



Operating and Maintenance Manual

Limbach L 2000

and series

**Engine for Powered Gliders and
Very Light Aircraft**

Edition: 7/92

Approval and translation has been done by best knowledge and judgement. In any case the original text in german language is authoritative

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1.2 **LOG OF REVISIONS**

The table of contents provides for checking if the manual is in a current status. The following table shows the revisions of the table of contents.

| Cons. Nr. | Date of Issue | Remarks |
|-----------|---------------|-----------------------------------|
| 1 | 07.92 | First Issue |
| 2 | 08.93 | 1st Revision, TB 20.2 |
| 3 | 07.95 | 2nd Revision, TB 39, TB 41, TB 48 |
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2. ENGINE DESCRIPTION

Horizontally Opposed 4-Cylinder 4-Stroke Reciprocating Engine

Ram Air Cooling

Wet Sump Forced Lubrication

Single or Dual Magneto Ignition

Direct Propeller Drive

Electrical Starter

Alternator

Mechanical Fuel Pump

Constant Pressure Carburetor

2.1 MODEL DESIGNATION

L 2000 E A 1 . X X

1. 2. 3. 4. 5. 6. 7.

1. LIMBACH (Manufacturer)

2. Displacement Class in cm³

3. (E) Single Ignition

(D) Dual Ignition

4. Equipment - Basic Type of Construction

- 0 = Tractor Propeller
Carburetor rear, bottom
Alternator rear
Starter rear

- A = Tractor Propeller
Carburetor rear, top
Generator front
Starter front

- B = Tractor Propeller
2 Carburetors rear, top
Generator rear
Starter rear

- C = Pusher Propeller
Carburetor rear, bottom
Alternator rear
Starter rear

- D = Tractor Propeller
Carburetor rear, bottom
Generator front
Starter front

- E = Tractor Propeller
2 Carburetors rear, top
Generator front
Starter front

5. Type of Propeller Flange

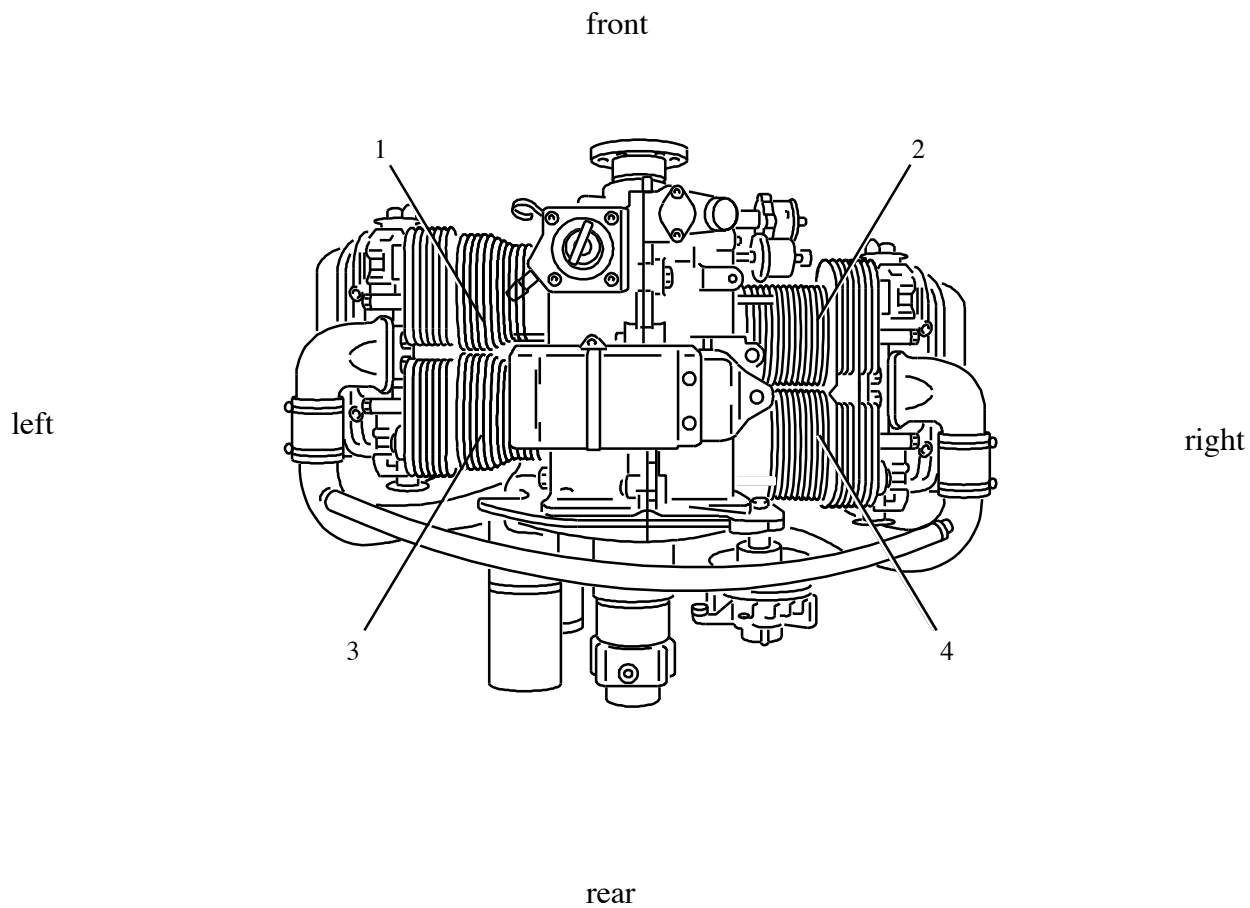
- 1 = Flange for Variable-Pitch Propeller
- 2 = Flange for Fixed-Pitch Propeller
- 3 = Flange for Fixed-Pitch Propeller (SAE 1)

6 + 7. Installation Type

Differences with regard to installation related changes

- X = Experimental Engine without Certification
- AA = Variant for powered glider GROB G 109
- AB = Variant for powered glider VALENTIN TAIFUN
- AC = Variant for powered glider HOFFMANN H 36 DIMONA

2.2 **CYLINDER DESIGNATION**



Front = Propeller Side

Rear = Accessory Mounting Side

3. TECHNICAL DATA**3.1 LIMBACH L 2000 E0****3.1.1 Dimensions**

| | |
|------------------------|-------------------------|
| Bore | : 90 mm |
| Stroke | : 78,4 mm |
| Displacement each Cyl. | : 498,5 cm ³ |
| Total Displacement | : 1994 cm ³ |
| Compression Ratio | : 8,4 : 1 |
| Crankshaft Rotation | : counterclockwise |
| Magneto Timing | : 30° BTC |
| Firing Order | : 1-3-2-4 |

3.1.2 Equipment:

| | |
|---------------------------|--|
| Magneto | : SLICK 4230, 4330 BENDIX S4RN21 |
| Spark Plugs | : BOSCH WB 4 A (WB 240 ERT 1) EYQUEM A 755 |
| Ignition Harness | : SLICK High-Temperature-Harness |
| Carburetor | : STROMBERG ZENITH 150 CD 3 |
| Fuel Pump | : APG - LIMBACH |
| Alternator | : DUCELLIER 14V-30A BOSCH 14V-33A BOSCH 14V-55A BOSCH 28V-35A |
| Starter | : FIAT 0.7 kW BOSCH 1.4 kW |
| Oil Pump | : Geared Pump |
| Oil Filter | : Oil Screen |
| Propeller Flange for E0 1 | : 201.031.310 |
| E0 2 | : 202.031.320 |
| E0 3 | : 205.031.300 |

NOTE:

Preferred propellers:

| | |
|--------------------------|--|
| Fixed-Pitch Propeller | : Hoffmann HO11* / HO11A : Mühlbauer MT |
| Variable-Pitch Propeller | : Hoffmann HO-V62 : Mühlbauer MTV-1 |

By means of the adapter 202.032.320, the propeller flange for E0 1 may be used for fixed-pitch propellers for E0 2, too.

3.1.3 Engine Ratings:

Max. Take-Off Power : 59 kW / 80 shp @ 3400 RPM
Max. Continuous Power : 51 kW / 70 shp @ 3000 RPM

3.1.4 Engine Rotational Speeds:

Max. permissible speed : 3400 RPM
Max. speed for cruise : *)
Min. continuous speed : 2300 RPM
Idle speed : 800 ± 100 RPM

3.1.5 Fuel and Oil:

Fuel : AVGAS 100 LL or
automobile fuel according to
DIN 51600 or OE C 1103 -
min. 96 octane (RON)
Engine Oil : see table on page 9.1

3.1.6 Pressures and Temperatures:

Fuel Pressure : 0.1 to 0.15 bar /
1.45 to 2.17 psi
Engine Oil Pressure max. : 4 bar / 58 psi
min. : 1 bar / 14.5 psi @ 2500 RPM
Engine Oil Temperature max. : 120 °C (**)
min. : 50 °C (indicated)
opt. : appr. 80 °C
Cylinder Head Temperature max. : 250 °C (**)
opt. : 150 to 170 °C (at cruise)

3.1.7 Oil Charge:

Engine Oil Charge max. : 2.5 l
min. : 1.5 l

*) refer to aircraft manufacturer`s flight and maintenance manuals.

