BOMAG
FAYAT GROUP

Service - Manual

BW 216 D-40 / PD-40

BW 218 D-40

S/N 101 583 39 .... / S/N 101 583 40 . . . .
S/N 101 583 41.....>

Single drum roller

Catalogue number.
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1 General

1.1 Introduction

This manual addresses the professionally qualified personnel or the after sales service of BOMAG, and should be of help and assistance in correct and efficient repair and maintenance work.

This manual describes the disassembly, dismantling, assembly, installation and repair of components and assemblies. The repair of components and assemblies is only described as this makes sense under due consideration of working means and spare parts supply.

Documentation

For the BOMAG machines described in this manual the following documentation is additionally available:

1 **Operating and maintenance instructions**
2 **Spare parts catalogue**
3 **Service information**

Use only genuine BOMAG spare parts.

Spare parts needed for repairs can be taken from the spare parts catalogue for the machine.

This manual is not subject of an updating service; for this reason we would like to draw your attention to our additional "Technical Service Bulletins".

In case of a new release all necessary changes will be included.

In the course of technical development we reserve the right for technical modifications without prior notification.

⚠ Danger

These safety regulations must be read and applied by every person involved in the repair /maintenance of this machine. The applicable accident prevention instructions and the safety regulations in the operating and maintenance instructions must be additionally observed.

BOMAG GmbH

Printed in Germany

Important notes

These safety regulations must be read and applied by every person involved in the repair /maintenance of this machine. The applicable accident prevention instructions and the safety regulations in the operating and maintenance instructions must be additionally observed.

Repair work shall only performed by appropriately trained personnel or by the after sales service of BOMAG.

Workshop equipment and facilities as well as the use and waste disposal of fuels and lubricants, cleaning agents and solvent as well as gases and chemicals are subject to legal regulations, which are intended to provide a minimum on safety. It is obviously your own responsibility to know and adhere to these regulations.

This manual contains headers like "Note", "Attention", "Danger" and "Environment", which must be strictly complied with in order to inform about and avoid dangers to persons, property and the environment.

i Note

Paragraphs marked like this contain technical information for the optimal economical use of the machine.

⚠ Caution

Paragraphs marked like this highlight possible dangers for machines or parts of the machine.

⚠ Danger

Paragraphs marked like this highlight possible dangers for persons.

Environment

Paragraphs marked like this point out practices for safe and environmental disposal of fuels and lubricants as well as replacement parts.

Observe the regulations for the protection of the environment.

General

- For repair and maintenance work move the machine on a firm base and shut it down.
- Always secure the machine against unintended rolling.
- Secure the engine reliably against unintentional starting.
- Mark a defective machine and a machine under repair by attaching a clearly visible warning label to the dashboard.
- Block the articulated joint with the articulation lock.
- Use protective clothes like hard hat, safety boots and gloves.
- Keep unauthorized persons away from the machine during repair work.
- Tools, lifting gear, lifting tackle, supports and other auxiliary equipment must be fully functional and in safe condition.
- Use only safe and approved lifting gear of sufficient load bearing capacity to remove and install parts or components from and to the machine.
- Do not use easily inflammable or harmful substances, such as gasoline or paint thinners for cleaning.
- Do not smoke or use open fire and avoid sparks when cleaning or repairing a tank.
- When performing welding work strictly comply with the respective welding instructions.

Transport work with cranes and lifting tackle

i Note

Cranes must only be operated by instructed persons who had been trained in handling cranes.

- Follow the operating instructions of the manufacturer when working with cranes.
- Follow the operating instructions of the operator when working with cranes.
- Always comply with the applicable accident prevention instructions when working with cranes and lifting tackle.

Precautions and codes of conduct for welding work

Welding work must only be carried out by properly trained personnel.

⚠ Danger

Electric shock!

Sparks, fire hazard, burning of skin!

Infrared or ultraviolet radiation (arc), flashing of eyes!

Health hazard caused by welding work on highly alloyed work pieces, metal coatings, paint coatings, plastic coatings, oil containing dirt deposits, grease or solvent residues, etc.!

- Check welding equipment and cables for damage before use (also the validity of inspection stickers).
- Ensure good conductivity between ground cable and workpiece, avoid joints and bearings.

- Start the extraction fan before starting work and guide with the progressing work as required.
- Always isolate the burner when laying it down (remove possible electrode residues).
- Protect cables from being damaged, use cables with insulated couplings.
- Ensure sufficient fire protection, keep a fire extinguisher at hand.
- Welding work in areas where there is a risk of fire or explosion, must only be carried out with welding permission.
- Remove any combustible materials from the welding area or cover such items appropriately.
- Name a fire watch during and after welding work.
- Place welding rod holders and inert gas welding guns only on properly insulated bases.
- Place the inert gas bottles in a safe place and secure them against falling over.
- Use a protective screen or hand shield with welding filter, wear welding gloves and clothes.
- Switch the welding unit off before connecting welding cables.
- Check electrode holders and electric cables at regular intervals.

Behaviour in case of faults

- In case of faults on the welding unit switch of the welding unit immediately and have it repaired by expert personnel.
- In case of failure of the extraction system switch the system off and have it repaired by expert personnel.

Maintenance; waste disposal

- Replace damaged insulating jaws and welding rod holders immediately.
- Replace the welding wire reels only in de-energized state.

What to do in case of accidents; First Aid

- Keep calm.
- Call first air helpers.
- Report the accident.
- In case of an electric accident: Interrupt the power supply and remove the injured person from the electric circuit. If breathing and heart have stopped apply reactivation measures and call for an emergency doctor.

