



MESSERSCHMITT

FLIGHT AND MAINTENANCE MANUAL

STATE AIRCRAFT FACTORY 112

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Messerschmitt Bf 109 G-2

Flight and Maintenance Manual

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This manual is a translation of the publication "Bf 109 G-2, Bedienungsvorschrift - Fl" (Juli 1942), Messerschmitt A.G. Translation into Finnish carried out by Engineer A. Lakomaa.

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Flight and Maintenance Manual

I. PREPARATION FOR FLIGHT

A. FINAL INSPECTION BEFORE FLIGHT

1. Fuselage

- Check the skin.
- Verify that there are no loose objects or tools lying about the aircraft or fastened onto it.
- Check that the seat has been adjusted to your height.
- Check the safety harness and the related locks and buckles.
- Check the fit of all access doors, inspection doors and quick-release fasteners.

2. Undercarriage

- Tyre pressure
 - Main wheels: 4.5 ata
 - Tail wheel: 4.5 ata

When operating from snowy or muddy fields, the undercarriage fairing can be removed to prevent snow or mud from packing between the fairing and the wheel.

3. Tail control surfaces

- Check the skin.

4. Controls

- Check the ease of movement of the controls.

5. Wings

- Check that all access and inspection doors have been closed tightly. The wings must be free of snow and ice.

6. Power plant

- Check the ease of movement of all engine controls. If the throttle feels too stiff, loosen the butterfly nut inside the lever case.
- Check that all access and inspection doors on the engine cowling have been closed tightly.

7. Equipment

- With high-altitude flights, ensure that the oxygen tank is full and the oxygen system works.
- Has the plane been loaded correctly?

B. START-UP, WARM-UP AND RUN-UP

1. Start-up

It is assumed that the engine has been properly serviced and its tanks have been filled up. Before starting up the engine, you must place chocks in front of the wheels, place a fire extinguisher in readiness, remove the ladder and face the aircraft upwind.

- 1) Close canopy.
- 2) Set stabiliser to "Tail-heavy".
- 3) Switch on master power switch (Pull the knob on the starboard side behind the pilot's seat)
- 4) Switch on automatic pitch control (on the starboard side in the cockpit near the foot pedal) and the master switch for the pitch adjustment system (on the primary electrical panel). Set the change-over switch underneath the throttle lever to "Manual" (Handverstellung).

Check that the blade pitch control works using the thumb switch on the throttle lever. Leave the airscrew pitch in the 12 o'clock position.

Set the change-over switch to "Automatic" (Automatik ein). The airscrew pitch indicator should move to 12:30 o'clock. If the blades move further, the battery voltage is too low. If you cannot replace the battery, the change-over switch must be left on "Manual" at less than 1,900 RPM.

- 5) Set fuel cock to P1 + P2.
- 6) Increase throttle to 1/3.
- 7) At low temperatures the airscrew has to be wound a few times by hand.

Note: Ignition off and with utmost caution. If the engine is warm, turning the airscrew is forbidden. While winding the airscrew, pump the priming handle 4 - 6 times.

- 8) Wind the inertia starter; the crank handle is in the tool compartment, the shaft is on the starboard side on top of the engine cowling.

Note: At temperatures below -10°C, the starter must be accelerated so that the crank rotates one revolution per second; then pull the starter control with the ignition switched off. Having repeated this three times, wind up the starter to full speed and pull the starter control with the ignition switched on (switch set to "M1 + M2").

After the engine has started, replace the crank handle in the tool compartment.

- 9) When winding up the starter, the fuel pipes should be filled using the electrical pump located in the tank (fuel pressure

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should be 0.3 kg/cm²). The switch is on the primary electrical panel.

To save the battery do not let pump run for longer than 30 seconds at a time.

Note: You can access the manual fuel pump through the inspection hatch underneath the forward section of the fuselage.

10) On report "Clear!", insert the ignition key and turn the switch to "M1 + M2".

11) Pump the priming handle several times. The handle should lie up against the guide nut.

12) Pull the starter control.

After the engine has started up, adjust the throttle so that the engine is running at 400 - 500 RPM.

13) Watch the oil pressure gauge. While the engine is cold after the start-up during the first 20 - 25 seconds, the reading should be 6 - 8 kg/cm², otherwise the engine must be shut down immediately and the lubrication system must be checked for leaks.

The fuel pressure gauge should indicate some pressure after a few seconds. If not, the engine must be shut down and the fuel system must be checked for leaks. If necessary, de-aerate the system.

If the engine does not start up, you must not retry before the starter has come to rest completely.

