INSTRUCTION MANUAL

LW 320 E
Nautic - AI

Breathing Air Compressor

COMPRESSORS L&W

LENHARDT & WAGNER GMBH

SAFETY PRECAUTIONS

General Notice

This instruction manual contains the operation and maintenance procedures necessary to safely run your L&W compressor.
We strongly recommend to read this manual thoroughly prior operation and to follow all the safety precautions precisely.

Damage resulting from any deviation from these instructions is excluded from warranty and liability for this product.
Be sure to pay attention to the following points:

- Fill only tanks with a valid hydrostatic test date
- Never exceed the working-pressure rating indicated on the tank
- Carry out proper maintenance on the compressor and filtration system
- Care must be taken to avoid the intake of contaminated air in to the compressor
- Do not exceed maximum operating temperatures

Safety Precautions

- Read the operation manual of your compressor carefully
- Allow only qualified personnel to run the compressor
- Do not place any objects on compressor while in operation
- Make sure no person or object can accidentally touch any moving parts while running
- Take care that the intake-air is pure and free of toxic gases
- All work on compressor must be carried out while compressor is disconnected for the power supply and depressurized
- Check unit regularly for air- & oil leaks
- Never weld damaged high-pressure tubes
- Filling-hoses must be in perfect condition; special attention should be paid to the connecting fittings
- Do not touch any hot compressor / engine parts while doing maintenance work as these may cause injury by burning. Wait until unit has cooled down.

Technical Data	LW 320 E Nautic AI
Type	3 cylinder, 3 stage, air cooled, oil lubricated
Delivery rate	320 Litre/min (19.2 m³/h)
Prime mover	7.5 kW E-Motor, 400 V / 50 Hz / 3-Phase
Operating temperature	+5°C - +50°C
Operating pressure	max. 350 bar
Cooling air requirement	approx. 2,250 m³/h
Air outlet temperature	appr. 8-10 °C above ambient
Breathing air filter capacity	900 m³ at +20°C (approx. 53.4 hrs.)
Compressor speed	1,580 RPM
Oil capacity and pressure *(compressor)*	1.8 Litre, 1.8 bar (+/- 0.3 bar)
Dimensions	L x W x H (mm) 1290 x 740 x 610
Weight	Alloy version: 170 kg
Noise level	83 dB[A] @ 1m distance

Options:

High pressure outlet (10L), no filling connections

Running hours counter

Automatic stop device, shuts down the compressor at final pressure,
includes external on/off switch for wall mounting,

Automatic drain device with magnetic valves, pneumatic condensation valve, timer and silencer

200/300 bar filling module, selection valve, safety valve, filling hose, valve and filling connection

Dual pressure filling module, 200 and 300 bar, pressure reducer, safety valve

Inter stage pressure gauges and oil pressure gauge, mounted in a console

German TÜV/CEOC certification

Breathing Air Quality according to:
DIN 3188 - EN 12021 - ISO 2533 – BS 4001 & BS 4275

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LW 320 E NAUTIC AL

Application:
Breathing- and industrial-air applications. Ideal for diving schools, ships and for applications where minimum extras are required due to logistical/expenditure factors. The compact construction makes the compressor ideal for applications with limited space.

Specification:
- Standard version: *Aluminium lightweight frame*
- All pistons with piston rings
- Low pressure oil pump
- Oil/water separators after each stage,
- Safety valve for each pressure stage
- Breathing air purification in accordance with EN 12021, filter capacity 900 m³ at +20°C
- Pressure maintaining and non-return valve
- Filling pressure gauge (0 – 400 bar)
- 4 filling hoses and valve *(or HP outlet)*
- Powder coated frame
- Foldable handles

NOTES

Check oil level of compressor before each day of use.

Only run the unit on hard and even ground!

Always ensure good room ventilation and pure intake air!

Breathing Air Compressor

LW 320 E NAUTIC AL

F U N C T I O N A N D O P E R A T I O N

Drive Motor

Compressor units can be delivered with various drive motors depending on customer requirements.
Standard specification:

7.5 kW - 400 V / 50 Hz / 3-Phase (LW 320 E NAUTIC AL)

Dump System

LW 320 E NAUTIC AL compressors come with a manual drain system as standard. Both waterseparators and the endfilterhousing have to be drained by hand operated drain valves about every 15 to 20 minutes (depenting on huminity).