Operation of high-voltage systems

i Note

The rules and statutory regulations valid in the corresponding do apply in addition to the notes given here.

⚠ Caution

The high-voltage system must only be operated and serviced by qualified and authorized personnel.

Before starting operation the operator must check the proper condition of the system.

⚠ Danger

Possibility of injury or even death caused by electric shock:

- **if persons come into contact with live parts,**
- **in case of faulty insulation of live parts,**
- **inadequate, unsuitable insulation,**
- **if melted parts flake off in case of short circuits.**

Old oils

Prolonged and repetitive contact with mineral oils will remove the natural greases from the skin and causes dryness, irritation and dermatitis. Moreover, used engine oils contain potentially hazardous contaminants, which could cause skin cancer. Appropriate skin protection agents and washing facilities must therefore be provided.

- Wear protective clothes and safety gloves, if possible.
- If there is a risk of eye contact you should protect your eyes appropriately, e.g. chemistry goggles or full face visor; a facility suitable for rinsing the eyes should also be available.
- Avoid longer and repetitive contacts with oils. In case of open incisions and injuries seek medical advice immediately.
- Apply protective cream before starting work, so that oil can be easier removed from the skin.
- Wash affected skin areas with water and soap (skin cleansers and nail brushes will help). Lanolin containing agents will replace natural skin oils that were lost.
- Do not use gasoline, kerosene, diesel, thinner or solvents to wash the skin.
- Do not put oil soaked cloths into your pockets.
- Avoid clothes getting soiled by oil.
- Overalls must be washed at regular intervals. Dispose of non-washable clothes environmentally.
- If possible degrease components before handling.

Environment

It is strictly prohibited to drain off oil into the soil, the sewer system or into natural waters. Old oil must be disposed of according to applicable environmental regulations. If in doubt you should consult your local authorities.

Hydraulics

- Always relieve the pressure in the hydraulic system before disconnecting any lines. Hydraulic oil escaping under pressure can penetrate the skin and cause severe injury.
- Always make sure that all screw fittings have been tightened properly and that hoses and pipes are in mint condition before pressurizing the system again.
- Hydraulic oil leaking out of a small opening can hardly be noticed, therefore please use a piece of cardboard or wood when checking for leaks. When injured by hydraulic oil escaping under pressure consult a physician immediately, as otherwise this may cause severe infections.
- Do not step in front of or behind the drums, wheels or crawler tracks when performing adjustment work in the hydraulic system while the engine is running. Block drums, wheels or crawler tracks with wedges.

Reattach all guards and safety installations after all work has been completed.

Environment

It is strictly prohibited to drain off oil into the soil, the sewer system or into natural waters. Oil oil must be disposed of according to applicable environmental regulations. If in doubt you should consult your local authorities.

Fuels

⚠ Danger

Repair work shall only performed by appropriately trained personnel or by the after sales service of BOMAG.

Follow the valid accident prevention instructions when handling fuels.

The following notes refer to general safety precautions for danger free handling of fuel.

Fuel vapours not only are easily inflammable, but also highly explosive inside closed rooms and toxic; dilution with air creates an easily inflammable mixture. The vapours are heavier than air and therefore sink down to the ground. Inside a workshop they may easily become distributed by draft. Even the smallest portion of spilled fuel is therefore potentially dangerous.

- Fire extinguishers charged with FOAM, CO^2 GAS or POWDER must be available wherever fuel is stored, filled in, drained off, or where work on fuel systems is performed.
- The vehicle battery must always be disconnected, BEFORE work in the fuel system is started. Do not disconnect the battery while working on the fuel system. Sparks could cause explosion of the fuel fumes.
- Wherever fuel is stored, filled, drained off or where work on fuel systems is carried out, all potential ignition sources must be extinguished or removed. Search lights must be fire proof and well protected against possible contact with running out fuel.

Hot fuels

Please apply the following measures before draining of fuel to prepare for repair work:

- Allow the fuel to cool down, to prevent any contact with a hot fluid.
- Vent the system, by removing the filler cap in a well ventilated area. Screw the filler cap back on, until the tank is finally emptied.

Synthetic rubber

Many O-rings, hoses, etc. are made of synthetic material, a so-called fluorocarbon elastomer. Under normal operating conditions this material is safe and does not impose any danger to health.

However, if this material becomes damaged by fire or extreme heat, it may decompose and form highly caustic hydrofluoric acid, which can cause severe burns in contact with skin.

- If the material is in such a state it must only be touched with special protective gloves. The protective gloves must be disposed of according to applicable environmental regulations immediately after use.
- If the material has contacted the skin despite these measures, take off the soiled clothes and seek medical advice immediately. In the meantime cool and wash the affected area of skin over a sufficient time with cold water or lime water.

Poisonous substances

Some of the fluids and substances used are toxic and must under no circumstances be consumed.

Skin contact, especially with open wounds, must be avoided.

These fluids and substances are, amongst others, anti-freeze agents, hydraulic oils, fuels, washing additives, refrigerants, lubricants and various bonding agents.

Engine

⚠ Danger

Do not work on the fuel system while the engine is running. (Danger to life!)

Once the engine has stopped wait approx. 1 minutes for the system to depressurize. The systems are under high pressure. (Danger to life!)

Keep out of the danger zone during the initial test rung. Danger caused by high pressure in case of leaks. (Danger to life!)

When performing work on the fuel system make sure that the engine cannot be started unintentionally during repair work. (Danger to life!)

