is down and perform a glide at the instrument speed of 160-170km/h. Retract the undercarriage and flap only if you are sure that planning the approach is correct

3. Perform the off-field landing on an unprepared area only, with the undercarriage retracted and the landing split flap extended

4. To execute the forced landing on the unprepared area, proceed as follows –

- retract the undercarriage
- close the fire valve
- switch the magneto, ignition and storage battery off
- extend the landing split flap
- at night, with poor visibility or in day time with limited visibility, switch the landing light on
- plan the approach with a small altitude excess to make a more exact analysis of slipping
- at holding-off jettison the cabin door

11.8. Pilot Actions in case of Emergency Undercarriage Extension

1. In case the pilot need to lower the undercarriage in an emergency, proceed as follows –

- deliver a radio message to ATC about the decision to perform the emergency undercarriage extension
- check for air pressure in the emergency bottle and close the valve of the main line CHARGING (in order to prevent release of air if the check valve turns out to be defective)
- **SET** the undercarriage lever to the **NEUTRAL** position
- open the EMERGENCY UNDERCARRIAGE valve for emergency undercarriage extension
- check the undercarriage extension via the illumination of the three green warning lights and mechanical indicators on each wing and the cowling
- **SET** the undercarriage lever to the position DOWN
- leave the valve of the emergency undercarriage extension in the open position until the flight is complete
- after the landing run, clear the runway and make sure that the brakes operate effectively. Inform ATC and then taxi to parking

In-flight undercarriage retraction after an emergency extension is **PROHIBITED**. The emergency undercarriage extension for the purposes of training should be done with counter pressure from the main system.

If the pilot fails to extend the undercarriage via the main system and via the emergency method, then land with the wheels up on a natural-surfaced runway to minimise aircraft damage.

11.9. Pilot Actions in case of Emergency Flap Extension

In the case of an emergency extension of the landing split flap, proceed as follows –

- deliver a radio message to ATC about the decision to perform the emergency flap extension
- check the air pressure in the emergency bottle
- close the valve of the mainline CHARGING (in order to prevent the release of air if the check valve turns out to be damaged)
- open the flap lever of the emergency undercarriage extension EMERGENCY UNDERCARRIAGE
- **SET** the flap lever to the position EXTEND
- check extension of the landing split flap by illumination of the red warning light FLAP EXTEND on the annunciator panel

11.10. Landing with the Flap Retracted

If the pilot does not extend the split-flap via the main or emergency method, then it is permissible to perform the landing with the flap retracted. The instrument approach speed after turn to final must be 150-160km/h. The landing procedure for the flap-up landing does not actually differ from the flap-down landing. In this case, keep in mind that the gliding range, time of holding-off and touchdown speed will be somewhat more than during a flap-extended landing.

11.11. Pilot Actions in case of Brake Failure

1. In case the brakes fail while taxiing-out/taxiing-in, stop the application of brakes, inform ATC and if possible, shutdown the engine and identify the reason for the failure

2. If brake failure takes place while during a ground run after landing, proceed as follows –

    - when the landing run is terminated, inform ATC about the failure and clear the runway if possible
    - **CHECK** pressure in the main air line when the aircraft is on the taxi-way and if the pressure is normal, **SHUTDOWN** the engine and identify the reason for the fault

11.12. Pilot Actions in case of Radio Station Failure

1. In all cases during a radio communication failure, proceed as follows –

    - **CHECK** the plug connections of the headset cord/s; **CHECK** whether the radio volume control is in the position for maximum readability
    - **CHECK** that the radio operates via other communication channels
    - **CHECK** whether the circuit breakers (intercommunication system) and (VHF station) are not switched off

On making sure, that the radio communication system is out of order, stop fulfilment of the flying mission and land

11.13. Pilot Actions in case of Generator Failure

1. a generator failure can usually be determined by the illumination of a red warning light GENERATOR FAILURE on the annunciator panel and from readings of the ammeter. The latter will indicate the appearance of a battery discharge

2. In the case of a generator failure, proceed as follows –

    - **SWITCH OFF** the generator
    - **DELIVER** a radio message to ATC
    - in a VFR flight, **SWITCH OFF** the maximum number of power consumers with the exception of the circuit breakers: IGNITION, UNDERCARRIAGE, ENGINE INSTRUMENTS, ELECTRIC TURN INDICATOR, LIGHT BEACON and at night AIR NAVIGATION EQUIPMENT
    - stop the fulfilment of the flying mission and make an alternate airfield landing. **SWITCH ON** the radio station transmitter or radio compass for a short time or alternately, if required

The airborne accumulator provides supply of the power consumers at night conditions during 35-40 minutes, in daytime for 50 minutes with the generator disconnected.

11.14. Pilot Actions in case of Converter Failure

If the converter fails, the radio compass and radio altimeter are switched off simultaneously. On having detected that the converter is damaged via an illumination of the red light FAILURE on the annunciator panel, perform the following procedures –

- **SWITCH OFF** the flight and navigation instruments
- **CUT-OUT** the circuit breakers, flight and navigation instruments
- **DELIVER** a radio message to ATC about the failure of the converter

Perform visual and instrument (electric turn indicator) flying, approach the airfield by radio compass and magnetic compass, and if necessary request a radio direction finder heading from ATC

11.15. Pilot Actions in case of Speed Indicator Failure

1. In case of a speed indicator failure, proceed as follows –

   - inform ATC and fly towards your airfield to stop fulfilment of the flying task in an appropriate fashion,
   - keep the flying regime using indications from alternate instruments and via the variometer and engine power settings (boost and rpm)

11.16. Pilot/Crew Actions in case of a Emergency Bailout

In the initial training version, for elementary and advanced pilot training, the emergency bailout can be performed by a crewmember with the co-pilot or another pilot remaining in the aircraft. Preliminary parachutes must be fitted whilst on the ground for all pilots.