If you have to make several start-up attempts at low temperatures, you also have to pull the spark retarding control handle for cleaning the plugs at the same time as the starter control to prevent the engine from backfiring (ignition excessively late).

2. Warm-up

The engine should be allowed to run idle only until the oil pressure has fallen to 4 - 6 kg/cm².

The coolant and oil radiator flaps are adjusted automatically if the switch in the cockpit on the starboard side below is set to "Automatic" (Automatik).

While the feed oil temperature is still below 30 - 40 degrees, you have to increase the engine RPM gradually and ensure that the oil pressure does not exceed 6 - 8 kg/cm². During the warm-up there must be no sudden increase in the oil temperature or decrease of oil pressure. Otherwise you must shut down the engine immediately and check the lubrication system.

You must constantly watch the engine control instruments.

During the engine warm-up you should carry out the following checks:

Fuel system: At 2,000 RPM the fuel cock switch is set alternately to "P1 and P2" for 30 seconds. During this time there must be no

drastic variation in the fuel pressure, the engine RPM must not fall off, and the engine must not run irregularly.

Ignition system: (magneto drop) The ignition switch has to be set to M1 and M2. The drop in RPM should not exceed 50. If the drop is greater, the spark plugs must be cleaned by pulling the retarding control handle while the engine is running at 1,700 - 1,800 RPM.

Generator and airscrew control system: Inspected while the engine is running at around 1,900 RPM. The battery is switched off (by pressing the switch on the instrument panel), the airscrew pitch control is set to 'Manual' (Handverstellung), the pitch is changed back and forth with the change-over switch in the throttle handle and finally set back to the 12 o'clock position. The airscrew pitch control is set back to 'Automatic' (Automatik) and the battery is switched on.

If the power plant works as it should and the pressure and temperature values are within the given thresholds, the run-up can be started.

3. Run-up

Excessive running up must be avoided.

Close canopy tightly.

Maximum RPM can be used if the following preconditions are met:

- Feed oil temperature is at least 40°C
- Oil pressure is roughly 3.5 - 8 kg/cm²
- Fuel pressure is 1.5 - 1.8 kg/cm²
- Coolant outlet temperature is 60 - 80°C

Control column fully back and firmly in your hand.

Advance throttle slowly to "Climb and combat power", oil pressure must not exceed 6 - 8 kg/cm².

Engine should obtain 2,500 - 2,600 RPM, boost pressure 1.30 ata.

Slowly decrease throttle to idle.

If the coolant outlet temperature exceeds 110°C, you must not shut down the engine but let the engine run at 800 RPM until the temperature has dropped to normal.

Avoid long periods of idling!

C. STARTING UP AN ENGINE PREPARED FOR A COLD START

WARM-UP AND RUN-UP

With an engine prepared for a cold start, carry out the following procedure:

- 1) At very low temperatures wind the airscrew a few times by hand and pump the priming handle several times before attempting to start the engine.

Note: You must exercise caution while winding the airscrew because the engine may start up even if the ignition is off.

2) The start-up is normal considering what was said above about start-ups in below -10°C conditions.

3) When the engine has started you should watch the oil pressure reading and raise the RPM in phases so that the pressure stays within 6 - 8 kg/cm² but does not exceed this. Having reached 2,600 RPM and if the engine is running smoothly, you can

4) perform a short run-up and take off immediately after it.

You can ignore the oil and coolant temperatures in this case.

Note: Prolonged warm-ups and idle periods with an engine prepared for a cold start are injurious; Only start up the engine if you are going to take off immediately.

D. ENGINE SHUTDOWN

With the engine running at about 1,800 RPM you must pull the spark plug retarding control handle for about 5 seconds.

The engine must be allowed to cool down gradually (run idle for about 2 minutes); otherwise it may experience valve damage. In such a case, you must set the ignition switch alternately to M1 and then to M2 for a few seconds.

You should note that the oil and coolant temperatures do not drop because of the automatic adjustment of the radiator flaps.

To shut down the engine, take the following steps:

- 1) Pull idle cut-off handle (the knob inside the throttle case)
- 2) Switch off ignition.

The above order must be followed. Remove the ignition key, and cut off fuel. If the electric fuel pump is still running, switch it off. Ensure that the vent on the oxygen bottle is closed.

E. READY FOR TAKE-OFF REPORT

The mechanic-in-charge reports to the pilot the following:

- 1) Rudder and elevator locks and covers have been removed.
- 2) Tyre pressure of all three wheels is 4.5 kg/cm²
- 3) All inspection and access doors on fuselage, wings and engine cowling have been closed.
- 4) Fuel and lubrication pipes without leaks.
- 5) Pressure oil pipes without leaks.
- 6) Coolant tank filled up.

