BOMAG
FAYAT GROUP

Service Training

BW 174 APO-4i / BW 174 AP-4i / BW 174 ACP-4i AM / BW 174 AP-4i AM

S/N 101 870 56 1001> / S/N 101 870 75 1001> / S/N 101 870 90 1001> / S/N 101 870 92 1001> /
S/N 101 870 17 1001> / S/N 101 870 76 1001> / S/N 101 870 91 1001> / S/N 101 870 93 1001>

Tandem vibratory roller

008 923 11

Table of contents

Table of contents

Table of contents

Table of contents

Table of contents

1 General

1.1 General

General

This manual:

- addresses the BOMAG customer service or professionally trained personnel.
- explains the design of the machine and its functions.
- serves as
  - document to be used during the training course
  - reference book for the purpose of repeating or deepening the training contents you have learned.

This manual describes components, assemblies and the essential functions of the machine. (As far as required for the BOMAG After Sales Service)

Index

The index is a reference register that will help you to find information in this Service Manual. The index lists keywords in alphabetical order. Cross references (keywords related to page numbers) enable quick and convenient search/navigation.

Keywords concerning the following subjects are listed in the index:

- Electrical operating means
- Plug designations
- Overviews
- Fault codes
- Troubleshooting
- ...

Documentation

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

- Operating and maintenance instructions
- Spare parts catalogue
- Service information (if necessary)

Genuine BOMAG spare parts

Use only genuine BOMAG spare parts.

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

Updating service

This manual is not subject of an updating service. For this reason we would like to draw your attention to the additionally published service informations.

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.

Copyright

1.2 Concerning your safety

1.2.1 General prerequisites

1.2.1.1 General

This BOMAG machine has been built in compliance with the latest technical standard and complies with the applicable regulations and technical rules.

However, dangers for persons and property may arise from this machine, if:

- it is used for purposes other than the ones it is intended for,
- it is operated by untrained personnel,
- it is changed or converted in an unprofessional way,
- the safety instructions are not observed.

Each person involved in the operation, maintenance and repair of the machine must therefore read and comply with these safety regulations. If necessary, the operating company must obtain the relevant signatures as confirmation.

Furthermore, the following obviously also applies:

- applicable accident prevention instructions,
- generally accepted safety and road traffic regulations,
- country specific safety regulations.

It is the duty of the operator to be acquainted with the safety regulations and to apply these accordingly. This also applies for local regulations and regulations concerning different types of handling activities. Should the recommendations in these instructions be different from the regulations valid in your country, you must comply with the safety regulations valid in your country.

1.2.1.2 Explanation of signal words used:

DANGER!

Danger to life if failing to comply!

Sections marked accordingly indicate an extremely dangerous situation that could lead to fatal or severe injuries, if this warning is disregarded.

WARNING!

Danger to life or danger of severe injuries if failing to comply!

Sections marked accordingly indicate a dangerous situation that could lead to fatal or severe injuries, if this warning is disregarded.

CAUTION!

Danger of injury if failing to comply!

Sections marked accordingly indicate a dangerous situation that could lead to fatal or severe injuries, if this warning is disregarded.

NOTICE!

Danger of material damage if failing to comply!

Sections marked accordingly indicate possible dangers for machines or components.

Sections marked accordingly indicate technical information or notes on using the machine or its components.

ENVIRONMENT!

Environmental damage if failing to comply!

Paragraphs marked accordingly indicate practices for safe and environment-friendly disposal of fuels and lubricants as well as replacement parts.

1.2.1.3 Personal protective equipment

Depending on the work to be carried out, personal protective equipment is required (to be provided by the operating company):

	Working clothes	Tight fitting working clothes with low tear resistance, tight sleeves and without any projecting parts protect against being caught by moving components.
	Safety shoes	To protect against heavy falling parts and slipping on slippery ground.
	Protective gloves	To protect the hands against excoriation, punctures or deep injuries, against irritating and caustic substances as well as against burns.

	Safety goggles	To protect the eyes against airborne particles and squirting fluids.
	Face protection	To protect the face against airborne particles and squirting fluids.
	Hard hat	To protect the head against falling parts and to protect against injuries.
	Hearing protection	To protect the hearing against too loud noise.

1.2.1.4 Intended use

This machine must only be used for:

- Compaction of bituminous material, e.g. road surface layers,
- Compaction work in earth construction and road bases.

Intended use also includes compliance with the specified operating, maintenance and repair measures.

1.2.1.5 Improper use

Dangers may arise from the machine when it is used for purposes other than the one it is intended for.

Any danger caused by improper use is the sole responsibility of the operating company or driver/operator, the manufacturer cannot be made liable.

Examples for improper use are:

- work with vibration on hard concrete, cured bitumen layers or extremely frozen ground
- cleaning the drums while driving or changing nozzles during travel
- driving on subsoils with too low load bearing capacity
- driving on slippery subsoils (e.g. ice and snow)
- driving on surfaces of insufficient size (danger of turning over)
- unauthorized use of public roads
- using the machine for towing

Transporting persons, except the machine driver, is prohibited.

Starting and operating the machine in explosive environments and in underground mining is prohibited.

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Examples for improper use are:

- work with vibration/oscillation on hard concrete, cured bitumen layers or extremely frozen ground
- cleaning the drums while driving or changing nozzles during travel
- driving on subsoils with too low load bearing capacity
- driving on slippery subsoils (e.g. ice and snow)
- driving on surfaces of insufficient size (danger of turning over)
- unauthorized use of public roads
- using the machine for towing

Transporting persons, except the machine driver, is prohibited.

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1.2.2 Definition of responsible persons

1.2.2.1 Operating company

The operating company is the natural or juridical person who uses the machine or in who's name the machine is used.

The operating company must make sure that the machine is only used for the purpose it is intended for and in strict compliance with the safety regulations mentioned in these operating and maintenance instructions.

The operating company must determine and assess the danger in its company. It must then take appropriate action to ensure health and safety at work for its employees and point out any remaining dangers.

The operating company must determine whether there are special operational hazards such as a toxic atmosphere or limiting soil conditions. Such conditions require special, additional measures to remove or reduce the hazard.

The operating company must make sure that all users read and understand the information concerning safety.

The operating company is responsible for the planning and professional execution of regular safety inspections.

1.2.2.2 Expert / qualified person

An expert / qualified person is a person who, based on his/her professional education and experience, has profound knowledge in the field of construction equipment and the machine in question in particular.

This person is acquainted with the applicable governmental industrial safety regulations, accident prevention instructions, guidelines and generally acknowledged technical rules and regulations (standards, directives, technical rules of other member states of the European Union or other contractual states concerning the agreement about the European Economic Area) in as far as is necessary to be able to judge the safe condition of this machine.

1.2.2.3 Driver / operator

This machine must only be operated by trained, instructed persons entrusted by the operating company aged 18 or more.

Observe your local laws and regulations.

Rights, obligations and rules of conduct for driver or operator:

The driver or operator must:

- be instructed about his rights and obligations,
- wear protective equipment as appropriate for the application,
- have read and understood the operating instructions,
- have made himself familiar with the operation of the machine,
- be physically and psychologically able to drive and operate the machine.

Persons under the influence of alcohol, medication or drugs are not allowed to operate, service or repair the machine.

Maintenance and repair work requires specific knowledge and must therefore only be performed by trained specialists.

1.2.3 Fundamentals for safe operation

1.2.3.1 Remaining dangers, remaining risks

Despite careful work and compliance with standards and regulations it cannot be ruled out that further dangers may arise when working with and handling the machine.

Both the machine as well as all other system components comply with the currently valid safety regulations. Nevertheless, remaining risks cannot be ruled out completely, even when using the machine for the purpose it is intended for and following all information given in the operating instructions.

A remaining risk can also not be excluded beyond the actual danger zone of the machine. Persons remaining in this area must pay particular attention to the machine, so that they can react immediately in case of a possible malfunction, an incident or failure etc.

All persons remaining in the area of the machine must be informed about the dangers that arise from the operation of the machine.

1.2.3.2 Regular safety inspections

Have the machine inspected by an expert / qualified person as required for the conditions the machine is working under, but at least once every year.

1.2.3.3 Modifications and alterations to the machine

Unauthorized changes to the machine are prohibited for safety reasons.

Original parts and accessories have been specially designed for this machine.

We wish to make explicitly clear that we have not tested or approved any parts or accessories not supplied by us.

The installation and/or use of such products may have an adverse effect on the active and/or passive safety.

1.2.3.4 Damage, defects, misuse of safety devices

Machines which are not safe to operate or in traffic must be immediately taken out of service and shall not be used, until these deficiencies have been properly rectified.

Safety installations and switches must neither be removed nor must they be made ineffective.

1.2.3.5 Roll Over Protective Structure (ROPS)

On machines with cab the ROPS is an integral part of the cab.

The frame of the machine must not be warped, bent or cracked in the area of the ROPS fastening.

The ROPS must not show any rust, damage, hairline cracks or open fractures.

The real machine weight must never exceed the testing weight for the ROPS.

No accessories may be welded or bolted on and no additional holes must be drilled without the consent of the manufacturer, since this will impair the strength of the unit.

The ROPS must therefore also not be straightened or repaired if it is damaged.

A defect ROPS must generally be replaced with an original spare part in close coordination with the manufacturer.

1.2.4 Handling fuels and lubricants

1.2.4.1 Preliminary remarks

The operating company must ensure that all professional users have read and follow the corresponding safety data sheets for the individual fuels and lubricants.