1. A forced abandonment of the aircraft by parachute is carried out –

   - in cases where there is an uncontrollable fire in the aircraft
   - in cases where recovery from a spin is impossible above 1000m
   - if it is impossible to restore aircraft controllability
   - in all cases, when the forced landing does not guarantee life safety for the crew members

Safe bailout during straight-line level flight and at glide conditions is provided up to an indicated = 220km/h. The minimum altitude during the straight-line horizontal flight where a safe escape can be made is 150m (500ft!)

2. Execution of the procedure. The aircraft commander (who is training the pilots) gives a command "Be ready for bail-out" and the command to be executed "Abandon the aircraft". The crewmembers will escape from the aircraft in the following sequence –

   - cadet (being trained)
   - commander (trainer)

   In the case of escape from an uncontrollable aircraft, only one command is given – "Abandon the aircraft". During parachute separation, the latter is put into action with an automatic parachute release unit or manually with the help of a suspension ring. The release is set to 3 seconds and to the altitude of 1000m (3,300ft)

3. Actions of the crew while abandoning the aircraft (with a controllable aircraft). Prior to escape from the controllable aircraft, achieve a straight and level flying regime and, if necessary, decrease the indicated airspeed to 220km/h. When bailing-out from the left seat from the command "Be ready to bailout", proceed as follows –

- **DISCONNECT** and remove the headset
- **SET** the seat to the rearmost position
- **UNFASTEN** the seat belts and harnesses

Upon the command "Bail-out" proceed as follows –

- **JETTISON** the left-side frontal door
- **TAKE** feet off the rudder pedals
- **TURN** to the left
- **GRASP** the front edge of the doorway with the right hand, the rear edge with the left one
- **PUT** the left leg on the wing, raise yourself from the seat, bend your head and separate yourself from the seat with an energetic jerk
- finding yourself on the wing, concentrate yourself and **SLIP OFF** the wing

When escaping from the aircraft from the right seat, perform the following procedures –

- **DISCONNECT** and remove the headset
- **SET** the seat to the rearmost position
- **UNFASTEN** the seat belts
- **JETTISON** the right-side frontal door
- **TAKE** feet off the rudder pedals
- **TURN** to the right
- **GRASP** the front edge of the doorway with the left hand, the rear edge with the right one
- **PUT** the right leg on the wing, raise yourself from the seat, bend your head and with an energetic jerk separate yourself from the seat
- finding yourself on the wing, concentrate yourself and **SLIP OFF** the wing

4. Instructions for the crew in case of a forced emergency bailout during inverted flight, in a spin, in a dive and in a spiral. When escaping from the aircraft in these cases, proceed as follows –

    - **JETTISON** the door
    - **DISCONNECT** and remove the headset
    - **TAKE** feet off the rudder pedals
    - **UNFASTEN** the seat belts

The escape from the aircraft in the spin or spiral should be done alternately into one door inwards the figure by means of an energetic push with arms and legs from the doorway edge and along the wing. The bailout preparation is the same as described in the items above.

11.17. Pilot Actions for Engine Hand Starting

CAUTION: this procedure is NOT to be attempted by inexperienced and unsupervised pilots!

Based on an experience hand-starting the M-14P with a good battery but no air.

- **AFTER** draining the intakes, pulling the propeller through, priming the main line pressure to **0.2 to 0.5** and priming the cylinders **6-8** times, flipping the switches and fulfilling the rest of the pre-start procedures, but **BEFORE** getting anywhere near the propeller, make **ABSOLUTELY** sure that you push in the start button and **HOLD IT IN** for a **MINIMUM** of **5 seconds** (more can be better)

- **TURN** the master switch and magnetos **OFF**, drain the intakes, pull the propeller through, prime the cylinders and pull the propeller through again, switch the master instruments **ON**, prime the carburettor and provide 3 more shots to the cylinders, pump throttle idle-full-idle-open 1/4", ignition switch **ON**, start button **PUSH**, hold it for about **5 SECONDS**, no sound, no hissing, no rotation, no clicking, nothing, then it is possible for the engine to start, magnetos **ON**, throttle to **IDLE**

  LESSON: if there's fuel/air in the cylinder and the shower of sparks is cooking, it could fire at anytime with no air, no rotation and no warning. If anyone asks you to hand prop an M-14P, you both better know **EXACTLY** what you're doing!

  DO NOT move the propeller when the engine is above 85°C. It can be **FATAL!**

REMEMBER, the cylinder head temperature (CHT) can still be **100°C** even **20 minutes** after shutting down and the engine **COULD START** even with the ignition and magnetos **OFF**. The best advice is to assume that the propeller is live at all times and to be cautious accordingly.

Under normal circumstances, the magneto switch should be in the **0** position until the engine starts on the sparks, then put onto both. The shower of sparks only works if you have a working battery. If the battery is flat there is no shower. If there is no air there is no rotation.

If the battery is flat then you can only try to start with the magnetos and you might as well have both switched **ON**. However, even with a full air bottle the rate of turn of the starter is seldom enough to get over the compression quick enough and the engine will usually fire **BACKWARDS** – not a good idea.