Option Automatic Drain:
Two solenoids open and drain three condensate separators about every 15 minutes.

We recommend the use of a 20 litre container to collect all condensate. It can then be deposed of like discarded oil. The drain noise of the final stage is kept to a minimum by an additional silencer.

Intake Filter

A micro filter cartridge is used as an air intake filter.
We recommend to replace it every 100 working hours *(depenting on pollution)* but at least every two years.
A dirty, contaminated filter restricts the airflow, reduces the compressors capacity and causes overheating.

Cylinder Heads and Valves

Inlet and outlet valves are located inside the cylinder heads.
Inlet valve open on the down stroke, outlet valves open on the upstroke.
All valves should be replaced after 1500 working hours due to normal wear and tear.
To replace valves the cylinder heads have to be removed. All three valves are combined valves which means that inlet and outlet valves form one unit.
The first stage valve is of plate valve design. Second & third stage valves use a spring operated piston inside a bronce alloy cylinder, sealing is done by alloy-ring & cap. There are no special tools required to change any of the valves

(2^{nd} & 3^{rd} stage valves do have a M6 thread in the body centre, use a matching bolt to pull them out of the head)

Lubrication

Crankshaft bearings and 1^{st} stage cylinder are lubricated by oil splash.
2^{nd} & 3^{rd} stage cylinders are lubricated by a mechanical oil pump
(average oil pressure: +1.8 bar).

Option
Oil pressure control is offered as an option.
An additional oil pressure switch (located next to the oil filter housing) controls the outlet pressure of the oil pump. In case of under pressure (below +1.5 bar) it turns off the machine automatically.
Oil pressure of the system can be checked by removing one of the plugs of the oil filter housing and fitting a suitable pressure gauge.

1.8 litre of synthetic compressor oil (order no. L&W 9001) is required for an oil change.
NOTE: Oil level should be at least at middle of oil dip stick marks

Starting the Compressor for the first Time

- Place the compressor on even ground (air temperature max. +50°C)
- Check compressor oil level
- Check if air filter cartridge is in place
- Make sure all filling valves are closed
- Start compressor (push green button)
- Check direction of rotation - immediantely after the start
- Run compressor to final pressure
- Restart compressor
- Check compressor unit for air leaks (push red button and do not release it until test is finished)
- Check dump system
- Release pressure by filling valve(s)

Safety Valves

Every pressure-stage is equipped with its own safety valve.
They protect the unit from over -pressure / load.
Safety valves are adjusted to:

1st Stage: 8 bar
2nd Stage: 60 bar
3rd Stage: final pressure

Blowing safety valves usually indicate problems with either inlet or outlet valve of the next following stage.

NOTE: A faulty safety valve has to be replaced immediately!

Oil / Water Separators

Oil / water separators (condensate separators) are fitted after every compression stage. Integrated sinter filters protect the compressor system from unwanted deposits. We recommend to clean the separator bodies & replace the sinter filters (plus required O-rings) every 1000 working hours.

Final Air Purifier (Mole Carbon Filter)

The mole carbon filter housing is mounted to the right hand side of the compressor frame, *capacity: 1.7 litre, P_{max}: 350 bar.*
Inside the filter housing a jet blows air to the housing body. Oil and water mist condenses and flows to the bottom of the housing. Air then flows through the mole carbon filter cartridge, which purifies the air from moisture and odours.
See chart for intervals:

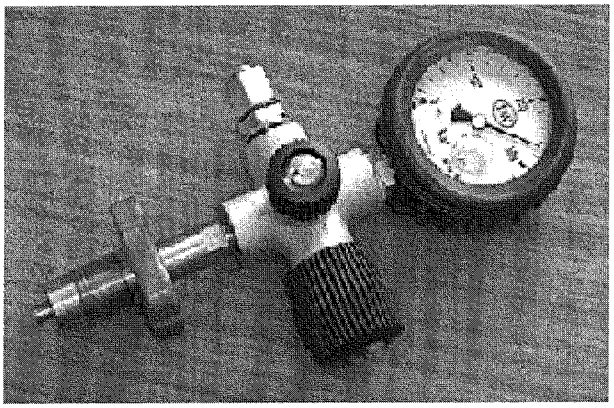
LW 320 E NAUTIC AL	1.7 ltr. Housing:	every 57 hours	(@ +20°C)