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- 7) Oil tank 36.8 litres (dipstick).
- 8) Main and auxiliary fuel tanks full.
- 9) Empennage and related devices in order.
- 10) Canopy closes tightly and stays closed.
- 11) Hydraulic lubrication system filled up (dipstick).
- 12) Oxygen tank indicates 150 ata.
- 13) Priming fuel topped up.
- 14) Brake fluid topped up.
- 15) Rudder, elevators and ailerons move without obstruction and have full travel.
- 16) Throttle moves easily and has full travel.
- 17) Auxiliary pump in the fuel tank works.
- 18) Landing flaps work.
- 19) Ailerons work with flaps fully extended.
- 20) Generator works (tested at 1,900 RPM).
- 21) Wheel brakes work.
- 22) Fuel cock has been tested in both positions for 30 seconds.
- 23) At climb and combat power, engine runs at 2,500 - 2,600 RPM, boost pressure 1.30 ata.
- 24) Engine mounting points in order.
- 25) All tail control surface bearings are secured, the jam nut secured.
- 26) Tool kit on board.
- 27) Radio equipment in order.
- 28) Weapons inspected and in order.
- 29) Life-saving and safety equipment in order.

II. FLIGHT SERVICE

A. PREPARING FOR TAKE-OFF.

Before take-off you must check the following:

- 1) Are parachute, safety harness and head set in order?

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- 2) Is oxygen system in order? Oxygen tank indicates 150 ata.
- 3) Is the cap of the auxiliary fuel screwed on tightly and the boost pressure switched to the auxiliary fuel tank?
- 4) Unless you are going to use the gun camera, the wire for the camera must be attached to the bottom of the frame and the plug must be connected to the stowage socket.
- 5) Is the pilot's seat adjusted to your height? Try to avoid bending the holding bolt lever.
- 6) Does the canopy close smoothly? The securing bolts in the front and rear of the canopy must work as expected. The sliding hatch must be able to move without obstruction.
- 7) The engine has been tested according to the instructions above.
- 8) Is the master power switch in the off position?
- 9) Is the fuel cock in the P1 + P2 position?
- 10) Does the fuel gauge indicate a sufficient quantity of fuel?
- 11) Are the pressures and temperatures within the given tolerances?
- 12) Has the switch for the radiator flaps been set to "Automatic"?
- 13) Has the airscrew pitch control been set to "Automatic"?
- 14) Is the electric turn and bank indicator on (the switch on the instrument panel)?
- 15) Is the undercarriage indicator on? (Green lights on).
- 16) Does the throttle stay in the adjusted position?
- 17) Has the tail wheel lock been removed?
- 18) Have the locks been removed from the rudder and elevator?
- 19) The horizontal stabiliser must be set to the +1 position (especially on night flights)?
- 20) Switch on pitot heat, navigation lights and instrument lights as required. The instrument light adjustment is on the primary electrical panel.

B. TAXIING

- 1) Remove chocks.
- 2) Flaps fully retracted (0°) in bad weather.

The coolant temperature in the outlet pipe must not exceed 110°C .

If you have to make sharp turns while taxiing, the tail wheel lock must be released (release switch on the left-hand side on the upper

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spar). To steer in sharp turns, pick up speed by increasing throttle, then reduce the throttle to idle and steer with the brakes.

C. TAKE-OFF

- 1) Set flaps to 20.

The control wheel is on the left, the position indicator on the port side flap (20 degrees flaps corresponds to 4 rounds on the control wheel).

- 2) Set pitch control to "Automatic". If you are going to take off with the manual setting, you must drive the airscrew pitch to the 12 o'clock position.

- 3) Before take-off the oil temperature in the feed pipe must be at least 40°C.

Avoid low revs before take-off to prevent the spark plugs from getting dirty. If this cannot be avoided, you must let the engine run at maximum RPM for a while before starting to roll, or use the spark plug cleaner.

When taking off in cold conditions, there is no need to pay attention to the feed oil temperature. You only need to ensure that the oil pressure does not exceed 6 - 8 kg/cm². With an engine prepared for a start in cold conditions you have to keep the coolant and oil temperature as high as possible during the flight.

- 4) Increase throttle in phases to "Climb and Combat" power (Steig und Kampfleistung). Tachometer 2,600 RPM, boost pressure 1.30. The use of WEP and take-off power is forbidden and the particular switch has been removed.

