Maintenance-Instruction Manual Sauer-Engine S 2400 UL

Attention
Please notice this manual is very essential for safety and security run of this engine.

Approval of translation has been done by best knowledge.
In any case the original text in german language is mandatory!

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Operating Manual S 2200 UL

1. List of content

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Operating Manual S 2200 UL

1. General

1.1 Status of correction:

Nr.	Page	Reference	Date	Signature

1.2 Register of valid pages

Page	Edition
1	01.03.2003
2	01.03.2003
3	01.03.2003
4	01.03.2003
5	01.03.2003
6	01.03.2003
7	01.03.2003
8	01.03.2003
9	01.03.2003
10	01.03.2003
11	01.03.2003
12	01.03.2003
13	01.03.2003
14	01.03.2003
15	01.03.2003
16	01.03.2003
17	01.03.2003
18	01.03.2003
19	01.03.2003
20	01.03.2003
21	01.03.2003
22	01.03.2003
23	01.03.2003
24	01.03.2003
25	01.03.2003
26	01.03.2003
27	01.03.2003
28	01.03.2003
29	01.03.2003
30	01.03.2003
31	01.03.2003
32	01.03.2003

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Operating Manual S 2200 UL

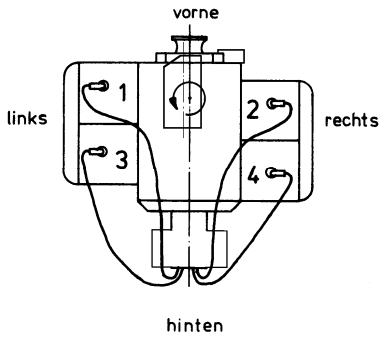
2. Structural description of engine

- aircooled four stoke „otto”-engine
- -- sequence of cylinder: horizontal, two cylinder each, oposite
- oil pressure lubrication by gearpump
- ignition by magnet or magnet + electronic
- ignition equipment: System Sauer
- Propeller actuation direct
- electr. starter
- A.C. voltage generator
- mechanical fuel pump
- one carburettor

2.1 Typedesing

S 2400 UL

2.2 Sequence of cylinder



3. Technical specification

3.1 Measurements and weight

Bore:	94 mm
Stroke:	84 mm
Pisten capacity:	583 cm^3
Displacement, in CC:	2332 cm^3
Commpression Ratio:	8,2 : 1
Direction of crankshhaft	anti-clockwise

Weight: engine case magnesium 70 kg
engine case aluminium 77 kg
dry, without airguide sheets exhaust system, but with electric starter, generator and ignition device..

3.2 Equipment - assecories

Ignition device:	Slick 4330 or with Sauer electr.
Firingtime:	25°v. O.T. / 20°electr. 2 ignition
Sequence of firing:	1-3-2-4
Sparkplugs:	BERU 14-6 DU, Bosch W6DC, NGK D6EA, BCP6E
Clearance electrodes:	0,5 mm
Thread of sparkplugs:	M14 x 1,25 x 19, M12 x 1,25 x 19
Ignition accesssories	System Sauer
Caburretor:	Bing 64/32, 94/40
mech. fuel pump:	BCD, Kyosan
Generator	Kubota,
Starter	Valeo
Oilcooler	different
Oilfilter	MANN W77
Gear for Starter	109/st

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Operating Manual S 2200 UL

3.3 Power

Power	100/74 PS/kW bei 3500 min^{-1}
Startcapacity (5min)	90/66 PS/kW bei 3000 min^{-1}
Permanent capacity	80/59 PS/kW bei 2700 min^{-1}