Safety data sheets provide valuable information about the following characteristics:

- name of substance
- possible dangers
- composition / information on constituents
- first-aid measures
- fire fighting measures
- measures in case of accidental release
- handling and storage
- limitation and monitoring of exposure / personal protective equipment
- physical and chemical properties
- stability and reactivity
- toxicological data
- environmental data
- notes on waste disposal
- information on transport
- legislation
- other data

1.2.4.2 Safety regulations and environmental protection regulations for handling diesel fuel

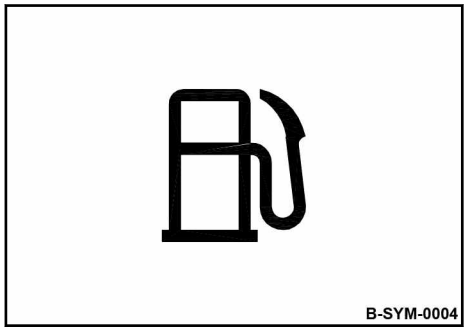


Fig. 1

WARNING!

Danger of burning by ignited diesel fuel!

– Do not allow diesel fuel to come into contact with hot components.
– Smoking and open fire is prohibited!
– Wear your personal protective equipment (protective gloves, protective clothing).

CAUTION!

Health hazard caused by contact with diesel fuel!

– Wear your personal protective equipment (protective gloves, protective clothing).
– Do not inhale any fuel fumes.
– Avoid contact.

CAUTION!

Danger of slipping on spilled diesel fuel!

– Immediately bind spilled diesel fuel with an oil-binding agent.

ENVIRONMENT!

Diesel fuel is an environmentally hazardous substance!

– Always keep diesel fuel in proper containers.
– Immediately bind spilled diesel fuel with an oil-binding agent and dispose of properly.
– Dispose of diesel fuel and fuel filters according to regulations.

1.2.4.3 Safety regulations and environmental protection regulations for handling oil

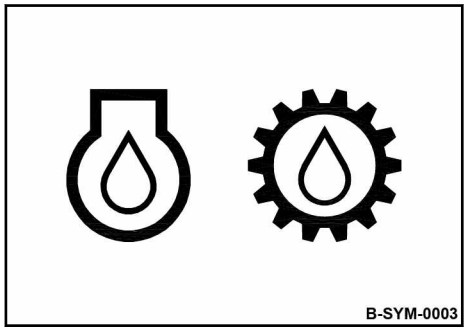


Fig. 2

WARNING!

Danger of burning by ignited oil!

– Do not allow oil to come into contact with hot components.
– Smoking and open fire is prohibited!
– Wear your personal protective equipment (protective gloves, protective clothing).

CAUTION!

Health hazard caused by contact with oil!

– Wear your personal protective equipment (protective gloves, protective clothing).
– Do not inhale any oil vapours.
– Avoid contact.

CAUTION!

Danger of slipping on spilled oil!

– Immediately bind spilled oil with an oil-binding agent.

ENVIRONMENT!

Oil is an environmentally hazardous substance!

– Always keep oil in proper containers.
– Immediately bind spilled oil with an oil-binding agent.
– Dispose of oil and oil filter according to regulations.

1.2.4.4 Safety regulations and environmental protection regulations for handling hydraulic oil

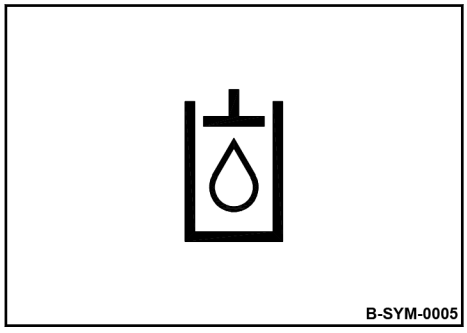


Fig. 3

WARNING!

Danger of injury caused by escaping pressure fluid!

– Always depressurize the hydraulic system before starting work in the hydraulic system.
– Wear your personal protective equipment (protective gloves, protective clothing, goggles).

Should pressure fluid penetrate the skin, immediate medical help is required.

WARNING!

Danger of burning by ignited hydraulic oil!

– Do not allow hydraulic oil to come into contact with hot components.
– Smoking and open fire is prohibited!
– Wear your personal protective equipment (protective gloves, protective clothing).

CAUTION!

Health hazard caused by contact with hydraulic oil!

– Wear your personal protective equipment (protective gloves, protective clothing).
– Do not inhale any oil vapours.
– Avoid contact.

CAUTION!

Danger of slipping on spilled oil!

– Immediately bind spilled oil with an oil-binding agent.

ENVIRONMENT!

Oil is an environmentally hazardous substance!

– Always keep oil in proper containers.
– Immediately bind spilled oil with an oil-binding agent.
– Dispose of oil and oil filter according to regulations.

1.2.4.5 Safety regulations and environmental protection regulations for handling coolants

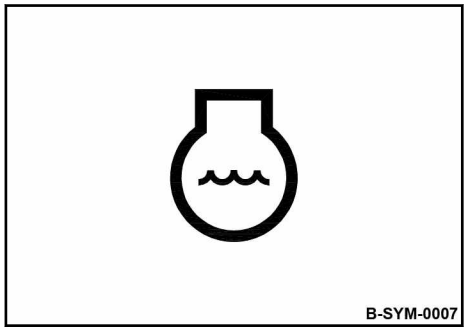


Fig. 4

WARNING!

Danger of scalding by hot fluid!

– Open the compensation tank only when the engine is cold.
– Wear your personal protective equipment (protective gloves, protective clothing, goggles).

CAUTION!

Health hazard caused by contact with coolant and coolant additives!

– Wear your personal protective equipment (protective gloves, protective clothing).
– Do not inhale any fumes.
– Avoid contact.

CAUTION!

Danger of slipping on spilled coolant!

– Immediately bind spilled coolant with an oil-binding agent.

ENVIRONMENT!

Coolant is an environmentally hazardous substance!

– Always keep coolant and coolant additives in proper containers.
– Immediately bind spilled coolant with an oil-binding agent and dispose of it according to regulations.
– Dispose of coolant according to regulations.

1.2.4.6 Safety regulations and environmental protection regulations for handling battery acid

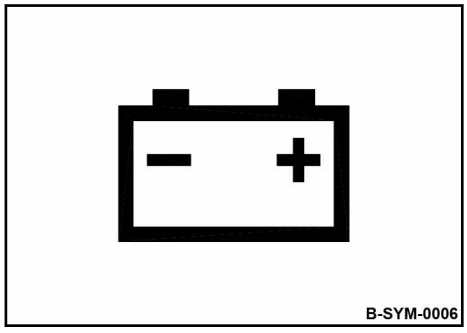


Fig. 5:

WARNING!

Danger of cauterization with acid!

- Wear your personal protective equipment (protective gloves, protective clothing, goggles).
- Do not allow clothes, skin or eyes to come into contact with acid.
- Rinse off spilled battery acid immediately with lots of water.

Rinse acid off clothes, skin or eyes immediately with lots of clean water.

Immediately call for medical advice in case of cauterization.

WARNING!

Danger of injury caused by exploding gas mixture!

- Remove the plugs before starting to recharge the battery.
- Ensure adequate ventilation.
- Smoking and open fire is prohibited!
- Do not lay any tools or other metal objects on the battery.
- Do not wear jewellery (watch, bracelets, etc.) when working on the battery.
- Wear your personal protective equipment (protective gloves, protective clothing, goggles).

ENVIRONMENT!

Battery acid is an environmentally hazardous substance!

- Dispose of battery and battery acid according to regulations.

1.2.5 Emergency procedures

1.2.5.1 Actuating the emergency stop switch

In events of emergency and in case of danger actuate the emergency stop switch immediately.

The machine is braked immediately, the engine is shut down.

Restart the machine only after the danger that caused the actuation of the emergency stop switch has been eliminated.

In case of frequent use the wear on the multi-discs brakes will be very high, you should therefore never use the emergency stop switch as a service brake.

1.2.5.2 Disconnecting the battery

In events of emergency, e.g. in case of a cable fire, disconnect the battery from the vehicle network.

Pull out the main battery switch or lift off the battery pole to do so.

1.2.5.3 Towing the machine

Tow the machine only in case of emergency or to avoid an accident.

Before releasing the parking brake apply suitable measures to secure the machine against unintended rolling.

Use a tractor vehicle with sufficient traction and braking power for the unbraked towed load.

You should generally use a tow bar.

Before starting towing operations make sure that the fastening means are able to withstand the load and are fastened at the points provided for this purpose.

Before removing the towing facility apply appropriate measures to secure the machine against unintended rolling.

1.2.6 Regeneration of exhaust gas aftertreatment system

During regeneration, the exhaust gas reaches very high temperatures and the exhaust gas quantity increases - fire hazard!

Components of the exhaust gas aftertreatment system get very hot.

Do not touch hot components or exhaust gases.

Ensure an adequate supply of fresh air.

Keep a safe distance to combustible or explosive materials.

When performing regeneration at standstill, park the machine outdoors at a safe distance from any combustible or explosive materials.

1.2.7 Parking the machine in secured condition

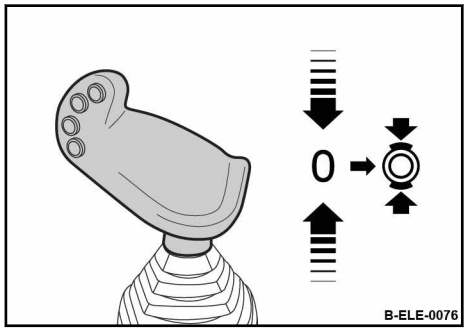


Fig. 6

1. Drive the machine onto level and firm ground.
2. To stop the machine return the travel lever to “Middle” position and shift it to the right to lock (parking brake position).
   ⇨ The parking brake warning light lights up.

NOTICE!

Danger of engine damage!

– Do not shut down the engine all of a sudden from full load speed, but let it idle for about two minutes.

If regeneration is running, switch the engine off only after regeneration has finished (warning light for regeneration off).

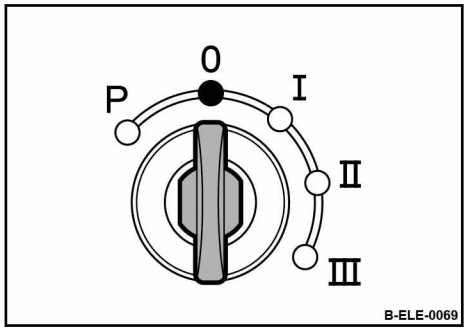


Fig. 7

3. Turn the ignition key to position “0” and pull it out.
4.

WARNING!

