

- drain the oil from the internal cavity of the pump;
 - bring the fuel to the pump inlet connection ;
 - rotate the propeller shaft till the storage grease is completely removed .
- 5.2.8. After finishing the preparation of the pump for service connect the fuel line and the carburetor fuel pressure measuring line . Connect the fuel line to the fuel pump and wirelock all the joints.
- 5.2.9. The other aggregates are not subject to the returning to service from storage .
- 5.2.10. Wipe the external surface of the engine and aggregates with gasoline .
- 5.2.11. The date of preparation for service shall be entered in the engine logbook .

5.3 *Installation of the engine on the airplane*

- read the contents of the engine logbook ;
- hoist the engine by means of the steel cable attached to the ring from the propeller shaft as per fig.3;
- attach the engine mounting with the cross-bars to the airplane ,screw the nuts;
- connect the oil ,fuel and air lines of the airplane to the mating nozzles from the engine ;
- connect the lines to the oil and fuel pressure transducers from the airplane ;
- connect and adjust the rods of the carburetor control cables (the throttle control lever shall be set at an angle multiple of 5°);
- connect and adjust the rods and the cables of the propeller governor control . The torque of the propeller governor attachment nuts : 1.5 ± 0.3 Kgfm ;
- install the speedometer transducer ;
- install the oil inlet thermometer ;
- connect the wires to the generator and the signaling screen to the electric circuit;
- install the spark plugs and connect the ignition wires to the spark plugs ;
- install the horn-carburetor air intake ;
- install the exhaust system ;
- install the propeller on the shaft ;
- feed oil,fuel and compressed air to the airplane ;

5.4 *After the engine is installed on the airplane*

- run the engine for 10-15 minutes at 1300 to 1700 r.p.m. and rise the oil temperature by 40°C , in order to remove the storage grease ;
- drain the oil from tank and engine ;
- check the tightness of the unions;
- visually inspect and wash the signaling and the oil screen and re-install them back in place ;
- oil must be changed ;

5.5 *Post-flight technical inspection of the engine*

This inspection shall be performed as per par. 8.6 .

5.6 *Replacement of the engine*

- the engine shall be replaced when its life time has expired or when it requires an overhaul ;

5.6.1 Preparation for storage

- warm up the engine at a rate of 35-41% , oil inlet temperature is 50°C and then drain the oil from the engine ;
- if is not possible to warm up the engine then spray interior of cylinders the oil heated at 40°C , by using the grease pump ;

5.7 *Engine dismantling from the airplane*

- remove the propeller from the shaft and install the tooling ring ;
- remove the engine cowl and disconnect the propeller governor link rod ;
- disconnect the air intake and the exhaust system ;
- disconnect all the connections of the ignition systems ;

- hoist the engine by means of the pulley block as per fig. and remove it from the airplane without damaging the ignition cable housing and aggregates .

5.8 *After removal of the engine from the airplane*

- install the engine on the overhaul stand ;
- apply a thin coating of melted petrolatum by brush or spray to all external unpainted steel and aluminum parts if the engine is to be stored for a longer period .

6.IN-FLIGHT ENGINE OPERATION

6.1 *Engine visual inspection before flight, starting pre-warm up and testing*

This activities shall be performed in compliance with chapter 8 of this specification .

6.2 *Taxiing*

- watch the gages that monitor the operation of the engine . This engine should not be operated at excessive high or low temperatures .

6.2.1 when carburetor air intake temperature is less than 10°C , the taxiing is made by preheating the air at +10°C .

6.3 *Take off*

6.3.1 Before take off:

- check if the engine is sufficiently warmed up and is running without any misfire or chokes ;
- the cylinder head temperature should be at 140...190°C and oil inlet temperature should be 40-65°C ;
- set propeller in LOW PITCH , high r.p.m. position ;
- test the operation of the propeller at 60% (2000 r.p.m.) by switching it from “LOW PITCH “ to “HIGH PITCH” and viceversa (the speed may drop up to 53% (1550 r.p.m.));
- if the engine is ready for flight , increase throttle , increase the speed and manifold pressure up to take off rating (depending on the selected running) and begin the take-off .