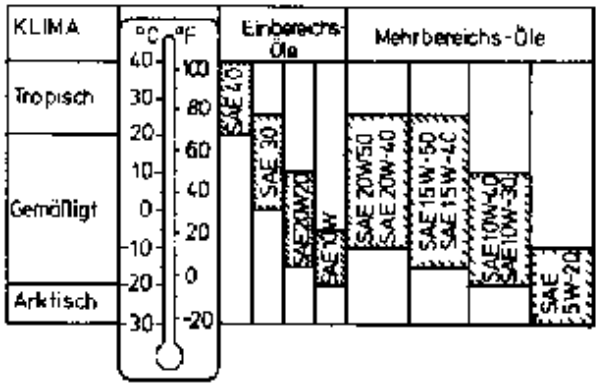
3.4 Revolution

maximal speed	3500 min^{-1}
Startrevolution max	3000 min^{-1}
Permanent speed	2700 min^{-1}
No-load operation speed	700 min^{-1}

3.5 Information of fuel and lubricants

Fuel:
Brand fuel "DIN EN 228 unleaded Super Plus **98 Oktan**" or "AVGAS 100 LL".

Luboil: Any engine oil 15W40 or 10W-40 under the classification of (API-Klassifikation (API SL/CI) or higher. Don't use any syntetic lub oil
The viscosity of the engine lub oil follows the existing airtemperature and accordingly there are different SAE classes.



Luboilvolume of engine:	max. 3,00 l
	min. 2,50 l
incl. oilfilter ca.	0,25 l
Oilstick shows min. and max level.Qantity between min. And max. is	0,5 liter
Oilpressure:	max. 4,5 bar
by 2000 min^{-1}	min. 2,0 bar
by no-load speed	1,0 bar
Oiltemperatur:	min. 50°C
	max. 120℃
Favourable temperatur	70 - 90°C

3.6 Cylinder head-temperatur:

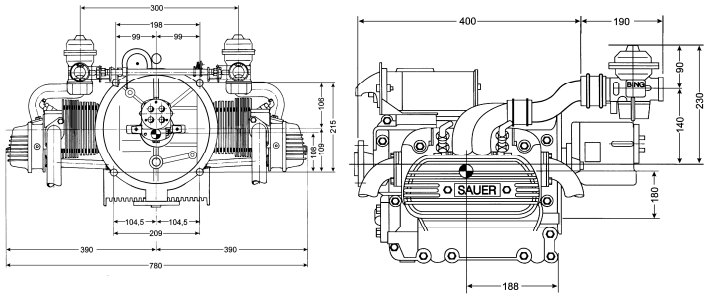
Not to exceed degree C 200° C
Cylinder Nr.4

3.7 Instruction and advice for mounting the engine into the hull of the plane and center of gravity.

For this conection use only DIN-bolts 10mm, quality class 8.8 or 10.9. All bolts are to be secured with safety wire against unforseen turning. We are providing the complete set for this engine-suspension.