***) The max. permissible temperatures constitute operating limitations to be maintained for a short period of time only. Continuous operation of the engine at these temperatures may impair engine life.

3.2 LIMBACH L 2000 EA
3.2.1 Dimensions

| | |
|------------------------|-------------------------|
| Bore | : 90 mm |
| Stroke | : 78,4 mm |
| Displacement each Cyl. | : 498,5 cm ³ |
| Total Displacement | : 1994 cm ³ |
| Compression Ratio | : 8,6 : 1 |
| Crankshaft Rotation | : counterclockwise |
| Magneto Timing | : 30° BTC |
| Firing Order | : 1-3-2-4 |

3.2.2 Equipment:

| | |
|---------------------------|--|
| Magneto | : SLICK 4230, 4330 BENDIX S4RN21 |
| Spark Plugs | : BOSCH WB 4 A (WB 240 ERT 1) EYQUEM A 755 |
| Ignition Harness | : SLICK High-Temperature-Harness |
| Carburetor | : STROMBERG ZENITH 150 CD 3 |
| Fuel Pump | : APG - LIMBACH |
| Alternator | : DUCELLIER 14V-30A |
| Starter | : BOSCH 0.4 kW BOSCH 1.4 kW SJCE 0.4 kW SJCE 0.9 kW |
| Oil Pump | : Geared Pump |
| Oil Filter | : Oil Screen |
| Propeller Flange for EA 1 | : 202.031.300 |
| EA 2 | : 202.031.320 |
| EA 3 | : 205.031.300 |

NOTE:

Preferred propellers:

| | |
|--------------------------|--|
| Fixed-Pitch Propeller | : Hoffmann HO11* / HO11A : Mühlbauer MT |
| Variable-Pitch Propeller | : Hoffmann HO-V62 : Mühlbauer MTV-1 |

By means of the adapter 202.032.320, the propeller flange for EA 1 may be used for fixed-pitch propellers for EA 2, too.

3.2.3 Engine Ratings:

Max. Take-Off Power : 59 kW / 80 shp @ 3400 RPM
Max. Continuous Power : 51 kW / 70 shp @ 3000 RPM

3.2.4 Engine Rotational Speeds:

Max. permissible speed : 3400 RPM
Max. speed for cruise : *)
Min. continuous speed : 2300 RPM
Idle speed : 800 ± 100 RPM

3.2.5 Fuel and Oil:

Fuel : AVGAS 100 LL or
automobile fuel according to
DIN 51600 or OE C 1103 -
min. 96 octane (RON)
Engine Oil : see table on page 9.1

3.2.6 Pressures and Temperatures:

Fuel Pressure : 0.1 to 0.15 bar /
1.45 to 2.17 psi
Engine Oil Pressure max. : 4 bar / 58 psi
min. : 1 bar / 14.5 psi @ 2500 RPM
Engine Oil Temperature max. : 120 °C **)
min. : 50 °C (indicated)
opt. : appr. 80 °C
Cylinder Head Temperature max. : 250 °C **)
opt. : 150 to 170 °C (at cruise)

3.2.7 Oil Charge:

Engine Oil Charge max. : 2.5 l
min. : 1.5 l

*) refer to aircraft manufacturer`s flight and maintenance manuals.

**) The max. permissible temperatures constitute operating limitations to be maintained for a short period of time only. Continuous operation of the engine at these temperatures may impair engine life.

3.3 LIMBACH L 2000 EB
3.3.1 Dimensions

| | |
|------------------------|-------------------------|
| Bore | : 90 mm |
| Stroke | : 78,4 mm |
| Displacement each Cyl. | : 498,5 cm ³ |
| Total Displacement | : 1994 cm ³ |
| Compression Ratio | : 8,4 : 1 |
| Crankshaft Rotation | : counterclockwise |
| Magneto Timing | : 30° BTC |
| Firing Order | : 1-3-2-4 |

3.3.2 Equipment:

| | |
|----------------------|--|
| Magneto | : SLICK 4230, 4330 BENDIX S4RN21 |
| Spark Plugs | : BOSCH WB 4 A (WB 240 ERT 1) EYQUEM A 755 |
| Ignition Harness | : SLICK High-Temperature-Harness |
| Carburetor | : 2 x STROMBERG ZENITH 150 CD 3 |
| Fuel Pump | : APG - LIMBACH |
| Alternator | : DUCELLIER 14V-30A BOSCH 14V-33A BOSCH 14V-55A BOSCH 28V-35A |
| Starter | : FIAT 0.7 kW BOSCH 1.4 kW |
| Oil Pump | : Geared Pump |
| Oil Filter | : Oil Screen |
| Propeller Flange for | : 201.031.310 |
| EB 1 | : 202.031.320 |
| EB 2 | : 205.031.300 |
| EB 3 | |

NOTE:

Preferred propellers:

| | |
|--------------------------|--|
| Fixed-Pitch Propeller | : Hoffmann HO11* / HO11A : Mühlbauer MT |
| Variable-Pitch Propeller | : Hoffmann HO-V62 : Mühlbauer MTV-1 |

By means of the adapter 202.032.320, the propeller flange for EB 1 may be used for fixed-pitch propellers for EB 2, too.

3.3.3 Engine Ratings:

| | |
|-----------------------|-----------------------------|
| Max. Take-Off Power | : 59 kW / 80 shp @ 3400 RPM |
| Max. Continuous Power | : 53 kW / 72 shp @ 3000 RPM |

3.3.4 Engine Rotational Speeds:

| | |
|------------------------|-----------------|
| Max. permissible speed | : 3400 RPM |
| Max. speed for cruise | : *) |
| Min. continuous speed | : 2300 RPM |
| Idle speed | : 800 ± 100 RPM |

3.3.5 Fuel and Oil:

| | |
|------------|---|
| Fuel | : AVGAS 100 LL or automobile fuel according to DIN 51600 or OE C 1103 - min. 96 octane (RON) |
| Engine Oil | : see table on page 9.1 |

3.3.6 Pressures and Temperatures:

| | |
|--------------------------------|---|
| Fuel Pressure | : 0.1 to 0.15 bar / 1.45 to 2.17 psi |
| Engine Oil Pressure max. | : 4 bar / 58 psi |
| min. | : 1 bar / 14.5 psi @ 2500 RPM |
| Engine Oil Temperature max. | : 120 °C **) |
| min. | : 50 °C (indicated) |
| opt. | : appr. 80 °C |
| Cylinder Head Temperature max. | : 250 °C **) |
| opt. | : 150 to 170 °C (at cruise) |

3.3.7 Oil Charge:

| | |
|------------------------|---------|
| Engine Oil Charge max. | : 2.5 l |
| min. | : 1.5 l |

*) refer to aircraft manufacturer`s flight and maintenance manuals.

***) The max. permissible temperatures constitute operating limitations to be maintained for a short period of time only. Continuous operation of the engine at these temperatures may impair engine life.

3.4 **LIMBACH L 2000 EC**

3.4.1 The technical data of the LIMBACH L 2000 EC model are identical to the technical data of the LIMBACH L 2000 E0 model.

3.4.2 "C" indicates the changes concerning the axial bearing for rear engine installation (pusher propellers).

3.4.3 Due to the rear installation (pusher), the propeller shaft rotation is changed to clockwise (in direction of flight).

3.5 LIMBACH L 2000 DA
3.5.1 Dimensions

| | | |
|------------------------|---|-----------------------|
| Bore | : | 90 mm |
| Stroke | : | 78,4 mm |
| Displacement each Cyl. | : | 498,5 cm ³ |
| Total Displacement | : | 1994 cm ³ |
| Compression Ratio | : | 8,5 : 1 |
| Crankshaft Rotation | : | counterclockwise |
| Magneto Timing | : | 25° BTC |
| Firing Order | : | 1-3-2-4 |

3.5.2 Equipment:

| | | |
|----------------------|------|--|
| Magneto | : | SLICK 4201, 4301 |
| Spark Plugs | : | EYQUEM A 755 L |
| Ignition Harness | : | SLICK High-Temperature-Harness |
| Carburetor | : | STROMBERG ZENITH 150 CD 3 |
| Fuel Pump | : | APG - LIMBACH |
| Alternator | : | DUCELLIER 14V-30A |
| Starter | : | BOSCH 0.4 kW SJCE 0.4 kW SJCE 0.9 kW |
| Oil Pump | : | Geared Pump |
| Oil Filter | : | Oil Screen |
| Propeller Flange for | DA 1 | : 202.031.300 |
| | DA 2 | : 202.031.320 |
| | DA 3 | : 205.031.300 |

NOTE:

Preferred propellers:

| | | |
|--------------------------|---|------------------------|
| Fixed-Pitch Propeller | : | Hoffmann HO11* / HO11A |
| | : | Mühlbauer MT |
| Variable-Pitch Propeller | : | Hoffmann HO-V62 |
| | : | Mühlbauer MTV-1 |

By means of the adapter 202.032.320, the propeller flange for DA 1 may be used for fixed-pitch propellers for DA 2, too.