- Maintenance and cleaning work on the engine must only be performed with the engine stopped and cooled down. Make sure that the electric system is switched off and sufficiently secured against being switched on again (e.g. pull off ignition key, attach a warning label).
- Observe the accident prevention regulations for electric systems (e.g. -VDE-0100/-0101/-0104/-0105 Electric precautions against dangerous contact voltages).
- Cover all electric components properly before wet cleaning.

Air conditioning system

⚠ Caution

Work on air conditioning systems must only be carried out by persons who can provide sufficient evidence of their ability (proof of professionalism) and only with the appropriate technical equipment.

- Always wear goggles and protective clothing when performing maintenance and repair work on air conditioning systems. Refrigerant withdraws heat from the environment when evaporating, which can cause injury by freezing when in contact with skin (boiling point of R134a -26,5 °C at normal pressure).
- Perform maintenance and repair work on air conditioning systems only in well ventilated rooms! Escaping refrigerant vapours will mix with the ambient air and displace the oxygen required for breathing (danger of suffocating).
- Smoking is prohibited when performing maintenance and repair work on air conditioning systems! Toxic breakdown products may be generated if refrigerant comes into contact with heat.
- Refrigerant should always be extracted and removed by flushing with nitrogen before starting welding or soldering work near components of the air conditioning system. The development of heat may cause the refrigerant to develop toxic and highly corrosive breakdown products.
- Pungent smell! The toxic substances, which are responsible for the pungent smell, must not be inhaled, since this may cause damage to the respiratory system, the lung and other organs. Extract toxic breakdown products with a suitable extraction system (workshop extraction system).
- When blowing out components with compressed air and when flushing with nitrogen the gas mixture escaping from the components must be extracted via suitable extraction facilities (workshop extraction systems).

Handling pressure vessels

- Since the fluid container is pressurized, the manufacture and testing of these pressure vessels is governed by the pressure vessel directive. The pressure vessels must be repetitively tested by an expert as specified in TRB 532 Inspection by Experts, Repetitive Tests. In this case periodically recurring inspections consist of external examinations, normally on containers in operation. In combination with the inspection, the refrigerant collector must be visually examined two times per year. Special attention must thereby be paid to signs of corrosion and mechanical damage. If the container is in no good condition, it should be replaced for safety reasons, in order to protect the operator or third parties against the dangers when handling or operating pressure vessels.
- Secure pressure vessels against tipping over or rolling away.
- Do not throw pressure vessels! Pressure vessels may thereby be deformed to such an extent, that they will crack. The sudden evaporation and escape of refrigerant releases excessive forces. This applies also when snapping off valves on bottles. Bottles must therefore only be transported with the safety caps properly installed.
- Refrigerant bottles must never be placed near heating radiators. Higher temperatures will cause higher pressures, whereby the permissible pressure of the vessel may be exceeded.
- Do not heat up refrigerant bottles with an open flame. Excessive temperatures can damage the material and cause the decomposition of refrigerant.
- Do not overfill refrigerant bottles, since any temperature increase will cause enormous pressures.

Environment

It is strictly prohibited to release refrigerant into the atmosphere during operation, maintenance

and repair work and when taking air conditioning systems into or out of service.

Battery

- Always wear goggles and protective clothing to service or clean batteries! Battery acid can cause severe injury by cauterization when coming in contact with skin.
- Work only well ventilated rooms (formation of oxyhydrogen gas).
- Do not lean over the battery while it is under load, being charged or tested (danger of explosion).
- Keep ignition sources away from the battery. Burning cigarettes, flames or sparks can cause explosion of the battery
- Use battery chargers etc. only in strict compliance with the operating instructions.
- After an accident with acid flush the skin with a sufficient amount of water and seek medical advice.
- Do not allow children access to batteries.
- When mixing battery fluid always pour acid into water, never vice-versa.

Special safety regulations

- Use only genuine BOMAG spare parts for repair and maintenance work. Genuine spare parts and original accessories were specially developed, tested and approved for the machine.
- The installation and use of non-genuine spare parts or non-genuine accessories may therefore have an adverse effect on the specific characteristics of the machine and thereby impair the active and/or passive driving safety. The manufacturer explicitly excludes any liability for damage caused by the use of non-original parts or accessories.
- Unauthorized changes to the machine are prohibited for safety reasons.
- Do not perform any cleaning work while the engine is running.
- If tests on the articulated joint need to be performed with the engine running, do not stand in the articulation area of the machine (danger of crushing!).
- If tests must be performed with the engine running do not touch rotating parts of the engine (danger of injury!).
- Always ensure an adequate supply of fresh air when starting in closed rooms. Exhaust gases are highly dangerous!
- Refuel only with the engine shut down. Ensure strict cleanliness and do not spill any fuel.
- Always ensure an adequate supply of fresh air when refuelling in closed rooms.
- Dispose of used filters in accordance with applicable environmental regulations.
- When performing repair and maintenance work collect oils and fuels in suitable containers and dispose of in compliance with applicable environmental regulations.
- Do not heat up oils higher than 160 °C because they may ignite.
- Wipe off spilled or overflown oil using suitable cleaning means and dispose of in accordance with applicable environmental regulations.
- Dispose of old batteries according to applicable environmental regulations.
- There is a danger of scalding when draining off engine or hydraulic oil at operating temperature! Allow engine and hydraulic system to cool down to a sufficient level.
- Do not exceed the max. permissible tire pressure.

General

- Before removing or disassembling parts, assemblies, components or hoses mark these parts for easier assembly.
- Before assembling and installing parts, assemblies or components oil or grease all movable parts or surfaces as required and in compliance with the compatibility of materials.

