

APE DIESEL HAMMERS

OPERATION INSTRUCTION





FOREWORD

This manual covers **APE Diesel Hammers and its operations**. This operator's manual should be stored in a literature holder or literature storage area.

To maximize the technical performance of the equipment and ensure safe and sustainable use of the equipment, please read this manual carefully before operating the equipment.

Some photographs or illustrations in this operator's manual show details or attachments that may be different from your equipment. Continuing improvement and advancement of product design may have caused changes to your equipment which are not included in this manual. Whenever a question arises regarding your equipment, or this manual, please consult with your APE dealer for the latest available information.

Using this operator's manual:

Refer to the Table of Contents for the page location of applicable sections.

All weights and measurements are in English and Metric units.

Please visit www.americanpiledriving.com for product data sheets and manuals and latest available information.

Check to the manufacturer to be informed on technical upgrade a modification.

Manufacturer keeps properties for this documentation, and it prohibits the spreading and the duplication, also partial, without written assent.



Note!

Read this manual before starting any job!

You must read this manual prior to handling the Diesel hammer. Observe the safety information and instructions contained in this manual, failure to reading could lead injury to yourself and other people.







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1. Introduction

This manual contains all information needed for safety use of the Diesel hammer. Keep it at an easily accessible location.

Operators for use and maintenance must be informed regarding the obligation to read this operating instruction and about it is kept.

Manual is a part of the machine. Then:

- Handle it carefully,
- Ship the handbook with the machine if sell the Diesel hammer.

How to preserve handbook

To keep the manual safe, put it together with the carrier equipment's manual. If manual will weak or miss, do not hesitate to contact the manufacturer to obtain a new copy.

Staff Qualifications

General legalities and additional regulations for preventing dangerous situations and the environment are to be followed in addition to the stipulations of the operating manual. The Diesel hammer may only be operated by trained personnel or personnel in training. These personnel should be very aware of the characteristics and the behavior changes to of the Diesel hammer. Maintenance, repairs, and service work should only be performed by specialized personnel. The operator must know and understand the operating manual and especially the safety regulations before beginning work.

Please pay attention to the following:

- Comply with the construction safety rules of all the relevant departments.
- Operators must receive the specialized training and obtain the qualification certificate. No person is allowed to operate the machine without authorization.
- Please wear the helmets when entering the construction site. During piling operations, please wear noise proof earflaps. If necessary, you should wear protective gloves and non-slip boots.



- When you work at height, you should wear seatbelts. While offshore operations, life jackets must be worn.
- During the electric maintenance on the site, the operators should wear insulated rubber boots and insulated gloves.
- No person shall stand and stay under the machine during the piling.
- The scope of the spur piles and the operation should be strictly according to the instruction manual.
- It is forbidden to operate the machine when there's strong wind, heavy rains, snow, fog, and thunder.
- Fire extinguishers should be equipped at the construction sites to satisfy the fire prevention requirements.
- The rope is the main part of the assembling, carrying, unloading, and transporting. The wire rope shall be scrapped as required.

If you have any question when replacing or repairing the spare parts, please contact us or the nearest after sale service center.



NOTE!

Please follow the instructions and pay attention to the warnings given in this manual.

The instruction manual introduces the working principles, operation procedures and the maintenance of the Diesel hammer, as reference for the managers, operators, and the maintenance staffs. Before using the machine, relevant staffs should read the instruction manual and other instructions on parts and components carefully and follow the guidance and instructions strictly. The operators should receive the specialized training to use the machine correctly, avoid the malfunction caused by the mistake in the operation, reduce the maintenance cost and cut-off interval and extend service life.

When using this machine, please use the wearing parts and the spare parts designated by our company. If you don't use the spare parts we have designated, we cannot assure you the proper operation of this machine.



The quality of the fuel and lubricants as well as the cleanliness of the fuel system and lubricant system greatly influences the working reliability and service life of the machine. Therefore, customers should be pay attention to it.

- The main technical data in the instruction manual only helps the customers to know about the performance of the Diesel hammer, which shall not be considered as basis for acceptance. Since the technique of the Diesel hammer is being improved continuously, no further notice will be given in case of any change of the technical parameters and structure.
- Don't modify the product. If necessary, please contact us.
- We will take no responsibility for any accident or malfunction caused by the alteration of the machine without authorization or failing to follow the instructions given in this manual.
- When transferring the product, the instruction manual shall be enclosed.
- Please do not reprint or reproduce the contents of the instruction.

Machine number

Please offer us the machine number when you contact us to order the spare parts or inquire about the malfunction. Machines with different machine number may have different parts



2. Safety rules

This chapter explains the operating procedures to be followed in the operation of the machine. Do not start to use this machine until you have fully understood this chapter.

Please also pay attention to the working environment and other conditions in addition to the matters needing attention in this chapter.

2.1 Safety regulations

The terms "**DANGER**", "**WARNING**" and "**NOTE**" have the following meanings in these operating instructions:



DANGER!

Death or serious injury will occur as a consequence of not following the instruction.



WARNING!

The possibility of death or serious equipment accident will occur as a consequence of not following the instruction.



NOTE!

Injury or damage of the spare parts will occur as a consequence of not following the instruction.



Hazards for operators can be eliminated or reduced, only if the Diesel hammer is used correctly according to the instruction written in this manual.

Only properly trained and authorized personnel shall work with the Diesel hammer!

There are safety regulations that must be always observed. Beyond that, each situation exhibits peculiarities that cannot always be indicated in the safety regulations. Always watch for safety risks and problems.

Plan and take care of problems as early as possible!

Prior to putting the unit into operation, it will be necessary do the following operation:

- Read technical documentation.
- Know safety devices available on the Diesel hammer, their location and functioning.
- Determine if last expert inspection was carried out within the last 12 months.

Inspection must be carried out by person that participated in an extensive training program. Such an expert inspection is also required after any structural change. The result of this inspection must be indicated in writing!

Obstacle in the work and transport areas, the load capacity of the soil as well as safety barriers for public traffic areas must be considered. It is particularly important to changing weather conditions, wind, decreasing visibility and changing soil condition.

Stop work for critical condition (storm)!

Visibility must be sufficient to allow proper operation of the pile-driving equipment by driver and operator without risking their lives and that of others. Lights must be used for work carried out under poor visibility condition or darkness. The lighting fixtures must provide a brightness of at least 100 lx for the work areas.

For transport in darkness, moving equipment must be fitted with lights providing a distance light level of at least 10 lx (7 m ahead of the equipment measured in the driving direction).

Keep a safe distance from:

- High-voltage overhead lines, phone lines and other overhead lines.
- Earth cable, water pipes, sewage water pipes and other pipes located below ground.
- Overhangs, edges, slopes, and unsafe oil.



Prior to beginning your work, ask the superintendent about the location of supply and disposal pipes and about the safe distances to be maintained.

2.2.2 Safety measures that shall be made to customers

Operators' selection

Diesel hammer must be used only by well-trained operators, because during working he will be the only responsible of its correct use.

The staff must absolutely be informed about dangers to which encounter in the execution of the own duties, and relatively to the operation and to the corrected use of the emergency devices available on the accessory.

Operator training can be obtained by specific information, and by specific acquiring of all knowledge contained in this manual.

It is advisable that operators have got physical, psychophysical requirements and responsibility sense to drive Diesel hammer and its carrier.

All workers must be healthy and strong enough to meet the physical challenges. Under no circumstances shall a worker be allowed to work under the influence of drugs, alcohol, and medications or similar.

You must observe local safety regulations issued by the respective legislature or by unions and similar organizations. Take the necessary measures with respect to sound and vibration emission occurring during the operation of the Diesel hammer.

Maintenance

Word “maintenance” indicates all control activity, regulation, repair, and cleaning of the Diesel hammer, necessary to keep the machine integrity and its safety devices.

If maintenance schedule is not respected may happens:

- Lack of function and safety.
- Diesel hammer shortening life.

Maintenance and repair work can be carried out by one person by one person only, when the Diesel hammer is completely shut off and all means to put it into operation are blocked.



2.2.3 More information

It is forbidden to change safety circuits and devices

Remember! The first thing to do prior to start work is protection and safety devices integrity.

If any problems occur do into use the Diesel hammer.