You must ensure that you have the correct airscrew airscrew pitch setting.

- 5) After take-off let the aircraft pick up speed up to 250 kph and then

- 6) Retract undercarriage.

The undercarriage lever must be secured by pressing it down. After that you must press the red button with "Flight" (Flug) written on it (undercarriage locking for the up position).

If the push button does not bounce back up on its own, you must pull it up. If the undercarriage cannot be locked properly, you must press the button again.

The aircraft is not equipped with a mechanical undercarriage retraction device.

You can monitor the status of the undercarriage operation from the mechanical indicator.

- 7) Monitor the undercarriage indicator lights.

Red - fully up
Green - down and locked

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The lights can be switched off for the flight. They will be automatically switched on when you start lowering the flaps.

8) You will hear an audible warning if the undercarriage is not down and locked and the flaps are down. The sound can only be heard when the engine is idle.

9) Retract flaps fully.

Note that your speed with the flaps fully down must not exceed 250 kph.

By adjusting the horizontal stabiliser you can counteract the changes in the plane's centre of gravity.

D. CLIMBING

Once you rotate the aircraft, keep the pitch low until you reach 270 kph, which is the most favourable climb speed.

The most favourable climb speeds at different altitudes:

Alt. 0 1000 2000 3000 4000 5000 6000 7000
Kph 270 - Not given in the original flight manual -

E. CRUISING

1. Operating limitations

The following speeds must not be exceeded at any altitude:

- 250 kph while operating undercarriage and flaps or with flaps fully down.
- 350 kph while undercarriage down
- 750 kph in dive.

Stress category without extra payload: H5

Stress category with payload (300-litre auxiliary fuel tank or 4 x 50 kg bombs or 1 x 250 kg bomb): H4

2. Engine RPMs and pressures

	Power Setting RPM	boost pressure 2% Std. ata.	Altitude km
<hr/>			
Takeoff and WEP*	2800	1.42 +0.02	0
Climb and combat	2600	1.30 +0.02	0
Max. continuous	2300	1.15 +0.02	0
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Emergency*	2800	1.42 +0.02	5.7
Climb and combat	2600	1.30 +0.02	5.8
Max. continuous	2300	1.15 +0.02	5.5
Economy cruise	2100	1.00 +0.02	5.7
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*Note: Takeoff and WEP setting must not be used. The particular switch

has therefore been disconnected.

You must fly by the RPM and monitor the boost pressure. While climbing the boost pressure can exceed the value of the level flight RPM setting by 0.03.

3. Operating the blade pitch control

- 1) In flight the blade pitch control should be kept in the automatic position if possible.
- 2) Warning: If you set the aircraft into a dive from all-out level flight or quickly apply full throttle in flight, you will be dangerously close to over-revving the engine.
- 3) While descending, the engine idling and your speed is speed less than 200 kph, you must set the blade pitch control to manual or closely monitor that the airscrew pitch does not get too low (over 12 o'clock).
- 4) Manual setting must be used:

When flying with the economy cruise setting, and the engine RPM and boost pressure are at the recommended values. You must set the pitch control to automatic before you start diving.

When flying with 0 airscrew pitch (descent setting), or if the governor fails.

- 5) If you fly with manual pitch control, you must ensure that you do not set the airscrew pitch lower than 12 o'clock because the emergency release will not engage before the 12:30 position.

The airscrew pitch must be set so that the given RPM and boost pressure values can be reached.

4. Fuel system

Fuel pressure 1.5 - 1.8 kg/cm²

If the fuel pressure starts to fall below 1.0 kg/cm² at a high altitude, the auxiliary fuel pump (in the tank) must be switched on. The switch is on the primary electrical panel.

The fuel gauge is on the instrument panel; the instrument system auto-switch on the primary electrical panel. The red light indicating low fuel is turned on when there is fuel for a 20-minute flight.

Aircraft with auxiliary tank

Before taking off, you must ensure that the pressure is switched to the auxiliary fuel tank (jettisonable). The fuel cock lever is on the left in the cockpit. By watching the fuel flow indicator on the right-hand side, you can monitor the fuel flow from the auxiliary tank.

If the auxiliary tank fuel flow controller in the main tank fails, you must switch the pressure off from the auxiliary tank.

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If the auxiliary or main fuel tank is damaged, you must jettison the auxiliary tank by yanking the handle on the right, down in the cockpit.

You must also jettison the auxiliary tank if you are going to land on a rough surface, or if you have to make an emergency or belly landing.

In any other case, you can jettison the auxiliary tank only when you engage the enemy.