Electrics

General

Due to the fast technical development electric and electronic vehicle systems become more intelligent and more comprehensive day by day, and can hardly be dispensed with in hydraulic and mechanical vehicle systems.

Diagnostics according to plan

Well structured trouble shooting procedures can save time and money.

Random tests have revealed that purely electronic components or control units only very rarely are the actual cause of failures:

- In approx. 10 % of the examined cases the problems were caused by control units.
- In approx. 15 % sensors and actuators were the cause of the problems.

By far the highest proportion of all faults could be traced back to wiring and connections (plugs, etc.).

General:

- Before changing any expensive components, such as control units, you should run a systematic trouble shooting session to eliminate any other possible fault sources. Knowledge in basic electrics is required for this purpose. If a fault was diagnosed without having pulled the plug of the control unit or inspected the wiring, this should be done before changing any parts.
- Check for good cable and ground contacts, therefore keep all mechanical transition points between electric conductors (terminals, plugs) free of oxide and dirt, as far as this is possible.
- Always use the machine related wiring diagram for testing. If one or more faults were detected, these should be corrected immediately.
- Do not disconnect or connect battery or generator while the engine is running.
- Do not operate the main battery switch under load.
- Do not use jump leads after the battery has been removed.
- Sensors and electric actuators on control units must never be connected individually or between external power sources for the purpose of testing, but only in connection with the control unit in question.
- It is not permitted to pull plugs off while the voltage supply is switched on (terminal 15 "ON")! Switch the voltage supply "OFF" first and pull out the plug.
- Even with an existing polarity reversal protection incorrect polarity must be strictly avoided. Incorrect polarity can cause damage to control units!

- Plug-in connectors on control units are only dust and water tight if the mating connector is plugged on! Control units must be protected against spray water, until the mating connector is finally plugged on!
- Unauthorized opening of control electronics (Microcontroller MC), modifications or repairs in the wiring can cause severe malfunctions.
- Do not use any radio equipment or mobile phones in the vehicle cab without a proper aerial or in the vicinity of the control electronics!

Electrics and welding

⚠ Caution

Before starting welding work you should disconnect the negative battery pole or interrupt the electric circuit with the main battery switch, disconnect the generator and pull the plugs off all control units in order to protect the electrical system of the machine.

- Disconnect the minus pole of the battery or interrupt the electric circuit with the main battery switch.
- Isolate the generator and all control units from the electric circuit.
- Always fasten the earth clamp of the welding unit in the immediate vicinity of the welding location.
- When choosing the location for the earth clamp make sure that the welding current will not pass through joints or bearings.

Battery

Rules for the handling of batteries

When removing a battery always disconnect the minus pole before the plus pole. When installing the battery connect the minus pole after the plus pole to avoid short circuits.

Fasten the terminal clamps with a little force as possible.

Always keep battery poles and terminal clams clean to avoid high transition resistances when starting and the related development of heat.

Make sure the battery is properly fastened in the vehicle.

Generator

Before removing the generator you must disconnect the ground cable from the minus pole of the battery while the ignition is switched off. Do not disconnect the generator while the engine is running, because this may cause extremely high voltage peaks in the vehicle wiring system ("Load Dump"), which could possibly damage control units, radios or other electronic equipment.

When disassembling the battery cable, the B+-nut underneath on the generator side may also be loosened. This nut must in this case be retightened.

When connecting e.g. the battery cable to the terminal of the generator you must make sure that the polarity is correct (generator B+ to the + pole of the battery). Mixing up the polarities by mistake causes short circuit and damage to the rectifier elements - the generator will be out of function.

The generator can only be operated with the battery connected. Under special conditions emergency operation without battery is permitted, the lifetime of the generator is in such cases especially limited.

Plus and minus cables must be disconnected during rapid charging of the battery or electric welding on the vehicle.

When cleaning the generator with a steam or water jet make sure not to direct the steam or water jet directly on or into the generator openings or ball bearings. After cleaning the generator should be operated for about 1 - 2 minutes to remove any deposits of water from the generator.

Starter motor

So-called jump starting (using an additional external battery) without the battery connected is dangerous. When disconnecting the cables from the poles high inductivities (arcs, voltage peaks) may occur and destroy the electrical installation.

For purposes like e.g. purging the fuel systems, starters may be operated for maximum 1 minute without interruption. Then you should wait for at least 30 minutes (cooling down) until trying again. During the 1 minute starting period this process should not be interrupted.

Starter motors must not be cleaned with high pressure steam cleaning equipment.

The contacts on starter terminals 30, 45, 50 must be protected against unintended shorting (jump protection).

When replacing the starter the ring gear on the engine flywheel must be checked for damage and its number of teeth - if necessary replace the ring gear.

Always disconnect the battery before starting assembly work in the starter area of the engine or on the starter itself.

Hydraulic system

⚠ Caution

Repair work on hydraulic elements shall only performed by appropriately trained personnel or by the after sales service of BOMAG.

Please note

i Note

Cleanliness is of utmost importance. Dirt and other contaminations must strictly be kept out of the system.