Furthermore the filterlife strongly depents on humidity and air temperature. Cartridges are vacuum packed. We recommend to open them just before they will be fitted to the compressor, as they could be saturated with moisture just being exposed to high humidity. To change the filter cartridge stop the compressor. It will then automatically release all remaining air pressure. This can take up to two minutes. Once the unit is depressurized the filter housing cap can be unscrewed with the T-shaped filter tool delivered with the compressor. If any pressure remains in the housing, it will be almost impossible to open the filter housing cap. The filter itself can also be unscrewed with the filter tool to be replaced by a new one. Screw cap on hand tight.

Filling Valve

The compressor comes with four filling valve as standard, an additional high pressure outlet is available as an option.
Standard length of filling hose: 0.65 meter
Available tank connectors:

DIN 200 bar & DIN 300 bar
INT
CGA 346 (200 bar) & CGA 347 (300 bar)
NF (200 bar)



Filling valve in cross design fitted with DIN 300 bar tank connector

Service, Repair and Maintenance

All repair, service and maintenance work is to be carried out when the compressor is stopped, isolated from the power supply and pressure free.
The unit is to be regularly checked for leaks of air/oil, air leaks can be localised using a leak detector or spray

It is recommended that only authorised L&W service technicians carry our repair and service on the bearing of the compressor (crankshaft and connecting rods)

Conservation / storage of the compressor:
If the compressor is not to be used for an extended period of time, we recommend the following conservation work is carried out before the storage:

- ✓ Run the compressor at 200 bar for approx ten minutes (control the flow with the filling valve to maintain the pressure).
- ✓ Replace oil.
- ✓ Open filling valve(s) and run the compressor for a few minutes.
- ✓ Stop the compressor and open the drain valves.
- ✓ Close the filling valves.
- ✓ Open the final filter housing and lubricate the O-Ring with a food grade grease or silicone grease.
- ✓ Store the compressor in a cool dry place free from dust and contamination. A cover is recommended as long as condensation can be avoided.

- ✓ Fuel Driven Units only: Fill up fuel tank to top level to avoid corrosion.

De-conservation, commissioning:
After the compressor has been stored, the following steps are to be taken:

- ✓ If the compressor has been stored for more than 12 Months, we recommend replacing the oil before use.
- ✓ Replace the final purification filter.
- ✓ Check oil level.
- ✓ Inspect the condition of the vee belts, replace if necessary
- ✓ Inspect the filling hoses visually for signs of deterioration, replace as necessary.
- ✓ Open the filling valves and run the compressor for approx 10 minutes with the filling valves open.
- ✓ Close the filing valves and allow the compressor to build up to working pressure.
- ✓ Check the correct safety valve setting and/or pressure switch setting (option).
- ✓ Check all connections and pipe work for leaks.

Once the above steps are completed to satisfaction, the unit is ready to use.

FILTERCHANGE
L&W Compressors

For the periodic filter cartridge change, please follow the time schedule in the instruction manual or the PURACON humidity control indication;
Only use the original filtercartridges, order numbers:

1.7 liter Housing: 000002 (Breathing Air)
2.3 litre Housing: 000003 (Breathing Air)

Do not open the sealing of the new filter cartridge yet !

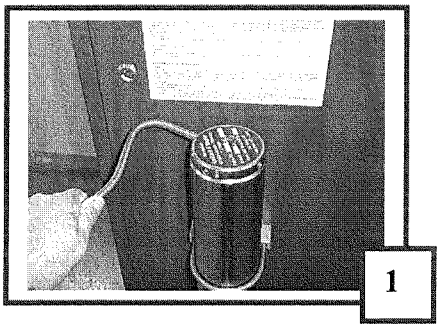
Before changing the filter cartridge, make sure the compressor is switched off and cannot be inadvertantly started. Disconnect it from the power supply or remove the key from the starter (Diesel types}.

After switching off the compressor, the automatic drain opens and the pressure in filter housing will be released, this can take up to two minutes.
If only a hand opreated drain is mounted, the drain valve of the combined separator / filter housing after the third stage has to be opened to release the pressure.