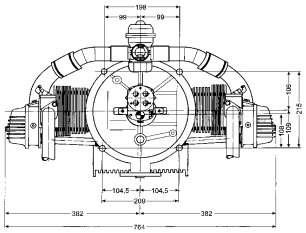
Backview **Sideview**

S 2400 UL 2 carburetor

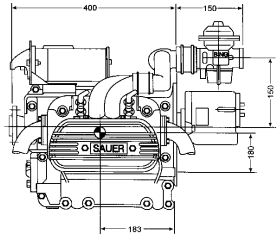


S 2400 UL single carburetor

Back wiev



Side wiev



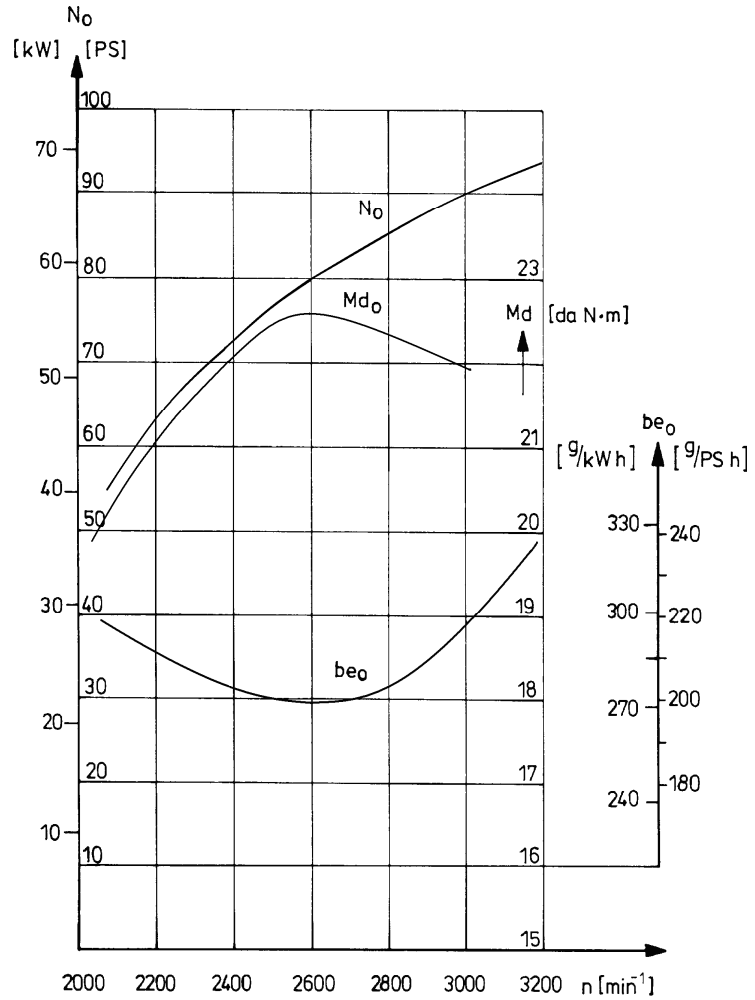
Due to unfavorable installation and running conditions there might be engine failure occure.
as - fuel injection
- cooling
- caburator icing

In this case we suggest:
- electr. Fuelpump
- Oilcooler

Carburettor pre-heating-system
Can be provided by your plane manufacturer

4. Powerdiagramm

Characteristic of engine S 2400 UL



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Operating Manual S 2200 UL

5. Operating instruction

The described maintenance and running instructions are basic necessity and strictly to be followed to guarantie a long and successful run of the engine!

5.1 Before start up:

- Ignition “off”
- dayly checkup performed ? (page 13)
- Gaslever area and clearance to by checked
- turn engine by hand, easy going ?
- check funktion of clutch of the ignition magnet.
- Listen for strange and abnormal noise

5.2 Start up

– Brake	closed
– Fuelvalve	open
– Gaslever	locked **!!!**
– Masterswitch	ON
– Choke	pull (ON)
– Ignition	ON
– Starter	switch ON
- Start engine with 1000 rpm	
– Oilpressure	after 5 sek. pressure to by indicatet on the gauge.

5.3 Warm up and break check:

- Engine to be run for appr. 2 min. with 1000 to 1500 rpm.
- Wait until oiltemperatur reachs 50 degree C.
- Check rpm by “full power” (see also flyhandbook of you aircraft)

Attention! Don`t overheat the engine during testrun on the ground

5.4 Take-off and climbing flight:

- Electric fuel pump ON
- Carburetor heat OFF
- Push gaslever quick until
- Start now. During the first part of your climbing flight you keep this position, than you reduce power.

Rpm, oilpressure, oiltemperatur, boostpressure and cylinderhead temperature should not exeed their limiting value !

5.5 Cruising

- Electric fuel pump OFF
- Rpm max. 2700 min^{-1}
- Oilpressure within green zone
- Oiltemperature within green zone
- Cylinderheadtemp. Within green zone

5.6 Descent

- Electric fuel pump ON
- Carburetor heat ON
- Gaslever no-load operation

5.7 Shut off engine

- Engine to be cool down. After running with nigh power, let the engine run approx. 2 minutes by 1000 rpm.
- Elekrtical fuel pump OFF
- gaslever in no-load operation
- Ignition OFF

5.8 Starting in the air follow the same procedure as on the ground.

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Operating Manual S 2200 UL

Remarks:

Please notice if you are using unleaded super gasoline, it might be happen that during very hot outside temperature or night in fluenees steam bubbles within the fuel system can be built up.
During those circumstances we strongly request you to use only AVGAS 100LL

5.9 Start up under could conditions:

- Choke to pull (ON)
- Gaslever **closed and in no-load position!!!**
- Sart up see 5.2 and 7.1

adjust gaslever and choke according to a smooth run of the engine.