It is absolutely forbidden to take off guards, identification plates, safety devices, etc. if it is necessary (i.e., for cleaning or repairing) be sure that nobody can use the Diesel hammer.

Anyway, the manufacturer does not approve any modification on the machine if it is not preventively informed and deny every responsibility in merit to eventual damages to persons and/or things, or losses of functionality of the machine.

The Diesel hammer must be fitted with at least 2 fire extinguishers, with following characteristic:

- Must have a minimum capacity of 6kg.
- Must be suited to extinguish oil and electric fires.
- Must be placed on the same side of the pile drive equipment.
- Shall not be placed in areas exposed to a high fire risk.
- Must be placed as close as possible to the operator and between the operator and the area with the greatest fire risk (at a very visible and easily accessible location for remote controlled Diesel hammer).
- Must be attached such that they can be removed without tools.

Maintain a minimum distance of 4m from the units to be driven during the operation of the Diesel hammer. Make sure that only the crane operator, operator, and foreman in charge of the pile-driving work move within an area of 1.5 times the lead height (or the height of the crane).

Close this area if required.

Also note that the mixture of fuel, exhaust gas, soot and air is at a high pressure blown out of the combustion chamber bolt opening when cleaning it. Maintain a safe distance and wear safety goggles.



DANGER!

Burn Risks!

Do not touch the Diesel hammer immediately after its operation. Particularly the impact head, exhaust and component located adjacent to the combustion chamber must be allowed to cool for a sufficient period.

Diesel fuel, ether and lubricants are very flammable and can explode under certain condition. Diesel fuel, ether and lubricants must be handled carefully. Take appropriate measures to prevent a spilling, igniting, inhalation, swallowing as well as skin or eye contact with diesel fuel, ether, or lubricants. The work area of Diesel hammer must always be ventilated. Under no circumstances will smoking or other activities with open flames or sparks be allowed during fuelling or in storage areas of diesel fuel, ether, or lubricants. These wastes should never be stored in foodstuff containers and the environment.



WARNING!

Exhaust Gas!

Exhaust gases forming during operation are poisonous. Do not inhale exhaust gas!

Work on Diesel hammer (maintenance, repair, converting ...) shall be carried out with a turned off machine. It must rest on the pile or ground or on the lower support device.

Avoid touching moving parts.

Pay careful attention at any time for components that come loose and fall from the Diesel hammer, lead, impact head, pile guiding system or from the pile itself.

Keep the job site tidy. Confusion can cause injuries!



2.2.4 Safety information for the operator

Wear a hard hat, safety boots, safety gloves, ear plugs, safety goggles and suitable, possibly reflecting. Work clothes when working with the Diesel hammer. This reduces the risk if injuries and prevents permanent hearing and eye damage.

Familiarize yourself with the operating instruction for the Diesel hammer and all its accessories prior to putting the unit into operation. Make sure you have a complete set of operating instructions.

Operate the Diesel hammer only when it is in a technically perfect condition. Carry out a thorough inspection prior to putting the equipment into operation. Make sure all warning signs are placed and easy to read. Do not operate Diesel hammer that is damaged or exhibits operating problems. Inform the foreman in charge of the pile-driving work about damages. All problems must be remedied prior to putting the equipment into operation.

You must consider that the operation of the Diesel hammer causes blows, impact forces and vibrations in the whole pile hammer structure and in the immediate vicinity.

Never work under the Diesel hammer, lead or material to be driven. Avoid standing in the area, in which the material to be driven touches the ground. Make sure repairs are carried out only by trained expert.

2.2.5 Safety information for the foreman in charge of the pile-driving work

The foreman in charge of the pile-driving work must have been trained with this unit and must be at least 18 years old. Provide the operator and crane operator with information ensuring a safe execution of the work. You are responsible for safety and all events in the work area of the Diesel hammer.

Familiarize yourself with the operating instruction for the Diesel hammer and all other accessories prior to putting the equipment into operation.

Make sure the equipment and associated attached units are inspected daily for obvious defect prior to putting them into operation. Make sure all warning signs are placed and readable. Defects are found most often in the following components:

- Diesel hammer
- Tripping device
- Guiding components
- Support devices
- Pile helmet and pile guiding system
- Brindle and cables

Prior to putting the equipment into operation, you must make sure that nobody is on or below the equipment. Sound the horn to warn persons of the impending putting into operation of the pile hammer.

You must consider that the operation of the Diesel hammer causes blows, impact forces and vibrations in the whole pile hammer structure and in the immediate vicinity.

2.3 Precautions before operation



DANGER!

- ☞ The machine shall be safely, and reliability installed on the guiding rail of the lead to prevent accidents.
- ☞ Hazard warning signs must be set up in piling operation area and where the power supply cables are dragged.



WARNING!

- ☞ The machine shall be safely and reliably installed on the guiding rail of the lead to prevent accidents.
- ☞ Hazard warning signs must be set up in piling operation area and where the power supply cables are dragged.
- ☞ The operators should receive the specialized training before using the machine.
 - ☞ It is necessary to be familiar with the surroundings, buildings, and geographical conditions around the working site before piling.
 - ☞ Do not work beyond the technical data and the piling ability of our company.
 - ☞ Stop working in case of any strong wind that is above level 6, heavy rains, snow, fog, and other inclement weather.
 - ☞ Before operation, the machine should be checked. If any anomaly happens, it should be fixed before the operation.
- ☞ Anyone who enters the construction site must wear safety helmet and safety shoes. When you work at height, you should wear seatbelts. It is a must to wear noise-proof earflaps when piling. While offshore operations, life jackets must be worn.
- ☞ Only if there's no irrelevant workers in the construction area can the operation be carried out.
- ☞ Fire extinguishers and other fire-fighting apparatus should be placed in the construction area.



NOTE!

- ☞ Operators should read the instruction carefully and please do not use the machine until you have fully understood the instruction. You can contact us if there's any problem.
- ☞ If the construction company needs to change the parameters or structure of the machine, please inform us in advance.

2.4 Precautions during the piling



DANGER!

- ☞ When the Diesel hammer is being operated, workers cannot stand under the machine.
- ☞ A Diesel hammer must never be started up unless it is resting on a pile or on a specially prepared test stand.
- ☞ Never start up the pile hammer which has been disconnected from the lead or which is resting on a skid, etc., as this may cause an accident.



WARNING!

- ☞ Never start up a Diesel hammer with the impact block hanging out. The impact of the piston would be transmitted directly to the cylinder end-ring above the impact block, destroying the end-ring and damaging the lower part of the cylinder.
- ☞ The center line of the pile must be accurately aligned with the center line of the pile hammer and must have the same line of travel. Never drive piles eccentrically and avoid the eccentric pile and ensure the uniformity force exertion of the pile head and avoid the accidents.
- ☞ Should think to replace the Diesel hammer which has been bigger striking energy according to the actual working condition if the pile sinks less than 50mm per 10 impacts. Shut down the pile hammer immediately if the pile



sinks less than 20mm (30mm @D128 above) per 10 impacts.

- ☞ If pile penetration is slow, check for excessive piston "rebound". Ensure that it does not strike the arrester groove in the upper cylinder. Regulate the pile hammer or shut it down in good time.
- ☞ To avoid accidents, keep clear of the pile hammer while it is in operation.
- ☞ Frequent checks are necessary to ensure that the guide clamps and guides are firmly attached.
- ☞ Replace worn or buckled guide clamps and gibs immediately. Otherwise, the hammer may jump out of the guide and cause an accident.
- ☞ Never exceed the permitted batter for the pile hammer being used when batter piling.
- ☞ If damage to the pile-driving equipment or the pile is discovered or predictable, stop all work immediately for examination.

NOTE!



- ☞ Don't use a lead if buckled or worn seriously, it may cause an accident.
- ☞ Slower penetration is possible, but it leads to more rapid wear of the pile hammer.
- ☞ Always make sure that all parts are properly lubricated.

2.5 Precautions during the assembly and disassembly

WARNING!



- ☞ Someone shall be at the construction site to give directions during the assembly or disassembly.
- ☞ Before the assembly and disassembly, all the tools, hooks and wire cables shall be carefully examined.
- ☞ When the Diesel hammer is assembled, it should be moved within 2m ahead the lead.
- ☞ All the screws or bolts of the Diesel hammer must be tightened according to the stated tightening torque criterion.