Filter cartridge change

- Unscrew the filter housing cap anti-clockwise, first with the special cartridge key and later by hand (1)
- Place the other end of the cartridge key in the filter cartridge in the filter housing (2)
- Unscrew the filter cartridge anti-clockwise and pull the cartridge out of the housing (3)
- Check O-ring for wear and grease thread of top cap
- Open the sealing of the new filter cartridge and use the cartridge key to place it in the filter housing (3)
- Screw in the new filter cartridge clockwise with the cartridge key hand tight (2)
- Refit the cap of the filter housing clockwise, first by hand and than by the filter key, hand tight (1)
- Close the drain valve of the separator / filter housing if only the hand operated drain is mounted.

The filter cartridge replacement is now completed, ensure that the saturated filter cartridge is disposed of correctly at an approved waste point.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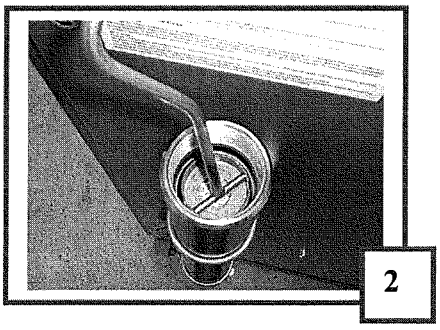
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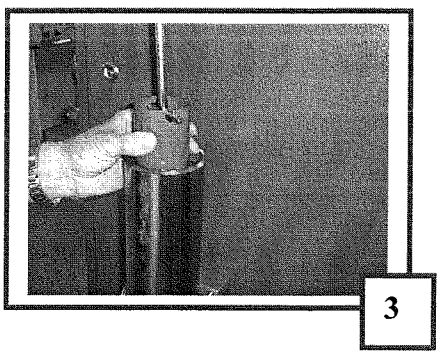
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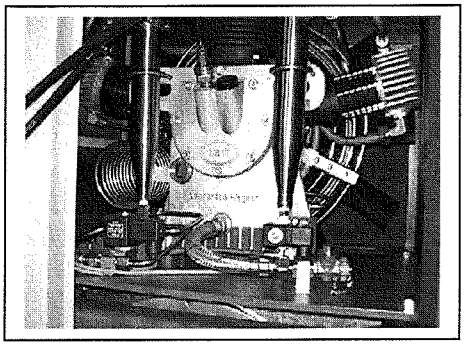
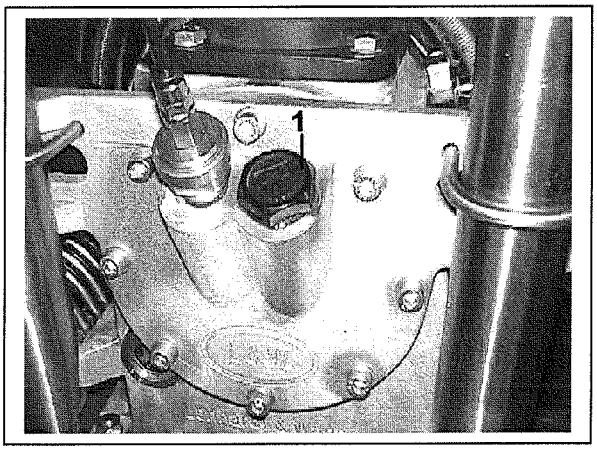
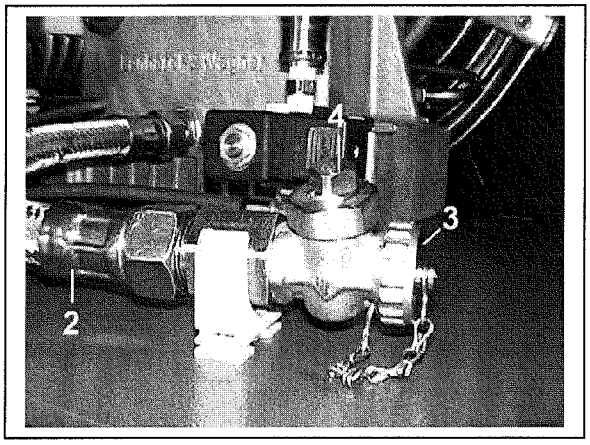
OIL CHANGE INSTRUCTIONS



For the periodic oil change, please follow the time schedule of the instruction manual.
Only use original L&W synthetic oil 9001/01 (1 ltr bottle) or 9001/12 (12 x 1 ltr bottle packing).