11.18. Special Feature of the Power Unit at low ambient temperatures

To provide trouble-free engine operation during low ambient temperatures of +5°C and less, the power unit of the aircraft should be prepared for operation in wintertime.

Section 12 - Operation of Systems and Equipment

12.1 Radio Station

1. The radio station is located on the instrument panel. The pilot controls this radio station both from the left or from the right seat

2. Prior to connection, the controls of the radio station should be **SET** to the following positions –

   - The radio toggle switch NOISE SUPRESSOR to the OFF position
   - the volume control to the position of maximum volume

3. To switch the radio station on, proceed as follows –

   - switch on the circuit breakers for the intercommunication system and the VHF on the switchboard. After two minutes the radio station is operation, receiver noises should be heard in the earphones
   - set-up the required frequency on the communication channel by using the radio control panel. To effect transmission, push the button indicated RADIO on the yoke

4. To switch the noise suppressor off, **SET** the toggle-switch NOISE SUPRESSOR to the position NOISE SUPRESSOR on the control panel

To switch the radio station off, **SET** the circuit breaker VHF to the OFF position

12.2 Radio Compass

12.2.1 General Information

The radio compass is intended to be used for automatic determination of radio bearings from radio stations and by air navigation radio compass locators and broadcasting stations, as well as for pre-landing manoeuvring and approaching.

The operating frequency range of the radio compass is from 150-1300 kHz. Radio coverage at a flight altitude of 1000m is approximately 160km (100miles). The radio compass is controlled from a control desk on the instrument panel from the right side and a separate instrument is used as the relative bearing indicator. Radio compass tuning to two operating frequencies is provided. For the fine adjustment of the receiver there are two frequency-setting controls TUNING and TUNING INDICATOR.

The switch INNER MARKER/OUTER MARKER on the instrument panel is for selecting the required operating frequency in flight and on the ground. An aural presentation of the call signal in the headphones is given when the switch RADIO COMPASS OFF on the panel of the intercommunication system is **SET** to the position radio compass. The latter is supplied from a 27V aircraft d.c. electrical wiring system and from the converter 115V, 400 Hz. Protection of the power-supply circuits is effected by circuit breakers and the radio compass mounted on the power panel.

12.2.2 Pre-flight radio compass switching-in, tuning and checking

To tune and check the radio compass, proceed as follows –

- **SWITCH** the circuit breakers and radio compass on the power panel on
- **SET** the switch DIRECTION FINDER OFF on the panel to the PK position
- **SET** the operation mode switch on the radio compass control panel to the position AERIAL and the switch to one position or another depending on the operation mode of the ground radio station
- **SET** the switch INNER MARKER/OUTER MARKER on the control panel to the on position, **SET** the frequency of the inner marker locator with the help of a left decade tuning knob, listen to call signs and obtain a fine tuning of the radio compass with the help of the knob TUNING by a maximum deviation of the tuning indicator pointer to the right

For more accurate tuning, it is advisable to decrease the deviation of the tuning indicator pointer up to two scale divisions by using the gain control from the control desk and after tuning is complete, **SET** the control to the maximum position –

- perform the analogous procedures with the right tuning knob after having **SET** the INNER MARKER/OUTER MARKER switch to the on position
- **SET** the operation mode switch on the radio compass control panel to the COMP position, in this case a pointer on the radio bearing indicator on the instrument must indicate the radio bearing of the outer marker locator and the telephone sets calls of this station should be listened to
- using the LEFT-RIGHT rotatable loop control, deflect the radio bearing indicator pointer by 45°-60° angle towards the side required
- on releasing the control, make sure that the radio bearing pointer is returned to the initial position

Make sure that the calls are being listened to correctly and the radio-bearing readings provided by the direction finder of the inner marker locator are stable.

12.2.3 Radio Compass Usage in Flight

Flight to a Radio Station

During the radio flight, the aircraft heading is **SET** so that the radio bearing indicator pointer stays on the indication equal to the drift angle, and the sum of the magnetic heading and radio bearing is equal to the great-circle magnetic course that is set. If the drift angle is unknown, then the magnetic course is selected as follows –

- by turning the aircraft, **SET** the radio bearing indicator pointer to zero and note the value of the magnetic course
- continue the flight, maintaining the course
- in case of changing the radio bearing by 3°-5° (this indicates the aircraft distance off track in decreasing the radio bearing to the right, in increasing to the left), perform a corrective turn of the aircraft towards the side, opposite to the drift and place the indicator pointer at a value of 6°-10° (350°-354°)
- continue the flight and observe the radio bearing variation
- if the radio bearing's variation continues, increase or decrease the heading correction by a value equal to a half of the previous correction
- the radio compass locator is marked during the fly-by by turning the radio bearing indicator 180°

Flight from the Radio Station

If the radio compass locator is available at the departure point or in transit of the course line, then it can be employed for the preset heading control using the radio compass. The magnetic heading is selected in this case such that the great-circle magnetic course set is equal to the aircraft magnetic bearing. For this, proceed as follows –

- tune the radio compass to the compass locator frequency
- place the aircraft on the desired course line with the heading **SET** and then calculate the aircraft magnetic bearing by a blunt edge of the radio bearing indicator pointer
- determine the heading correction
- heading correction is equal to aircraft magnetic bearing minus great-circle magnetic course set
- correct the magnetic bearing by a value of the found correction and continue the flight with the corrected heading

If the aircraft magnetic bearing is more than the great-circle magnetic course set, then the aircraft is deviated from the desired course line to the right and if less to the left.