- Connections and screw fittings, filler neck covers and their immediate surrounding areas must be cleaned before removal.
- Before loosening hoses, pipe lines etc. relieve all pressure from the system.
- During repair work keep all openings closed with clean plastic plugs and caps.
- Never run pumps, motors and engines without oil or hydraulic oil.
- When cleaning hydraulic components take care not to damage any fine machine surfaces.
- Chemical and rubber soluble cleansing agents may only be used to clean metal parts. Do not let such substances come in contact with rubber parts.
- Rinse of cleaned parts thoroughly, dry them with compressed air and apply anti-corrosion oil immediately. Do not install parts that show traces of corrosion.
- Avoid the formation of rust on fine machined caused by hand sweat.
- Use new O-rings or seal rings for reassembly.
- Use only hydraulic oil as sliding agent when reassembling. Do not use any grease!
- Use only the specified pressure gauges. Risk of damaging the pressure gauges under too high pressure.
- Check the hydraulic oil level before and after the work.
- Fill in only clean oil as specified in the maintenance instructions.
- Check the hydraulic system for leaks, if necessary find and rectify the cause.
- Before taking new hydraulic components into operation fill these with hydraulic oil as specified in the operating and maintenance instructions.
- After changing a hydraulic component thoroughly flush, refill and bleed the complete hydraulic system.
- Perform measurements at operating temperature of the hydraulic oil (approx. 40 °C).
- After changing a component perform a high and charge pressure test, if necessary check the speed of the exciter shaft.
- The operating pressure of the exciter shaft to a great extent depends on the base under the vibrating drum. On hard ground place the drums on a suitable base and check the drum pressure. Do not activate the vibration on a hard, concreted base, danger of bearing damage.
- After the completion of all tests perform a test run and then check all connections and fittings for leaks with the engine still stopped and the hydraulic system depressurized.

Before commissioning

- Fill the housings of hydraulic pumps and motors with hydraulic oil. Use only hydraulic oils according to the specification in the maintenance instructions.
- After changing a component flush the hydraulic system as described in the flushing instructions.

Taking into operation

- Bleed the hydraulic circuits.
- Start up the hydraulic system without load.
- Check the hydraulic oil level in the tank, if necessary top up with hydraulic oil as specified in the operating and maintenance instructions or drain oil off into a suitable container.

After taking into operation

- Check fittings and flanges for leaks.
- After each repair check all adjustment data, system pressures, rotational speeds and nominal values in the hydraulic system, adjust if necessary.
- Do not adjust pressure relief valves and control valves to values above their specified values.

Air conditioning system

Chemicals/ozone layer regulation

The chemicals/ozone layer regulation, which became effective on 01.12.2006, supplements the still directly applicable regulation (EG) no. 2037/2000 from 29.06.2000 concerning substances, which cause decomposition of the ozone layer and at the same time replaces the previously valid German CFC-halon 0prohibition from 06.05.1991.

Work on air conditioning systems must only be carried out by persons who:

- have proven to have sufficient expert knowledge,
- have the necessary equipment to undertake such tasks,
- are reliable and
- are not any directives regarding their activities when carrying out inspection and maintenance work acc. to § 4 section 2 of the chemical/ozone layer regulation.

The inspection and maintenance tasks, including leak tests and possible repair activities, must be recorded in the operating instructions together with information about the refrigerant quantities used and regained, whereby the operator is obliged to keep these records over a period of at least five years.

i Note

Cleanliness is of utmost importance. Dirt and other contaminations must strictly be kept out of the system.

- Tools used on refrigeration circuits must be of excellent condition, thus to avoid the damage of any connections.
- During repairs on refrigerant lines and components, these must be kept closed, as far as this is possible, to prevent the system from being contaminated by air, moisture and dirt. The operational safety of the system can only be assured as long as all components in the refrigerant circuit are kept internally clean and dry.
- Connections, screw fittings and their immediate surrounding areas must be cleaned before removal.
- Before loosening hoses, pipe lines etc. relieve all pressure from the system.
- During repair work keep all openings closed with clean plastic plugs and caps.
- All parts to be reused should be cleaned with a gasoline free solvent and blow-dried with clean compressed air or dried with a lint-free cloth.
- Before opening all components should have warmed up to ambient temperature, to avoid that damp air is drawn into the component by the difference in temperatures.
- Damaged or leaking parts of the air conditioning must not be repaired by welding or soldering, but must generally be replaced.
- Do not fill up refrigerant, but extract existing refrigerant and refill the system.
- Different types of refrigerant must not be mixed. Only the refrigerant specified for the corresponding air conditioning system must be used.
- Refrigerant circuits with refrigerant type R134a must only be operated with the compressor oil / refrigeration oil approved for the compressor.
- Used compressor oil/refrigeration oil must be disposed of in strict compliance with applicable environmental regulations.
- Due to its chemical properties compressor oil / refrigeration oil must never be disposed of together with engine or transmission oil.
- Compressor oil / refrigeration oil is highly hydroscopic. Oil cans must strictly be kept closed until use. Oil rests should not be used, if the can had been opened over a longer period of time.
- All O-rings/seal rings as well as pipe/ hose fittings must be oiled with compressor/refrigeration oil bfore assembly.
- When replacing a heat exchanger, e.g. evaporator or condenser, any compressor oil/refrigeration oil lost by exchanging the components, must be replaced with fresh oil.
- A too high compressor oil / refrigeration oil level adversely affects the cooling performance and a too low oil level has a negative effect on the lifetime of the compressor.
- Use new O-rings or seal rings for reassembly.
- Always used 2 spanners to work on pipes/hoses to avoid damages .
- Tighten screw fittings with the specified torque.
- Check all pipes/hoses, screw fittings or components for damage, replace if necessary.
- Do not leave the refrigerant circuit unnecessarily open to the atmosphere.
- In case of a repair on the refrigeration system you should first evacuate the air conditioning system for at least 45 minutes to remove any moisture from the system, before you start to refill. Moisture bonded in the compressor oil / refrigeration oil (PAG oil) can only be removed from the system by changing the oil.
- Compressor valves must only be opened after the system has been properly sealed.
- The use of leak detection spray is not permitted. If such substances are used the WARRANTY will become null and void.