Severe injury caused by uncontrolled opening of the maintenance door

– Never open the maintenance door in slanted position.
– Do not stand in the swing-out area of the maintenance door.

Open the left hand maintenance door.

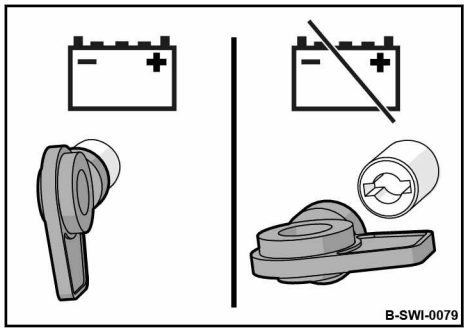


Fig. 8

5. Turn the main battery switch anticlockwise and pull it out.
6. Close the left maintenance door.

1.2.8 Maintenance work

1.2.8.1 Preliminary remarks

Adhere to the specified operating, maintenance and repair measures.

The machine must only be serviced by qualified and authorized personnel.

Keep unauthorized persons away from the machine.

Perform maintenance work only with the engine shut down.

Make sure that the engine cannot be accidentally started during maintenance work.

1.2.8.2 Work on hydraulic lines

Relieve hydraulic pressures before working on hydraulic lines. Hydraulic oil escaping under pressure can penetrate the skin and cause severe injury. Immediately call for medical advice when injured by hydraulic oil.

Do not step in front of or behind the machine when performing adjustment work in the hydraulic system.

Do not change the setting of pressure relief valves.

Drain the hydraulic oil at operating temperature – danger of scalding!

Any hydraulic oil must be collected and disposed of in an environmentally friendly way.

Always collect and dispose of hydraulic oils separately.

Do not start the engine after draining the hydraulic oil. Once all work is completed (with the system still depressurized!) check all connections and fittings for leaks.

Hydraulic hoses must be visually inspected at regular intervals.

Do not mix up hoses by mistake.

Only genuine BOMAG replacement hydraulic hoses ensure that the correct hose type (pressure range) is used at the right location.

1.2.8.3 Working on the engine

Do not work on the fuel system while the engine is running - danger to life due to high pressures!

Wait until the engine has stopped, then wait approx. another 15 minutes.

Keep out of the danger zone during the initial test run.

In case of leaks return to the workshop immediately.

Drain the engine oil at operating temperature – danger of scalding!

Wipe off spilled oil, collect leaking oil and dispose of it in an environmentally friendly way.

Store used filters and other oil contaminated materials in a separate, specially marked container and dispose of them in an environmentally friendly way.

The settings for idle speed and highest speed must not be changed, since this would affect the exhaust gas values and cause damage to engine and power train.

Engine and exhaust system work at high temperatures. Keep combustible materials away and do not touch any hot surfaces.

Check and change coolant only when the engine is cold. Collect coolant and dispose of it in an environmentally friendly way.

1.2.8.4 Maintenance work on electric components and battery

Before starting to work on electric parts of the machine disconnect the battery and cover it with insulating material.

Do not use fuses with higher ampere ratings and do not bridge fuses.

When working on the battery, smoking or open fire is prohibited!

Do not lay any tools or other metal objects on the battery.

Do not wear jewellery (watch, bracelets, etc.) when working on the battery.

The connection cables of the battery must not touch or rub against machine parts.

1.2.8.5 Working on the air conditioning

Faults on the air conditioning should only be remedied by authorized service personnel.

Do not perform welding work in the vicinity of the air conditioning. Danger of explosion!

Do not clean the condenser in the air conditioning system with a hot water jet. Danger of explosion!

Do not release refrigerant into the atmosphere, but dispose of it in an environmentally friendly way.

1.2.8.6 Working on wheels and tyres

Explosion-like bursting of tyres or parts of tyres and rims can cause most severe or even fatal injuries.

Do not drive with damaged wheels or tyres.

Install the tyres only if you are sufficiently experienced and with the right tools at hand. If necessary have the tyres assembled in a qualified workshop.

Always ensure the correct tyre pressure and do not exceed the specified maximum pressure.

When checking the tyre pressure stand in the extended path of the tyre track. Use an at least 6 meter air hose, so that you can keep a safe distance to the tyre.

Always consider the heavy weight of a wheel during disassembly and assembly. Use a crane or forklift truck equipped with suitable claws or a belt-type hoisting device.

1.2.8.7 Cleaning work

Do not perform cleaning work while the motor is running.

Allow the engine to cool down before starting cleaning work on engine and exhaust system.

Never use gasoline or other easily inflammable substances for cleaning.

When cleaning with a high pressure cleaner, do not subject electrical parts and insulation material to the direct jet of water, or cover them beforehand.

Do not guide the water jet into the exhaust pipe and into the air filter.

1.2.8.8 After maintenance work

Reassemble all guards and protective devices.

Close all maintenance flaps and maintenance doors again.

1.2.9 Repair

Identify a defective machine with a warning sign.

Only operate the machine after it has been repaired.

Repairs must only be performed by an expert/qualified person.

When replacing safety relevant components, only original spare parts must be used.

1.2.10 Signage

Keep stickers and signage in good and legible condition and comply with their meaning.

Replace damaged and illegible stickers or signage immediately.