6.3.2 Take-off

- this engine should not be operated over 5 minutes period at take-off
- take-off may be performed with the carburetor air heater disconnected if the carburetor air intake temperature is min.+10°C.

6.3.3 Climb

- after take-off adjust propeller to NOMINAL I or NOMINAL II position (this setting may be made also to cruising position) ;
- if during climb the oil temperatures and cylinder head temperatures exceed the allowed limits , gear down the selected run for climb or switch to level flight . If the temperature continues to rise , abort the flight , find the cause and repair the failure ;
- in order to throttle the engine to cruising r.p.m., first of all reduce the manifold pressure and select cruising r.p.m. by the simultaneous movement of the throttle valve and propeller governor control levers .

It is not allowed to set the propeller in high pitch without previously reducing the manifold pressure in order to avoid the excessive loading of the crankshaft .

- in order to increase the run of the engine open the throttle and increase the speed up to the prescribed value ,reduce the pitch and then rise the manifold pressure up to the prescribed value by setting the propeller in high pitch .The sudden rise of speed up to 109% is allowed for max. 1 second . The total

running time to 109% during life service shall not exceed 30 minutes .Enter the time of running at 109% (3200 r.p.m.)in the engine logbook .

6.3.4. The level flight is performed at:

- a. Nominal I
- b. Nominal II
- c. Cruise I
- d. Cruise II

- In case of an extended flight at low temperatures in order to avoid the thickening of the oil in the propeller governor , switch the propeller at every 25-30 minutes of flight from low to high pitch, by changing the speed between 67-55% (1950-1650r.p.m.) then switch to the initial speed . It is allowed to drop oil pressure for a short while up to 2 kgf/cm² .(The oil pressure must recover to normal within 8-11 sec).
- Watch oil pressure gage during flight , it shall be min.4 kgf/cm² , excepting the gliding at “low throttle “ when the oil pressure shall be min.1,0 kgf/cm² .
- When the signaling screen lamp is lit , watch the instruments and depending on the case , the pilot may choose to land .

It is absolutely **FORBIDDEN** to perform other flights before ascertain trouble that made the signaling screen lamp lit .

6.4 Diving ,gliding and landing

- 6.4.1 During diving or sudden gliding , the speed shall not exceed 86% (2500 r.p.m.) . Is acceptable for 1 minute only .The minimum cylinder head temperatures shall be 120 °C and oil temperature shall be minimum 40 °C .
- 6.4.2 In gliding , when the engine is operated with the mixture control in “Lean “ position, move mixture control slightly toward “Full Rich” position (for 2-3 seconds) in order to avoid the propeller self-rotation and the generation of some dynamic loads on the engine parts.
- 6.4.3 If airplane must execute a prolonged glide or under cold weather conditions , shut the cowl and oil cooling radiator shutters and keep turning the engine under partial throttle so as to retard rapid cooling .
- 6.4.4 During gliding , before landing , set propeller in low pitch , so that the engine will be ready for instantaneous application of power.
- 6.4.5 Taxi the airplane at low r.p.m. and all controllable cowling flaps, baffling ,etc set at their “Full Open” position and oil cooling radiator with shutters open , in order to avoid engine overheating .
- 6.4.6 The inlet oil pressure may drop during the aerobatics flight (max. 0.5 seconds) up to 0.5...1kgf/cm² , in case of some overloading close to zero or negatives . It is allowed to drop the inlet oil pressure for max. 5 seconds , during the flight (except aerobatics), up to 1.8 kgf/cm². The total operating time at this oil pressure during service life shall not exceed 5 minutes.