Before changing the oil, be sure the compressor is switched off and cannot be inadvertantly started. Disconnect it from the power supply or by switch off the starter of the gasoline or Diesel engine.





To conduct an oil change, the temperature of the oil must be at least +20°C to allow it to flow easily. In cold climates, the compressor should run first for about 15 minutes, dependent on the ambient temperature;

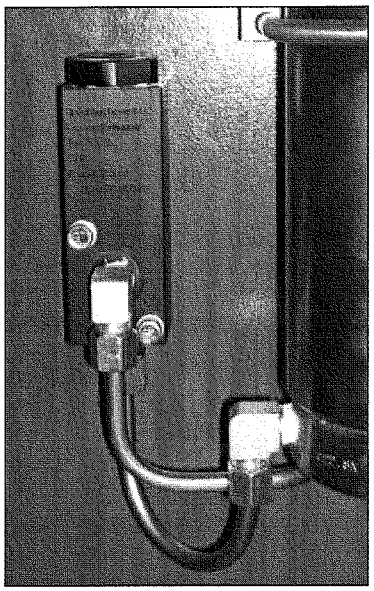
Oil change

- Unscrew the filling cap anti-clockwise (1)
- Remove the oil drain hose from it´s holder (2)
- Unscrew the drain hose cap anti-clockwise (3)
- Hold the drain hose over a container for waste oil and open the drain valve (4)
- Let the oil drain completely, close valve (4), screw on plug (3) and relocate the hose
- Refill the block with original L&W compressor oil (appr. 1.8 ltr) by using a funnel
- The dipstick (1) should be filled up to the top mark - **DO NOT OVERFILL WITH OIL!!**
- Refit the oil filler cap

The oil change is now completed, **ensure the filling cap (1) is securely refitted.**
The schedule in the maintenance manual will indicate the next oil change or the ECC display.
Ensure the waste oil is disposed of correctly at an approved waste oil point.

Pressure maintaining and non-return valve

The combined pressure maintaining / non-return valve is located in the system directly after the final filter housing



Pressure Maintaining Valve

Pressure maintaining valve

The pressure maintaining valve serves to keep the pressure in the final filter housing at a minimum of 150 to 180 bar. This high pressure creates more condensation in the separator/housing that can be mechanically removed (opening the drain valve) before the air is finally purified in the final filter, thus extending the life of the filter cartridge.

When the compressor is started, the pressure will build up in each stage as the compressor runs. The pressure in the final filter housing will increase until the pressure maintaining valve set pressure is reached. As a result of this function, the filling pressure gauge will not show any pressure for approx 1 min after the compressor is started and no air will flow out of the filling valve if opened.

Once the pressure maintaining valve opens, the pressure gauge will respond by climbing quite rapidly (within a few seconds) to the set pressure of the pressure maintaining valve (default 150 to 180 bar).

Adjusting the pressure maintaining valve:

- Open the filling valve to vent the system completely, close the filling valve *(Pressure gauge reads 0 bar)*
- Start the compressor
- Monitor the pressure gauge
- The valve will open and the pressure the gauge climbs to quickly to the set pressure, this should be 150 – 180 bar
- If the pressure setting is outside this valve, adjust the pressure maintaining valve as follows:

Increase the pressure setting:

- Stop the compressor and open the drain valves
- Open the filling valve to vent the system after the pressure maintaining valve *(Pressure gauge reads 0 bar)*
- Loosen the locking screw on the pressure maintain valve
- Using a suitable tool, screw the valve setting screw clockwise to increase the spring tension
- Start the compressor and check the pressure setting, adjust as necessary
- Re-tighten the locking screw
- Check the pressure maintaining opening pressure once again

Decrease the pressure setting:

- Stop the compressor and open the drain valves
- Open the filling valve to vent the system after the pressure maintaining valve *(Pressure gauge reads 0 bar)*
- Loosen the locking screw on the pressure maintain valve
- Using a suitable tool, screw the valve setting screw anti-clockwise to decrease the spring tension
- Start the compressor and check the pressure setting, adjust as necessary
- Re-tighten the locking screw
- Check the pressure maintaining opening pressure once again

Warning:

If the pressure maintaining valve is set at a higher pressure than the maximum working pressure, the final safety valve will blow off before the pressure maintaining valve opens, the pressure gauge will read 0 bar!
After repair work where the pressure maintaining valve is not yet adjusted, the basic setting is the setting screw approx 3 turns in to the housing.