2.6 Precautions during the transport and hoisting



WARNING!

- ☞ Someone shall be at the construction site to give directions during the transport and hoisting.
 - ☞ The ropes and lifting appliances must be enough intensity.
- ☞ Crosstie should be used and properly fixed when the machine is being installed and transported.

2.7 Precautions during the maintenance



DANGER!

- ☞ Don't provide the maintenance to the machine when the Diesel hammer is being operated.



WARNING!

- ☞ Maintenance must be operated on the ground or operating platform.
- ☞ The signboard of "equipment maintenance" should be set up at the site during the maintenance of the machine.
 - ☞ Wear the seatbelts when working at high-altitude.
- ☞ Before operation, the maintenance tools and the equipment should be carefully examined.
- ☞ Examination must be carried out before the operation with the monthly and annual self-examination.
- ☞ In case of any defect found in the examination, the machine shall not be operated before the examination is fully completed.
- ☞ Only the components designated by our company can be used to replace the spare parts. When the substitute is used, the substitute shall satisfy the relevant requirements.
- ☞ Only the lubricants and grease of the designated brand may be used as specified in this manual.

2.8 Precautions during the close-down of the machine



WARNING!

- ☞ Upon completion of the piling, the pile frame should be put on the solid ground while the Diesel hammer should be put on the crosstie or the underground pile. Close the fuel power switch, install the cover, the exhaust cover completes, the locking screws and the securing clamp. The control lever of the pile frame should be placed in the stop position.

- ☞ When the machine is in idle for long, the Diesel hammer shall be removed. Install the securing clamp, discharge the diesel oil and lubricant, clean the combustion chamber, apply the rust preventing oil on the bowl and take rainproof measures.

Description

3.1 General description

Diesel hammer is a machine used to driving of suitable units into a supporting soil layer. Said units may be piles, pipes, sheet piles, etc. that will not be destroyed by the impact forces applied by the Diesel hammer.

All other uses such as the deforming or compacting of materials or the removal of piles constitute an improper use and are thus not permitted for safety reasons!

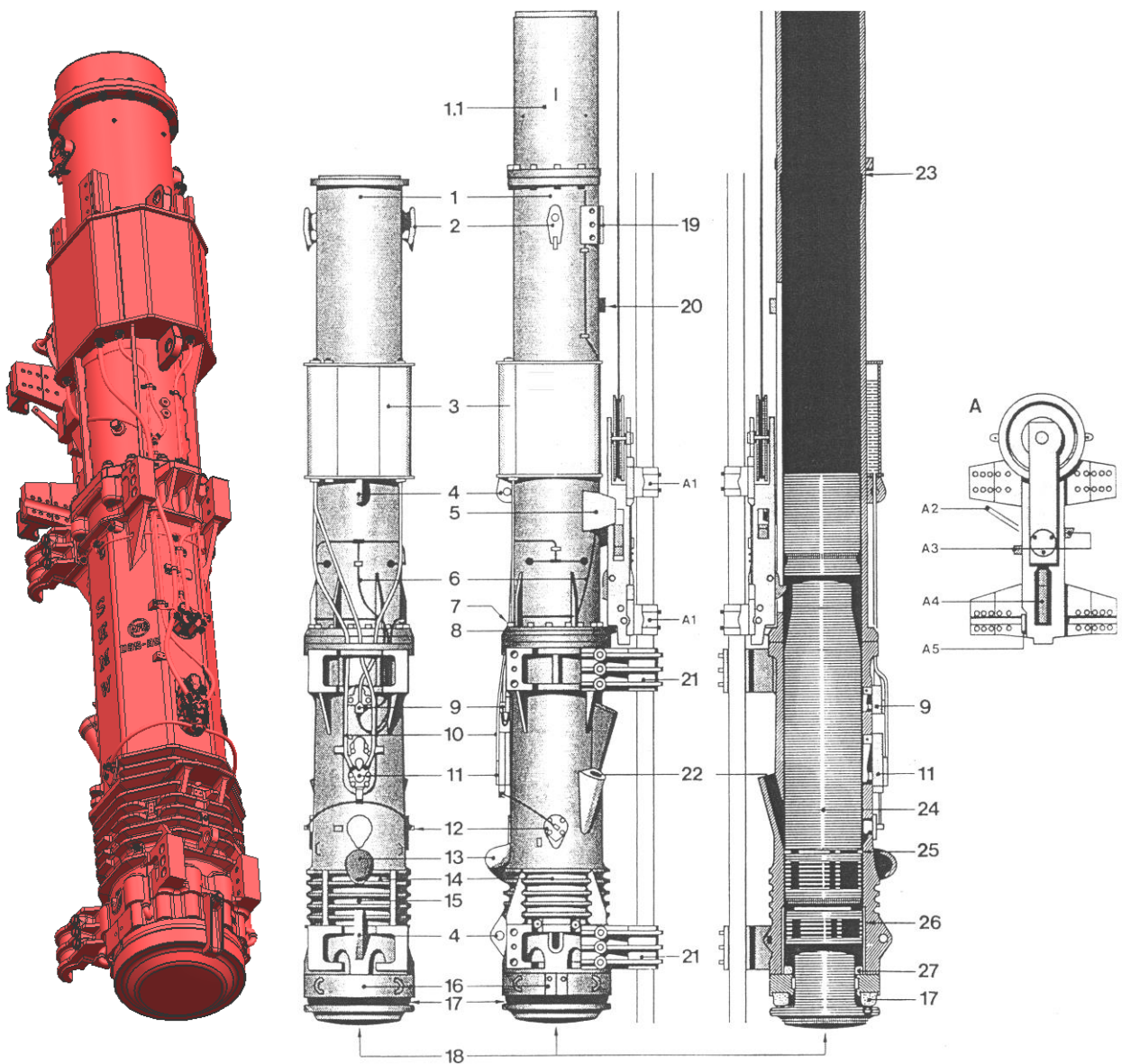


Fig.1 – General View of Diesel hammer



Major components

No.	Description	No.	Description
1	Cylinder upper part	1.1	Upper cylinder extension
2	Suspension plates	3	Fuel tank (lube oil tank and ether tank built-in)
4	Transport eyes	5	Carrier (on both sides)
6	Lube oil lines	7	Connecting screws
8	Catch for pawl lever	9	Lube oil pump
10	Fuel/breather line	11	Variable delivery fuel pump
12	Injection valve (s)	13	Pump guard
14	Cylinder lower part	15	Locking screw
16	Cylinder end ring (two parts)	17	Rubber ring (two parts)
18	Impact block	19	Plates to fit the guide tubes
20	Stop for pawl lever	21	Guide clamps
22	Exhaust openings	23	Catch groove
24	Striking weight (piston)	25	Catch piston ring
26	Cylinder sleeve (s)	27	Inner damping rings (two parts)
28	Piston ring		
A	Tripping device (Trip gear)		
A1	Guide gibs	A2	Lever
A3	Driving pin	A4	Pawl
A5	Pawl lever		



3.2 Structure and functions

The Diesel hammer is mainly composed of hammer body, oil supply system, tripping device and accessories.

Hammer Body

The hammer body is the main part of Diesel hammer, which is composed of such main components as cylinder upper part, cylinder lower part, piston, and impact block.

1) Cylinder Upper Part

The cylinder upper part is the guiding part when the piston moves up and down. On the outside of top, the suspension plate for lifting the Diesel hammer and stop for pawl lever are welded, there are the catch for pawl lever on the lower part; there are the locking screws on the side, the screws should be twisted when no working or transporting, and the piston can be fixed tightly. There is the rectangular groove used for starting the piston; when being free of service, the cylinder slot cover complete should be employed to properly cover the rectangular groove. The carriers are welded on both sides of the groove.

There is the inclined step ring slot in the interior of upper end of cylinder upper part to prevent the piston jumping out of the cylinder together with the catch piston ring when producing the severe explosion. The fuel tank and the lubricating oil tank are located on the upper cylinder.

2) Cylinder Lower Part

The cylinder lower part is of working cylinder. On the exterior, the fuel pump and lubricating oil pump as well as the guide plate assorted with the guide rail of pile frame can be installed and there is the cleaning hole on the outside of cylinder wall for the combustion chamber to be used for inspecting the condition inside the combustion chamber and clean it.