7.ENGINE OPERATION UNDER LOW AMBIENT TEMPERATURES

7.1 Preparation for winter of the propeller-engine assembly

- in winter time , cover the engine with hoods (so that to be able to pour oil into the tank) and heat the engine with warm air . The hood shall be tight on the cowl. The pipes from the heater shall be trimmed with heat insulating materials to avoid burning .
- the durain hoses and the electric wires on which warm water drops may fall during preheating shall be protected with asbestos .
- the oil metallic lines will be wrapped in two layers of heat-insulating material.
- if the oil tank does not get warm on the airplane wrap it in a special hood on its whole surface excepting the drain hole .

- watch the complete drain of the oil from the oil system through the oil sump drain plug .
In case the oil lines are obstructed with oil plugs , replace them .
- check the oil drain from the oil cooler .

7.2 *Oil dilution with gasoline*

- at ambient temperatures lower than +5 °C oil viscosity rises making engine starting difficult and may lead to the damage of the engine rotating parts .This is why it is recommended to dilute oil with the gasoline actuating the engine .

- for oil dilution with gasoline proceed as follows :

1. Preheat the engine up to +30°C of the cylinder heads ;
2. Start and warm up the engine up to inlet oil temperature of 40-50°C;
3. Set the propeller at low pitch and the engine should be throttled to 1600 r.p.m. (54%);
4. Press the knob of the EKR-3 electrically controlled valve and keep it pressed for the entire duration of the dilution , the oil pressure may be lowered by max 1kgf/cm² . Below this value it is necessary to cease oil dilution . The opening time of the electrically controlled valve will be defined depending on the previous dilution specified in the table on the board of the airplane . The quantity of the gasoline necessary for the dilution of the MK-22 or MS-22 oil is determined by computing 10-12% from the oil volume existing in the oil system and in the engine .
5. Release the knob of the EKR-3 valve and for the mixture of oil and gasoline running for 3 minutes at this speed . Switch the propeller 3 or 4 times from low pitch to high pitch to allow the filling of the governor propeller cylinder with diluted oil .
6. Stop the engine .
7. On no account should oil temperature at engine intake be rise over 50°C and that of the cylinder heads over 160°C .

7.3 *Operational features of the engine with diluted oil*

7.3.1 Warm up the engine about 5..6 minutes at 41...44% (1200-1300r.p.m.). Gradually increase throttle until tachometer shows about 51% (1500r.p.m.). The engine should run continuously and oil pressure should be 4-6kgf/cm² . The engine is ready for flight when cylinder head temperatures are min. 120°C and the inlet oil temperature is min. +25°C .

7.3.2 If oil pressure drops below 1 kgf/cm² at idling speed , because of an excessive dilution and loss of viscosity , fill up with undiluted oil and check oil pressure .

7.3.3 Wash all oil screen after the first dilution .

7.4 *Engine preparation for starting*

7.4.1. In cold weather operation , at an ambient of -10°C up to +5°C, the engine can be start without preheating if use diluted oil .

7.4.2 In extreme cold weather operation , at an ambient of -10°C preheat the engine , the propeller cylinder and the oil system with hot air The outlet hot air temperature should be min. 100-120°C . Preheat the engine till the cylinder head temperature reaches min .30°C

7.4.3. Set switch on “Off” position , turn engine over several times. The propeller shaft should rotate easily , and the oil from the tank is considered as heated if it leaks freely from the level rod of the oil tank .

7.4.4. In extreme cold weather operation , at an ambient of -10°C,after airplane parking with the drained oil , lubricating oil should be removed from oil tank , heated up to 75-80°C and replaced before starting .

7.4.5. Pour 2-3 l of oil heated to 75-80°C through the rear crankcase breather .

7.4.6. By filling the engine oil system with heated oil , disconnect inlet oil pump connection and drain 3 liters of oil , in order to heat the oil line that connects the oil tank to the oil pump .

7.5 *Starting*

The preheated engine shall be started in compliance with chapter 9.2“Starting”

7.6 *Warm up and ground testing*

7.6.1. Engine warm up and ground testing shall be in compliance with chapter 8.3 “Engine warm up and ground testing” .

7.6.2. In order to provide a good quality to the mixture and to prevent the potential icing of the horn carburetor air intake , the air intake temperature shall be min +10°C .