6. Maintenance instruction

6.1 Daily checkup

- Remove engine cowling
- Check engine on missing parts and scratches.
- Check ignition cable.
- Check all connections and tubes for gas, chock, and carburetor.
- Check engine oil by pushing the oilstick until resistance, pull out and check oilleved. If necessary, you add oil. The oillevel in the middle of max. and min.
- Check oil and fuelsystem. Make sure there is no leak.
- Replace cowling.
- Engine testrun.
- Check temperature and pressure of all systems. Watch speed up carefully. For a short period you run the engine full speed. Check cooling system.

6.2 Periodical control

After the first 25 running hours the engine is to by checked as under 6.2.1 deseribed. Maintenance control is to by done every 50 hours. In addition every 100 hours the engine is to by checked as under 6.2.3. Every 250 hours as under 6.2.4

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Operating Manual S 2200 UL

6.2.1 Checkup after 25 hours

- Change engine oil and oilfilter, clean oilstrainer and renew gaskets.
- Check and clean sparkplugs.
- Check exhaust.
- Check all wirering of starter and magnet.
- Check all fastener and clamps of starter and magnet.
- Check valve play. The valve clearance is to by adjusted.
- Check engine suspension and all bolts and nuts.
- All existing ball and socked joints are to be greased.
- Fuelsystem is to be checked. Clean all filter and check all joints
- Check all electr. Wirering.
- Testrun of engine acc. To 6.1.

6.2.2 Checkup after 50 hours

- Ignitiontiming to be controlled, event.
- Check lub.-system
- Change oil and Filter
- Check and clean sparkplugs
- Check valve play. The valve clearance is to by adjusted.
- Check all joints, clean engine.
- Check fuel system, clean all filter and check all joints, hoses and tubes.
- Check exhaust (muffler, tubes, clamps)
- Check airguiding sheets
- Chack crankcase on cracks or leakage
- Check crankase ventilation
- Check all electr. Wirering and cable
- Engine test run acc. To 6.1.

6.2.3 Checkup after 100 hours

- Same as under 6.2.2.
- Check diaphragm of caboret.
- Change airfilter.
- Clean fuelfilter
- Clean luboilstrainer, replace all gaskets
- Check start gear
- Check compression by compression monotoring device

6.2.4 Checkup after 250 hours

- Same as under 6.2.3.
- check ignition magnet (Slick) according to manufacturer standard
- Check carburettor float spindle

Repair can only be done by authorized workshops and inspectors who are licensed by LBA.

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Operating Manual S 2200 UL

6.3 Preserve engine against corrosion:

If the engine is not running for more than 30 days, preservation against corrosion is to be done.

1. Warmup engine and drain engine-oil.
2. Use 2,5 Liter spezial anticorrosion-oil and run engine for thirty seconds under no-load operation.
3. Remove airfilter, run engine and pour 25 to 30 ccm anti-corrosion-oil into the caburator. Stop engine.
4. Remove all sparkplugs and spray anti-corrosion-oil into the combustion chamber.
5. Turn engine by hand serveral times.
6. Preserve sparkplugs with anti-corrosion-oil and replace.
7. All Carburettor joints are to be preserved
8. All openings as exhaust, crankcase ventilation and airfilter are to be closed.
9. Preserve the engine from outside by using spray gun with anti-corrosion-oil. Be aware that rubberparts, hoses and all non-metallic parts are not in touch with the anti-corrosion-oil. Don`t run the engine after preservation. Otherwise you have to repeat the whole procedure.