3) Piston (Striking Weight)

The piston belongs to the impact part of Diesel hammer, which has decisive function on the energy of Diesel hammer; therefore, its mass is served as the main parameter of Diesel hammer generally.

There is the bulb used for impacting and atomizing on the lower end of the piston and a screw hole to be used for installing the lifting rings at the upper end. The piston rings and the catch piston ring are installed on the lower part of upper piston; the catch piston ring is installed on the piston ring. When the piston jumps too high, the catch piston ring will be blocked into the inclined step ring slot on the upper cylinder to prevent the piston jumping out of the cylinder.



4) Impact Block

The impact block undertakes the impact from the piston and transfers the impact force towards the pile via the pile helmet. The impact block is installed at the lower end of cylinder lower part to connect the lower cylinder by employing two semi-circle retaining rings and the cylinder end rings, thus, the impact block can only slide within a certain scope but not being pulled away. The impact plane between piston and impact block is even, after the oil sprayed from the fuel pump falls on the collision surface of impact block and is collided via the upper piston and the impact block, the atomization degree of oil is improved to guarantee the sufficient combustion.

There are damping rings made of anti-oil rubber between the impact block and the contact surface of the cylinder end rings to slow down the collision while working. The security clamp is installed on the outside at the end of impact block, when being out of service, the screws should be employed to fix it and prevent the impact block sliding out from the cylinder.

Oil Supply System

The oil supply system covers the oil pump, oil pipe, joints, and the filter.

The oil pump is used for supplying the oil equipment for Diesel hammer; according to the purpose, the oil pump is divided such two types as fuel pump and lubrication pump.

1) Fuel Pump

The fuel pump is an important part of fuel supply system and is a radial pump, which is composed of pump body, pump cover, pump element complete, pump lever, switch cam shaft and suction valve as well as check-non-return valve. When the upper piston is lifted, the pump lever and the plunger heave towards the inner of cylinder under the function spring force, and the fuel enters into the oil chamber via the suction valve; when the lower piston falls, the pump lever is pushed; when the fuel oil is compressed up to a certain pressure by the plunger, open the check-non-return valve and enter into, and then open the valve piston of the injection valve to spray the oil into the cylinder; the volume of oil capacity is determined by the stroke of plunger.

The stroke of plunger is adjusted by the cam switching device. When pulling the right hand-rope, the cam can turn one step via the ratchet wheel device. After the cam turns, the radius of cam can diminish to cause that the push rod located above the rim of cam moves down and the pump lever is lifted towards the interior of cylinder in a certain distance to increase the stroke of plunger, completes the adjustment for class-I oil capacity, thus, the fourth class can be adjusted in turn to ensure that the fuel delivery is maximal. Conversely, if pulling the left hand-rope, the oil capacity will reduce gradually via the cam switching device until it stops.



This fuel pump is also provided with an emergency cut-off, there is a valve at the place of stop valve complete to pull the operating rope and jack the valve screw open, thus, when the fuel pump presses the oil, the oil will return to the fuel oil tank fully and will not enter into the cylinder to realize the emergency cut-off of tubular Diesel hammer.

2) Lubrication Pump

The lubrication pump is an important element in the automatic lubricating system of Diesel hammer, and it is a radial pump as well; the lubrication supplied by it will be used for lubricating the piston and impact block as well as the cylinder upper part and cylinder lower part. The lubrication is performed while operating of the Diesel hammer.

Tripping Device

The tripping device of Diesel hammer is provided with such two functions. First: lifting the pile hammer; the Diesel hammer is required to be lifted in the process of piling to realize the pile sinking; Second: starting the piston, the first starting circulation of Diesel hammer must be realized by the external force to ensure the Diesel hammer ignites and starts.

The tripping device is composed of the guide body, the pawl, and the driving pin. When the tripping device is lifted, the driving pin will hook the carriers on both sides of cylinder upper part to ensure that the whole Diesel hammer is lifted. When the lever is retracted into the tripping device, the tripping device falls, and the pawl lever is lifted upward after bumping the catch for pawl lever of Diesel hammer; when the pawl stretches out and hitches the piston, lift the tripping device, the pawl lever bumps the stop for pawl lever and starts the retraction of pawl, and the piston falls depending on the dead load, and then the Diesel hammer can be started.

3.3 Working principle

The working principle of Diesel hammer is as follows:

3.3.1 Stage I - Fuel supply and compression commencement

The falling piston actuates the pump lever whereby a certain amount of diesel oil is injected onto the surface of the impact block. As soon as the falling piston passes the exhaust ports, compression of the air trapped in the cylinder commences. The increasing compression presses the impact block and pile helmet firmly onto the pile head.

3.3.2 Stage 2 - Impact and explosion

The piston falls continuously to overcome the resistance of compressed air and collide with the impact block, namely, producing the impact, meanwhile, the diesel oil in the combustion chamber is atomized and the pile is driven downward into the ground. The atomized fuel ignites in the highly compressed air and the resulting explosion energy drives the pile further into the ground and simultaneously throws the piston upwards.

3.3.3 Stage 3 - Exhaust

The piston is pushed upward by the expansive gas; when the nethermost piston ring on the piston departs from the exhaust openings and releasing the high-temperature and high-pressure exhaust gases, then the pressure in the cylinder returns to normal.

3.3.4 Stage 4 - Scavenging

As the piston continues to ascend, fresh air is sucked in through the exhaust ports thoroughly scavenging the cylinder and thereby releasing the pump lever the pump lever returns to its original position sucking again diesel oil into the fuel pump. After the piston reaches the peak, due to the function of dead weight, the piston falls downward to compel that the gas inside the cylinder is stirred to cause that partial of mixed gas is exhausted out of the cylinder.