7.6.3. Before take-off switch the propeller 2 or 3 strokes from LOW pitch to HIGH pitch reverse in order to heat oil in the propeller governor .

7.7 *Flight*

7.7.1. All flight conditions of the engine (take-off , climbing ,level flight) and in case of low temperatures in summer time are similar to the engine operating conditions in winter .

The following circumstances will be taken into consideration :

a- take-off and climbing are allowed with air heating system disconnected when intake air temperature is +10°C...45°C . In case of freezing , connect the carburetor air heater .

b- in order to avoid oil freezing in the propeller cylinder governor during level flight , periodically (at intervals of 20-30 minutes) switch the propeller from LOW pitch to HIGH pitch and reverse .

c- during gliding at high altitude in winter connect the carburetor air heater and close the cowl shutters to avoid the excessive cooling of the cylinders and periodically warm up the engine , maintaining cylinder head temperature at min 120°C .

7.8 *Stopping*

Air-cooled engines cool rapidly and should not be shut down quickly except in emergencies . Stopping of the engine in winter is the same with that in summer , excepting the following specific features :

a- dilute oil with gasoline before stopping , as necessary ;

b- when using undiluted oil , drain oil from the airplane oil system and engine oil system if the ambient is max -5°C . Oil drainage shall be made at oil temperature of min 30°C through the oil tank drain and oil strainer drain .

c- all oil sump drain plug will remain open after oil draining till the next engine starting .

8 MAINTENANCE SCHEDULE

The engine manufacturer guarantees the normal operation of the engine and its aggregates to the warranty term established provided these operation instructions are closely observed .

The following inspections and maintenance schedule are established for the engine and its aggregates :

a- preparation before flight

b- visual inspection prior to operation

c- maintenance after first engine flight test and after first 5 hours of operation

d- after every 100±10 hours of operation

e- after every 200±10 hours of operation

f- after every 300±10 hours of operation

All periodical maintenance works will be recorded in the engine logbook .
The maintenance of the V530TA-D35 propeller is made according to the propeller operation manual .

8.1 *Inspection prior to operation*

Do not attempt to start the engine unless inspection and service has been completed .

- a- Visually inspect all nuts and bolts on both engine and mount for tightness and safetying , and see that propeller hub is tight and properly locked .
- b- Visually inspect the engine cowl , the exhaust system , carburetor air heater and see that they are properly locked . Visually inspect the propeller blades that should not show marks of impacts or other mechanical damages.
- c- Check fuel ,oil and compressed air lines and fill tanks . See that gasoline is flowing at the carburetor. Check all lines for leaks .
- d- Drain 0.5-0.8 l of fuel from fuel strainer drain .
- e- Make sure that oil line from oil tank to oil pump is open .
- f- Check that all fittings are properly tightened .
- g- Check controls to see that they are functioning properly .
- h- Check that throttle and mixture control levers operate the carburetor to the extremes of their “open” and “closed” positions ; the travel should be smooth without jamming and clearances at the joints .
- i- Check ignition and ground wire connections , making sure that there is no possibility of loose connection .
- j- Fill the fuel system by means of the primer plunger , under a pressure of 0.12-0.15 kgf/cm² and check the fuel line for leaks .

CAUTION : If there are leaks it is allowed to remove them by tightening the fittings or replacing the seals.

- k- See that tachometer and oil pressure gauge are properly connected and that oil thermometers are properly installed and functioning .
- l- Set switch on “Off” position , turn engine over by hand several times to make certain that everything is in readiness for starting and especially that cylinders are not loaded with engine oil sufficient to restrict rotation of the propeller.