6.4 Operation during wintertime

In any case maintenance should be done before the beginning of the cold season.
For extrem low temperatures you act as follows:

You cover the oilcooler it the ground temperature is below 10 degree C. Otherwise you will not reach the oiltemp. of 80 degree C.

Maintenance electr. system:

- Avoid corrosion on all elektr. connections otherwise you will have start-problems and line drop in the system

- During winter you check the battery every 6 to 8 wecks.
  Check acid level and density.
  Charge the battery and messure each cell under load.
- Clean and preserve cable connections.
  Use grease without acid, like Vaseline.

6.5 Operation in tropical areas:

To protect the engine against heat and dust we suggest as follows:

- Use the right airfilter and cleaning.
- Shorten the time of oilchange and renewing oilfilter.
- Close all openings if you don`t operate the engine, to prevent entering dust or sand.

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Operating Manual S 2200 UL

- If you are in an area with high humidity you have to preserve the engine as under 6.3 clean airfilter every day.

- Clean airfilter every day !

7. Maintenance

7.1 Luboilchange

- warmup engine
- drain oil, renew oilfilter, put same oil on the rubber- seal – ring of the new filter
- remove strainer from sump and clean
- replace the drain- screw and use new copper-ring
- refill crankcase with new luboil
- 3,0 Liter pf you change oilfilter
  2,75 Liter pf you don`t change oilfilter
- check oil level
- check all over to make sure there is no leak.
- Don`t use any additive into your luboilsystem!

7.2 Mounting magnet and reset fiering time

Attention! Ingnitionkey “off”!
Remove all connecting cable from sparkplug
To avoid electr. sparking conect
Contactspring with mass point.

Remove sparkplug from cyl. 1. Put your tumbe on the opening of the sparkplug and turn the crankshaft until you feel the strong pressure of compression. In this position both valves of cyl. 1 are closed. Now you turn the crankshaft the opposite. Checking the marker top dead-center on the starter wheel. Direction 25 degree before dead centre o point. The ignitionmark on the starter wheel. Overlap with the mark on the enginebody. Now ignitionmagnet is to be installed and Inserted into the clutch. Clamps are to be fixed. Slick timing light, mod. 2300 withR-or L cable is to be conected to the shortcut conection of the magnet.
Conect the brown cable with masspoint.
Turn magnet by händ in motordirection until the controllamp goes off. Turn magnet back until the controllamp goes off. In this position you fix the magnet (20 Nm).
Adjustment to be controlled os follows:

- Propeller to be turned until magnet react
- Turn propeller bachward until lamop goes off
- Turn again in the opposite direction until lamps goes on.
- Check it the two marks are in line

7.3 **Adjustment of carburettor**

Gaslever on non-load position.
Fix synchron-tester connection with both carburettorinlet.
Start engine. Adjust the tester with the synchronising screw in the middle of the throttle until both factors are equal. Now you adjust the no-load operation with the trottle screw on both caburettor on 700 rpm.
Emission control to be adjusted by no-load operation screw and CO2-tester within the range of 1,5-2,5 %.
At 2200-2400 rpm 5-6% CO, max. EGT 650℃
At full load 6-7% CO, max. EGT 700℃

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Operating Manual S 2200 UL

7.4. Sparkplugs

Remove sparkplugs only by cold engine.

- Don`t use brass-or steel brush for cleaning !
- Don`t sandblast!
- Only synthetic fiber brush and degreasing solvent. Use only graphit for the threat.
- Check clearence of electrodes (0,5mm)
- Renew sparkplugs after 150 running hours.
- Fasten again after few running hours

The color of the sparkplugs shows:

dark brown ,brown:sparkplugs and adjustment of carburettor are o.k.
black: clearance of eletrodes is to much, Airfilter dirty, carburettor is not o.k. Engine doesn`t reach the running engine Temperature.
Oily shining: interruption of ignition, to much oil inside combustion chamber.
Pearls: wrong sparkplug, valves are not properly closing, carburettor to meager
light brown to white: carburettor attitude to meager

7.4.1 Valve clearance

- Intake Valve 0,30 mm
- Exhaust Valve 0,30 mm

7.5 Compressiontest

7.5.1 Compressiontest with printer

With direct compression recording instrument:
A minimum pressure indication is nor given, as indications will vary depending on the measuring equipment.
The indications are to be judged correspondingly.
The pressure differences should not be greater than 2 bar.