Track Monitoring and Position Finding

Monitoring of track ranging is carried out by evaluating a fly-by moment of the route checkpoints, to which the known values of the side radio bearings correspond. The magnetic bearings from the radio set are primarily transferred to the flight chart. The designated magnetic bearings must correspond to the fly-by checkpoints. The aircraft's location is determined using a cross-cut on the chart for the aircraft magnetic bearings from two radio stations or by a point of intersection between the radio set magnetic bearings and the actual course line. The actual accuracy of the track ranging control and the aircraft position finding is provided, if the radio sets are placed at a distance of 100 km from the desired course line and the angle of the bearings crossing lies within 30°-150°.

Landing Approach Manoeuvring

Flight in terminal areas are performed according to the stated plots. Landing approach manoeuvring by radio compass is carried out as follows –

- tune the radio compass channel MAIN to the beacon bearing frequency of channel and GUARD channel to the beacon bearing frequency of channel
- go into the beacon bearing with the magnetic heading equal or close to the landing magnetic track
- make the turn to the cross-wind leg, turn onto the downwind leg and onto base leg according to thr chart for the given airfield
- when the radio bearing = 285° (75°) make a base leg turn to the radio bearing = 0° and note the magnetic heading
- comparing the magnetic heading with the landing magnetic track, determine the aircraft position relative to the landing direction, if the magnetic heading is equal to the landing magnetic track the aircraft is located at the landing line, if the magnetic heading is more than the landing magnetic track the aircraft is to the left from the landing line and if the magnetic heading is less than the landing magnetic track, it means that the aircraft is more to the right. If the difference between the magnetic heading and the landing magnetic track exceeds 10°, the aircraft makes a corrective turn by 15-20° towards the landing line and takes the landing course by the radio bearing indicator. If the difference is less than 10°, the aircraft makes corrective turns by angles not exceeding 10°
- during final approach, set the magnetic heading equal to the magnetic course ± angle of drift, in this case the radio bearing will be equal to the angle of drift or **360°** - angle of drift
- at the moment of the beacon bearing (channel) over-flight change the radio compass over to the guard channel, after this, the indicator pointer will show direction towards the beacon bearing channel

Radio Compass Switching Off

To switch the radio compass off, proceed as follows –

- set the operation mode switches on the control panel and the switch on the intercommunication subscriber's apparatus to the OFF position
- switch the circuit breakers for the APK to off

12.2.3.1 Compass System

Designation

The heading system serves to determine and to indicate the heading and turn angles of the aircraft and to provide magnetic (or true) bearings, it is fitted with the complete set given below –

- Flux-gate sensor 1 pos
- Erecting mechanism 1 pos
- Console 1 pos
- Gyroscopic unit 1 pos
- Indicator 1 pos
- Slaving unit 1 pos

Depending on the flight conditions and the tasks to be executed, the system can operate in one of two regimes –

- magnetic slaving or
- gyro direction indicator

The main mode of operation is the gyro direction indication regime.

12.2.3.2 Pre-Flight Compass Switching-on

To switch the compass system on prior to flight, proceed as follows –

- set the console switch NORTH-SOUTH to the NORTH position when flying in the northern hemisphere and to the SOUTH when flying in the southern hemisphere;
- set the take-off airfield latitude on the respective potentiometer on the console
- set the magnetic declination, equal to zero on the erecting mechanism
- switch the compass system power on

The readiness time of this compass system for operation in the magnetic slaving regime 5 minutes. In 3 minutes after the power has been supplied, carry out the pre-flight checking of the compass system serviceability.

Pre-flight Compass System Checking

To check the compass system before the flight, perform the following procedures –

- set the MONITORING switch to the positions 0 and 300 respectively, make sure, that the compass indicator shows the indications within 0±10° and 300±10°
- set the gyro direction indicator regime and deflect the heading set switch, make sure that the movable scale is rotating
- set the slaving regime and by using the heading set switch on slave the system

In-flight Usage of Compass System

1. Flight in the magnetic slaving operation mode

To perform flights in the magnetic slaving regime, proceed as follows –

- set zero on the erecting mechanism
- set the magnetic slaving regime

- after take-off and climbing, place the aircraft to the initial route point
- fly over the departure point on the first route leg course
- when approaching the intermediate route point, turn the aircraft by a value of the linear leading a turn to take the next route point course. In such away fly over all the subsequent route legs

2. Flight in gyro direction indicator operation mode

For flight in the directional gyro mode, proceed as follows –

- set the scale of the erecting mechanism to zero
- set the departure aerodrome latitude on the latitude scale
- set the operation mode switch to the gyro direction indicator regime
- on the line-up take-off position, if it is required, set the magnetic heading by using the heading set switch

From this point on, the compass heading indicator will show the great-circle magnetic heading relative to the departure aerodrome meridian –

- fly the aircraft to the first route leg with the great-circle magnetic heading equal to the great circle magnetic course set minus drift angle

As a result of compass instrument errors, mistakes in the determination of the drift angle and piloting can occur. The assigned direction can be maintained with a certain angular error, this can cause a gross track error. To reduce the distance-off-track when tracking the course, perform the following procedures –

- check the course by the indicator
- follow variation of the drift angle
- control taking the course by other air navigation aids

In flight, in order to maintain the desired course line make the heading correction, if required, so that the sum of the magnetic heading and drift angle is constantly equal to great-circle magnetic course set

- when approaching the next route leg, determine the turn angle by the formula (turn angle) = (great-circle magnetic course set of the subsequent route leg minus (great-circle magnetic course set of the subsequent route leg)

If the turn angle (ЦJP) has a plus sign, then make a turn to the right, if minus -to the left

- when approaching the landing airfield area (prior to climb), change the compass system over to the magnetic slaving mode and by using the heading set switch obtain slaving
- after slaving the compass system, shift it to the gyro direction indicator mode

NOTE
Monitoring of the compass system working in the gyro direction indicator mode is to be carried out with the help of the magnetic compass and erecting mechanism.