3.5.3 Engine Ratings:

| | |
|-----------------------|-----------------------------|
| Max. Take-Off Power | : 55 kW / 75 shp @ 3200 RPM |
| Max. Continuous Power | : 51 kW / 70 shp @ 3000 RPM |

3.5.4 Engine Rotational Speeds:

| | |
|------------------------|-----------------|
| Max. permissible speed | : 3400 RPM |
| Max. speed for cruise | : *) |
| Min. continuous speed | : 2300 RPM |
| Idle speed | : 800 ± 100 RPM |

3.5.5 Fuel and Oil:

| | |
|------------|---|
| Fuel | : AVGAS 100 LL or automobile fuel according to DIN 51600 or OE C 1103 - min. 96 octane (RON) |
| Engine Oil | : see table on page 9.1 |

3.5.6 Pressures and Temperatures:

| | |
|--------------------------------|---|
| Fuel Pressure | : 0.1 to 0.15 bar / 1.45 to 2.17 psi |
| Engine Oil Pressure max. | : 4 bar / 58 psi |
| min. | : 1 bar / 14.5 psi @ 2500 RPM |
| Engine Oil Temperature max. | : 120 °C **) |
| min. | : 50 °C (indicated) |
| opt. | : appr. 80 °C |
| Cylinder Head Temperature max. | : 250 °C **) |
| opt. | : 150 to 170 °C (at cruise) |

3.5.7 Oil Charge:

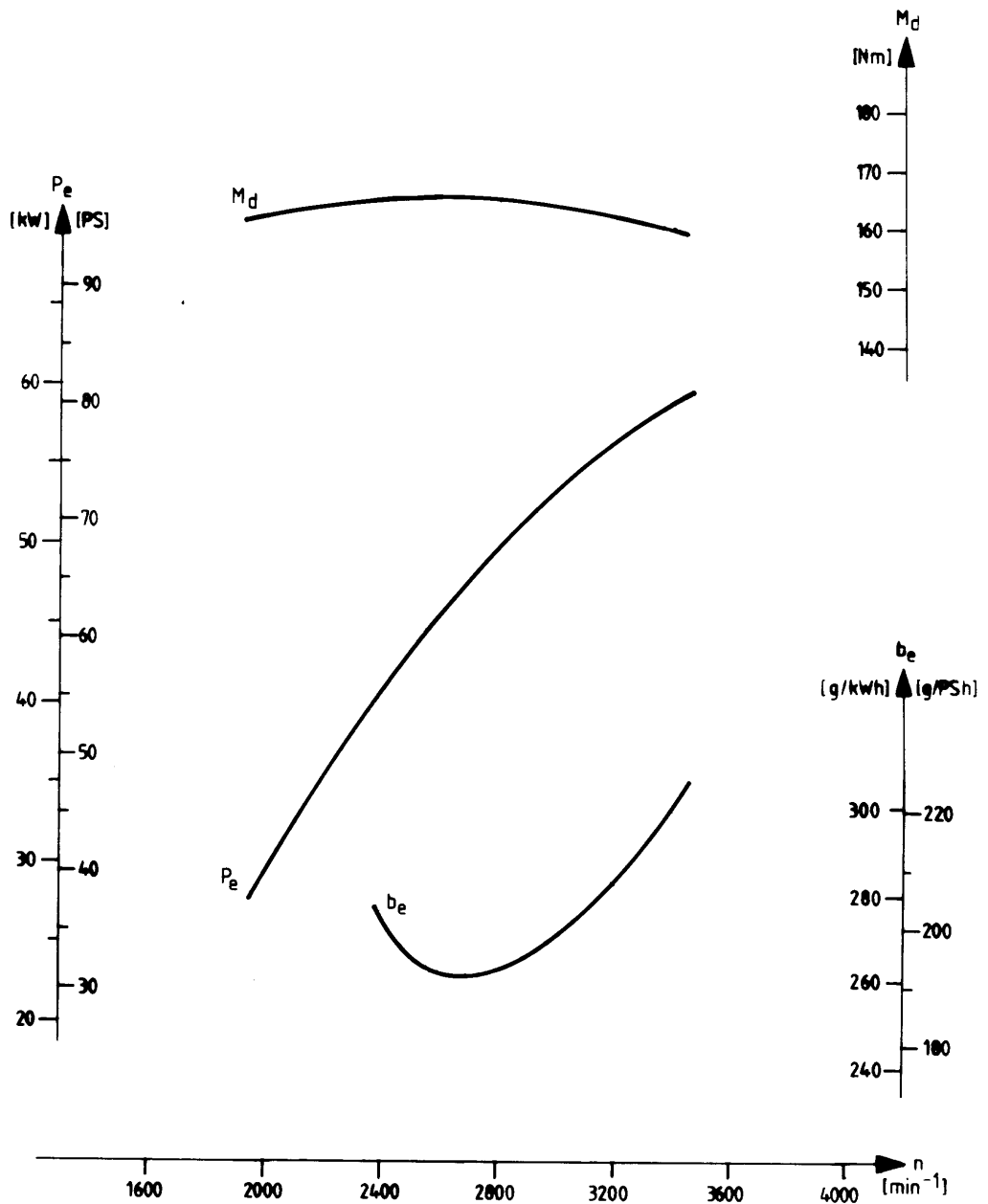
| | |
|------------------------|---------|
| Engine Oil Charge max. | : 2.5 l |
| min. | : 1.5 l |

*) refer to aircraft manufacturer`s flight and maintenance manuals.

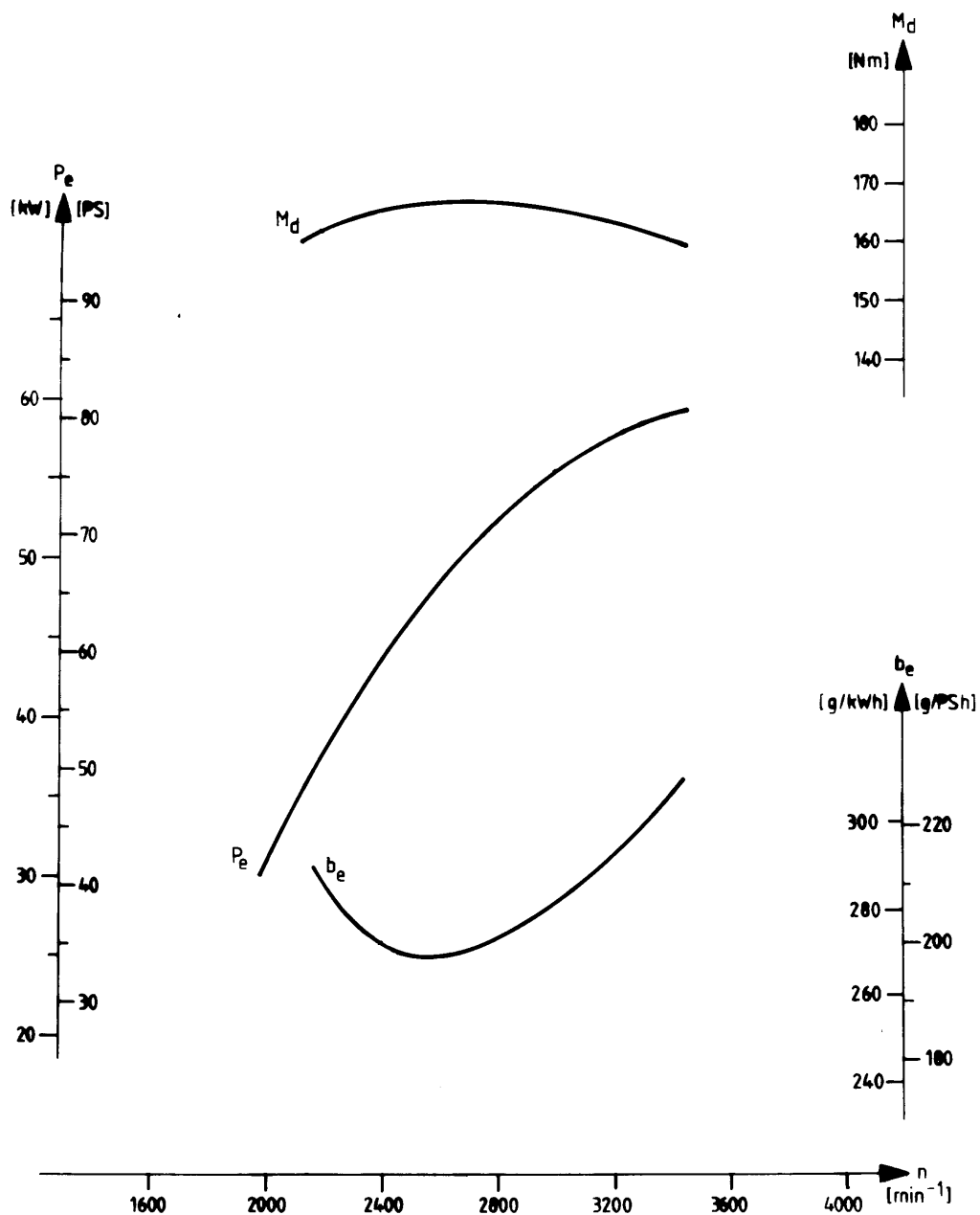
***) The max. permissible temperatures constitute operating limitations to be maintained for a short period of time only. Continuous operation of the engine at these temperatures may impair engine life.