Non-return valve

The non-return valve is located in the system after the pressure maintaining valve and prevent air from flowing back from the filling lines into the final filter housing/compressor block. The non-return valve is operating correctly if the pressure gauge on the filling valve remains constant when the drain valves on the compressor are opened.

V-Belts

The compressor block is driven by the engine via 2 V-belts.
Check V-belt condition / tension at least once a month.

In case of high V-belt wear, check the following:

- V-belt tension
- Check if both V-belts are the same length / specification
- Check pulley grooves for marks / scratches / damage
- Check if pulley grooves are free from oil / grease

How to tension the V-belts

Attention: Do not work on hot compressors / engines

- Stop compressor and wait until it has cooled down
- Tilt compressor frame until you can loose all 4
- Slightly loose nuts of motor flange *(use 19mm spanner / socket)*
- Adjust motor tensioning bolt until correct V-belt tension is achieved
  (located next to the motor flange)
  - use 19mm spanner / socket
- Tighten nuts of motor flange
- Check tension of V-belts *(readjust if necessary)*

ATTENTION:

Insufficient V-belt tension leads to higher vibrations and increases the noise level of the compressor unit.
Replace faulty V-belts immediately.
Always use V-belts of identical length / specification.

Tightening Torques

LW 160 E	LW 190 B	LW 225 E V3	LW 245 B V3
LW 170 D - *Nautic*	LW 170 E - *Nautic*	LW 200 E - *Nautic*	

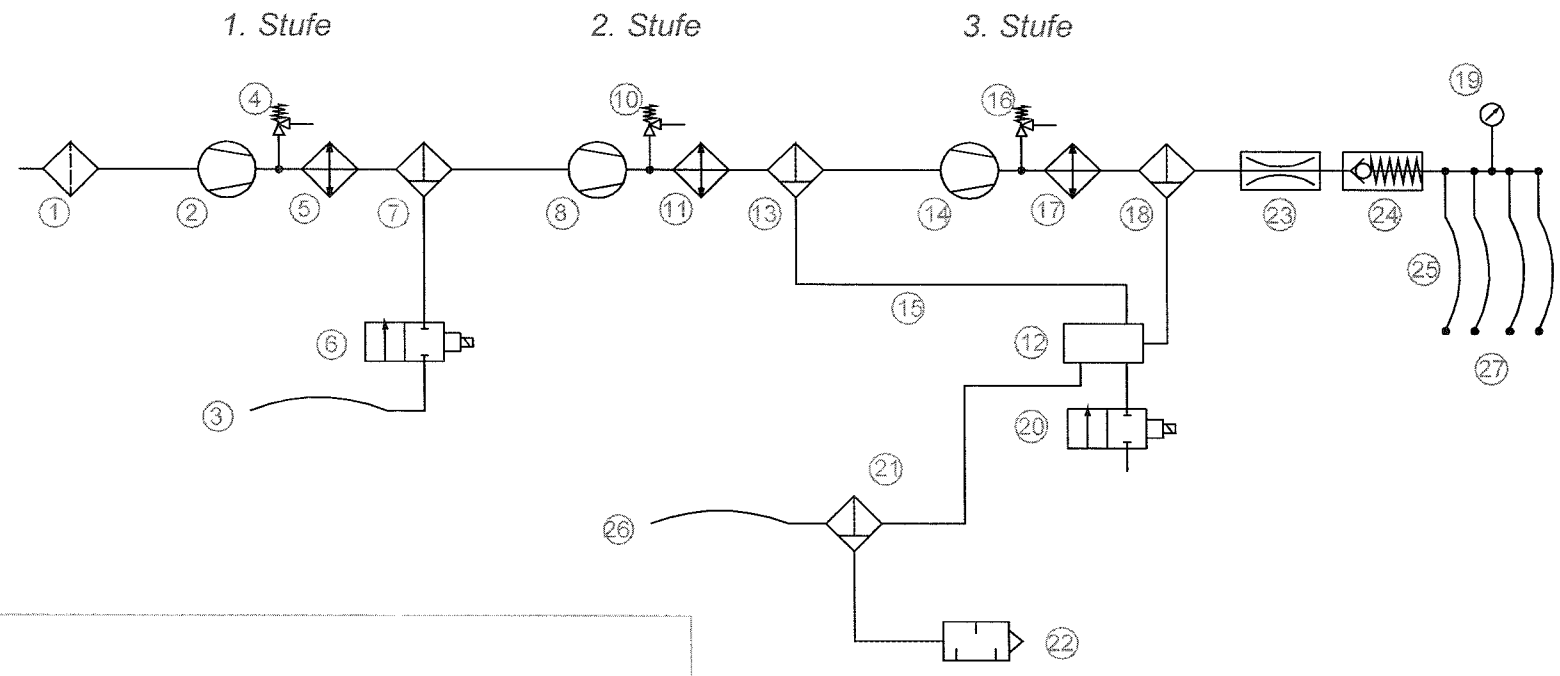
Cylinder Head Bolts	1st Stage	22 - 24 Nm
Cylinder Head Bolts	2nd & 3rd Stage	28 Nm
Nuts M10	(8.8)	44 Nm
Cooling Fan Bolts	(8.8)	20 Nm
Slider Guide Bolt		10 Nm