- If the air conditioning system had been opened for repair work, a new drier should be installed in the refrigerant circuit.
- After completion of repair work screw locking caps (with seals) on all valve connections service connections.
- Before start up of the air conditioning system after a new filling: - Turn the compressor approx. 10 revolutions by hand using the clutch or V-belt pulley of the magnetic clutch. - Start the engine with the compressor/control valve switched off. - Once the idle speed of the engine has stabilized switch on the compressor and run it for at least 10 minutes at idle speed and maximum cooling power.
- Never run the compressor with an insufficient amount of refrigerant.

Fuel hoses

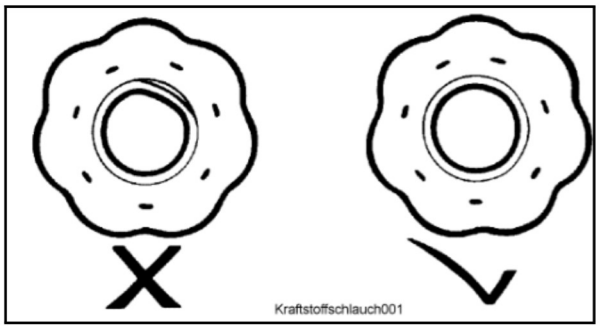

Fig. 1

⚠ Caution

All fuel hoses have two layers of material, a reinforced rubber coating outside and an internal Viton hose. If a fuel hose has come loose one must make absolutely sure that the internal Viton layer has not been separated from the reinforced outer layer. In case of a separation the hose needs to be replaced.

Gaskets and mating surfaces

Leaking sealing faces can mostly be traced back to incorrect assembly of seals and gaskets.

- Before assembling a new seal or gasket make sure that the sealing surface is free of pitting, flutes, corrosion or other damage.
- Inappropriately stored or handled seals (e.g. hanging from hooks or nails) must under no circumstances be used.
- Assemble seals and gaskets only with sealing compound, grease or oil, if this is specifically specified in the repair instructions.
- If necessary remove any old sealing compound before assembling. For this purpose do not use any tools that could damage the sealing surfaces.
- Sealing compound must be applied thin and evenly on the corresponding surfaces; take care that the compound does not enter into oil galleries or blind threaded bores.
- Examine the contact faces for scratches and burrs, remove these with a fine file or an oilstone; take care that no grinding dust and dirt enters into tapped bores or enclosed components.
- Blow out lines, ducts and gaps with compressed air, replace any O-rings and seals that have been dislodged by the compressed air.

Assembly of radial seals

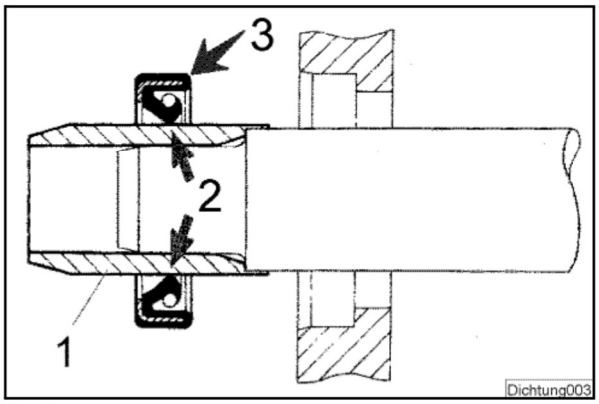

Fig. 2

- Lubricate the sealing lips (2) (Fig. 2) with clean grease; in case of double seals fill the space between the sealing lips with a generous amount of grease.
- Slide the seal over the shaft, with the lip facing towards the fluid to be sealed.

i Note

If possible, use an assembly sleeve (1 (Fig. 2)), ***to protect the lip from being damaged by sharp edges, threads or splines.*** *If no assembly sleeve is available, you should use a plastic tube or adhesive tape to prevent the sealing lip from being damaged.*

- Lubricate the outer rim (arrow 3 (Fig. 2)) of the seal and press it flat on the housing seat.

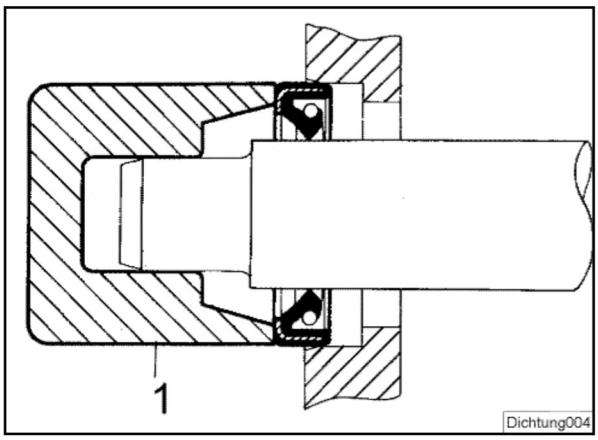

Fig. 3

- Press or knock the seal into the housing, until it is flush with the housing surface.

i Note

If possible, use a "bell" (1 (Fig. 3)), to make sure ***that the seal will not skew.*** *In some cases it may be advisable to assemble the seal into the housing first, before sliding it over the shaft. Under no circumstances should the full weight of the shaft rest on the seal.*

If you have no proper service tools at hand, use a suitable drift punch with a diameter which is about 0,4 mm smaller than the outer diameter of the seal. Use VERY LIGHT blows with the hammer if no press is available.