CAUTION : In order to prevent hydraulic shock turn engine over by hand several times . If the propeller does not rotate or there is necessary a higher load , as well as after a more than 3 days parking , when refueling or at the second unsuccessful attempt to start the engine , proceed as follows :

- a- remove the drain plugs from the inlet pipes of the cylinders #4,5,6 and remove one of the spark plugs of these cylinders ;
- b- turn ignition switch to “Off” position ,turn engine over by hand 3-4 times ; in this case the accumulated oil or fuel and oil mixture should drain completely . At an ambient less than +5°C , this operation should be made after engine preheating .
- c- reinstall and tighten the spark plugs .
- d- reinstall and wirelock the drain plugs .

If the fuel tank is located higher than the engine longitudinal axis , check the leakproofness of the primer plunger . The free drain of the fuel into the cylinders may cause hydraulic shocks .

8.2 *Starting*

8.2.1. Set propeller in LOW pitch ;

8.2.2. Move control air heater carburetor to open position if the ambient is lower than +10°C ;

8.2.3. Move throttle almost to the 28-38% (800-1100r.p.m.) ;

8.2.4. Turn on the instruments that monitor engine operation ;

8.2.5. Turn ignition switch to Off position and to prime engine use approximately 8-12 strokes (in summer) and 15-20 strokes (in winter) of the primer plunger , at the same time turning propeller over . This will make the engine shaft to rotate for

filling the cylinders with air-fuel mixture and provide the lubricating oil on the cylinder walls before starting . Let fuel evaporate for 1-2 minutes in summer and 3-5 minutes in winter .

CAUTION : THE CORRECT AMOUNT OF PRIMING REQUIRED FOR EACH ENGINE CAN BE DETERMINED ONLY BY EXPERIMENT . OPERATORS ARE CAUTIONED AGAINST “OVER-PRIMING”AND THE DANGER OF WASHING THE LUBRICATING OIL THE CYLINDER WALLS .

- 8.2.6. By using the hand pump (if the pump is installed on the airplane) set a fuel pressure of 0.2-0.5 kgf/cm² ;
- 8.2.7. Check if in the propeller operation area there are no people or objects , turn on main gasoline supply valve and depress START knob to provide turn on of the EK-48 compressed-air valve . After engine has been started turn ignition switch to “Both On“ position ;

CAUTION : Don’t depress the START knob more than 30 seconds , the pause between the customary depression of the knob will be min. 3 minutes and after 10 attempts to start the engine the pause will be minimum 10 minutes . For a better starting of the engine , after the first explosions use the primer plunger to provide an additional fuel quantity . During starting,after the first explosions, pump throttle from closed to open position for 2-3 seconds .

- 8.2.8 If engine refuses to start in 30 seconds turn ignition switch to “Off” position and throttle completely open “back engine up” 8-10 revolutions , turning propeller over by hand and then repeat the starting.
- 8.2.9 If engine refuses to start after two attempts, it is necessary to proceed as follows :
 - a- remove the drain plugs from the inlet pipes of the cylinders #4,5,6 and remove one of the spark plugs of these cylinders and insert by means of the grease pump 30-40g of fresh oil heated up to 75-80°C.
 - b- turn ignition switch to “Off”position ,turn engine over by hand 3-4 times ; in this case the accumulated oil or fuel and oil mixture should drain completely .
 - c- reinstall and tighten the spark plugs ,reinstall and wirelock the drain plugs and repeat the starting
- 8.2.10. After engine has been started , increase throttle until tachometer shows about 38-41%(1100-1200 r.p.m.) , set the primer plunger lever on neutral position and see oil pressure gauge . Failure of oil pressure gauge to show pressure (minimum 1kgf/cm²) within 15-20seconds after starting is sufficient reason to stop the engine and ascertain trouble before continuing operation .
- 8.2.11. After correcting the failure ,restart the engine .