7.5.1 Difference-pressure-methode

with the system the presure difference between the given pressure and the shown pressure of the cylinder should not be less than 20% (general given pressure: appr. 5,5 bar (80 PSI)

7.6. Mechanical Fuelpump

within the 100 hours checkup the fuel filter is to be cleaned

- mainvalve “closed”
- all hoses and tuber to be disconnected
- clean filter by airpressure
- connect all hoses and tubes

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Operating Manual S 2200 UL

7.7 Exhaust-system

- Remove heatexchanger
- Visual check on damages and leakage
- Connect to engine and contol hot air system
- Check hot-air operation for cabin heating and carburettor heating

7.8. Actuating mechanisms

for throttle, choke and preheating for carburettor

- Check easy and smooth mouvement of all wireing
- Check all safety devices as conternuts and (ball-)joints
- Check hinges for free clearance. Clean and assemble with

8. Overhaul

8.1. General – overhaul (TBO)

Classification
Will be done by manufacturer only.
Recommended time between overhauls (TBO) at present is 1600 h of operation. The increase of TBO due to field experience will be published in the Service Bulletins of the manufacturer.

8.2. Same as under 8.1.

Ground-touch of propeller. In any case the engine is to be dismantelt.
X-ray of crankshaft is mandatory!
All parts are to be measured.

8.3 Exchange of luboil-and hoses

- Every six years all luboil-pressure- and fuel hoses are to be replaced if the material is rubber or teflon.

9. Chart for torque of screws:

Sparkplug	20 Nm
Nut for cylinder head	25 Nm
Nut for oilstrainer	8 Nm
Stopnut for oildrain	25 Nm

Oilfilter: see seperate instruction !

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Operating Manual S 2200 UL

10. Troubleshooting

10.1 Engine failure:

Reason	Help
Ignition „off“	Ignition „on“
Gaslever ration no-load operation	Pull gaslerver
Mainvalve closed, filter dirty	Mainvalve open, clean filter
Fueltank empry	Filling fueltank
Sparkplugcable wrong connect.	Ignition sequence 1-3-2-4
Ignitioncable loose or damaged	Renew cable connection
Mal functioning of magnet	Check clutch, clearance of rubber Segment, check sound of magnet
Condensation inside cover	Keep dry
Sparkplugs wet, to much fuel. Overflow carburettor	Keep sparkplugs dry, check fuelsystem
Carburettor float spindle dirty or dented	Clean or renew
Carburettor nozzle blocked	Cleaning or renew
Distance of electrores sparkplugs to wide	Adjust distance, 0,7mm
Low battery	Charge battery or renew
Water inside carburettor	Clean carburettor, filter tubes and seperator
Unsufficient compression	Pressure loss-test, see also 7.4
Damages inside crankcase (housing)	Check strainer for metall-parts. If yes, don`t start engine again. Contact manufacturer

10.2 Rough running engine

Reason	Help
No-load operation wrong adjustment	Adjust caburettor with synchron test device
Carburettor float spindel dirty or dented	Clean or replace
Airintake leakage	Replace demaged parts Tide up all bolts and nuts
Ignitioncable loose	Check cable connection
Disruptive breakdown of ignition cable	Check cable or renew
Sparkplugs dirty or defect	Clean or renew
Firing failure	Check whole ignitionsystem
Disruptive break down because of tracking current due to humidity	Check parts for disruptive breakdown renew and dry up all parts
Magnet out of function	Repair or renew by manufacturer
Wrong ignition adjustment	Check ignition firing
Ceramic-or contact tube damaged	Renew contact tube
Wrong balanced propeller	Remove propeller for balancing
Fuel-intake filter closed	Remove filter and clean