LW 280 E / ES	LW 320 E Nautic AI

Cylinder Head Bolts	1st Stage	37.5 Nm
Cylinder Flange Bolts	1st Stage	35 Nm
Cylinder Head Bolts	2nd Stage	30 Nm
Cylinder Head Bolts	3rd Stage	30 Nm
Guide Cylinder Flange Bolts	2nd & 3rd Stage	41 Nm
Block Fixing Bolts M10	(8.8)	44 Nm

LW 450 D / E / ES	LW 570 E / ES

Cylinder Head Bolts	1st Stage	37.5 Nm
Cylinder Head Bolts	2nd Stage	32 Nm
Cylinder Head Bolts	3rd Stage	32 Nm
Cylinder Head Bolts	4th Stage	32 Nm
Cylinder Flange Bolts	1st Stage	35 Nm
Cylinder Flange Bolts	2nd Stage	35 Nm
Cylinder Flange Bolts	3rd Stage	35 Nm
Block Fixing Bolts M10	(8.8)	44 Nm



Flow Diagram

1 Intake Filter
2 1st Pressure Stage
3 Condensate Drain Hose
4 Safety Valve 1st Stage
5 Heat Exchanger
6 Condensate Solenoid
7 Oil- / Water Separator
8 2nd Pressure Stage
9 Condensate Drain Hose
10 Safety Valve 2nd Stage
11 Heat Exchanger
12 Pneumatic Condensate Valve
13 Oil- / Water Separator
14 3rd Pressure Stage
15 Control Pressure 2nd Stage
16 Safety Valve 3rd Stage
17 Heat Exchanger
18 Oil- / Water Separator
19 Pressure Gauge
20 Solenoid
21 Condensate Drain Final Stage
22 Silencer
23 Pressure Maintaining Valve
24 Non-Return Valve
25 High Pressure Hose
26 Condensate Drain Hose
27 Tank Connector *(DIN / Yoke or CGA)*