4. **PERFORMANCE CHARTS**

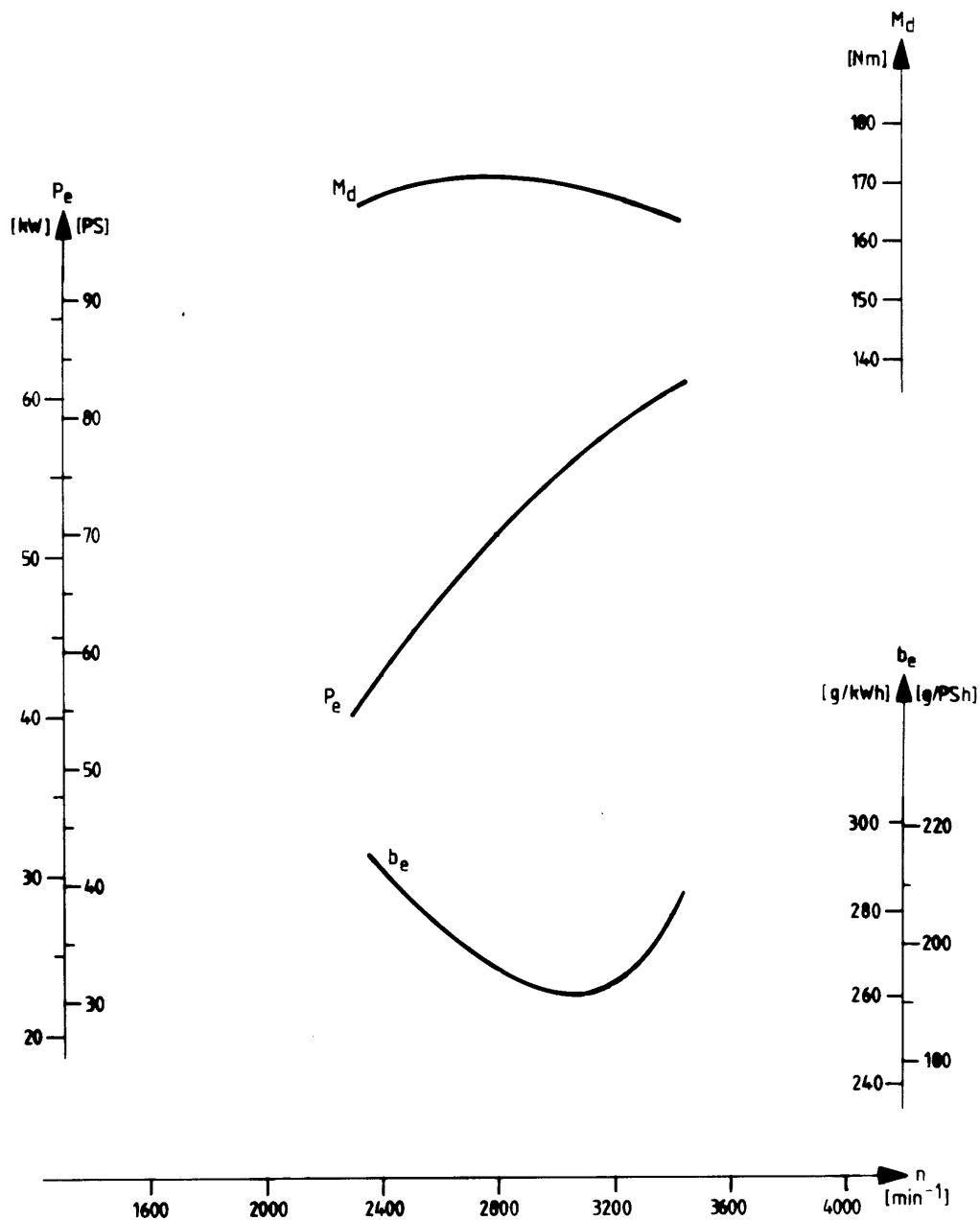
4.1 **LIMBACH L 2000 E0 and L 2000 EC**



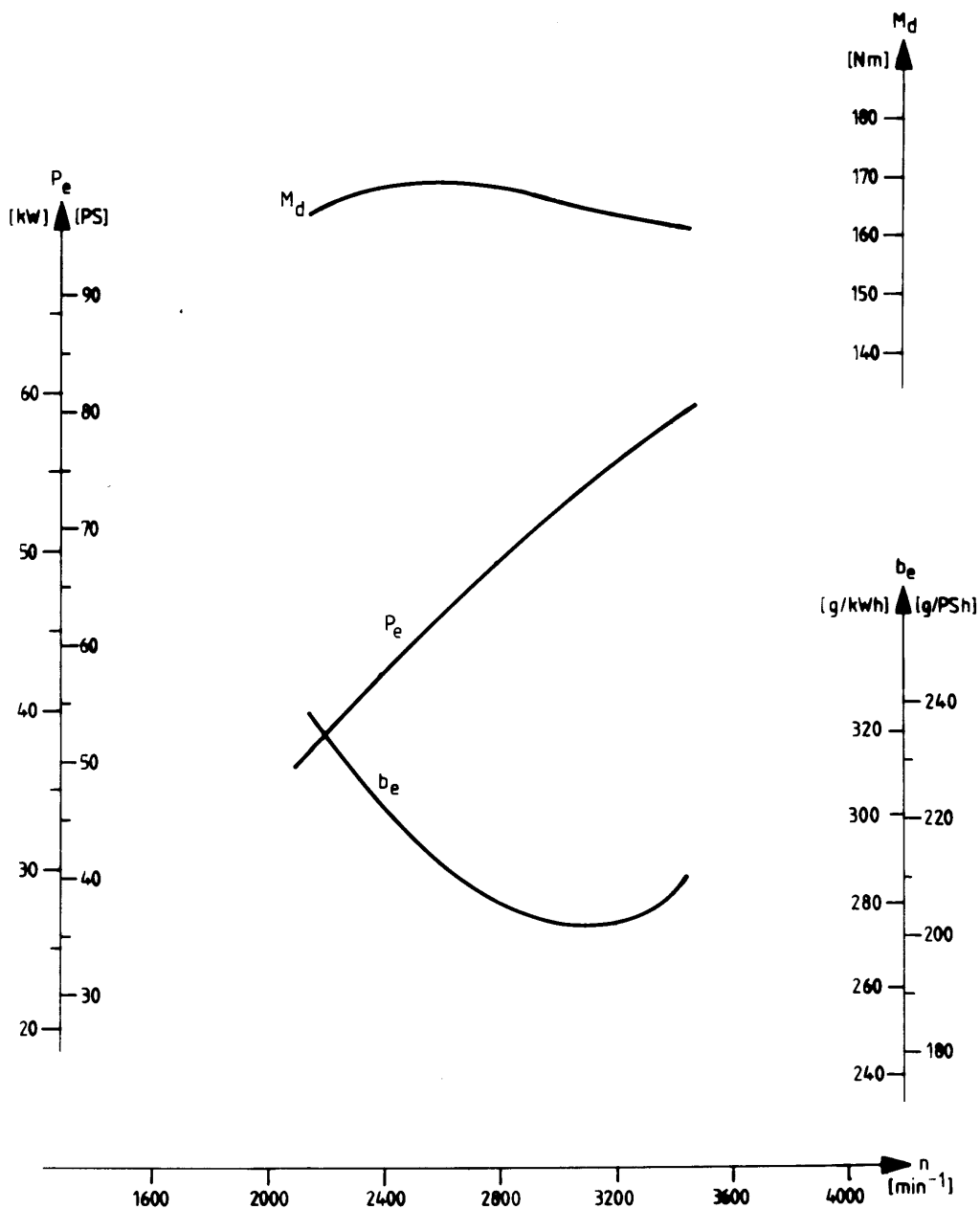
4.2 **LIMBACH L 2000 EA**



4.3 **LIMBACH L 2000 EB**



4.4 LIMBACH L 2000 DA



5. OPERATING INSTRUCTIONS

Strict adherence to the information contained in this operating manual is the basis for undisturbed operation of your engine.