10.3 Engine overheated above 120°C

Reason	Help
Damaged measuring device	Replace thermocouple
Wrong adjustment ignition firering	Timing of ignition new
Fuel mixture too meager	Check adjustment and work conditions of carburettor
Aircooling sheets, not alined or damaged	Repair or renew, check sealing

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Operating Manual S 2200 UL

Reason	Help
Unsufficient oil supply	Check oil level, refill oil
Poor quality	Change oil brand to right quality
Oilpipesystem or strainer	Clean the whole system
Damaged bushings and bearings	If metal particle are found in the sump, general overhaul of engine

10.4 Low luboil pressure

Reason	Help
Unsufficient oil in the sump	Check oil level add oil
Damaged oilgauge	Renew oilgauge
Oilstrainer dirty	Take out and clean
Pressureloss due to leakage	Check the whole luboilsyst.
High oiltemperature	See 10.1
Oilgearpump damaged	Renew oilpump
Bearing damged, no oilpressure	General overhaul of engine

10.5 Engine does not develop full power

Reason	Help
Wrong adjustment of accelerator	New adjustment of accelerator and throttle
Failure in the airintoke system	Replace demaged parts tiden up all joints
Airfilter closed (dirty)	Clean or renew airfilter
Fuel not as per specification	Refill fuel tank with gasoline as specified
Firing interruption	Check ignition timing all Fs to tiden up us measuring instrument
Unsufficient fuel	Check fuelfilter, strainer
Cabrburettor diaphragm damaged	Renew diaphragm

10.6 Rough running engine after or dispite stop

Reason	Help
Firingtime wrong	Adjust firingtime
Carbon and other remains inside combustionchamber	Check fuelquality Check oilconsumption Check thermalconductivity of sparkplugs
Ignitionkey damaged	Switch to be renewed Check masscable
Engine overheated	Run engine with approx. 1000rpm

10.7 Oilconsumtion to high

Reason	Help
Luboilpipesystem leak	Check, repair amd test
Less quality of luboil	Change oil, use oil according to specification
Damaged bushings and bearings	Check oilsump and filter if you find metallpartical, don`t start engine GENERAL OVERHAUL
Wear and tear on pistonrings	GENERAL OVERHAUL

10.8 Engine pinking, knocking

Reason	Help
Fuel with less oktan,	Use fuel as per manufacturers recommendation,
Thermal conductivity Of spark plugs to low	Use sparkplugs as per manufacturers recommendation
Firingpoint to earty	Adjust firingpoint
Carbon and other remains inside comberstion	Check for reason
Gasoline air mixture too meager	Extending carburetor nozzles

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Operating Manual S 2200 UL

11. Inspection list
Kind and subject of controll

	Intervall: 25 h	50 h	100 h
1. Drain engine oil (warm) replace sealing ring of oil drain scew. Fill with 3 ltr.		x	x
2. Renew oilfilter		x	x
3. Visual check whole luboil system for leaks	x	x	x
4. Clean or renew air filter		x	x
5. Clean and check sparkplugs		x	x
6. Check motorsuspension, all joints, tubes, hoses cooling and pre-heating system	x	x	x
7. Clean engine	x	x	x
8. Check fuelsystem, clean filter	x	x	x
9. Check exaustsystem	x	x	x
10. Check ignition system	x	x	x
11. Check clamps and bolts from starter and magnet	x	x	x

Edition 01.03.2003

	Intervall:	25 h	50 h	100 h
12.	Check all cooling sinks	x	x	x
13.	Ceck diaphragm of carburettor	x	x	x
14.	Check electr. fuelpump of leaks		x	x
15.	Check ignition timing	x	x	x
16.	Check all electr. wirering and cable		x	x
17.	Compression test			x
18.	Check starter gear			x
19.	Check air guiding sheets	x	x	x
20.	Check crankcase-ventilation pipe, for leaks and cracks	x	x	x
21.	Check starter ring gear for any damage			x
22.	Check valve deplacement 0,3 mm when mechanical lifters installed			x