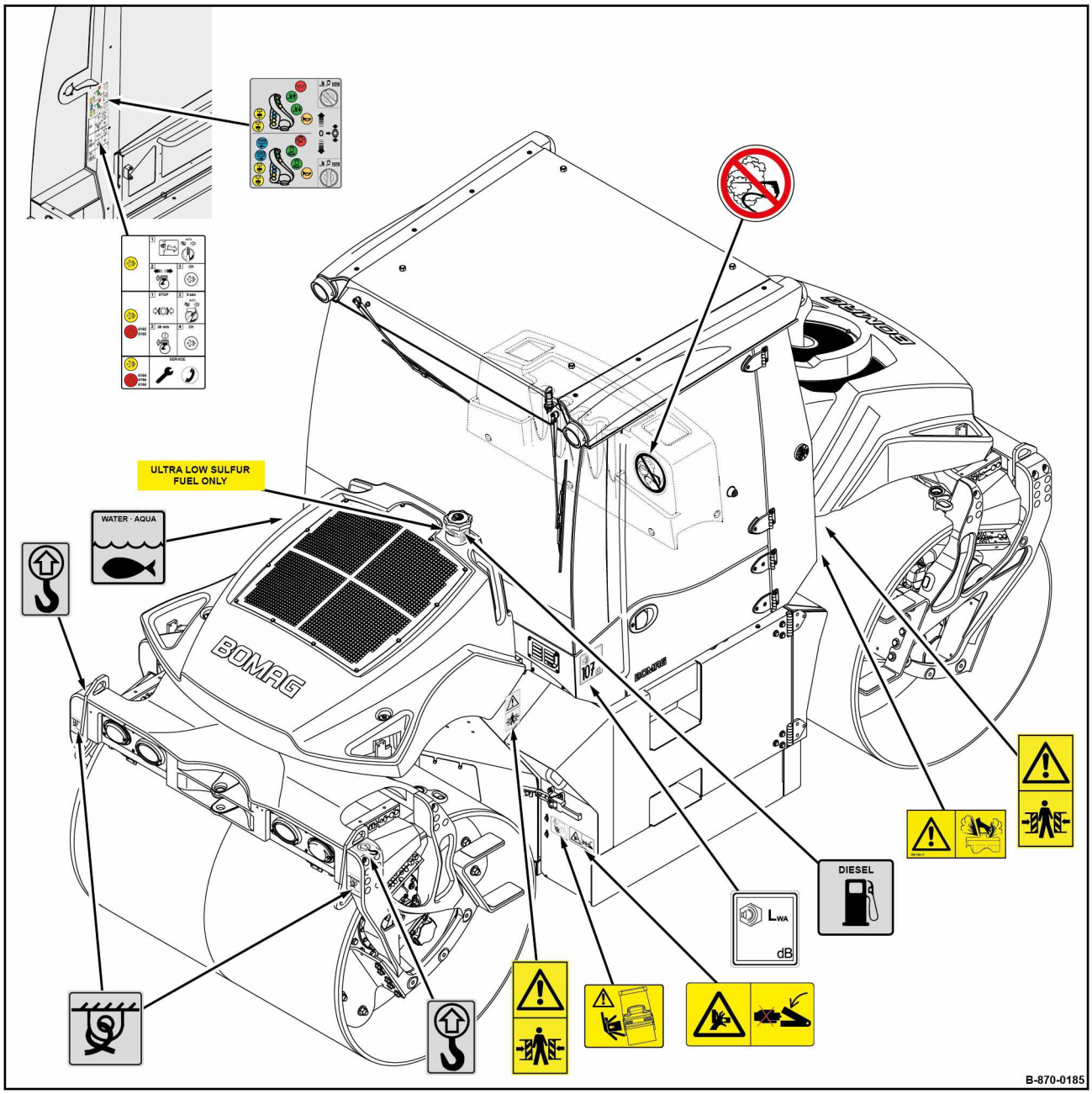


Fig. 9: Signage on the machine, outside left

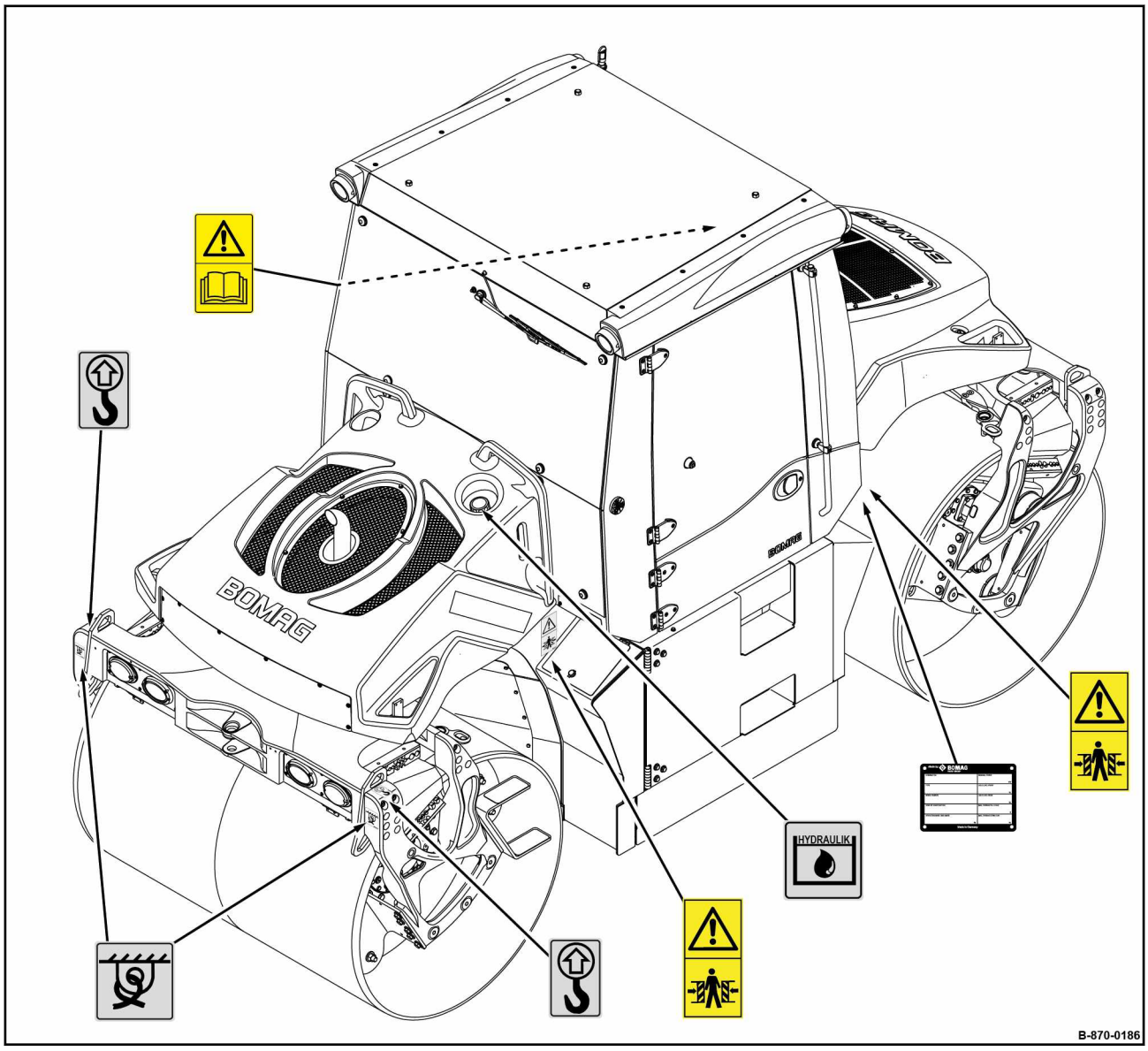


Fig. 10: Signage on the machine, outside right

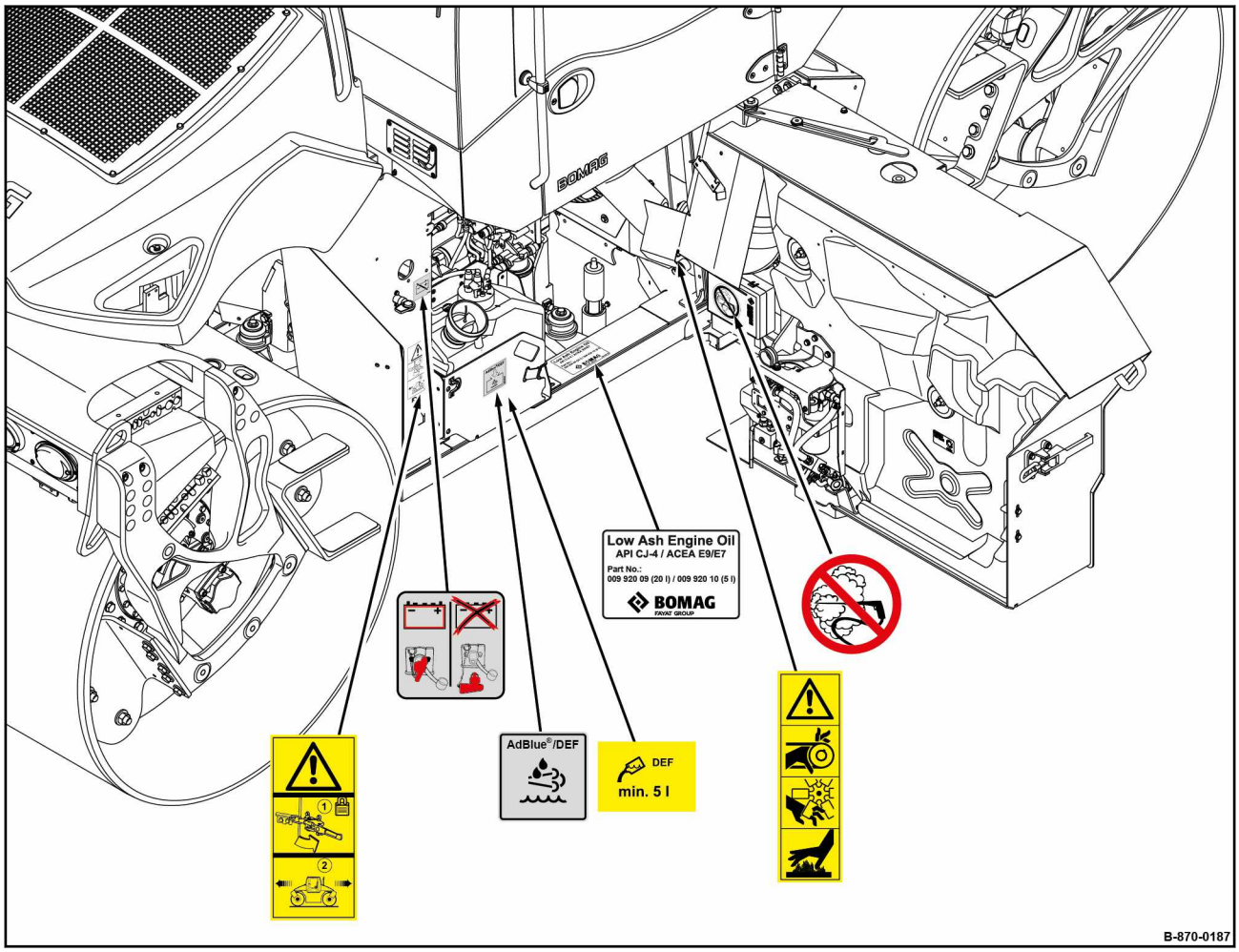


Fig. 11: Signage in the engine compartment, left