5.1 BEFORE STARTING

- Perform daily check (see page 6.1)
- Move power lever to throttle full open position.
Check for interference and free movement between the idle cutoff and full open stops at the carburetor.
- Check function of choke button.
Choke must move to the full open and closed positions.
- Turn propeller manually several times with ignition switched off.
Check function of impulse coupling of magneto(s) and for abnormal sound and rough movement of the engine.

CAUTION:

When turning the engine, be aware that engine starting is possible at any time!

5.2 ENGINE START-UP

Open fuel shutoff valve.

Switch electrical fuel pump(if any).

Operate choke button.

Set throttle slightly above idle.

Turn master switch and ignition on.

Check propeller clearance.

Crank engine.

When the engine is firing, release starter button and set engine speed to appr. 1000 RPM by means of the throttle lever.

Disengage choke.

Check oil pressure (must increase within 10 sec.).

5.3 RUNUP, PERFORMANCE CHECK

Run the engine for approx. 2 min. at 1000 RPM. Then increase speed to 1500 RPM until oil temperature is 50 °C.

Due to the sluggish action of the indication, there will be sufficient effective operating temperature at 50 °C already.

Check magnetos for proper function (dual ignition only).

Set engine speed to 2000 RPM. Then switch to the right and subsequently to the left magneto only. The speed drop must not exceed 100 RPM.

Performance Check

Move throttle lever to full-throttle stop. **Engine has to reach the full-throttle static speed** published in the flight and maintenance manual of the aircraft manufacturer. Return throttle lever to idle.

Check carburetor heating for proper functioning.

Refer to the flight and maintenance manual of the aircraft manufacturer.

CAUTION:

If full-throttle ground runs are made for a longer period, overheating of the engine is possible!

5.4 HOT ENGINE START-UP

Hot engine starting is performed as described in Chapter 5.2, but **with choke closed**. After starting run the engine with increased idle speed (1500 RPM) for approx. 3 to 4 min., in order to assure that there will be no vapor lock in the fuel system.

5.5 TAKE-OFF

Increase engine speed steadily to full throttle and perform first part of climb with this setting, then reduce power.

Check oil temperature and oil pressure. The limit values must not be exceeded.

CAUTION:

With increasing ambient temperatures the engine power and the lift up of the wings will be reduced. This applies especially to situations in which the runway has been heated up by sunlight.

5.6 ENGINE SHUT-DOWN

Shut engine down by switching ignition off.

CAUTION:

After taxiing for an extended period or at high power, run the engine at approx. 1000 RPM for 2 to 3 min.

Close fuel shutoff valve.

5.7 INFLIGHT SHUT-DOWN AND RESTARTING

Set throttle to idle, let engine cool down and switch off ignition

To avoid windmilling bring propeller into feathered position. On aircraft with fixed pitch propeller activate propeller brake or reduce speed

Starting engine is the same as on the ground.

As long as the engine is still warm, do not activate cold start device.

If the engine is cold, perform warm-up.

At low ambient temperatures and after prolonged soarings:

- the engine oil may have cooled so much, that the engine cannot be started anymore
- the capacity of the starting battery may be reduced

(see chapter 7.22)

5.8 USE OF AUTOMOBILE FUEL (MOGAS)

When using automobile fuel, it might be possible that malfunctions of the fuel system will occur due to fuel vapor lock at very hot days and/or high altitudes. The use of AVGAS 100 LL is recommended as remedy. If not already installed, an electrical fuel pump should be retrofitted (contact your aircraft manufacturer for details).

6. MAINTENANCE SCHEDULE

Maintenance at Limbach aircraft engines is to be performed after fixed time periods or when reaching a certain interval of operating hours. In addition, a "daily check" has to be performed before each flight.

Exhaust muffler, fuel filter and carburetor heating system are not part of the engine manufacturer's scope of delivery. Inspections and maintenance have to be performed according to the aircraft manufacturer's specifications.

6.1 DAILY CHECK

- Remove engine cowling.
- Check bolted connections.
- Check baffle assembly.
- Check harness.
- Check condition of drive belt.
- Check cowling for cracks and correct attachment.
- Check clearance of throttle pushrods and bowden cables.
- Check engine oil level and refill as necessary.
 Volume difference between max. and min. markings: 1 l.
- Check oil and fuel system for leakage.
- Perform test run (see Chapter 7.20).

6.2 PERIODICAL CHECKS**6.2.1 EVERY 6 MONTHS FOLLOWING 100 h INSPECTION**

Check carburetor diaphragm of the Stromberg-Zenith carburetor for brittleness, strain or cracks and replace, if necessary.

6.2.2 EVERY 2 YEARS AFTER THE LAST OVERHAUL

Disassemble and check magneto(s) and replace as necessary (SLICK Magnetos only).

6.2.3 EVERY 4 YEARS AFTER NEW OR MAIN OVERHAUL

Replace oil and fuel hoses (mounted to the engine).

The oil and fuel hoses mounted to the engine are signed with a lapse date, e.g. 5.94 - i.e. to be replaced not later than May 1994.

6.3 OPERATING TIME RELATED INSPECTIONS

| | Chapter | | | | | |
|------------------------------|---------|-------|-------|-------|-------|-------|
| | 6.3.1 | 6.3.3 | 6.3.4 | 6.3.5 | 6.3.6 | 6.3.7 |
| After 5 Operation hours | x | | | | | |
| After 25 Operation hours | | | x | | | |
| Every 25 Operation hours | | x | | | | |
| Every 50 Operation hours | | | x | | | |
| Every 100 Operation hours | | | x | x | | |
| Every 250 Operation hours | | | x | | x | |
| Every 500 Operation hours | | | x | x | x | x |

6.3.1 AFTER THE FIRST 5 OPERATING HOURS

- Check valve clearance, replace cylinder head cover gasket as necessary.

6.3.2 AFTER THE FIRST 25 OPERATING HOURS

- Work as specified in Chapter 6.3.4

6.3.3 EVERY 25 OPERATING HOURS

- Grease magneto couplings.
Applicable to all engines except L 2000 EA, DA.

6.3.4 EVERY 50 OPERATING HOURS

- Check fuel and lubrication system.
- Clean engine.
- Check crankcase ventilation
- Clean induction air filter or replace, if necessary.
- Change engine oil, clean oil screen.
- Check valve clearance, replace cylinder head cover gasket as necessary.
- Check compression.
- Clean and check spark plugs.
- Check drive belt tension.
- Check and grease throttle pushrods and bowden cables.
- Check oil level of Stromberg-Zenith carburetors.
- Grease magneto couplings (except L 2000 EA, DA)
- Check harness.
- Check bolts, nuts, safety pins, and engine mounting frame for tight fit and proper condition.
- Perform engine test run.

6.3.5 EVERY 100 OPERATING HOURS

- Check carburetor diaphragm of the Stromberg-Zenith carburetor.
- Check magneto timing and adjust, if necessary.
- Clean fuel pump screen.
- Work as specified in Chapter 6.3.4

6.3.6 EVERY 250 OPERATING HOURS

- Disassemble and check magneto(s) and replace as necessary (SLICK Magnetos only).
- Work as specified in Chapter 6.3.4

6.3.7 EVERY 500 OPERATING HOURS

- Disassemble and check magneto(s) and replace as necessary (BENDIX Magnetos only).
- Replace float valve.
- Check play of throttle shaft (L 2000 EB only)
- Check valve shaft projecting length.
- Work as specified in Chapter 6.3.4
- Work as specified in Chapter 6.3.5
- Work as specified in Chapter 6.3.6

7. MAINTENANCE INSTRUCTIONS

This chapter describes the performance of maintenance work. In addition, the preservation of engines as well as winter and tropical operation is covered.

CAUTION:

Remove ignition harness from the spark plugs before starting any work on the engine.

NOTE:

Vacuum pump equipped aircraft engines must never be turned opposite to the engine rotation because the vacuum pump might be damaged.

Check with your airworthiness inspector if inspection is mandatory before starting work.

It is recommended to mark the position of parts to be removed before commencing disassembly work in order to facilitate assembly later on. This is only applicable to parts which might be installed in different positions. During assembly, pay attention to markings provided by the manufacturer (e.g. magneto timing markings).

The ignition harness is marked by the manufacturer. The coupling nuts are bearing letters and numbers. The letter "T" refers to upper, the letter "B" to lower spark plugs (dual ignition only). The figure behind the letter is representing the cylinder number.

In addition, the distributor blocks of engines with dual ignition are marked with the letter "L" = left magneto or "R" = right magneto (view from back to the engine).

7.1 OIL CHANGE

Warm up engine.

Drain oil.

Remove five cap nuts from the oil screen cover and unfasten the sixth. Lift oil screen cover from the case by means of a screwdriver and drain oil.

Clean oil screen

Wash oil screen in gasoline used for cleaning purposes and clean it off by using compressed air.

Mount oil screen.

Replace sealings, gaskets and self-locking cap nuts!