8.3 *Engine warm up and ground testing*

- 8.3.1 After engine has been started proceed to warm up at about 41- 44% (1200-1300 r.p.m.) till the inlet oil temperature begins to rise ;
- 8.3.2 After engine has run at 41-44% (1200-1300r.p.m.), increase throttle until tachometer shows about 44-48%(1300-1400 r.p.m.) in summer and up to 51%(1500r.p.m.) in winter and keep on warm up the engine at these speed till the cylinder head temperatures is min. 120°C and inlet oil temperature is min. 40°C.
- 8.3.3 In winter , warm up of engine will be done with all controllable cowling flaps ,baffling , oil cooling radiator shutters, etc set at their closed position . Engine is ready for ground testing when the cylinder head temperature is min. 120°C and inlet oil temperature is min 40°C . By adjusting the opening of the oil cooling radiator shutters the recommended temperature condition is maintained .
- 8.3.4 Proceed to warm up the propeller cylinder by switching the propeller pitch and test the operation of the engine in different runs . Adjust propeller to NOMINAL II position . The engine shall run smoothly and without chocks

- . Compare the instrument readings with the values from the specification . To avoid overheating, engine ground operation for a long time is not allowed .
- 8.3.5 Test magnetos separately for proper firing and spark plugs . Increase throttle until tachometer shows about 64%(1860-2050r.p.m.) and set propeller in low pitch and disconnect in turn each magneto for 10-15 seconds. Speed of engine with steady throttle should not drop over 3% (85 r.p.m.) on either single magneto from the “Both” magneto operating position . Connect “Both” for 20-30 seconds between switching from one magneto to another .
 - 8.3.6 Test the generator (all electric devices being connected). Move the throttle until tachometer shows about 57-58% (1680-1700 r.p.m.) When depressing the knob of the voltmeter , the voltage shall be 27-27.5 V .
 - 8.3.7 Check operation of the propeller mechanism and the propeller governor . The engine should be throttled to NOMINAL II r.p.m. and propeller in low pitch (70% (2050 r.p.m.)). With steady throttle smoothly adjust propeller to “High Pitch” Speed of the engine with steady throttle should not drop over up to max. 53%(1500 r.p.m.) . At the reverse movement of the propeller governor control lever the engine r.p.m. should be the initial one , allowing at the same time a drop of the inlet oil pressure for a short while up to 2 kgf/cm² (the oil pressure must recover to normal within 8-11 sec).
 - 8.3.8 Check the propeller operation and propeller governor at steady speeds as follows : set propeller in low pitch and the engine should be throttled to 70% (2050r.p.m.) . Increase the propeller pitch up to 64% (1860 r.p.m.) and without driving propeller pitch lever , open and close the throttle valve (not completely) by changing in a certain range the manifold pressure . The engine r.p.m. shall be steady. At the sudden opening and closing of the throttle valve , the engine r.p.m. may rise or decrease by 2-4%(60-120 r.p.m.) ; after 2-3 seconds the engine r.p.m. will restore up to the steady speed .
 - 8.3.9 Check engine acceleration capability as follows : simultaneously close throttle to idle position and set propeller in low pitch . Open the throttle at maximum and increase the speed to take-off in 0.5-3 seconds In this case the engine should be throttled from idling speed to take-off speed without misfires , in max. 3 seconds .In order to provide a normal acceleration capability the cylinder head temperature shall not be less than 120°C and inlet oil temperature min. 40°C .
 - 8.3.10 Check engine operation at take-off . Open the throttle from idle position to full throttle and increase the speed to take-off in 0.5-3 seconds , running at this speed for 20-30 seconds . Open the throttle from idle position to NOMINAL I position ,82% (2400 r.p.m.) running at this speed for 20-30 seconds .Oil temperatures , cylinder head and barrel temperatures , and other conditions set forth on the “Specific Operation Instruction” sheet should be complied with .

REMARK: If the ambient is below 0°C ,during engine ground testing , it is allowed to decrease take-off speed . The new value of the take-off speed is determined in compliance with the change curve of the engine r.p.m. depending on the ambient conditions , as per Fig.4 and it shall not be higher than that fort in Fig.4 .