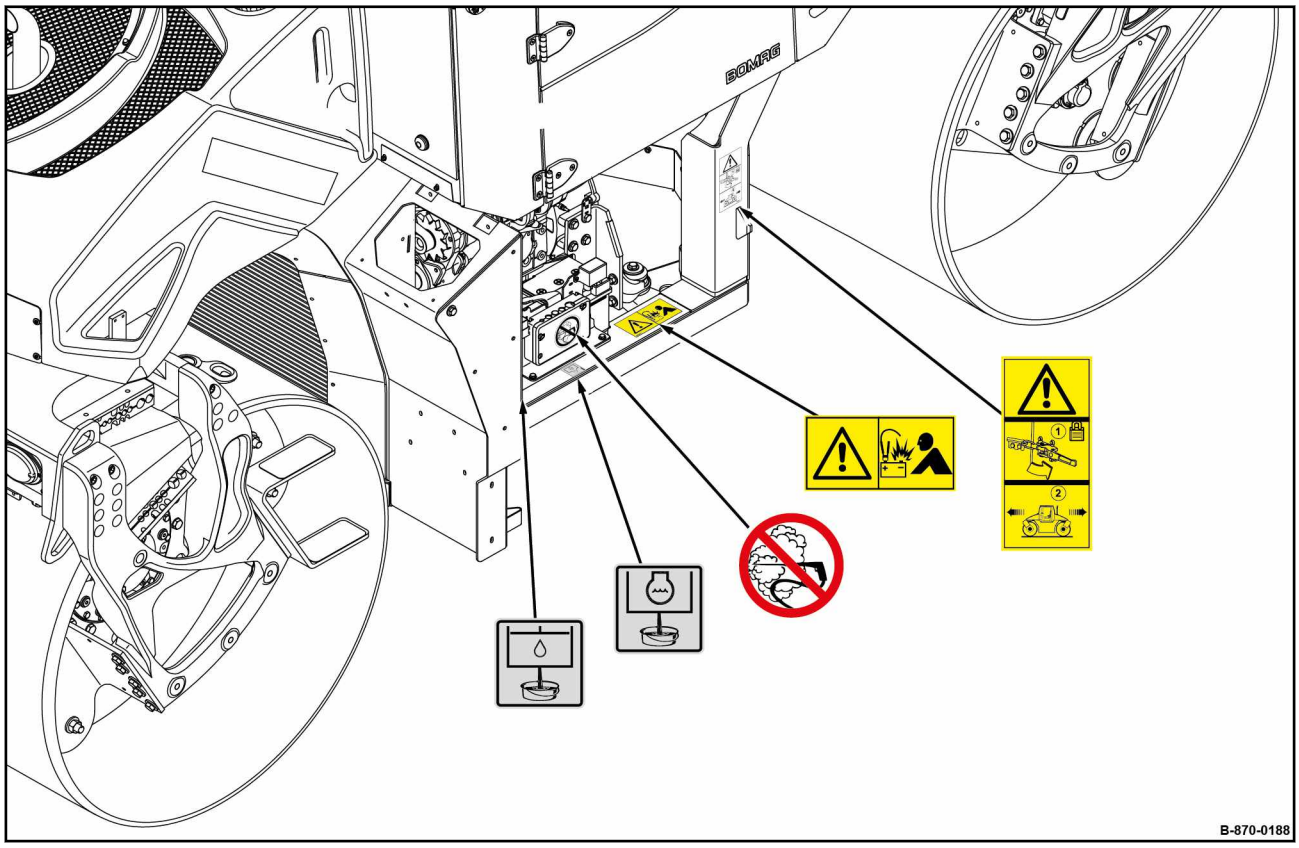


Fig. 12: Signage in the engine compartment, right

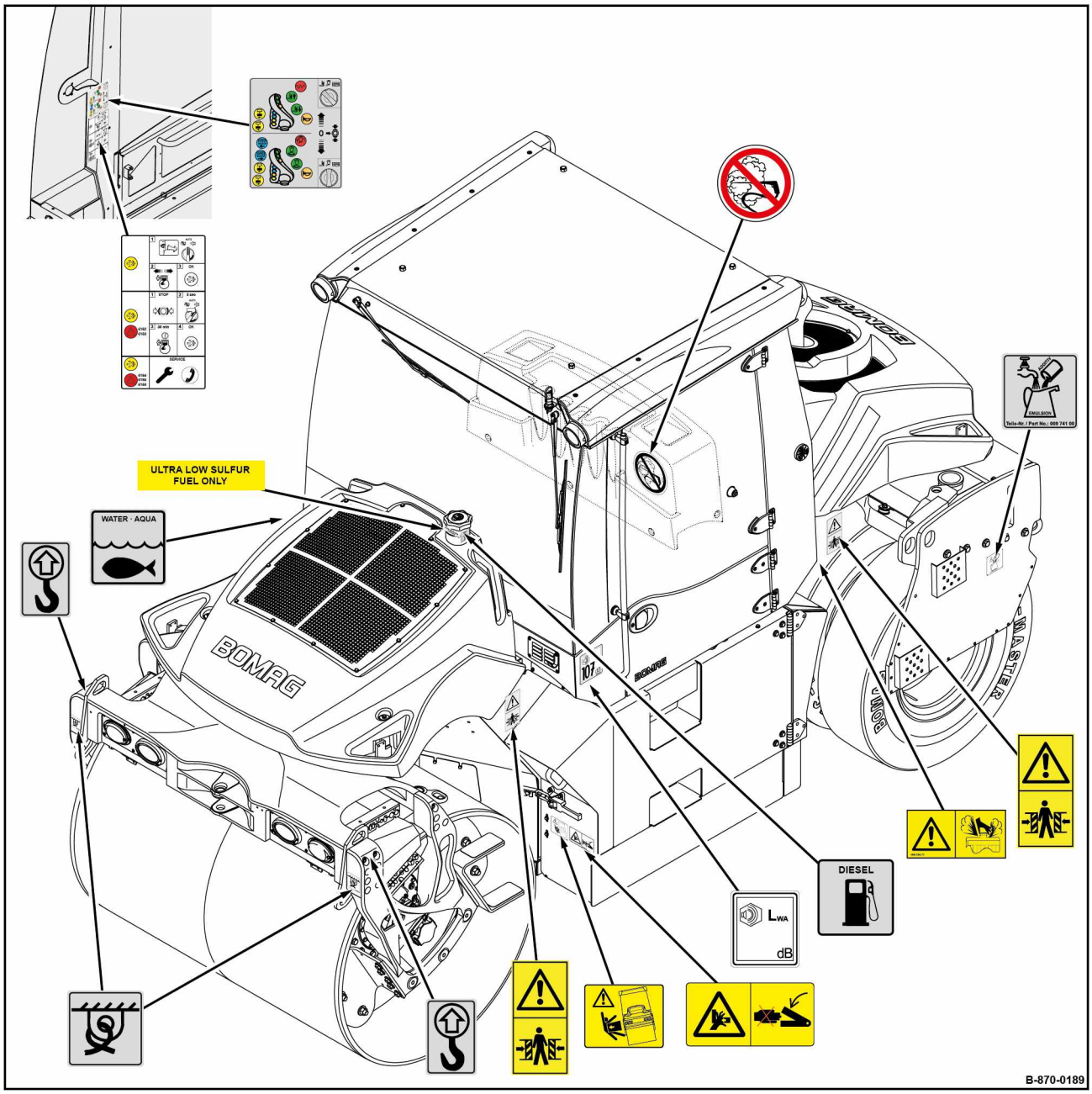


Fig. 13: Signage on the machine, outside left

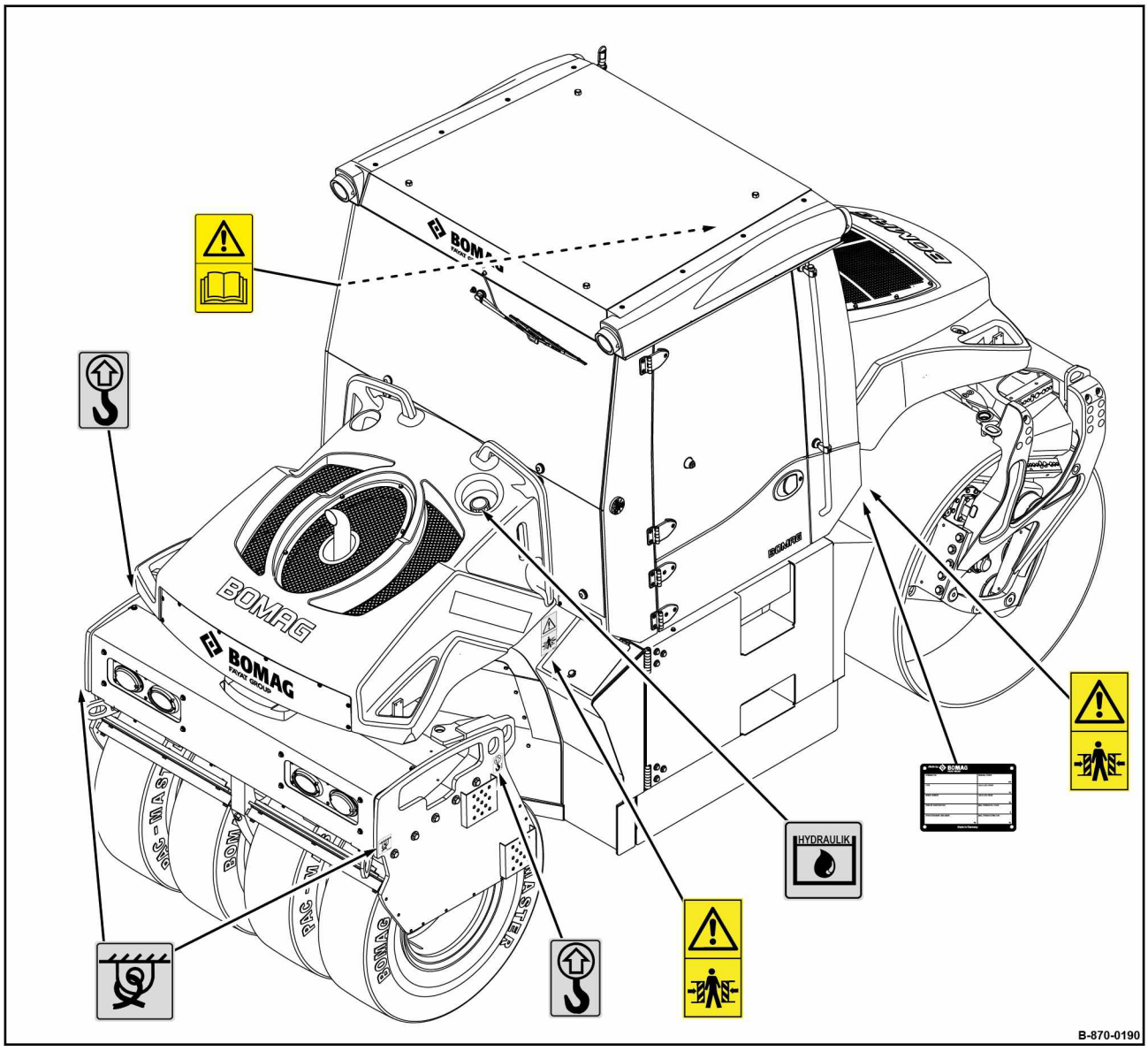


Fig. 14: Signage on the machine, outside right