12.2.3.3 Troubles and failures of the Gyro-magnetic Compass

Trouble, Its Signs, Crew Actions

1. Failure of the gyroscopic	A lamp GYROSCOPE TILTING	Use the energetic mechanism

unit	lights up on the console	indicating the magnetic heading and a compass to determine the aircraft course
2. Failure of the flux-gate sensor and the erecting mechanism	Readings of the magnetic heading on the erecting mechanism and gyro magnetic heading in the straight line flight are incorrect and unstable	Use readings of the indicator when the compass system is operating in the gyro direction indicator regime, indications of the magnetic compass and indications of the instrument are employed

12.2.3.4 Magnetic Compass

The magnetic compass is used as a standby instrument for determination of the aircraft magnetic heading. When using the magnetic compass it should be borne in mind that a value of residual deviation on individual courses can constitute 10°.

12.2.3.5 Gyro-horizon

1. The gyro-horizon is designed to inform the pilot about the aircraft pitch and bank angles relative to the true horizon and also about slipping direction of the aircraft

2. The gyro-horizon is switched on after the engine has been started and the converter turned on. In order to switch the gyro-horizon on, cut-in the circuit breakers on the switchboard. The gyro-horizon caging is automatic after turning the power on. The correct gyro-horizon start is provided at pitch and bank angles at rest of ±4°

3. On the line-up take-off position prior to take-off, the crew must check whether the gyro-horizon is proper and make sure that:

    - the aircraft symbol on gyro-horizon indicator occupies the horizontal position and coincides with the horizon line
    - while rotating the pitch angle set knob, the scale is deviating, on having checked the indicator serviceability, set the pitching scale to zero
    - a red no-power warning light on the gyro-horizon is out

If one of the above mentioned requirements are not met, the take-off is **PROHIBITED**. The take-off is allowed only after the gyro-horizon will get ready for operation (not earlier than in 3 minutes after its connection).

CAUTION

It is not permitted to use the caging button when the gyro-horizon is started and also during its normal operation on the ground and in flight.

4. The gyro-horizon bank and pitch angles are **360°** with the exception of pitch-up and dive angles of 85-95°. Allowable errors in the gyro-horizon readings -

    - after take-off error not more than ±3°
    - errors in the bank angles indications after **360°** degree turns not over ±3° (separate overshoots up to 5-6° are possible)
    - errors in bank and pitch angles readings after aerobatics manoeuvring -not more than ±5°

5. If in flight, the gyro-horizon provides wrong indications, it is necessary to make a transition to levelling out and push the button CAGING ONLY OF LEVEL FLIGHT placed at the horizon indicator front panel. In this case, a caging light on the indicator illuminates and goes out when the caging is over. Make sure that the gyro-horizon operates properly. Further flight must be performed with special attention paid to the gyro-horizon

indications that must be compared with those of the electric turn indicator and to the position nose-over and canopy front portions relative to the natural horizon.

NOTE

It is advisable to use the caging button at pitch angles more than +4°, as after caging the gyro erection can be switched off. Setting the circuit breaker on the switchboard to the off position turns off the gyro-horizon.

6. In case of gyro-horizon failure in flight, determine the spatial attitude of the aircraft by the natural horizon and by the indicator and indications of the variometer.

Electric Turn Indicator

The electric turn indicator is designed to indicate the correct 45-degree banked turning of the aircraft in flight about a vertical axis. It combines a turn indicator and a slip indicator in one unit. The aircraft turn is shown by the pointer and slipping by a ball. The indication accuracy error at normal conditions of the flight with 15, 30, 45 degree banks and angular velocities 1.1°C, 2.3°C and 4°C respectively is ±1.5°.

Radio Altimeter

General Information

The radio altimeter is intended to be used for measuring absolute flight altitude in the range of 0-750m and warning that the aircraft has reached the assigned altitude, which value is preset on the indicator. The instrument placed on the instrument panel is employed as the altitude indicator. The instrument flange accommodates an altitude setting control with a built-in yellow warning light and a button (CHECKING) with built-in red warning light. By rotating the ALTITUDE SET control, warning setting of the desired altitude is provided, its value is determined by a yellow triangular marker moving over the indicator scale. When the aircraft has achieved the command altitude, the yellow light is illuminated and simultaneously a 400-Hz audio signal is applied to the pilot's telephones during 3-9 seconds. When the CHECKING push-button is pressed, a 15±1.5m test altitude is set on the proper radio altimeter's indicator, if no button is used, the radio altimeter shows the flight absolute altitude (or H=0 on the ground). The radio altimeter switching as well as protection of the supply circuits are provided by the altimeter circuit breaker located on the switchboard.