Refill engine oil.

The oil charge is 2.5 l. Check oil level by means of the oil-measuring stick. The MAX marking must not be exceeded.

See chapter 9 for oil specifications.

As the temperature ranges of adjacent SAE classes are overlapping, there is no need to change the oil for short time temperature variations.

The max. permissible oil temperatures might be exceeded due to the use of single-viscosity oil SAE 10 W or multi-viscosity oil SAE 5 W 20 or SAE 10 W 30/40. Therefore, continuous high engine speed and maintained heavy loads must be avoided. The use of these viscosity grades **requires an oil change every 10 to 15 operating hours.**

Lubricant additives - no matter what type - must not be added to the oil.

7.2 **CLEANING OF INDUCTION AIR FILTER**

Remove induction air filter.

Clean air filter.

Replace dry air filter (cloth filter).

Wash oil-wetted air filter (wire screen) in gasoline, clean it off by using compressed air and wet with oil.

Special filters are to be cleaned according to the aircraft manufacturer's instructions.

7.3 **CHECK AND GREASING OF CARBURETOR CONTROL**

Check pushrods and joints.

Ball socket seats must not be worn out.

Lubricate joints with engine oil.

7.4 **REPLACING OF FLOAT VALVE**

Remove carburetor.

Remove fuel bowl.

Remove float and needle valve.

Check float position.

Use new seals for reassembly.

7.5 CHECK / REPLACEMENT OF CARBURETOR DIAPHRAGM

Unscrew and demount piston damper.

Dismounting of carburetor diaphragm.

Remove carburetor cover.

Take out compression spring and diaphragm with piston.

Check of carburetor diaphragm.

Check carburetor diaphragm for cracks and extensions and replace, if necessary.

Replacement of carburetor diaphragm.

Remove mounting bolts from piston and demount diaphragm with clamping ring.

Attach new diaphragm to piston so that the cam at the inner edge of the diaphragm will engage to the respective slot of the piston.

Attach clamping ring and fasten with bolts.

Installation of piston with diaphragm.

Insert piston into carburetor so that the cam at the outer edge of the diaphragm will engage to the respective slot of the carburetor housing. Attach carburetor cover and fasten with bolts.

Installation of piston damper.

Check oil level in the piston guide and correct as necessary.

Tighten piston damper manually.

7.6 CARBURETOR OIL LEVEL CHECK

Unscrew piston damper.

Check oil level and correct as necessary.

Oil level should be approx. 4 mm below the top edge of the piston guide (the piston guide has two opposite notches at the top edge). For refilling, use carburetor damper oil only (P/N: 170.210.005).

Overfilling of the piston guide is not dangerous - excess oil will be fed to the combustion process of the engine.

Install piston damper.

7.7 FUEL PUMP SCREEN CLEANING

Close fuel shutoff valve.

Removal of screen.

Unscrew mounting bolt of the pump cover.

Demount cover and screen with sealing.

Cleaning of screen.

Wash the screen by means of gasoline used for cleaning purposes and clean it out by using compressed air.

Installation of screen.

Use new sealings for screen and mounting bolt. Oil mounting bolt slightly before installation.

7.8 FUEL FILTER CLEANING

Draining and cleaning of fuel filter.

Refer to flight and maintenance manual of aircraft manufacturer.

7.9 FUEL AND LUBRICATION SYSTEM LEAKAGE CHECK

Check all hoses, hose connections, fittings, related equipment and engine casing joints for leaks, proper attachment, installation and replacement periods.

7.10 CRANKCASE VENTILATION CHECK

Check visually for damages and clean breather line as necessary. Check suitability and installation of breather line - it has to be stable at engine operating temperatures (danger of buckling) and must be installed properly (no bucklings, no reduction in cross-sectional area, no suction effects at the end of the line).

7.11 COMPRESSION CHECK

Compression checks should be performed when the engine is "warm to touch".

Remove spark plugs.

Measure compression by means of a compression pressure recorder.

Perform measurement with throttle full **open**. Record compression pressure at starting RPM for every cylinder until the recorder doesn't show any more pressure rise.

Wear limit: 6 bar / 87 psi.

Permitted pressure difference: 2 bar / 29 psi

7.12 CHECK AND SETTING OF VALVE CLEARANCE

Valve clearance must be checked or set only at cold engine (ambient temperature).

CAUTION:

Remove ignition harness from the spark plugs before commencing work.

Remove valve cover.

Valve clearance check.

Turn propeller according to engine rotation until the valves of the second cylinder are overlapping. Now, the valve clearance of the first cylinder may be checked (see cylinder designation at page 2.3).

Move thickness gauge between valve shaft and setscrew. The thickness gauge must be movable slightly "sucking". It must not jam.

Valve clearance setting.

Untighten nut of setscrew and turn setscrew until thickness gauge can be moved slightly "sucking". Tighten nut and check valve clearance again, readjust, if necessary.

Order of adjustment

The order of adjustment is: 1 - 3 - 2 - 4, i.e. the propeller has to be turned by 180° after the first cylinder has been set, in order to check the valve clearance of the third cylinder. After another 180° turn according to the engine rotation, the valve clearance of the second cylinder may be checked, etc..

Valve clearance: Intake Valve 0.20 mm
 Exhaust Valve 0.20 mm

Check cylinder head cover gaskets and replace, if necessary.

7.13 CHECK OF VALVE SHAFT PROJECTING LENGTH

Remove cylinder head covers.

Dismount rocker arm shafts.

Measurement of valve shaft projecting length by means of measuring device P/N: 803.001.130.

If the projecting length is less than 24 mm for the intake and exhaust valve the cylinder heads have to be replaced by new ones.

CAUTION:

If the measurement is within limits, however the valve measured is less than 24.5 mm, the projecting length of the valve shafts has to be checked every 100 hours.

Install rocker arm shafts.

Use sealing P/N: 170.211.200 for the bearing piece joints. Torque mounting bolts M8 (Strength grade 10) to 25 Nm.

Check valve clearance and readjust, if necessary.

Mount cylinder head cover.

Check gaskets and replace as necessary.

7.14 CLEANING, CHECK AND SETTING OF SPARK PLUGS

Removal of spark plugs.

Remove ignition harness from the spark plugs. Do not unscrew spark plugs when engine is hot.

Cleaning of spark plugs.

Clean spark plugs by means of a plastic brush in a degreasing solution. Do not use a steel or brass brush for cleaning. Do not sandblast spark plugs.

Check electrode gap and adjust, if necessary.

Check electrode gap by means of a thickness gauge and adjust it by bending the ground electrode.

The electrode gap is 0.4 to 0.5 mm, at low ambient temperatures = 0.3 to 0.4 mm.

Installation of spark plugs.

Grease spark plug thread with graphite grease P/N: 170.210.010.

CAUTION:

Electrodes must always be free from graphite grease! Do not use copper paste.

Use the following spark plugs:

BOSCH WB 4A (WB 240 ERT 1)

P/N: 170.123.100

EYQUEM A 755

P/N: 170.123.101

For dual ignition engine types:

EYQUEM A 755 L

P/N: 205.123.100

It is recommended to change spark plugs every 150 operating hours.

NOTE:

The condition of the spark plugs removed from the engine discloses the following information:

Light grey:

Spark plug and engine adjustment o.k.

Velvet black:

Electrode gap too big

Mixture too rich

Lack of air (induction air filter contaminated)

Engine does not reach required temperature

Oillike glossy:

Interrupted spark plug operation

Excess oil in combustion chamber

Cylinder or piston rings worn out

Pearl formation:

Wrong spark plug

Loose spark plug

Mixture too lean ("false air")

Valves do not close properly

Induction air temperature too high (carburetor shielding defective)

7.15 DRIVE BELT CHECK, STRETCHING AND REPLACEMENT

Drive belt check.

Check for wear, cracks and oil traces.

Drive belt tension check.

It must be possible to push the drive belt through with a strong thumb load by 5 to 10 mm .

Stretching of drive belt.

Unfasten mounting bolt of clamp at the crankcase or accessory housing. Unfasten mounting nut of alternator with locking at the clamp. Stretch drive belt by moving the alternator. Tighten and lock all bolts and nuts.

Replacement of drive belt.

Front-mounted alternator:

Mark position of propeller relative to starter ring gear and remove propeller.

Unfasten mounting bolts of clamp and detach drive belt from the belt pulley of the alternator.

Demount starter gear and remove drive belt.

Place new drive belt to starter gear and mount starter gear. Ignition timing markings at starter ring gear and propeller hub must be in coincidence.

Place drive belt to alternator belt pulley and stretch drive belt. Lock mounting screws.
Install propeller.
Check propeller blade track.

CAUTION:

After propeller installation airworthiness inspection is mandatory.

Rear mounted alternator and accessory housing with drive belt opening of 15 mm of width:

Remove engine.
Demount starter.
Demount alternator.
Demount magneto.
Remove accessory housing.
Replace drive belt.
Mount accessory housing.
Install starter.
Install alternator.
Install magneto.
Stretch drive belt.
Install engine.
Check ignition timing.