LW 230 E / LW 280 E
LW 230 ES / LW 280 ES
LW 300 B

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Symptom	Problem	Trouble Shooting
Final pressure is not reached	Connections leaking	Re-tighten, clean and/or replace
	Final pressure safety valve blows off	Replace
	Cooling pipe leaking	Replace
	Condensation drain valves	Check tightness, clean and/or replace
	Final pressure switch cuts off (option)	Re-set final pressure cut off
Compressor vibrates excessively	V-Belt tension in sufficient	Tighten V-Belts
	Compressor block and/or prime mover mounting screws loose	Re-tighten
	Shock absorbing feet worn down	Replace
	Uneven surface	Move compressor accordingly
Compressor overheats	Inlet filter cartridge blocked	Replace
	Ambient temperature too high	Improve ambient conditions or run for shorter periods
	Cooling air feed/exhaust not sufficient	Adhere to the installation data
	Inlet hose too long	Reduce the length and/or increase the diameter
	Inlet hose diameter too small	Increase diameter
	Compressor turning in the wrong direction	Ensure correct rotation (phase)
	Suction/pressure valve blocked	Clean and/or replace
Safety valve blows off	Suction / pressure valve in the following stage defect	Clean and/or replace
	Sinter filter in the following stage blocked	Replace
	Safety valve leaks	Replace (do not tamper)
Air tastes of oil	Molecarbon filter needs replacing	Replace
	Incorrect compressor oil	Use only authorised oil type
	Non conform type of filter	Replace with correct filter
	Cylinders and / or piston rings worn	Replace
Delivery rate too low	Suction/pressure valve blocked	Clean and/or replace
	Cylinder / piston rings worn	Replace
	Also see section „final pressure is not reached“	
Automatic condensation drain not functioning *(Option)*	Solenoids defect	Replace
	Cable/wiring defect	Repair
	Timer defect	Replace
	Sinter filter from pneumatic valve blocked	Replace
	Piston in the pneumatic valve blocking	Dismantle pneumatic valve
Automatic condensation drain operates between cycles	Pilot pressure for pneumatic valve too low	Replace suction/pressure valve / safety valve
	Piston seat in the pneumatic valve damaged/contaminated	Clean / Replace
	Timer settings incorrect	Set default settings

Symptom	Problem	Trouble Shooting
(Option)	Timer defective	Replace
Compressor switches off before final pressure is reached *(Option)*	Final pressure switch not properly set	Reset
	Pressure maintaining valve set too high	Reset
	Fuse/breaker tripped	Refer to the correct fuse ratings for the supply
Filter cartridges times too short	Pressure maintain valve set too low	Reset to 170 bar
	Non conform type of filter	Use only correct filters
	Shelf life exceeded	Adhere to date of expiry
	Packing damaged and / or filter packing opened too long before use	Store properly and open immediately before use
	Ambient temperature too high	Ensure correct and sufficient cooling air feed and exhaust
	Cylinder / piston rings worn	Replace
Excessive oil consumption	Cylinder / piston rings worn	Replace
	Incorrect compressor oil	Use only authorised oil type
	Operating temperature too high	Adhere to operating parameters
	Oil leak in the compressor block	Check relevant components especially shaft seal and replace/re-tighten

MAINTENANCE LIST LW 320 E Nautic AI

Maintenance Work	Intervals	Qty.	Order No.
Replace Filter Cartridge ***Filter Capacity 1.7 ltr.:***	LW 320 E Nautic AI: every 53 working hours *(@ +20 °C)*	1	LW 300/450 8005
Check Oil Level	once a day *(before 1st Start)*		
Oil Change	1st Oil change after 50 working hours *(in total)* 2nd Oil change after 200 working hours *(in total)* thereafter every further 1000 working hours - but at least once a year	1800 ml per Fill	LW 300/450 9001
Replace Air Intake Cartridge	depends on pollution - but at least every two years	1	LW 300/450 7017
Check V-Belts	every 100 working hours	2	LW 260 0035E
Replace Valves ***1st Stage*** ***2nd Stage*** ***3rd Stage***	every 1500 working hours	 1 1 1	 LW 260 0092 LW 260 0084 LW 260 0064
Check Pressure Maintaining- / Non Return Valve	every 500 working hours		
Check Safety Devices	at least once a year This should only be done by professional engineers		
Check Pressure Pipes for Air Leaks	every 200 working hours		

MAINTENANCE LIST LW 320 E Nautic AI

Maintenance Work	Intervals	Qty.	Order No.
Clean Pressure Pipes	depends on pollution - but at least every two years		
Check Condition of Filling Hoses	once a day *(before the 1st fill)*		
Replace Sinter Filter of Condensate Valve	1st change after 1000 working hours thereafter every 2000 working hours	1	LW 300/450 2011 b
Clean Oil-/Water Separators	every 1000 working hours - but at least once a year		
Replace Sinter Filters of Water Separators ***1st Stage*** ***2nd Stage*** ***3rd Stage***	 every 1000 working hours every 1000 working hours every 1000 working hours	 1 1 1	 LW 260 0121 LW 260 0121 LW 300/450 10004
Replace Silencer	every 500 Working Hours	1	LW 300/450 2014
Check / Retorque Connections & Bolts	after 15 working hours - thereafter every 500 working hours		