Radio altimeter usage in flight

1. Prior to take-off

Switch the radio altimeter power on using the circuit breaker. In this case a red light should go on and the altitude indicator point will be displaced towards a digit 750m and go beyond the scale black sector. After radio altimeter warm-up the red light should extinguish and the indicator pointer should be set to 0±0.8 m scale division. Using the ALTITUDE SET control, place the marker of the desired altitude warning unit against a 10m division of the scale. Press and hold the CHECKING push button in this position. The indicator pointer in this case will show the test altitude value of 15±1.5 m. Release a button CHECKING, when this is done the indicator pointer will be displaced towards a zero value on the scale. When it passes a 10m division, the warning light on the altitude indicator will light up and an audio signal will be fed to the pilot's telephones. The radio altimeter is disconnected by the switch on the switchboard.

2. In flight

In flight the radio altimeter operates as follows –

- when the aircraft climbs at a level of 750m and over, the indicator pointer of the instrument goes beyond the scale black sector and it will be there until the aircraft starts to descend to an altitude of 750m. At the moment the indicator pointer passes the marker of the assigned altitude, a yellow warning light goes on at the instrument and an audio signal will come to the telephones of the pilots
- when the aircraft climbs at a level of 1200m and more, a red warning light built-into the CHECKING control will be illuminated, it will extinguish when the aircraft descends below 1200m
- at altitudes of 750m and below the indicator pointer will show the absolute flight altitude and at a further descent the radio altimeter warns when the desired altitude will be achieved (a yellow lamp on the instrument lights on and an audio signal will be heard in the telephones during 3-9 seconds). The light illuminates until the aircraft lands and will extinguish after the power of has been off

CAUTION

It is not advisable to use readings when the bank and pitch angles exceed 30° -

- switch the radio altimeter off after landing
- if the radio altimeter failure Occurs in flight at a level of less than 750m, a red warning light goes on in the altimeter
- a fault signal, in this case switch the radio altimeter off

Instrument Approach Apparatus

General information

This apparatus is to be used by the homemade heating-glide path system and for International Instrument Landing System (ILS) approaches.

This system provides signals of the aircraft diversion from the heading and glide path equi-signal zones formed by the ground beacons and the inner and outer marker locators flyover warning from the radio markers signals. The apparatus is controlled by the unit located on the instrument panel from the left. The control unit accommodates the following controls: power switch, frequency set control with a computer, operation mode switch ILS, apparatus checking buttons.

By using the frequency set control, one can provide the operating frequency of the localizer receiver over the range of 108.1-111.9 MHz with 0.2 MHz frequency spacing. Simultaneously, tune the operating frequency of the glide-path receiver. The marker receiver, which operates at a 75 MHz fixed frequency, is switched on in conjunction with the apparatus and has no controls. The apparatus is fitted with built-in serviceability checking push-buttons, monitoring is carried out from the control unit. The apparatus is supplied from a 27V DC aircraft electrical wiring system. The power circuit is protected by the circuit breaker placed on the switchboard.

Apparatus pre-flight switching-on and checking

To switch the apparatus on and to check it, proceed as follows –

- switch the circuit breaker on at the switchboard
- set the power switch on the control unit to the ON position
- set the switch ILS to the position
- using the frequency set control set 110.3 MHz on the counter
- press the left CHECKING push-button. This must result in response of the heading and glide-path magnetic indicators of the instrument the heading pointer will be

deflected to the left and occupy a space between 3 and 5 dots, and the glide-path pointer will go upwards and occupy the position between 3 and 5 dots. A MARKER window must be illuminated on the annunciation panel

- switch-off the apparatus by using a switch on the control unit

In-flight apparatus operation when the landing system is used

To provide operation of the apparatus in flight, proceed as follows –

- switch the apparatus on using the switch on the control unit
- set the ILS switch to be position
- by using the frequency set control, provide on the counter a beacon frequency of the system of the airfield where the aircraft will land
- as soon as the aircraft enters the action zone of the heading and glide path beacons on the instrument, the magnetic indicators will function and the pointers will show the aircraft diversion from the heading and glide path equi-signal zones
- while over flying the outer and inner marker locators, a MARKER will be illuminated on the annunciation panel as long pulses (dashes) and short pulses (dots) when flying over the outer and inner marker locators, respectively
- after landing, switch the apparatus off using the switch on the control unit and the circuit breaker at the switchboard

Intercommunication System

General Information

This system is designed to provide –

- getting on for a radio contact for the crew members by a radio set
- inter-aircraft radio communication for the crew members between each other
- capability for all crew members to listen to one radio-navigation device
- reception of two signals DANGEROUS ALTITUDE and of a marker receiver by the crew members. Besides, aural presentation of the intercommunication signals to two additional operators is provided. Two user's sets are placed at the left and right boards of the instrument panel. Two main connectors for connecting the airman's headset are mounted on the brackets in a zone of the door edge. The intercommunication system is supplied from 27V DC circuit

Use of the intercommunication system

			Users	
Functional capabilities	Controls	Position	Instructor	Cadet
Switching-on the intercommunication power from the aircraft electrical wiring system	Circuit break of	Switchboard		+
Getting on for a radio contact	Push-button RADIO	On the yoke	+	+
	Push-button INTERCOM SYSTEM	On the yoke	+	+
Listening to radio compass	Toggle-switch RADIO COMPASS-OFF	On the user’s apparatus	+	+

Apparatus maintenance

Power switching on	
The circuit breaker of the apparatus on the cadet’s switchboard	Switch on

Establishing external communication by the user	
1. A push button RADIO on the yoke of a cadet or instructor	Press the push button to be engaged in communication
2. RAD knob on the user's apparatus of the cadet or instructor	Set the volume required
Establishing internal communication by the user	
1. A push button on the yoke of a cadet or instructor	Press the button to be engaged in communication
2. A push button on the user's apparatus of the cadet or instructor	Set the required volume of signals from the amplifier

The apparatus provides a constant listening to the external communication signals when using the internal communication network and internal communication signals when using the external communication network with 100% loudness level.