Feather keys and keyways

⚠ Caution

Feather keys may only be reused if they are free of damage.

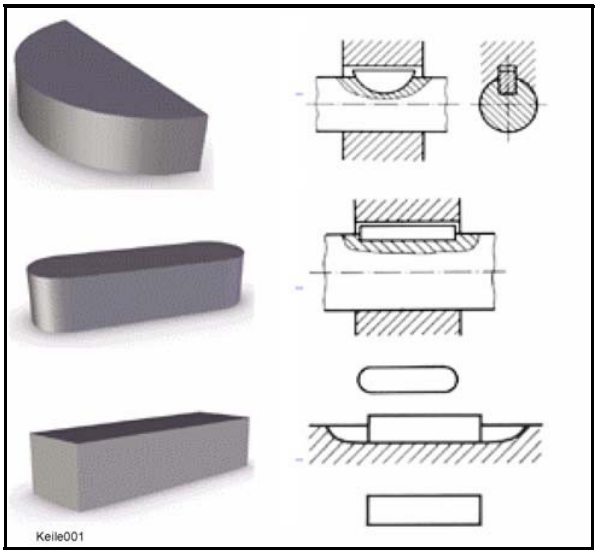

Fig. 4

- Clean and thoroughly examine the feather key.
- Deburr and thoroughly clean the edges of the keyway with a fine file before reassembling.

Ball and roller bearings

⚠ Caution

Ball and roller bearings may only be reused if they are free of damage and do not show any signs of wear.

Fig. 5

- If a ball or roller bearing of a bearing pair shows defects, both ball or roller bearings need to be replaced.
- Remove any lubricant residues from the ball or roller bearing to be examined by washing it with gasoline or any other appropriate degreasing agent. Ensure strict cleanliness.
- Check balls or rollers, running surfaces, outer faces of outer races and inner faces of inner races for visible damage. Replace the ball or roller bearing if necessary.
- Check the ball or roller bearing for clearance and resistance between the inner and outer races, replace if necessary.
- Lubricate the ball or roller bearing with the recommended type of grease before assembly or reassembly.
- On greased bearings (e.g. wheel bearings) fill the space between ball or roller bearing and outer seal with the recommended type of grease before assembling the seal.

- Check shaft and bearing housing for discolouration or other signs of movement between ball or roller bearing and seats.
- Make sure that shaft and housing are free of burrs before assembling the ball or roller bearing.
- Always mark the individual parts of separable ball or roller bearings (e.g. taper roller bearings) to enable correct reassembling. Never assemble the rollers to an outer race that has already been used, replace the complete ball or roller bearing instead.

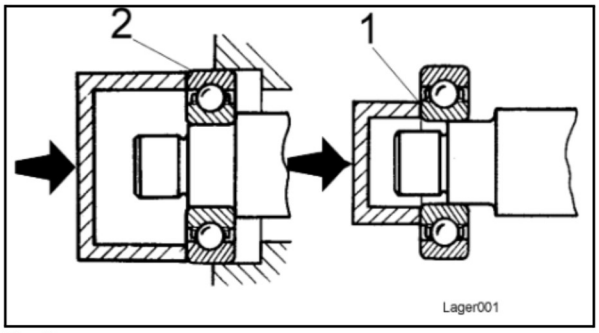

Fig. 6

⚠ Caution

When assembling the ball or roller bearing to the shaft load must only be applied to the inner race 1 (Fig. 6).

When fitting the bearing into the housing load must only be applied to the outer race (2).

Screws and nuts

Tightening torque

⚠ Caution

Tighten nuts or screws with the tightening torques specified in the following tables of tightening torques. Tightening torques deviating from the ones in the table are specially mentioned in the repair instructions.

Damaged screws must under no circumstances be used any longer. Recutting threads with thread cutters or taps adversely affects the strength and leak tightness of the screw joint. Damaged or corroded thread pitches can cause incorrect torque value readings.

Self-locking nuts must generally be replaced after disassembly.

The use of screws with too high strength can cause damage!

- Nut of a higher strength can generally be used instead of nuts of a lower strength classification.
- When checking or retightening screw joints to the specified tightening torque you should first relieve by a quarter turn and then tighten to the correct torque.
- Before tightening you should lightly oil the thread, in order to ensure low friction movement. **The same applies for self-locking nuts.**
- Make sure that no oil or grease will enter into blind tapped bores. The hydraulic power generated when turning in the screw could cause breakage of the effected part.

Strength classes, metric screws

The strength classes (from 3.6 to 12.9) are specified for all strength classes from a nominal diameter of 5mm. The corresponding identification can be found where allowed for by the shape of the screw.

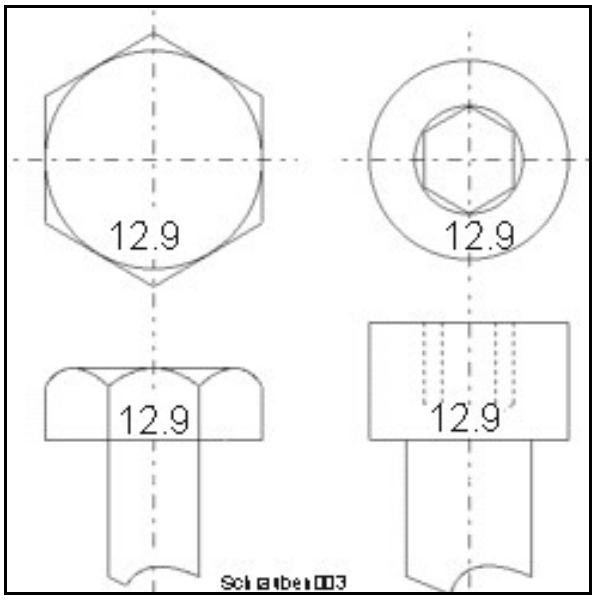

Fig. 7 Identification of screws

Example: A screw is identified with 12.9.