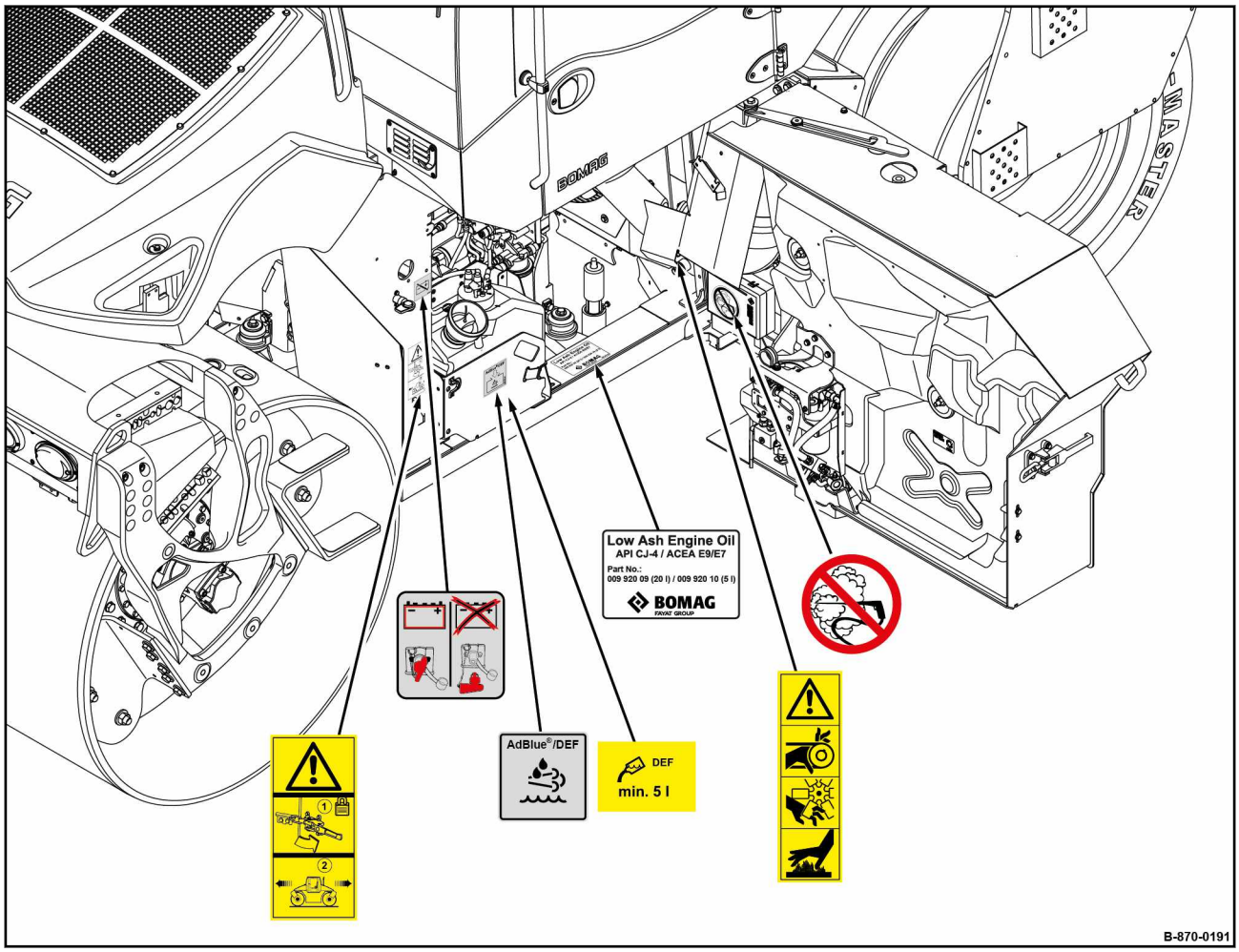


Fig. 15: Signage in the engine compartment, left

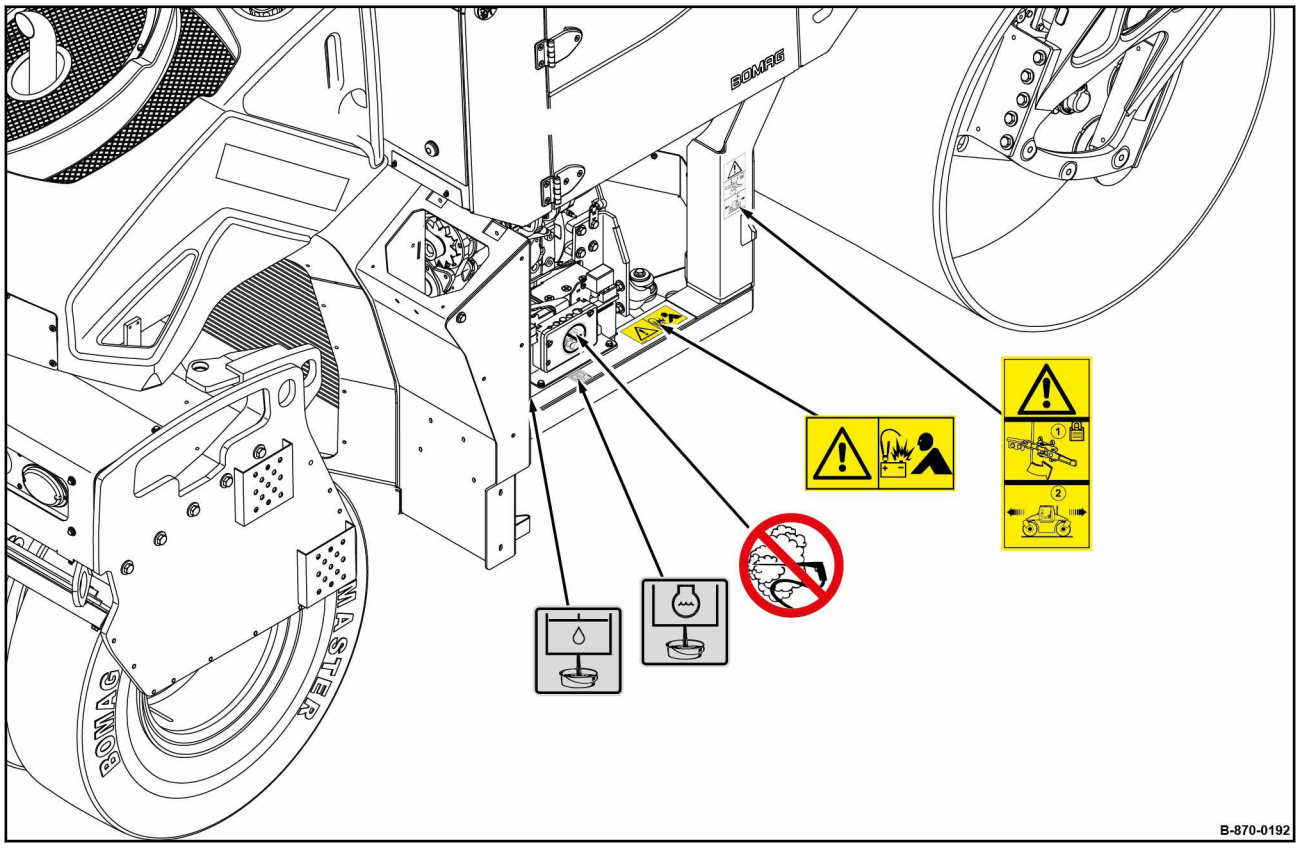


Fig. 16: Signage in the engine compartment, right

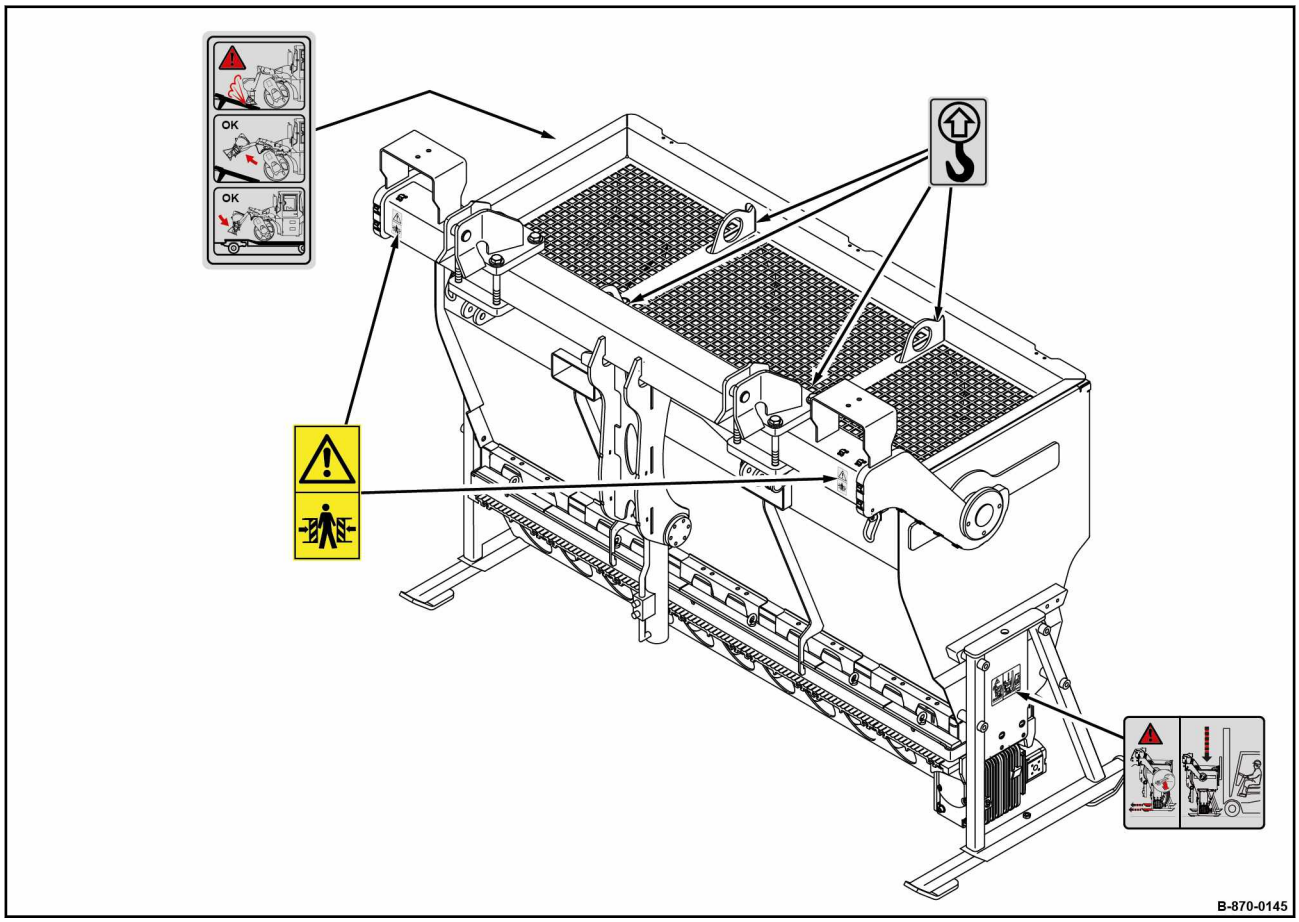
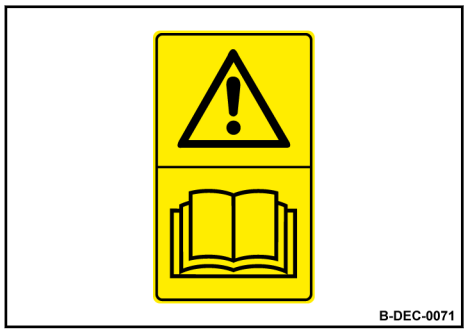