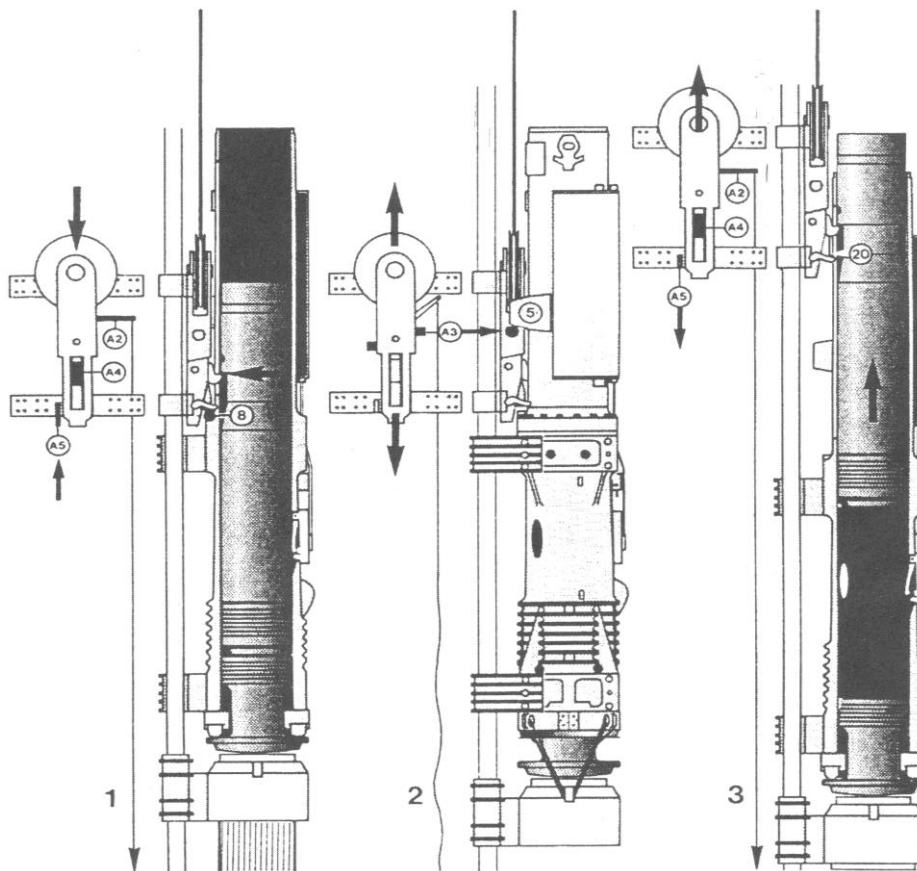


Fig. 2 – Raising and Lowering of Upper Piston

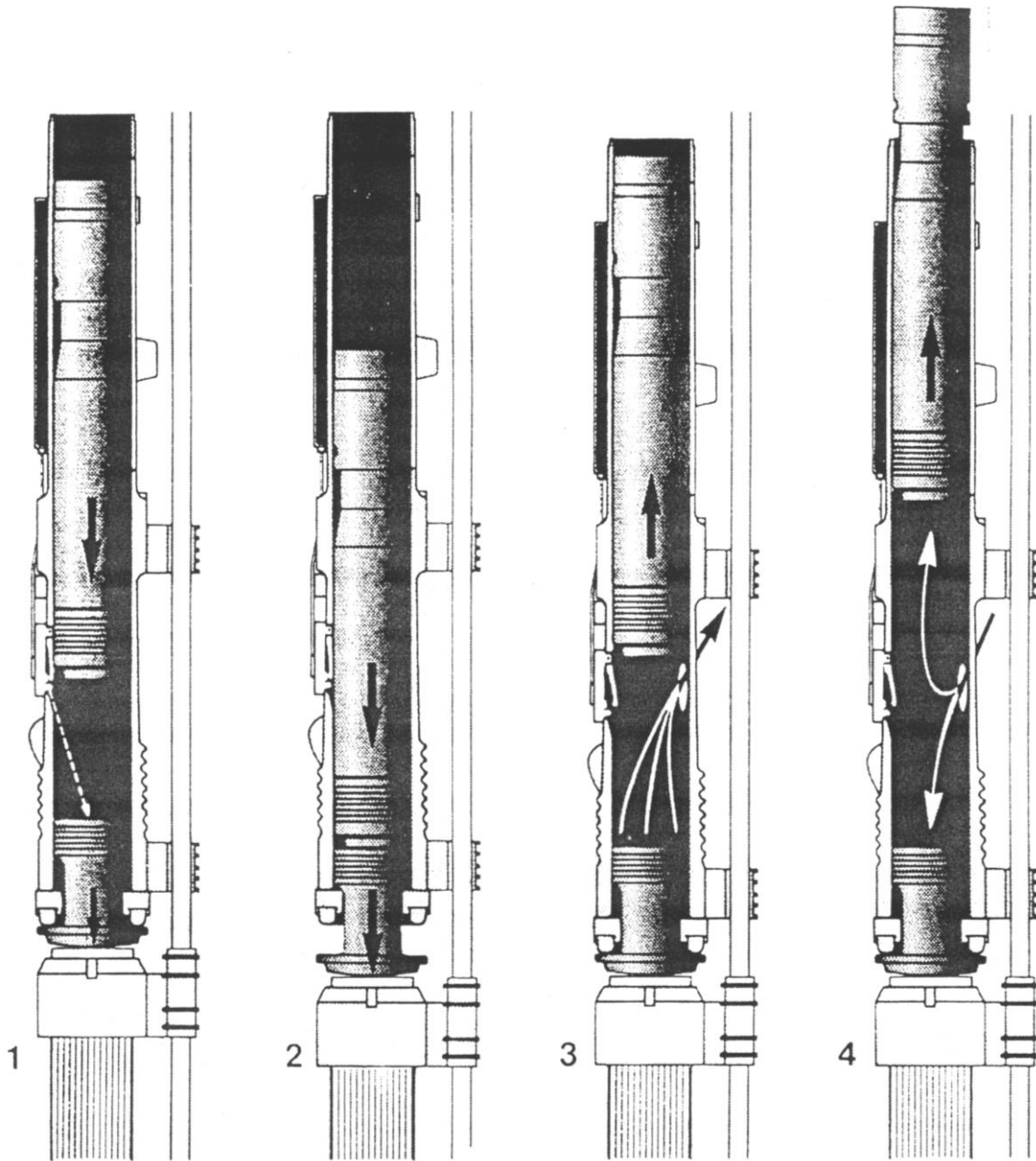


Fig. 3 – Working Principle of Diesel hammer

The first working circulation of Diesel hammer is started by the external force, the work suspending is realized by depending on closing the oil supply valve, the piling process of Diesel hammer is acted jointly by the combustion explosive force and impact force, as shown in Figure. Firstly, the piston produces an impact on the impact block, and then, the gas combustion produces an explosive force to complete the process of secondary piling. Although the explosive force is less than the impact force, it functions on the impacted pile and has great function on pile sinking.

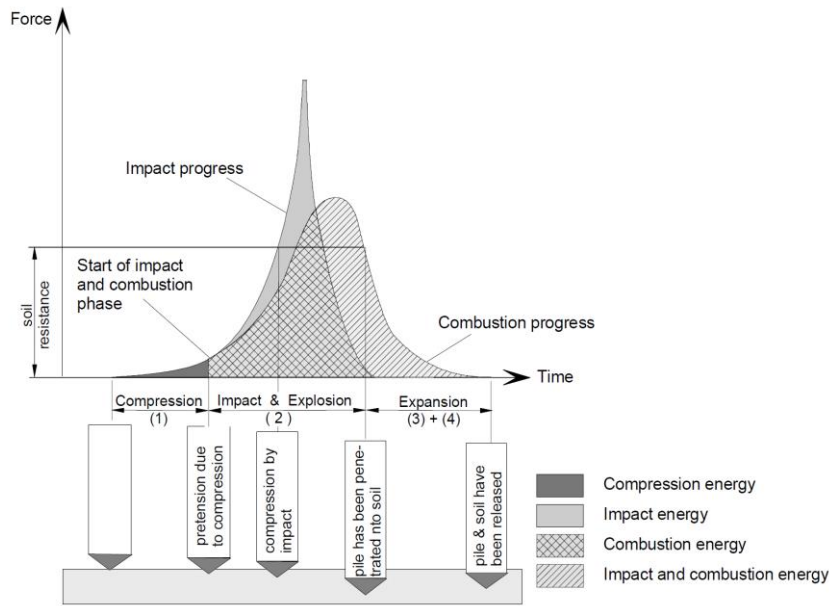


Fig 4 – Impact Force and Explosive Force Functions of Diesel hammer

3.4 Jumping height and striking energy of Diesel hammer

Under the condition that the weight of piston is invariable, the higher the piston, the greater the energy achieves. However, when the over-long stroke is impacted, the greater stress can be caused in the pile and piston to cause the damage, generally, the jumping height of Diesel hammer is within 2.5m~3.4m. In the process of piling, the jumping height of upper piston is difficult to be measured; in general, the upper piston can be observed as free falling, the jumping frequency per minute is reckoned to be converted as the jumping height, the formula is as follow:

$$H = 4415 / N^2$$

H- Jumping height of upper piston (m)

N- Jumping frequency of upper piston (min⁻¹)

Since the energy consumed by friction and air compression is less relatively, therefore, the impact energy of Diesel hammer is computed by the weight of upper piston multiplying the jumping height, namely, $E=mgH$.

When the fuel pump of Diesel hammer is in different gears, the striking energy per blow can be different.

Blow energy plate for the driving of batter piles. The increased friction and of the impact block cause a decrease in the blow energy when driving batter piles. The wear on the cylinder and guiding components, for example, is also increased. The remaining blow energy can be calculated with the formula shown below:

$$\text{Remaining...blow...energy} = \frac{\cos \alpha - 0.1 \sin \alpha}{\cos \alpha + 0.1 \sin \alpha} * 100$$