Listening to the radio navigation devices and special signals	
The switch RADIO COMPASS OFF on the user's apparatus of the cadet or instructor	Set to position

Signals DANGEROUS ALTITUDE and of a marker receiver are listened to with 100% volume irrespective of the controls position.

CAUTION

The switch (a standby one) on the user's apparatus must be always in OFF (down) position, if the user's apparatus happens to be out of order, then set this switch up to change your telephones over to other user's apparatus.

How to Use Wiper

1. The wiper can be switched on when the aircraft is flying at a speed of 220km/h. It is controlled from a WIPER switch placed at the left board of the instrument panel. The WIPER switch has four fixed positions: START, 1 SPEED, 2 SPEED, **NEUTRAL** (off position) and one pressed position INITIAL POSITION

2. The wiper switch is turned-on using the following sequence -

   - at ambient temperatures of 30 to -20°C the switch can be set to any of its positions START, 1 SPEED or 2 SPEED. The switch operation time in flight when it is being in the START position should not exceed 5 minutes, when it is in the position I SPEED or 2 SPEED time is not limited

NOTE:

1. If the temperature exceeds -20°C, the wiper is allowed to be directly switched on at the first or second speed
2. Several double brush turns can be made during the first minute when the WIPER switch is set to 1 SPEED -64 to 90, 2 SPEED -38 to 60
3. At ambient temperatures below -20°C the WIPER switch can be set to the START position for not more than 3 minutes and then it should be changed over to 1 SPEED

CAUTION

1. At ambient temperatures below –20°C it is **PROHIBITED** to set the wiper switch to the 2 SPEED position

2. If testing the wiper on dry glass, do not switch it on for more THAN 10s
3. Switching-off the wiper from any speed is accomplished by setting the WIPER switch to the **NEUTRAL** position
4. The wiper's brush can be returned to the initial position only after it has stopped. The WIPER switch can be kept in the INITIAL position for not more than 2-3 seconds

12.2.4 The Heating and Ventilation System

A heating and ventilation system is provided to ensure normal temperature conditions inside the aircraft's cabin. In winter an air heater is placed in the nose section under the cowling. A supply of hot air from the heater can be delivered to the cabin by using a control from the right-hand side of the cabin. Hot air to the cabin is fed from the heating extension pieces mounted near to the pilot's feet. The windscreens of the cabin are heated. Switching-on of the heating system is possible both in flight and on the ground after the engine has been started. In summer, the heater is removed and there is ventilation from the velocity head. The cabin ceiling has a rotating spindle for controlling personal ventilation of cool air.

12.2.5 Aneroid and diaphragm actuated instruments and the pitot static systems

Description and Usage

The following instrument panel mounted aneroid and diaphragm instruments: the altimeter, speed indicator and variometer are used for measuring the flight altitude, horizontal and vertical velocities. The pilot and static pressures are applied to the instruments by means of the pilot-static tube and pilot pressure pipelines (painted in black) and static pressure pipelines (white color). The instruments are connected to the static pressure pipelines and only a velocity indicator is connected to the pitot pressure pipelines.

The pitot-static tube is mounted on the left detachable wing assembly on a special-purpose boom and is brought out forwards at a 500-mm distance from the wing leading edge to the undisturbed-flow area. The pitot-static tube is fitted with a heating element, which is switched on using the circuit breaker, HEATING CLOCK, which is placed at the board under the middle instrument panel. The heating element of the pitot static tube is supplied from 27V-10% DC voltage.

Prior to flight

Set the barometric aerodrome pressure on the altimeter pressure scale according to the air traffic control data at the take-off moment.

Prior to take-off

Make sure, that the scale indications of the altimeter pressure scale correspond to the aerodrome atmospheric pressure.

In flight

1. After take-off and transition climb set the barometric pressure on the altimeter pressure scale to 760mm of Hg

2. If the aircraft turns out to be in a zone of rain, snow and icing, switch-on the heating of the pitot-static tube using the circuit breaker HEATING CLOCK

3. In the descent mode control the vertical speed by the variometer

4. On getting approach clearance, change the altimeter scale barometric pressure of 760 mm of Hg to the indication, which corresponds to the atmospheric landing airfield pressure, in the horizontal flight at the transition level. Prior to setting the airfield pressure on the altimeter transmitted by the approach controller, compare the landing

airfield pressure with that one reported in the previous weather information. While approaching, the height keeping control is carried out by the radio altimeter

After Landing

Before taxiing, switch the heating of the pitot-static tube off (if it was turned on).

12.2.6 Operational Limitations

1. A permissible discrepancy between the barometric and atmospheric pressure scale indications at the airfield level for the altimeter is 1.5mm of Hg. Do not match the altimeter scales directly on the aircraft

2. Time of the heating element continuous operation of the pitot static tube on the ground is not more than 1.5m

Failures in the pitot and static pressure feed systems and actions of pilot in case of these failures

1. Clogging or icing of the static-pressure pick-up (static vents). This trouble, providing air-tightness of the static pipe line is proper, is isolated by the following signs –

   - the variometer pointer is set to the zero position and does not change with variation of the flight altitude
   - the altimeter does not change its readings with variation of the flight altitude
   - the speed indicator at climb will provide too low readings, and too high during at descent

Pilot Actions

If the altimeter, speed indicator and variometer turn out to be detective, the pilot must deliver a radio message to ATC, abort the task execution and take the course to the landing airfield by indications of the gyro-horizon and the radio altimeter.