Rear mounted alternator and accessory housing with drive belt opening of 40 mm of width:

Unfasten mounting bolts of clamp and detach drive belt from belt pulley of alternator.
Remove magneto and detach drive belt from crankshaft drive pulley.
Attach new drive belt to crankshaft belt pulley and install magneto.
Attach drive belt to alternator belt pulley and stretch drive belt.
Tighten all mounting bolts.
Check ignition timing.

New drive belts are stretching more during the first time of operation. **A check is required after 10 operating hours.** Set belt tension as necessary.

7.16 EXHAUST SYSTEM CHECK

Check for damages, leaks and condition.
Refer to flight and maintenance manual of aircraft manufacturer.

7.17 BOWDEN CABLE CHECK

Check for condition, ease of motion and proper attachment.
Refer to flight and maintenance manual of aircraft manufacturer.

7.18 HARNESS CHECK

Check proper installation, attachment and tight fit of connections and terminals. Vibration of harness during operation must be avoided.

7.19 CHECK OF BOLTED CONNECTIONS

Check all accessible bolts and nuts for tight fit and check existing locks visually.

7.20 ENGINE TEST RUN

Check of starting performance.

At normal conditions (temperature, maintenance condition) the engine starts easily. If this is not the case check fuel supply and ignition system.

CAUTION:

Do not operate the starter a prolonged period of time (Risk of overheating).

Warming up

Run the engine for approx. 2 min. at 1000 RPM. Then increase speed to 1500 RPM until the oil temperature is 50 °C.

Temperatures and pressures

Refer to "Technical Data".

Check of throttle response.

Move power lever steadily to full throttle. Engine must show immediate response, engine speed must increase steadily.

Engine performance check.

Move throttle lever to full-throttle stop. Engine has to reach the full-throttle static speed (refer to flight and maintenance manual of aircraft manufacturer). Set variable-pitch propellers to Take-off pitch.

7.21 ENGINE PRESERVATION

Engines, which will be out of operation for more than 4 weeks, require preservation. The use of special preservation oils is not necessary if ground time is less than 3 months because HD-oils, which comply with the oil specification shown in chapter 9, have sufficient corrosion protection properties. Use special preservation oil for ground times of more than 3 months.

CAUTION:

After corrosion protection, the engine must not run any more as this would disable corrosion protection.

NOTE:

For engines, running every two weeks for at least 20 minutes under load and reaching operating temperatures, no corrosion protection is necessary.

At high humidity, it is recommended to close the exhaust muffler exit.

Performance

Installed engine:

Warm up engine and drain engine oil after engine shut-down. Clean oil screen.

Clean engine thoroughly.

In any case, corrosion protection has to be performed by using fresh engine oil.

Charge 2.5 l of engine oil and run engine for approx. half a minute with increased idle speed.

Remove air filter and spray 25 to 30 cm³ of engine oil slowly into the carburetor(s) of the running engine.

Stop engine during spraying.

Wet all carburetor hinges with engine oil.

Close all openings to avoid entry of dirt or moisture.

Spray engine surface with engine oil. Take care of not exposing rubber parts to engine oil.

Removed engine:

Remove spark plugs and spray engine oil into the combustion chambers so that the upper part of the cylinder barrel is wetted, too. Crank engine manually or with starter for a few turns. Spray spark plugs with engine oil and install them again.

Wet all carburetor hinges with engine oil.

Close all openings to avoid entry of dirt or moisture

Spray engine surface with engine oil. Take care of not exposing rubber parts to engine oil.

7.22 OPERATION AT LOW AMBIENT TEMPERATURES

In general, engine maintenance should be performed before the beginning of the cold season. Furthermore, the following hints for operation at extremely low ambient temperatures should be observed:

Fuel system

At temperatures between - 5 °C and + 20 °C, especially at high humidity conditions, carburetor icing is possible. Under such weather conditions, monitor engine speed continuously and switch on carburetor heating as necessary.

If there is no carburetor heating device, ice accretion can be avoided in most cases by mixing anti-ice-additives (e.g. 2% isopropyl alcohol) to the fuel. If the engine is still tending to carburetor icing, the retrofit of a carburetor heating system is highly recommended (contact your aircraft manufacturer for details).

Electrical system

At low ambient temperatures, the capacity of the starting battery is reduced. This may lead to starting problems.

Check all wiring connections in the ignition system and clean as necessary, oxidized terminals cause voltage drops and thus starting problems.

The electrode gap of the spark plugs may be decreased to 0.3 to 0.4 mm (normally 0.4 to 0.5 mm) at low ambient temperatures, in order to facilitate engine starting.

Crankcase ventilation

At low ambient temperatures and high humidity, saponification of vent dome and breather line is possible. Make sure by means of special inspections that this cannot happen - a total lock might cause the engine oil to leak through the sealings due to overpressure. This would lead to high oil losses and possibly to the destruction of the engine.

Engine oil

For prolonged soaring (with stopped engine) please note that the viscosity of the engine oil increases extremely with the cooling down of the engine. In extreme cases the viscosity may have increased so much, that the starter cannot turn the engine anymore. When planning your flight, consider prolonged soaring and fill engine with appropriate oil. Eventually you should start the engine inbetween to warm up the engine oil again.

7.23 OPERATION IN TROPICAL CONDITIONS

The following measures are necessary to protect the engine against heat and dust:

Air induction filter

If the engine is operated in areas of high dust accumulation install larger air filter (contact your aircraft manufacturer for details).

Oil-measuring stick

Seal oil-measuring stick by inserting a felt washer below the oil stick cap. To achieve a tight fit of the oil stick in its guiding tube, bend stick as necessary.

Dust protection of engines out of operation

Close exhaust pipe, crankcase ventilation, and induction air filter with a dustproof sealing.

Corrosion protection of engines out of operation

The different actions are described on page 7.10

Maintenance hints:

Air filter: Check daily and clean or replace as necessary.

Drive belt: Check drive belt tension daily. If wear is evident, replace drive belt.

Fuel pump: Check fuel pump screen every week and clean, if necessary.

7.24 MISCELLANEOUS

For further advice on maintenance and repair, refer to our maintenance instructions and technical bulletins.

8. **OVERHAUL**

8.1 **MAJOR OVERHAUL**

Major overhaul must be performed by the manufacturer or overhaul shops, authorized by the manufacturer. Therefore, the engine has to be forwarded to the manufacturer or an authorized overhaul shop, after the operating time limit has been reached.

The permissible operating time (TBO) is determined by the latest issue of Technical Bulletin No. 9.

8.2 **MAJOR REPAIR**

Major repair and major modifications must be performed only by the manufacturer or licensed fixed base operators, authorized by the manufacturer.

After ground or obstacle contact of the propeller, the engine has to be disassembled in any case and the crankshaft has to be checked outside the engine. Eccentricity measurement of crankshaft or propeller flange at installed conditions is inaccurate and not acceptable.

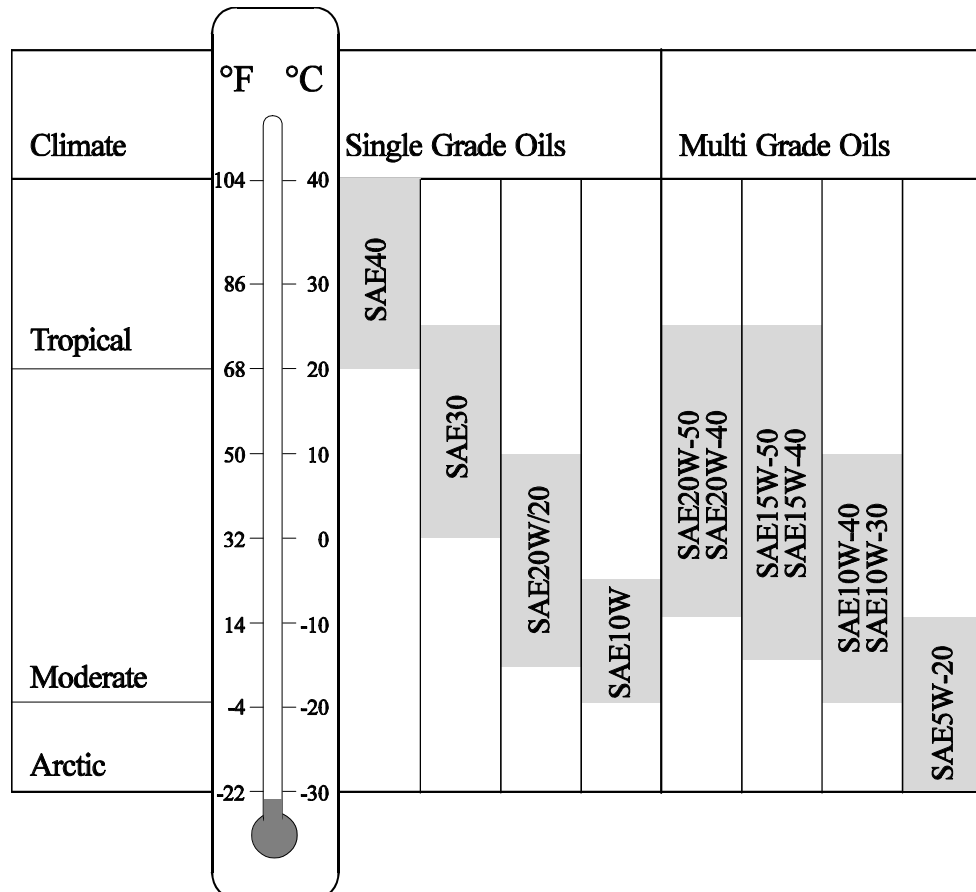
If ground or obstacle contact of the propeller has not been mentioned when ordering repair or major overhaul of an aero-engine, the liability of the owner for sequential damages will continue even after repair or major overhaul has been performed.