The first number corresponds with 1/100 of the nominal tensile strength (minimum tensile strength) in N/mm^2.

- The nominal tensile strength is 12 X 100 N/mm^2 = 1200 N/mm^2.

The second number specifies 10-times the ration between lower yield point and nominal tensile strength (yield point ratio).

i Note

When exceeding the lower yield point, the material will return to its original shape when being relieved (plastic deformation).

When exceeding the upper yield point the material will not restore its original shape after being relieved.

- The lower tensile strength is 9/10 X 1200 N/mm^2 = 1080 N/mm^2.

i Note

However, these values are by no means identical with the tightening torques, which are to be set on a torque wrench. The corresponding calculation requires a higher effort and, in the end, depends on the materials to be bolted together.

Strength classes of metric nuts

Nuts are differentiated by three load groups. Each load group has a special designation system for the strength class assigned, so that the load group can be clearly identified.

Nuts for screw joints with full load capability (4, 5, 6, 8, 10, 12)

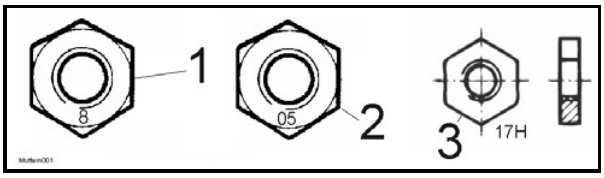

Fig. 8 Identification of nuts

In a connection with a screw, these nuts 1 (Fig. 8) must be able to bear the full pre-load at the yield point.

Nut height above 0.8 d (d = nominal dimension).

Strength class of nut	Strength class of associated screw
4	3.6, 4.6, 4.8
5	3.6, 4.6, 4.8 5.6, 5.8
6	6.8
8	8.8
9	9.8
10	10.8
12	12.8

Nuts for screw joints with limited load factor (04, 05)

The preceding "0" indicates that, due to their low height, nuts 2 (Fig. 8) in this group are only able to withstand the force of a screw to a limited extent.

Nut height below 0,8 d (d = nominal dimension).

Nuts for screw joints without specified load factor (11H, 14H, 17H, 22H)

This standard contains strength classes (hardness classes) for nuts 3 (Fig. 8), for which no load values can be specified, e.g. because of their shape and dimensions, but which can only be classified by their hardness.

Nut height below 0,5 d (d = nominal dimension).

Identification in clock system

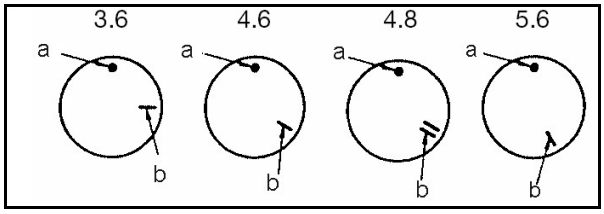

Fig. 9 Identification of nuts in clock system

For small nuts (Fig. 9) the clock system can be used for identification.

- The 12 o'clock position is identified by a dot or the manufacturer's symbol.
- The strength class is identified by a dash (b).

Identification of UNF-threads

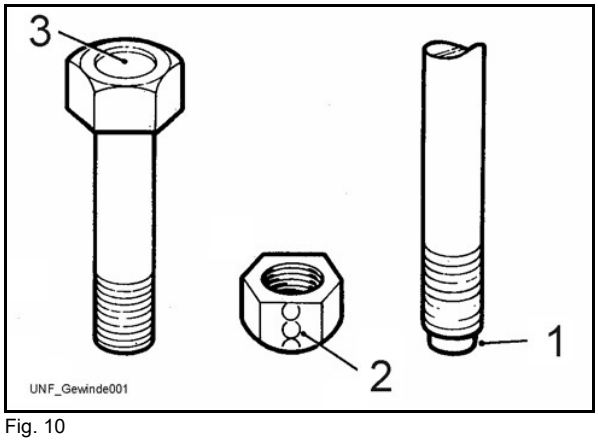

Fig. 10

Screws

The screw head is marked with a stamped in, round cavity 3 (Fig. 10).

Nuts

An uninterrupted series of stamped in circles parallel to the axis of the nut on a hexagon area (2).

Studs and brake rods

At the outmost end a short end of the component is reduced to its core diameter (1).

Cotter pins

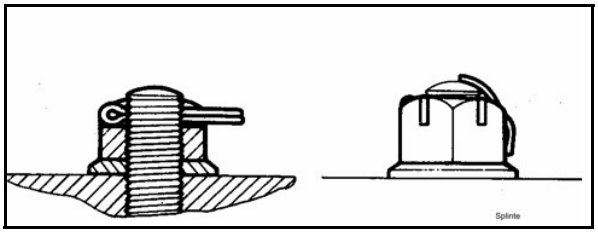

Fig. 11

In places where cotter pins are used, these must be reassembled. Cotter pins must generally be renewed after disassembly.

Cotter pins must be assembled as shown in the illustration, unless specified differently.