Fig. 17

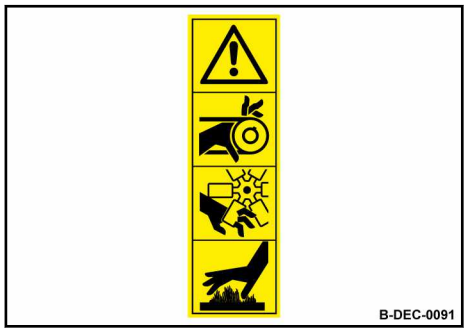
Warning sticker - Danger of crushing

Fig. 18



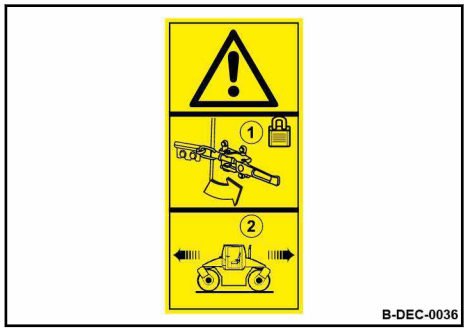
Warning sticker - Follow operating instructions

Fig. 19



Warning sticker - Danger of being pulled in by belt drive and cooling fan and hot surface

Fig. 20



Warning sticker - Close the maintenance door before starting to drive

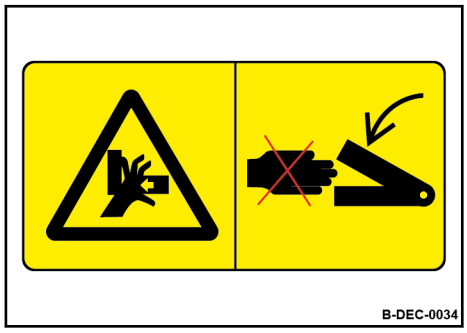
Fig. 21

Warning sticker - Danger of scalding when opening the cooler seal

Fig. 22

Warning sticker - Explosion hazard battery

Fig. 23



Warning sticker - Hand injuries

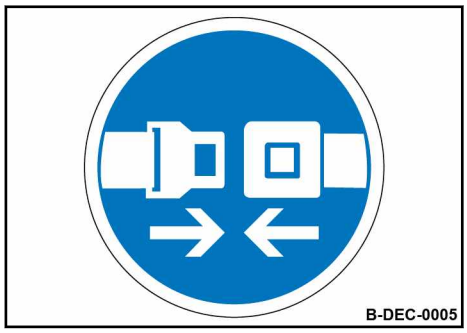
Fig. 24

Warning sticker - Never open the maintenance door in slanted position

Fig. 25

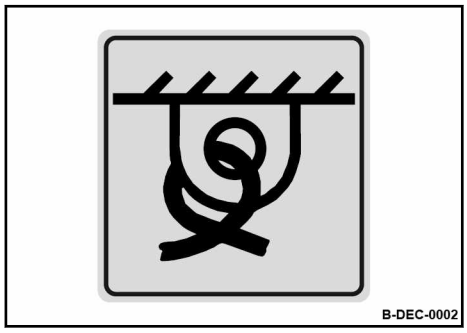
Prohibition sticker - High pressure cleaning

Fig. 26



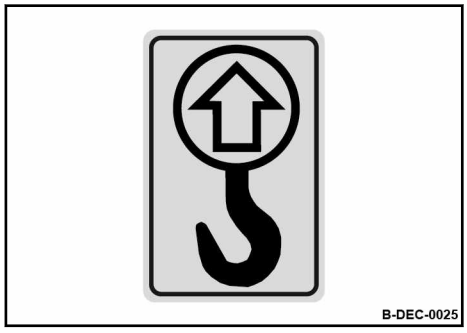
Instruction sticker - Always wear your seat belt

Fig. 27



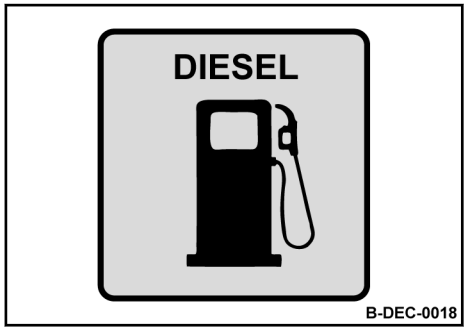
Information sticker - Lashing point

Fig. 28



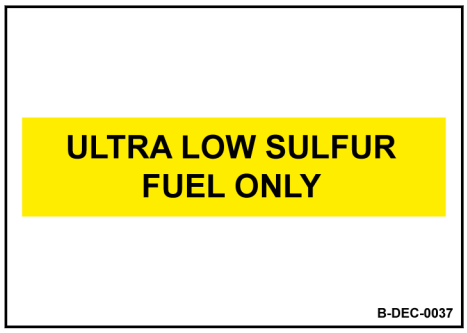
Information sticker - Lifting point

Fig. 29



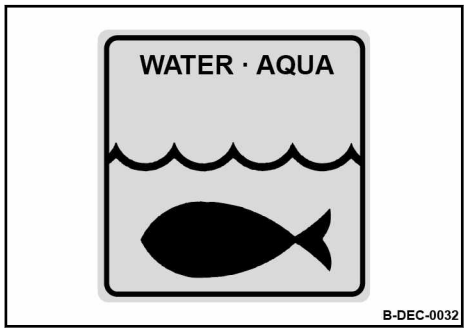
Information sticker - Diesel

Fig. 30



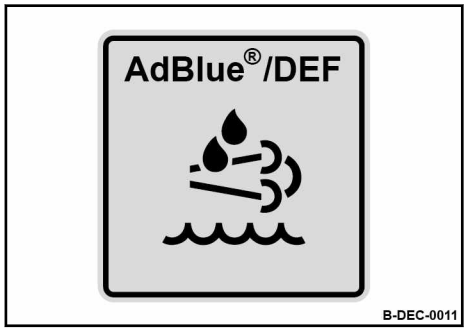
Information sticker - Ultra-low sulphur fuel

Fig. 31



Information sticker - Water

Fig. 32

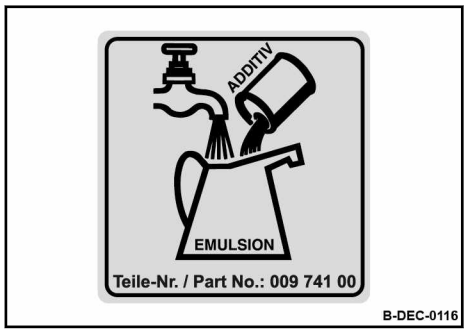


Information sticker - AdBlue®/DEF

Fig. 33

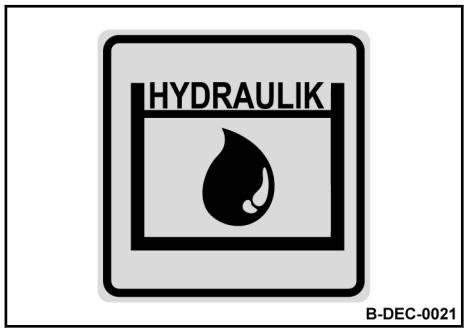
Information sticker - Minimum topping up quantity AdBlue®/DEF

Fig. 34



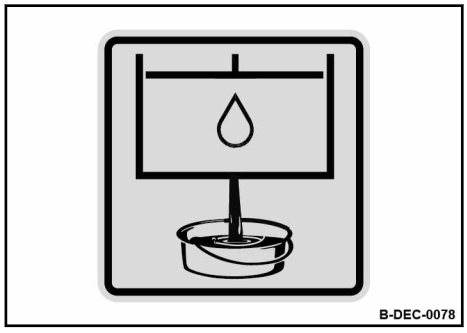
Information sticker - Emulsion

Fig. 35



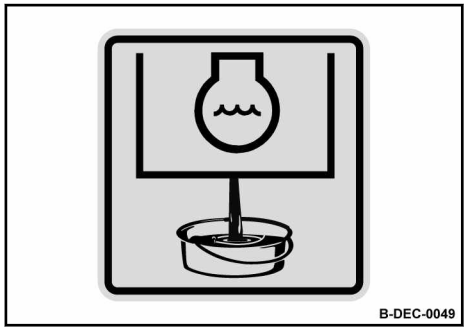
Information sticker - Hydraulic oil

Fig. 36



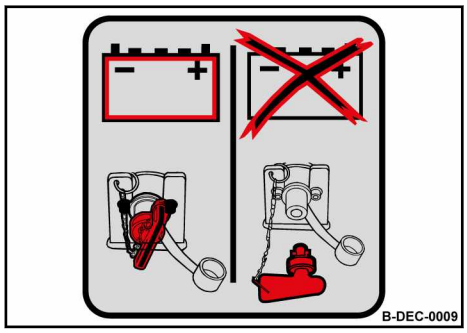
Information sticker - Hydraulic oil drain