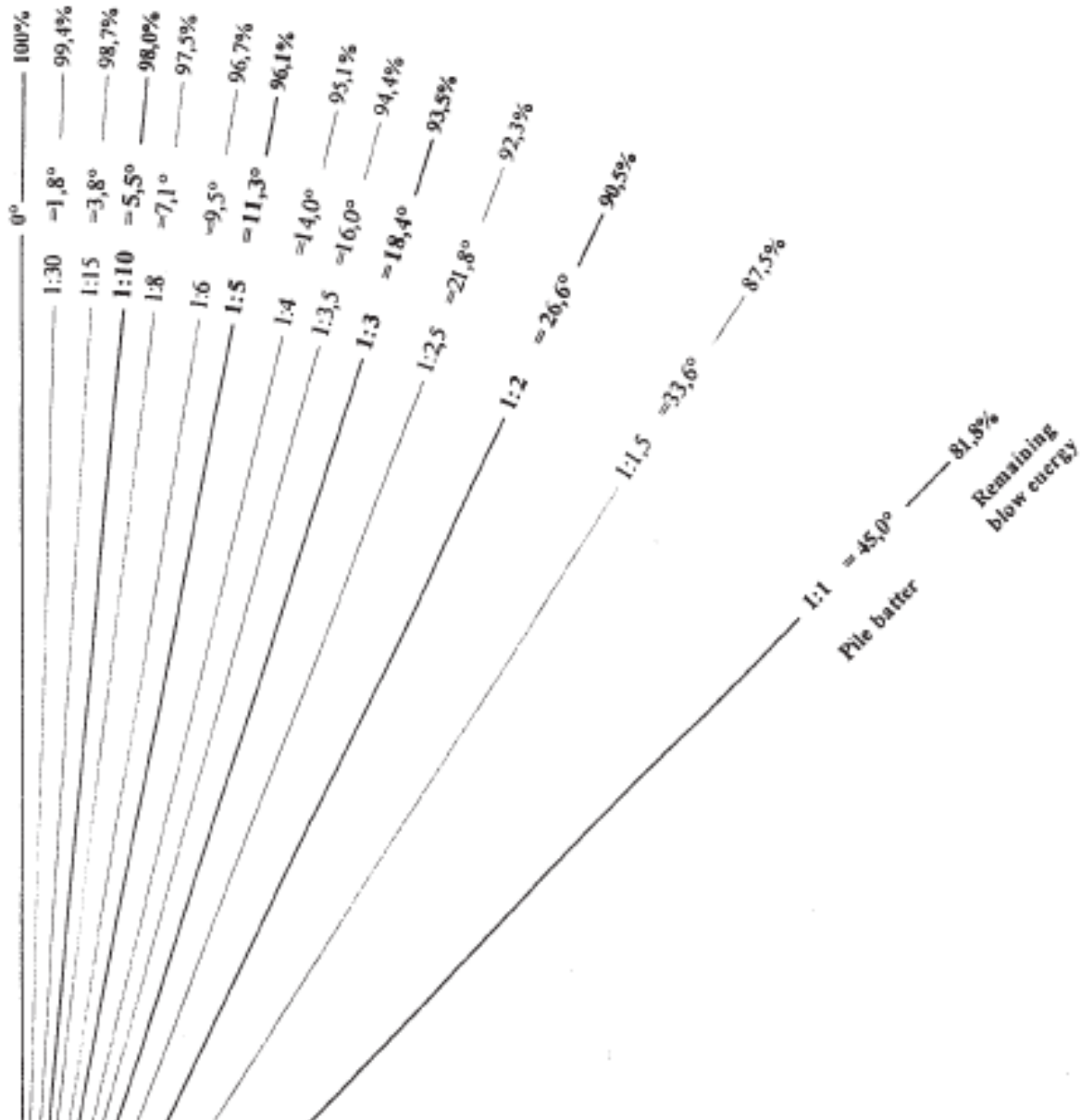


Fig 5 – Pile Batter and Remaining Blow Energy

3.5 Selection for Diesel hammer

During the construction of pile foundation, the Diesel hammer should be employed. Due to special mechanism and working principle, when the capacity of Diesel hammer is over great, the continuous igniting can't be performed due to over-rapid sinking of pile at the initial stage of piling, furthermore, the pile is easily damaged. On the contrary, when the capacity of Diesel hammer is too small, not only the construction efficiency is low, but also the over-load work for a long term can destroy the Diesel hammer and pile head. During the actual construction, the difficulty of pile sinking not only depends on the ratio between the Diesel hammer weight and pile weight, more important, it is determined according to the soil condition.



Therefore, while hammering the pile-sinking, the selection of Diesel hammer type should be determined according to the geology, strength of pile body structure, bearing capacity of pile and performance of Diesel hammer as well as combined with the construction experiences or trial piling condition. The impact weight of pile hammer should conform to the bearing capability of pile, namely, the pile with larger bearing force must be stricken by the Diesel hammer with greater impact energy. It is free of effect hardly by employing the small hammer striking the big pile.

3.6 Hammer-stopping standard

The sinking capacity of pile is an important standard to measure the working status of Diesel hammer and mark the working capability of Diesel hammer, generally, the effective penetration is served as the standard. For Diesel hammer, if the penetration is too small, the produced energy can cause the hammer to jump, thus, the Diesel hammer can be damaged, and generally, the minimal effective penetration value is stipulated, namely, average sinking value of pile when 10 impacts is employed to perform the hammering. If the stratum during working is very hard, when the effective penetration per hammer is less than the specified value, it is deemed to work on overload. The overload of Diesel hammer can bring enormous impact so that both Diesel hammer and pile are damaged. For the Diesel hammer with powerful hammering energy, due to the great impact, therefore, except that the maximal effective penetration is stipulated, the minimal pile displacement is also stipulated, namely, effective penetration of pile and elastic distance of pile, thus, the elastic distance can play the buffer function so as to protect the Diesel hammer. During piling operation, if overloaded, timely halt or replace the equipment, if the resilience is insufficient, the necessary measures should be taken, for example, the cushion pad is added in the pile helmet, the equipment can be employed effectively and safely.

Except that the penetration of pile is considered for Diesel hammer stopping, the continuous hammering also can't exceed the standard hammer-stopping time, if the continuous hammering time is too long and the hot load of Diesel hammer exceeds the designed rated value and the cooling capability of Diesel hammer, the explosive combustion of diesel can produce the incomplete combustion to cause the overheating of Diesel hammer, the high temperature caused by overheating is up to the flash point of grease to cause the grease liquefaction, meanwhile, since the high temperature caused by overheating exceeds the metallographic change temperature of cylinder body materials to cause that the metallographic structure produces the change, and the surface hardness and abrasive resistance of materials are reduced greatly to intensify the abrasion of cylinder body.

3.7 Personal protection equipment

Workers who operate with the Diesel hammer, workers who operate with the carrier and all other people in the working area must wear personal protection equipment like: hard hat, safety gloves, safety boots and suitable work clothes.



Fig. 6 – Personal Protection Equipment

- **Work clothes:** Operators must wear tight clothes without hanging parts, which can be entrapped in moving part.
- **Safety boots:** To avoid crushing by dropping material.
- **Ear protection devices:** Because of the acoustic pressure is greater than 90 dB(A).
- **Safety gloves:** To avoid cutting, abrasion, burning.
- **Hard hat:** To avoid hazards from dropping materials.



3.8 Sound Emission

The use of all types of pile driving equipment will produce noise to varying degrees, which can be injurious to health.

EAR PROTECTORS must be always used when in the vicinity of any pile driving operation.

The amount of noise produced when driving piles with a diesel pile hammer depends on several factors:

1. Explosion and Exhaust Noise

The explosion and exhaust noise is not, as often supposed, the main source of noise. A noise reduction mantle would reduce the overall sound level only a very small degree. The installation of a noise reduction mantle also inhibits proper escape of the exhaust gases and, therefore, reduces the fresh air supply for scavenging. This would impede the proper function of the pile hammer.

2. Noise generated by the piston hitting the impact block.

This noise is inside the lower cylinder of the hammer, so it is not the main source of noise.

3. Noise generated by impact block hitting the pile helmet.

This is where the main noise develops. It can be reduced to a large extent by using a very "soft" pile helmet cushion.

4. Noise generated by the pile helmet hitting the piles.

This is another main source of noise. In order to soften the impact it is necessary to use a soft cushion here, so that a reduction of noise can be achieved.

5. Noise generated from the piles themselves.

By taking the above-mentioned measures the structure-borne noise generation of the piles can be diminished considerably. Of course, the noise development also depends on the kind of piles used. If steel piles are used, the noise development will be higher than for concrete piles. Moreover the soil conditions

have an effect on the generation of noise. If the soil is rocky, arid, or hard, there will be more vibration of the piles than if the soil consists of coarse clay. For the above reasons it is impossible to predict the exact noise level for a particular construction site.

The noise levels measured when pile driving with a diesel pile hammer is actually somewhat higher than the noise levels generated by alternate methods of pile installation: rotary drilling, percussion drilling or construction of diaphragm walls, but when examining the noise on a construction site, it is important to compare the noise level in relation to the duration of the noise. If this is done, the noise irritation caused by a diesel pile hammer will be the relatively insignificant.