5. Lubrication system

The flaps of the oil cooler are adjusted automatically by a thermostat (uses motor oil for operation).

Feed oil temperatures: at least:	30°C
Normal:	75° - 80°C
Momentarily:	85°C

Oil pressure: at least 2.4 kg/cm² at 2,600 RPM with oil temperature at 75°C.

6. Cooling system

The radiator flaps are adjusted automatically by a thermostat (uses the fluid from the hydraulic system for operation).

Coolant temperature in the outlet pipe: max 110°C near the ground, at altitude, falling according to the given boiling curve.

If the thermostat fails, or in special cases, the thermostat can be disengaged, after which you must manually adjust the flaps. The control lever is on the right in the cockpit. The lever can be set to "open" (auf), "closed" (zu) or "off" (Ruhe), which means that the flaps stay where they are. In the "automatic" (Automatik) position the thermostat controls the flap setting.

If either one of the liquid coolers is hit, the damaged cooler must be disconnected from the system immediately by pulling the handles on the left and right in the forward part of the cockpit depending on which of the radiators was damaged.

7. In-flight engine failure

If you have to descend for a long time with low RPM, you should use the spark retarding control to prevent engine failure. Set the power to 1,800 - 2,000 RPM and pull the handle for five seconds.

8. Cockpit ventilation

You can adjust the cockpit ventilation with the nozzle on your right.

F. DIVING AND DESCENDING**1. Diving**

Adjust the stabiliser so that the plane stays in a dive when you push the stick forward. The forces and loading on the elevator and stabiliser become considerable at high speeds. Changing the position of the stabiliser must be carried out smoothly and consistently. When you adjust the stabiliser, you should feel a clearly detectable notch. In any other case, the stabiliser is allowed to move on its own.

The pitch control must be set to "automatic" if you have flown with the manual setting so far.

Adjust the throttle to the white line.

Maximum RPM in dive - 2,800.

Maximum speed in dive - 750 kph.

Using full stick deflection in a dive, especially when recovering from the dive, may induce fractures in the airframe.

2. Descending

Decrease throttle to flight idle. If you're descending from high altitude, you must increase throttle every now and then to prevent the engine from cooling too much and to keep the spark plugs clean.

Oil and coolant temperatures must not drop below 40°C.

G. FLYING AT NIGHT

Precondition: A well-serviced aircraft.

You must practise the use of levers, especially the electric switches in the dark.

Before take-off pay special attention to the position of the horizontal stabiliser.

The instrument panel must be illuminated during the flight. You can adjust the brightness of the instrument lights with the knob on the primary electrical panel.

H. HIGH-ALTITUDE FLIGHTS WITH OXYGEN EQUIPMENT

Before take-off ensure that the oxygen tank indicates 150 ata.

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J. LANDING

Before landing on a rough airfield, you must jettison all extra payload. If you land with extra payload, you must exercise great caution.

1) Slow down to 220 kph.

2) Set pitch control to "automatic" if you have flown with manual setting so far.

If you must use the manual setting, set the airscrew pitch to the 11.30 position.

3) Extend undercarriage.

Press the green "Landing" (Landung) button. If the button does not bounce back up, you must pull it up.

If the undercarriage does not get locked down properly, press the button again.

Follow the position of the undercarriage from the mechanical position indicator.

4) Monitor undercarriage indicator lights:

Red - fully up
Green - down and locked

Manual extension (in an emergency).

Press the green "Landing" (Landung) button followed by a sharp pull of the emergency handle on the instrument panel. If the undercarriage does not get locked down automatically (the green light does not come on), try rocking the aircraft.

5) You will hear a warning tone if the undercarriage is not locked down properly and you start extending the flaps. The sound can only be heard when the engine is idle.

6) Flaps fully down. Note that you must not exceed the speed of 250 kph.

To counteract the changes in the flight balance adjust the stabiliser.

7) Approach speed is 180 kph

8) Use the wheel brakes as little as possible after touchdown.

9) Shut down the engine as explained in "I.D."

Go-around

Flaps fully down until at sufficient altitude. Retract the flaps slowly and adjust the stabiliser as required. With the flaps down do not exceed 250 kph.

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K. EMERGENCY PROCEDURES

1. Forced landing

If you're flying below 1,000 m and you're forced to land as quickly as possible or on an unfavourable site, keep the undercarriage retracted.

Slow down to 200 kph.

Flaps fully down.

Switch off master power switch and ignition. Cut off fuel.

Open both side windows fully.

You do not necessarily have to jettison the canopy because it may serve as protection if the plane flips over.

Tighten safety harness.