The flight speed is controlled by the engine power settings (by readings of the pressure and vacuum gauge and tachometer).

2. Clogging or icing of the pitot tube.

The main reason of the inlet port choking of the pitot-and-static tube is icing of the tube nose, which can occur as a result of the heating element failure or if the latter was not switched on. In case of pitot-and-static tube icing, clogging of its inlet port can take place and drain orifices remain open. In this case, in the pitot-pressure chamber the pressure equal to the atmospheric one is being set and the pitot tube becomes the static-pressure pick-up. If the inlet port of the pitot-static tube and its drain orifices get clogged, this is detected by the following signs –

- the speed indicator maintains steady-state readings and does not respond to the speed variation during the horizontal flight
- while climbing, the speed indicator readings will be increased and will decrease during descent

Actions of the pilot

Check whether the heating element of the pitot-static tube is switched on (the circuit breaker HEATING CLOCK, must be turned on). If in 2-3 minutes after the pitot-static tube heating has been switched on, the speed indicator readings are not restored, the pilot must inform ATC and terminate the flight and take the appropriate course towards the landing airfield. Check the flight speed from readings of the variometer and power settings of the engine using indications of the vacuum gauge and tachometer.

12.2.7 Light Facilities

Exterior Equipment

1. The outside facility incorporates the navigation lights, a flashing beacon and a land/taxi lamp. 2. The running flights with a filament lamp and the tail navigation light with a filament lamp are mounted on the aircraft

2. A red flashing light beacon with two reflector lamps is placed at the fin tip of the aircraft

3. A lamp with two filaments: landing (200 W) and taxiing (130 W) ones is used as a land/taxi lamp. It is mounted on the port wing leading edge

4. On the main and frontal undercarriage legs two light warning fixtures are installed to provide the extend undercarriage warning for the finisher on the ground. The type fixtures with a filament lamp are used as lights

Interior Equipment

1. The interior light facility is designed for illumination of the instrument panel, general and local illumination of the common cockpit

2. A system of red lights is employed to illuminate the instruments, sub-panels, panels and signs

3. The lights are intended to be used for illumination of the instruments, sub-panels, console's panels and the instrument boards with a red light. Each lighting fixture contains two lamps. The lighting fixture are divided in two groups: main illumination -six fixtures and emergency lighting -two fixtures

4. A slot-type vertical lighting fixture serves to illuminate sub-panels, consoles and individual instruments and notices on the panels. It uses a lamp

5. A lighting fixture An M is used to illuminate signs made by the light pipe method. The fixture uses a lamp

6. General illumination of the common cockpit is provided with the help of a dome lamp, placed on the cockpit ceiling. A lamp is used there

7. Local illumination of the cadet's (left pilot) station is carried out by a light fixture with a lamp. The illumination enables to make recordings, to use a chart and other working papers

Lighting facility maintenance in night flights

1. Prior to the engine start, turn-on the general illumination of the cockpit and illumination of the crew instrument panel. Supply is provided from the aircraft accumulator or the airfield network

2. When the engine and generator have been started, turn-on the flashing beacon running lights and the tail navigation light

3. By using the adjusting rheostats, select intensity sufficient to read properly the indications of the instruments and signs

NOTE

Intensity of the scale lighting must not blind the pilot and produce bright dazzles on the instruments glass, on canopy and doors.

4. Prior to taxiing beginning, cut-in a low light (taxiing filament) of the land/taxi lamp, where a lamp-light is used as the light source

NOTE

1. If required, light from a landing filament (high light) can be employed, but no longer than 5m
2. If day light visibility is not sufficient or limited, usage of taxiing lamps, in the day time is permissible

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5. Prior to take-off on the ground, switch the general illumination dome light in the cockpit off, if it was not done before taxiing. Check intensity adjustment of the instrument panel

6. Before take-off beginning, change from a low light to a high one (switch the light's landing filament on)

7. On gaining 100-150 altitude, switch the light off

8. Adjust intensity of the instrument panel illumination, taking the eye's light adaptation to the outer light background into account (illuminated city, lead-in light)

9. Use a floodlight lighting fixture when keeping records or employing the chart

10. While lowering the flight level, adjust the cockpit illumination proceeding from the landing conditions (illuminated or non illuminated airfield) -

    - adjust intensity of the instruments illumination
    - switch the dome light off

11. After turn to final at 100-150 m altitude switch the high light of the land/taxi lamp on

NOTE

Sometimes, when approaching (if it is raining, falling snow or dust and so on) the so-called light screen can appear when the lamps are switched on, this makes it difficult to pilot the aircraft. In this case, it is advisable to switch light of the lamps on and off recurrently and make landing at the most favourable conditions of the landing illumination for this type of weather or go to a diversion airfield.

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12. At the end of the landing run, switch the high light off and cut-in the low one (the taxiing filament of the lamp)

13. After taxiing-in for landing switch-off the land/taxi lamp, navigation lights, flashing beacon MCA-3

14. When all post-flight operations are completed, switch off the illumination of the instrument panel and general illumination of the common cockpit

15. Cut-out the internal battery or ground supply

Index