The data sheet below was made at the factory test stand on a refusal pile.

Diesel Hammer Type	Sound pressure level dB(A) at distance from hammer	
	7m (13 ft)	300m (984 ft)
D8-22	100	73
D12-42	102	76
D19-52	106	79
D25-52	110	84
D30-52	110	84
D36-52	111	85
D46-52 / D50-52	111	85
D62-52 / D70-52	114	86
D80-42	116	88
D100-42	119	92
D125 / D138	n.a.	n.a.
D160 / D180	n.a.	n.a.
D220/D260	n.a.	n.a.



Warning label for high acoustic pressure emission

3. Putting into operation

4.1 Generality

This chapter contains all operating instructions to put into operation the machine and to use it without risks.

Before starting be sure to have read and have understood all safety measure described before.

All installation work required to put the unit into operation must be carried out by qualified and authorized experts.



NOTE!

If faults are determined when putting it into operation, operation must not be started. Operation may only start after elimination of the faults.

Apart from the following explanations especially the safety instructions in chapter 2 must be observed.

4.2 Destination and previewed atmosphere of use

4.2.1 Environmental condition

Diesel hammer can be used outdoor on soil ground or over water, also over sea.

When operate in salt water clean moving parts and lubricate them shall be more than scheduled in maintenance chapter.

Materials which Diesel hammer is made guarantee life and strength of the machine in wet ambient, hot, and cold condition.

Used in different conditions, or in critical atmospheres with characteristic particular of chemical aggressiveness (corrosive substances) need special component. Ask APE for these conditions.



WARNING!


Use the Diesel hammer in explosive atmosphere is strictly forbidden!



4.2.2 Typical use condition, proper use

The Diesel hammer proper use is defined as the driving of suitable units into a supporting soil layer. Said units may be piles, pipes, sheet piles, etc. that will not be destroyed by the impact forces applied by the Diesel hammer.

Diesel hammer's carrier can operate on soil ground or over water (sea, lake and river). In these condition operators must pay careful attention to avoid leak of balance.



WARNING!


Do not operate in critical weather condition, especially over water!

4.2.3 Improper use and forbidden action

Use specified in the manual as wrong, should never be allowed, under no condition.

Use of the Diesel hammer for forbidden manoeuvre, improper use, and lack of maintenance, may cause dangerous situation especially for operators, people in work area, and prejudice machine integrity and itself safety.

Following forbidden action, cannot cover all "bad use" possibilities, but can be taken as reasonable most predictable and must be considered absolutely forbidden.



DANGER!

Be Absolutely Forbidden!

- ☞ Move the Diesel hammer to a position different from the permitted.
- ☞ Lift the Diesel hammer while operators or others stay in the maneuver zone.
- ☞ Lift the Diesel hammer with machine not suitable for its weight.
 - ☞ Use wear rope to lift the Diesel hammer;
- ☞ Lift the Diesel hammer without be sure that it is correctly hooked up (try very slowly).
- ☞ Lift the Diesel hammer in critical weather condition (strong wind, storm, etc.).
- ☞ Move the Diesel hammer over people under any condition.

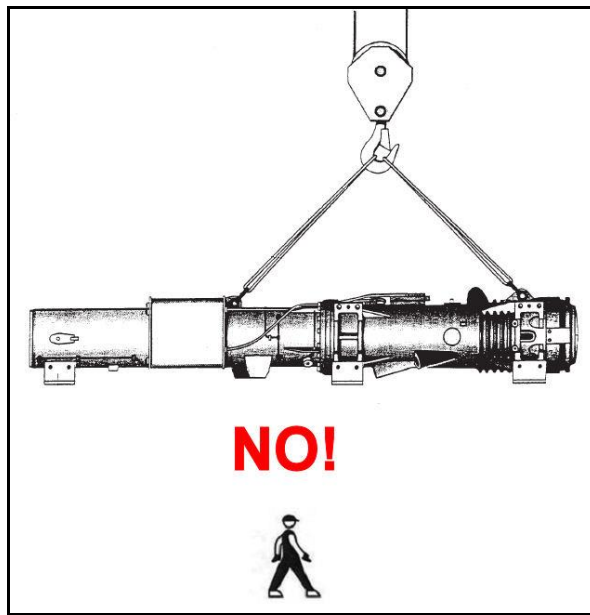


Fig.7 – Be Forbidden to Move the Diesel hammer Over People



DANGER!

Be Absolutely Forbidden!

- ☞ Operate or still under lifting Diesel hammer;
- ☞ Operate or still near the carrier during lifting or lowering maneuver.
- ☞ Operate without read and understand the use handbook and without respect safety norms and enforced national legislation.
- ☞ Operate without use suitable personal protective equipment (PPE).



DANGER!

Be Absolutely Forbidden!

- ☞ Operate on slope layer.
- ☞ Operate on muddy and/or slippery not strong ground, to support the carrier.
- ☞ Operate in critical weather condition (strong wind, storm).



4.3 Examination before using the Diesel hammer

Examination on rope, rope clamp

All the visible parts of the rope and the connections of the rope clamp should be checked. The rope shall be replaced in one of the following conditions:

The surface of the ropes abraded or corrupted and the diameter of the rope are partially reduced by 7%.

Abnormal conditions of the ropes (such as part of the squash, twist, bend, cage-like distortion, strand or wire extrusion, wire diameter increases and the partial wavy and so on.)

The break of the rope within certain distance reaches the standard specified in table below.

The broken ropes are gathered lower than the 6 times diameter of the ropes or in a pitch.

Table: Discarding Standard of the Broken Ropes

Rope structure	Scope of the length of the broken rope	Number of the broken rope	
		Specification 6×37+1	Specification 18×19
alternate lay	6d	19	27
	30d	38	54
Ng-lay	6d	10	13
	30d	19	27

- Check the power unit, winch, hydraulic system, and the electric system of the pile frame, which should be operated according to the instruction.
- Specified lubricant grease should be used on the leader guide rail of the pile frame.
- Check the fuel and the lubricant grease of the pile hammer to make sure that they satisfy the requirements specified in the instruction manual.
- Check the work conditions of the trip gear of the Diesel hammer and apply the lubricant grease; when the abrasion of the surface of the top of the pawl is larger than 10mm, it should be repaired or replaced.
- The plug screw of cleaning hole of the Diesel hammer should use graphite powder instead of the lubricant grease.
- Check the abrasion of the guide clamps of Diesel hammer. When the abrasion of the oriented surface is larger than 10mm, it should be repaired or replaced.
- Check the damping rings of the Diesel hammer, replace if necessary.
- Check the connection between the Diesel hammer and the pile helmet, replace the joint ropes if necessary.
- Check the lubricant condition of every part of the Diesel hammer.
- Check every part of the Diesel hammer to make sure whether the joint screw or bolt is tight and complete.

4. Operating

5.1 Generality

To ensure the normal operation of Diesel hammer and operation, be sure the following order.

Follow all safety measures described in Chapter 2

Operate the Diesel hammer and lead only when they are in a perfect technical condition. Particularly the guiding components and tripping device should show no signs of wear

Immediately halt the pile-driving operation when a dangerous situation develops (e.g., when unauthorized persons enter the danger zone or in the event of damage). Operate the Diesel hammer only after the dangerous situation has been taken care of.



WARNING!

You must keep a distance of at least 4 m from the operating equipment; no unauthorized person should be within a danger zone of 1.5 times the lead height. Said zone must be blocked off and designed with signs written in the language spoken in the job site.

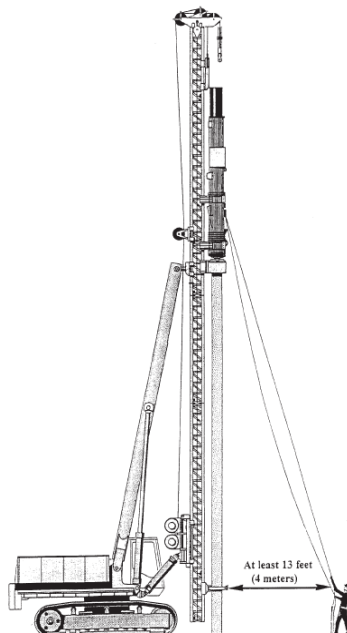


Fig 8 – Working Distance



Make sure the impact block never hangs out or gets stuck. The Diesel hammer does not properly rest on the impact head when the impact section is hanging out (e.g., with sticking guides). This will cause damage to the end ring and cylinder. With a sticking impact block, the cylinder is unable to freely drop on the impact head unit (possibly due to defective damping rings).