Turn the Revi sight out of the way.

If you're flying above 1,000 m, perform an emergency landing with the undercarriage extended only if you have found a site that looks large and hard enough.

To make the best use of the aircraft's glide ratio, it behoves you to extend the undercarriage and flaps only when you're below 1,000m.

Set the pitch control to "manual" and airscrew pitch to 0 (glide).

Extend undercarriage. If you have experienced an engine failure, you must use the emergency winding handle.

Flaps fully down.

Switch off master power switch and ignition, etc. as above.

a) Landing on water.

Always performed with undercarriage retracted.

Flaps fully down.

Before landing switch off master power switch and ignition, cut off fuel, jettison canopy.

Tighten safety harness, turn the Revi sight out of the way.

After landing, unfasten safety harness and parachute as quickly as possible.

Abandon aircraft immediately and climb on a dinghy (if one is available).

2. Baling out

Slow down as much as you can.

If there's time, switch off the ignition and master power switch, cut off fuel.

Unfasten safety harness.

Open fuel jettison nozzle and jettison canopy (emergency release handle on the upper longeron on the left).

Airflow will remove the canopy. To protect your head, lean forward and bow down.

Bale out.

III. MAINTENANCE**A. GENERAL INSTRUCTIONS****1. Towing**

Before towing the aircraft you should verify that the tyre pressure and oleo strut pressure are sufficient.

Tow speed must not exceed 10 kph.

When starting to tow, tighten the tow cable slowly. Yanking is forbidden. Use a tail fork to help towing if necessary.

If you have to turn steeply, release the tail lock.

Towing with only one cable connected to the tow ring on the undercarriage leg is forbidden. It is also forbidden to pull from the leading edge slats and to push from the elevator or rudder.

Towing from the tailskid is forbidden.

If there is no towtruck available, it takes 4 - 5 men to tow the aircraft.

2. Locking and unlocking the controls

Locking: To lock the ailerons, rudder and elevator you must set the stick to the 0 position, turn the locking pipe up, set the knob on top of it into the ring on the control stick and turn the handle 90 degrees.

Unlocking: Turn the handle 90 degrees and turn the locking pipe right.

3. Picketing and covering

If you intend to leave the aircraft outside for longer periods, you must picket it to the ground with steel cables as shown in Figure 3. The picketing rings are below the wings.

Flaps must be fully retracted and the rudder and elevator must be locked with the locking mechanism to the centre position (Figure 4). The locking mechanisms must be equipped with clearly visible signs.

4. Refuelling

a) Fuel

A fire extinguisher must be near at hand.

During refuelling you must not touch any electric switches (the master power switch should be switched off before refuelling the aircraft).

Fuel octane rating: 87 (German classification B4).

Main tank capacity: 400 litres.

Auxiliary fuel tank capacity: 300 litres.

Refuelling the main tank:

Refuelling must be interrupted every once in a while to let air bubbles escape. When removing the fuel hose ensure that the vent cap has not got stuck in the "open" position.

Refuelling with a funnel is permitted.

Measuring fuel quantity:

With the aircraft's tail on the ground, you can check the fuel quantity with the dipstick in the upper part of the tank. After measuring the stick must be screwed in tightly.

In level flight the electric measuring system measures the fuel quantity (the switch on the instrument panel).

When refuelling you can tell that the tank is full when excess fuel escapes through the fuel vent.

Filling in the auxiliary tank is done through the refuelling hole in the tank. After refuelling the cap must be closed carefully or otherwise the boost pressure escapes through the hole and no fuel is fed up into the main tank.

If the auxiliary tank is not emptied in flight or if the engine is stopped after a run-up with the auxiliary tank full or nearly full, you must depressurise the auxiliary tank to the atmosphere by adjusting the boost pressure because otherwise some fuel may start escaping through the main tank fuel vent after some time. Before taking off you must remember to redirect the boost pressure back to the auxiliary tank.

b) Priming fuel

Published: March 1943	Revised:	10056
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In the winter and at night or early in the morning in warmer seasons you have to use special priming fuel. In hot conditions you must use light avgas A3 or B4, for example (but never C3).

The priming fuel tank volume is 0.5 litres. The refill port is left from the cockpit.

Fill the tank up to its rim. Use a funnel with a fine-meshed filter.

c) Lubricant

Type: Red band (Rotring).

The volume of the tank is 36.8 litres of oil & 6 litres of air. Use a funnel with fine-meshed filter.

The cap must be screwed in carefully on the refill port with the catches pointing to the direction of flight.