A change of the propeller hub has to be considered a major repair in any case.

9. **LIST OF LUBRICANTS**

Do not use ashless dispersant or straight mineral aircraft engine oils!

Use only brand-name oils based on mineral oil or partially synthetic oil (no fully synthetic oils). The oils must comply at least with API-SG or API-SH specifications as well as with Volkswagen-Standards VW 501 01 or VW 500 00.



CAUTION:
 When using engine oil of viscosity SAE 10 W, SAE 5 W 20 or SAE 10 W 30/40, continuous high engine speed and maintained heavy loads must be avoided. The use of such viscosity grades requires an oil change every 10 to 15 operating hours. Furthermore, coking of the oil at the valves is possible.

10. RECOMMENDED NUT TORQUES

| | | | |
|--|-------|-----|----|
| Oil screen cover to housing | | 7 | Nm |
| Oil drainage screw to oil screen cover | | 35 | Nm |
| Air filter to carburetor | M8 - | 20 | Nm |
| Carburetor to induction pipe | | 20 | Nm |
| Carburetor cover to carburetor | | 2 | Nm |
| Fuel bowl to carburetor | | 2 | Nm |
| Float valve to carburetor | | 12 | Nm |
| Diaphragm to regulator piston | | 1 | Nm |
| Crankcase ventilation to case | | 20 | Nm |
| Spark plug to cylinder head | | 25 | Nm |
| Ignition harness to spark plug | | 10 | Nm |
| Nut of valve clearance setscrew | | 15 | Nm |
| Cover to fuel pump | | 2 | Nm |
| Clamp to alternator | M6 - | 8 | Nm |
| | M8 - | 20 | Nm |
| Clamp to case | | 20 | Nm |
| Alternator to case | | 45 | Nm |
| Magneto to housing | | 20 | Nm |
| Exhaust flange to cylinder head | | 20 | Nm |
| Engine support to case | M10 - | 45 | Nm |
| Grounding wire to magneto (SLICK) | | 1.5 | Nm |

11. TROUBLE SHOOTING

"Small", apparently neglectable causes are often responsible for a "big" effect, i.e. disturbance of engine operation. Detection of the causes is not always easy. The hints to possible trouble causes and their correction contained in this section serve as a guideline for the engine user, listing the most frequent faults. This list of causes, however, does not claim for completeness. Repair work must be done only by persons authorized to perform the specific task.

11.1 ENGINE STARTING TROUBLE

| Possible Cause: | Remedy: |
|--|--|
| Battery discharged or defective. | Charge or replace battery. |
| Battery wiring not connected to starter motor or defective, possibly insufficient contact. | Clean connectors. Connect or replace ground wire. |
| Starter motor defective. | Repair or replace starter motor. |
| Starter relay defective. | Replace starter relay. |
| Insufficient compression (no valve clearance, leaky valves, engine overheated). | Adjust valve clearance, repair cylinder head, tighten cylinder heads according to specification. Investigate and remove cause of overheat. |
| Engine defective (blocked or worn out). | Overhaul engine. |
| Ignition switched off. | Switch ignition. |
| Magneto defective. | Repair magneto. |
| Short circuit at capacitor connector, wiring or ignition switch. | Clear short circuit. |
| Magneto impulse coupling does not work. | Repair or replace impulse coupling, note assembly clearance. |
| Ignition harness disengaged, mixed up or damaged. | Fasten or replace ignition harness, Ignition sequence 1-3-2-4. Note marking of sleeve nuts. |

Possible Cause:

Spark plugs wet due to excess fuel.

Electrode gap of spark plug too wide.

Fuel tank empty (faulty indication of fuel gauge).

Fuel valve closed or filter locked.

Fuel line defective or not connected.

Fuel pump defective.

Induction system leakage.

Carburetor contaminated or locked.

Choke not operated to its stop (cold engine).

Remedy:

Remove spark plugs, clean and dry. Determine and eliminate cause of excess fuel.

Correct electrode gap to 0.4 to 0.5 mm or replace spark plugs.

Refuel, replace fuel gauge.

Open fuel valve, clean or replace filter.

Replace or connect fuel line.

Repair or replace fuel pump.

Check induction system for leakage and replace, if necessary, tighten joints.

Clean carburetor.

Operate choke and check as necessary.

11.2 ENGINE OPERATING TROUBLE

The following phenomena are considered to be engine operating trouble:

- uneven and irregular engine run
- temporary interruptions
- low power
- engine overheat
- rough engine run

FUEL SUPPLY
Possible Cause:
Remedy:

Insufficient fuel flow (Fuel ventilation locked, lines blocked or defective, filter or screens blocked).

Check tank ventilation, lines, filter and screens and replace as necessary.

Insufficient fuel pump pressure.

Check fuel pump pressure and correct, if necessary.

Fuel pump defective.

Repair or replace fuel pump.

Float valve contaminated, jammed or worn.

Clean or replace float valve.

Wrong carburetor float level.

Adjust float level.

Carburetor float defective.

Replace float.

Carburetor diaphragm defective.

Replace diaphragm.

Lack of damping oil in carburetor.

Refill damping oil.

Wrong idling speed.

Adjust idling speed.

Throttle does not open fully.

Repair throttle control.

Carburetors not synchronous (2-carburetor system).

Adjust carburetor setting.

Wrong installation of carburetor gasket (at air filter).

Replace gasket, consider notches.

Choke engaged at warm engine.

Disengage choke.

Choke defective (worn out).

Repair or replace choke.

Wrong mixture setting.

Check setting and operation of carburetor and correct as necessary.

Possible Cause:

Carburetor icing.

Induction air filter badly contaminated or blocked.

Induction system leakage.

Wrong fuel.

Remedy:

Operate carburetor heating system.

Clean or replace air filter.

Seal or replace induction system.

Refill fuel tank with specified fuel.

IGNITION
Possible Cause:

Magneto defective.

Wrong magneto timing.

Ignition switch defective.

Ignition harness loose or defective.

Spark plug defective.

Wrong spark plugs.

Remedy:

Repair or replace magneto.

Check and set magneto timing as necessary.

Check grounding wire and switch and replace as necessary.

Fasten or replace harness.

Replace spark plug.

Use specified spark plugs.

COOLING
Possible Cause:

Insufficient or damaged baffling.

Carburetor shielding defective or missing (2 carburetors).

Cooling air inlet disturbance (missing spinner, cross section too small).

Fresh air and heating system ducts defective.

Cooling air outlet disturbance (Cross section too small or cowlfap does not open sufficiently).

Remedy:

Repair or complete baffling. Seal leakages.

Replace carburetor shielding.

Install spinner, increase air inlets in cowling.

Replace ducts.

Increase air outlet in cowling

LUBRICATION

| Possible Cause: | Remedy: |
|---|---|
| Bad engine oil quality. | Change oil. Use specified oil. |
| Oil screen blocked. | Remove and clean oil screen, check condition and replace, if necessary. |
| Oil temperature sensor or indicator defective. | Check temperature sensor and indicator and replace as necessary |
| Lack of oil in the oil sump. | Check oil level and refill oil as necessary. |
| Oil pump defective. | Repair or replace oil pump. |
| Oil pressure regulating piston or spring defective. | Replace regulating piston or spring |
| Oil loss due to blocked crankcase ventilation. | Clean ventilation, replace and properly install breather line (no bucklings or contractions). |

MECHANICAL SYSTEM

| Possible Cause: | Remedy: |
|---|---|
| No valve clearance. | Set valve clearance. |
| Leaking or sticking valve. | Repair cylinder head. |
| Strong accumulation of deposit in the combustion chamber. | Demount cylinder heads, remove deposits. |
| Propeller unbalance. | Balance propeller. Check propeller blade track. |
| Engine suspension defective. | Replace engine suspension. |
| Excessive gas leakage at the piston. | Repair engine |
| Bearing defective. | Repair engine. |
| Engine defective. | Repair engine. |