Fig. 37



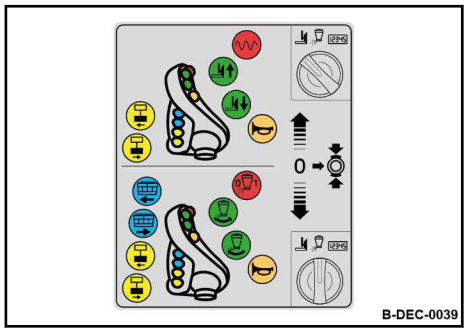
Information sticker - Coolant drain

Fig. 38



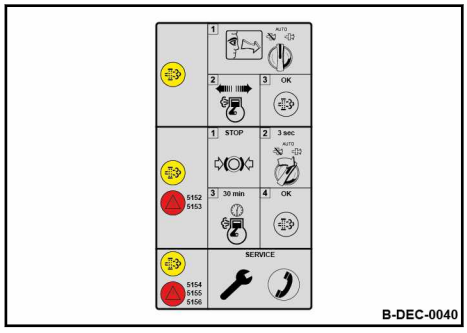
Information sticker - Main battery switch

Fig. 39



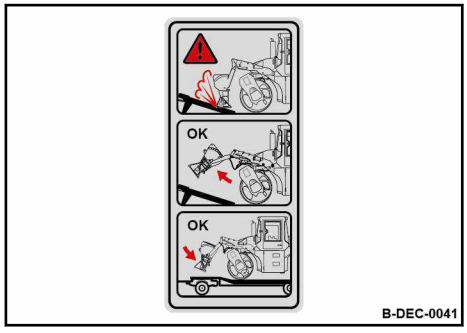
Information sticker - Push button assignment on travel lever

Fig. 40



Information sticker - Regeneration of exhaust gas aftertreatment system

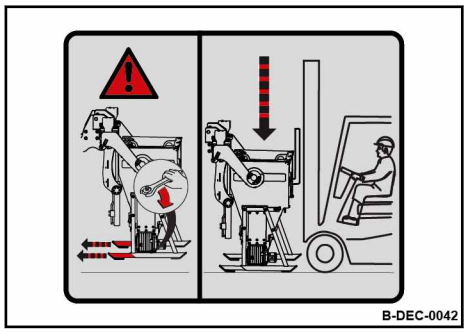
Fig. 41



Information sticker - Load precision spreader

(optional equipment)

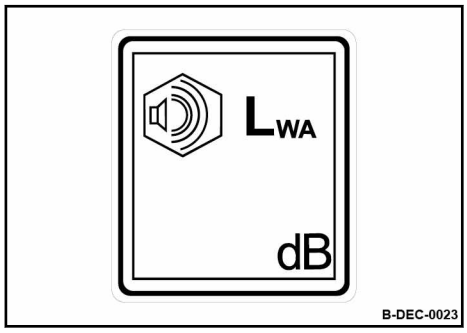
Fig. 42



Information sticker - Shut down precision spreader

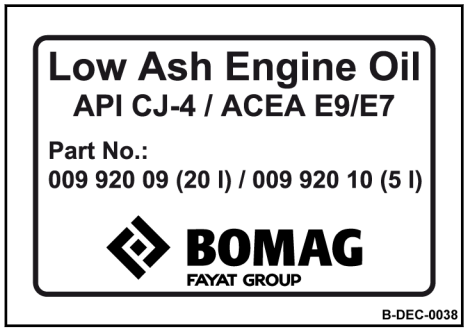
(optional equipment)

Fig. 43



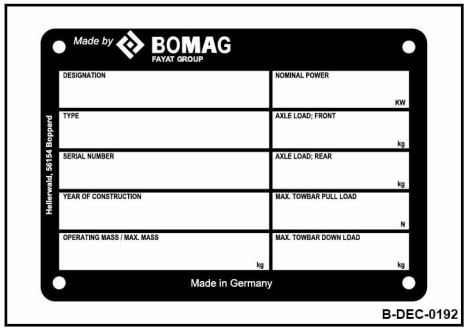
Information sticker - Guaranteed sound capacity level

Fig. 44



Information sticker - Low ash engine oil

Fig. 45



Machine type plate (example)

Fig. 46

1.3 Fuels and lubricants

1.3.1 Fuels and lubricants

1.3.1.1 Engine oil

1.3.1.1.1 Oil quality

The following lubrication oil specifications are permitted:

- Low-ash engine oils acc. to API-classification CJ-4.

Avoid mixing of engine oils.

1.3.1.1.2 Oil viscosity

Since engine oil changes its viscosity with the temperature, the ambient temperature at the operating location of the engine is of utmost importance when choosing the viscosity class (SAE-class).

The temperature data of the SAE-class always refer to fresh oils. In travel operation engine oil ages because of soot and fuel residues. This adversely affects the properties of the engine oil, especially under low ambient temperatures.

Optimal operating conditions can be achieved by using the following oil viscosity chart as a reference:

Ambient temperature	Oil viscosity
higher than 25 °C (77 °F)	SAE 30 SAE 10W-30 SAE 15W-40
-10 °C to 25 °C (14 °F to 77 °F)	SAE 10W-30 SAE 15W-40
below - 10 °C (14 °F)	SAE 10W-30

1.3.1.1.3 Oil change intervals

If the oil change intervals are not reached over a period of one year, the oil change should be performed at least 1 x per year, irrespective of the operating hours reached.

However, engine oil must also be changed when the maintenance interval for regeneration of the exhaust gas aftertreatment system has dropped to five hours or less.

1.3.1.2 Fuel

1.3.1.2.1 Fuel quality

In order to fulfil the regulations of the exhaust gas legislation, diesel engines equipped with an exhaust gas after-treatment system, must only be operated with sulphur-free diesel fuel.

The following fuel specifications are permitted:

- EN 590
- ASTM D975 Grade-No. 1-D S15 and 2-D S15

The recommended Cetan index number is 45. A Cetan index number higher than 50 should preferably be used, especially at ambient temperatures below -20 °C (-4 °F) and when working at altitudes of 1500 m (4921 ft) and more.

1.3.1.2.2 Winter fuel

For winter operation use only winter diesel fuel, to avoid clogging because of paraffin separation.

At very low temperatures disturbing paraffin separation can also be expected when using winter diesel fuel.

Diesel fuels suitable for temperatures down to -44 °C (-47 °F) are available for Arctic climates.

NOTICE!

Danger of engine damage!

– The admixture of petroleum and the addition of “flow enhancing additives” (fuel additives) is not permitted.

1.3.1.2.3 Storage

Even traces of zinc, lead and copper can cause deposits in the injection nozzles, especially in modern Common-Rail injection systems.

Zinc and lead coatings in refuelling systems and fuel lines are not permitted.

Copper containing materials (copper lines, brass items) should be avoided, because they can cause catalytic reactions in the fuel with subsequent depositing in the injection system.

1.3.1.3 Coolant

Always use a mixture of anti-freeze agent and clean, dehardened water with a mixing ratio of 1:1.

Under particularly extreme temperature conditions you should consult our customer service concerning the anti-freeze agent to be used.

There are various types of anti-freeze agents available. For this engine you should use ethylene glycol.

Before filling in the coolant mixed with anti-freeze agent the radiator must be flushed with clean water. This procedure should be repeated two to three times to clean the inside of radiator and engine block.

NOTICE!

Danger of engine damage!

– Do not mix different coolants and additives of any other kind.

Mixing the coolant:

- Prepare a mixture of 50% anti-freeze agent and 50% low mineral, clean water.
- Stir well before filling it into the radiator.
- The method of mixing water and anti-freeze depends on the brand of the anti-freeze agent (see standard SAE J1034 and also standard SAE J814c).

Add anti-freeze agent:

- If the coolant level drops because of evaporation,only clean water is to be used for topping up.
- In case of leakages you must always fill in anti-freeze agents of the same brand and the same mixing ratio.

Do not use any radiator cleaning agent after the anti-freeze agent has been mixed in. The anti-freeze agent also contains a corrosion protection agent. If this mixes with cleaning agent it may cause the development of sludge, which could damage the cooling system.

Anti-freeze concentration	Freezing point
50 %	-37 °C (-35 °F)

1.3.1.4 Hydraulic oil

1.3.1.4.1 Mineral oil based hydraulic oil

The hydraulic system is operated with hydraulic oil HV 46 (ISO) with a kinematic viscosity of 46 mm^2/s at 40 °C (104 °F) and 8 mm^2/s at 100 °C (212 °F).

For topping up or for oil changes use only hydraulic oil, type HVLP according to DIN 51524, part 3, or hydraulic oils type HV according to ISO 6743/3.

The viscosity index (VI) should be at least 150 (observe information of manufacturer).

1.3.1.4.2 Bio-degradable hydraulic oil

The hydraulic system can also be operated with a synthetic ester based biodegradable hydraulic oil.

The biologically quickly degradable hydraulic oil Panolin HLP Synth.46 meets all demands of a mineral oil based hydraulic oil according to DIN 51524.

In hydraulic systems filled with Panolin HLP Synth.46 always use the same oil to top up.

When changing from mineral oil based hydraulic oil to an ester based biologically degradable hydraulic oil, you should consult the lubrication oil service of the oil manufacturer, or our customer service for details.

NOTICE!

Danger of damage to the hydraulic system!

- After the changeover check the hydraulic oil filters increasingly for contamination.
- Have regular oil analyses performed regarding the water content and mineral oil.
- Replace the hydraulic oil filter at the latest after 500 operating hours.

1.3.1.5 Gear oil SAE 75W-90

Use a fully synthetic gear oil in accordance with SAE 75W-90, API GL5 with a kinematic viscosity of at least 16 mm^2/s at 100 °C (212 °F).

1.3.1.6 Gear oil SAE 80W-140

Use a fully synthetic gear oil in accordance with SAE 80W-140, API GL5 with a kinematic viscosity of at least 20 mm^2/s at 100 °C (212 °F).

It is a hypoid lubricant of highest quality class for transmissions under extreme strain.

1.3.1.7 Lubrication grease

For lubrication purposes use an EP-high pressure grease, lithium saponified (penetration 2), acc. to DIN 51502 KP 2G.

1.3.1.8 Optipit lubrication grease

For lubrication use a water and dirt repellent lithium saponified grease (Optipit).