To check the quantity of the lubricant use the dipstick attached to the side of the refill port.

d) Preparations for a cold start

Having returned from a flight refill the fuel and lubricant tanks and let the engine cool down until oil temperature reaches 30°C (max 40° and min 20°).

Start up the engine and let it run at 800 RPM. With the engine running, open the cold start tap and run some fuel into the lubrication oil according to the instructions specified below.

Close the tap and shut the engine down.

An aircraft prepared for a cold start must be clearly designated for the pilot to be able to take an appropriate course of action.

Because the evaporation of fuel from the lubrication oil depends on the temperature and the stress the engine undergoes, you must check the composition of the lubrication oil with a viscosimeter every five days. The same applies to an aircraft prepared for a cold start if it has not been used for over two weeks.

e) Cooling agent

The tanks must be refilled after every flight.

Mixture ratio water:glycol - 1:1.

When adding coolant in cold conditions the coolant to be added must be 65°C. You can only add cold coolant to an engine that has properly cooled down.

The coolant system volume is roughly 75 litres.

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The refill port is on the left bleeder tank. When refilling the tank, lift the top left protective cover up.

During refilling the tailskid must be on the ground.

If the engine is hot you should exercise caution when opening the cap (danger of effervescence).

Refill the tank with a funnel until some of the liquid flows over.

After the first run-up you must refill the tank.

f) Hydraulic system

Operating liquid: "Fl-Drucköl".

The tank is to the left of the engine attached onto the left engine member. To refill the tank lift the top left protective cover up.

Fill the tank up to the indicator on the dipstick.

g) Oxygen equipment

Refill aperture on the starboard side of the fuselage.

Fill the oxygen tank up to 150 ata.

5. Draining the systems

a) Fuel tank

The fuel tank must be drained before larger repairs or transportation as described below:

Open the starboard upper part of the engine cowl.

Disconnect the fuel lines from the engine.

The line on the refill pump is connected to the connecting piece, as well as the disconnected fuel lines.

Note: Ensure that the lines attached to the connecting piece are tight or otherwise the suction pump sucks air into the tank and the tank will not be drained.

Open the fuel cock.

Pump the tank empty.

Close the fuel cock, disconnect the connecting piece and reconnect the lines to the engine. Secure the fitting bolts and let the cowl down.

b) Lubrication system

The system must be drained while the engine is still warm. The oil drain cock is behind the engine beneath the oil feed lines. You can access the cock by opening the lower part of the engine cowl.

Drain the oil tank through the drain pipe at the bottom of the tank.

Drain the oil to a container reserved for that purpose.

c) Cooling system

If the aircraft is left outside in very cold conditions (below -30°C), you must drain the coolant.

The draining taps are on the radiator and you can open them from the outside with special fork wrenches.

Open the filler while draining the cooling system.

6. Cleaning the aircraft

Careful cleaning of the aircraft is necessary because only in a well-serviced aircraft can you spot fatigue failures and other fractures in time.

The aircraft must be cleaned from dust and dirt accumulated in the cockpit. Dirt stuck on the aircraft is washed off with lukewarm water.

The main wheels and the tail wheel are washed with water using a brush.

The dirtiest as well as oily and rusty parts are cleaned with kerosene.

The engine is cleaned externally. It is forbidden to use benzine, benzol or cleaning agents containing these fluids for cleaning the aircraft or its parts.

You must not let benzine, benzol, alcohol or liquids containing these agents come into contact with the Plexiglas panes on the aircraft.

All dampened parts are wiped dry with soft cloths.

The Plexiglas panes are washed with water using a sponge and dried with great caution.

B. DAILY TASKS

1. Aircraft

a) Fuselage

Look for any loose objects inside the fuselage.

Check the plates on the fuselage for possible dents and fractures.

Ensure that all hatches and lids remain tightly closed.

b) Undercarriage

Check the pressures:

- oleo struts: 25 ata (unloaded)
- main wheel tyres: 4.5 ata
- tail wheel tyre: 4.5 ata

Ensure that the main wheels have not moved from their positions (slid so that the red markers do not meet).

Check the condition of the main wheel tyres frequently.

Fuel quantity of the oleo struts: 1.1 litres.

Brakes must be checked if necessary and the breaking system must be refilled (red EC brake fluid).

Tightness of the lines must be verified.

c) Flight controls

Check the rudder and elevator by moving the control column and rudder pedals.

The tension of the adjustment cables of the horizontal stabiliser is checked in the following way:

With the tail wheel on the ground, set the elevator to fully tail-heavy and wind back the adjustment wheel 1/4 of a turn.

Open the hatch on the port side of the fuselage and check with a calliper the distance between the cables at the fifth section of the fuselage.

Hang a 5-kg weight on the lower cable and measure the distance again.

The difference between the results must not exceed 36 mm +/-2.

If necessary, you can tighten the cable with the clamp connected to the lower cable located next to the cockpit.

The arresting gear of the horizontal stabiliser's control system must be adjusted so that you feel distinctive resistance when you turn the wheel.

d) Rudder, elevator and wings

Check the skin.

Verify that all hatches and lids remain tightly closed.

Check the screws on the hatches and lids and tighten them if necessary.

Verify that flaps, fins, rudder and elevator are firmly in place.

e) Lubrication

Undercarriage, flight and engine controls must be kept well-lubricated. If necessary, these parts must be lubricated with cold-resistant lubricants according to Figure 5.

The ball bearings are greased during scheduled maintenance.

The rack for the auxiliary fuel tank must also be greased carefully.

2. Power plant

The engine must be kept clean to reduce the risk of fire. Grease, oil and exhaust dirt must be wiped off.

Ensure that the liquid and oil cooler cells are clean externally. If necessary, wash the liquid coolers under the wings by spraying water on them. First from front and then from behind.

Verify that there are no leaking pipes and ensure that the auxiliary tank is tight.

Fitting nuts must be impeccably secured.

Check the engine mounting points, as well as spark plug connectors and terminal lugs. Any loosened sections must be tightened.

Check the operation of engine controls by adjusting the levers.

Check the airscrew against damage and its mounting.

Clean the feed oil filter by winding the handle on the filter several times.

3. Equipment

The battery must be serviced according to the special instructions provided. Ensure that the master power switch is off when disconnecting the battery or reconnecting it.

Replace the lead battery with an Edison battery in the winter.

C. SCHEDULED MAINTENANCE

1. 12.5-hour maintenance

Remove and clean the feed oil filter.

Grease the coolant pump.

Clean the filter of the hydraulic system.

2. 25-hour maintenance

Remove any water which has possibly got into the ASI lines through the ram air tube. The spill chamber is located in the left wing. After draining the chamber the plugs must be inserted carefully.

Clean the fuel filter in the fuel cut-off system. You can access the device through the hatch located in the low forward section of the fuselage.

Remove and clean the spark plugs.

Detailed instructions on how to service the engine can be found in the engine manual. The same applies to changing the lubrication oil.

D. STRUCTURE OF INDUCTION FILTER AND ITS MAINTENANCE

To separate sand and dust from suction air, you can mount an induction filter in front of the suction box. It can be adjusted to let the suction air into the engine without obstruction or through the filter. The filter device consists of two Delbag filters and two shutter flaps. The latter can be controlled from the cockpit with a handle in the front left-hand side.

Using the filter during flight service

You must use the filter at take-off, landing and possibly during low-level flights. The shutter flaps must be kept as open as possible in flight. The shutter flaps can be opened by pulling the handle in the cockpit. The handle must be locked after you have pulled it. The flaps can be closed, in other words, you engage the filter by unlocking the handle and a spring will close the shutter flaps.

Servicing the filter

The filtering capability of the oil-dampened filters is limited which is why they have to be cleaned after every two flights. To ensure quick take-offs in case of a scramble, you should always have clean and working filters available that can be replaced with dirty ones.

Replacing the filters for cleaning

Remove the filters by loosening the forward and back clamps. Before removing the forward clamp, the shutter flaps must be closed. Cleaning the filters: You can use benzine, benzol, kerosene, hot mineral water, hot P3 solution, trichlorethylene, etc. The cleaning agent does not have to be absolutely clean. If no cleaning agents are available, the filters can be cleaned with pressurised air.

Note: Knocking the filters does not help much and is even harmful.

Removed, dirty filters must be rinsed in large enough vats. The rinsed filters are set to dry in dust and sand-free place. You can speed up the drying process with pressurised air.

If you use something else than benzine for rinsing, mineral water or kerosene, for example, you have to rinse the filters once more with hot water.

Dampening the filter: Done with motor oil. The oil does not have to be absolutely clean; used oil will do just as well.

Dip the rinsed and dry filters into the oil and let excess oil drip away so that the oil forms a thin coating on the walls of the filter. Hot oil or heating up the filter before dipping it in the oil speeds up drying. If pressurised air is available, you can blow excess oil away with a blast of air until a thin coating remains.

Quick-dampening: Use a spray gun to spray the oil onto the filter.

Excess oil on the filter dirties the induction manifold and is dangerous.