Piles should never be driver eccentrically. This may cause damage to the cylinder and guide components as well as damage and vibrations to the material to be driven.

Make sure the allowable batter is not exceeded when driving batter piles. Make sure the Diesel hammer is maintained regularly and properly.

Stop the Diesel hammer if the penetration rate is less than 2 cm per blow. Lower penetration is possible, but it causes height wear of the Diesel hammer. Make sure that maintenance of the Diesel hammer is carried out regularly and expertly.

Blow area

A perpendicular and plane blow area is required for a perfect driving pile. The center line of the material to be driven must be in line with the Diesel hammer's center line. This is necessary to avoid jarring blows. Jarring blows could cause:

- Cracks in and deformation of the cylinder.
- Vibrations n and damage for the material to be driven.
- Directional deviation for the material to be driven.
- Increased wear in the guide components.

Remedy

Use a pile helmet that is guided at the lead and matches the pile profile. Use a pile helmet cushion selected in an optimal manner with respect to the material to be driven and to the bow energy. When it is impossible to guide the pile helmet at the lead, it will be necessary to hold the material to be driven at the lead with at least one pile guide.

Deviation from the original direction of the material to be driven can also occur under the best condition. Accordingly, it will be necessary for the foreman in charge of the pile driving work to continuously monitor the pile driving phase and to have the lead corrected, when required.



Shutting off

Pull the center rope (at the shut off valve) and keep it taut until the piston is completely at rest.

The Diesel hammer can also be shut off by setting to "0" the fuel control pump. To do so, jerk the left control rope as often as required.


5.2 Tripping device

The tripping device is an auxiliary means:

- To lift the Diesel hammer at the lead.
- To lower the Diesel hammer at the lead.
- To lift the piston when starting the Diesel hammer.

The tripping device is operated with the help of a winch on the carrier equipment or hydraulically.

5.2.1 Installation



DANGER!


Tripping device

You must use the tripping device supplied. Check the tripping device for damage prior to its installation. Use tripping devices that are technically perfect only.

Use a height safety device to prevent a fall (mandatory at a least height of above 5 m).

Use only approved steel cable.

- Attach the two lower and one upper guide strip to the tripping device.
- Place the steel cable in the cable pulley. To do so, you must remove the cable pulley bolt and install it again when the steel cable is positioned.




DANGER!

Safety bolt

Use the bolt safety to secure the cable pulley bolt after its re-installation.

- Lift the tripping device and place the guide gibs.
- Install the second upper guide gib.
- Attach the 35 m long cable (in the toolbox) to the lever (ref, A2 in Fig 1).

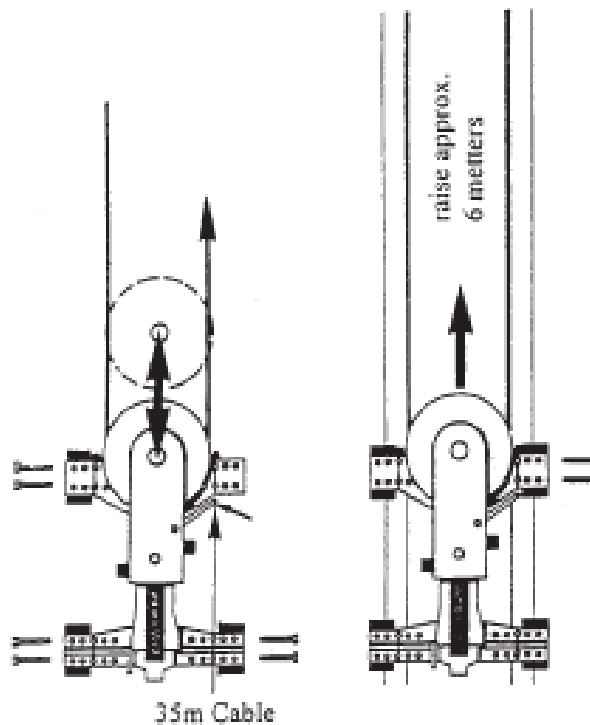


DANGER!

Safety pulling cable

Use only the safety pulling cable supplied. We cannot guarantee a proper functioning with the use of other cable.

- Pull the tripping device upward for approximately 6 m.

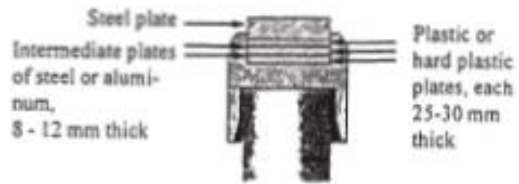


5.3 Assembly of pile helmet cushions

The pile helmet cushions transfer the impact from the impact block to the material to be driven. A targeted assembly can dampen the impact to a certain degree.

Reduction factors for different pile helmet cushions

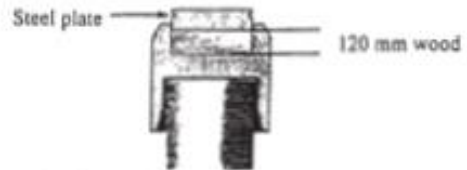
The use of different damping materials achieves different decreases in the blow force. Some examples are given in the following:



Reduction factor $R_f = 1.75$ to 2
 Hard plastic: Resitex Tx40, Novotex
 Plastic: Tufnol B 13
 Tufnol Vole Brand RCH 1000



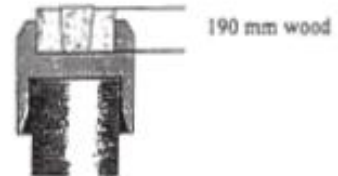
Reduction factor $R_f = 1.0$
 No cushion = max. blow force



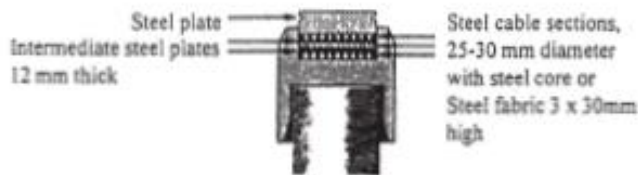
Reduction factor $R_f = 2.6$
 Wood: Bongossi
 Root wood (Beech or similar)



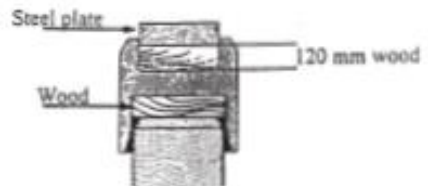
Reduction factor $R_f = 1.1$



Reduction factor $R_f = 2.8$ to 3
 Wood: Bongossi
 Root wood (beech or similar)



Reduction factor $R_f = 1.22$ (steel cable sections)
 Reduction factor $R_f = 1.42$ (steel fabric)

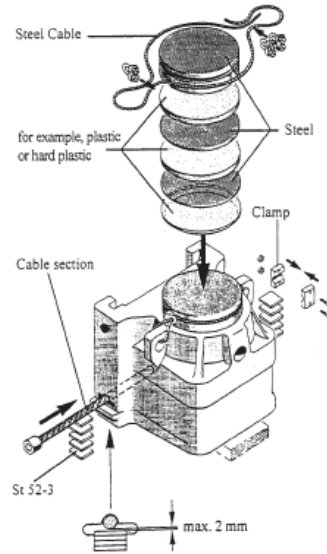


Reduction factor $R_f \sim 4.0$

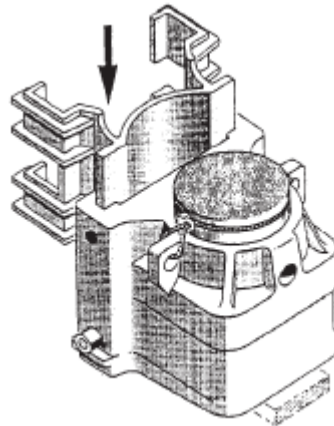
Fig 9 – Reduction Factor for Different Helmet Cushions

5.3.1 Assembly

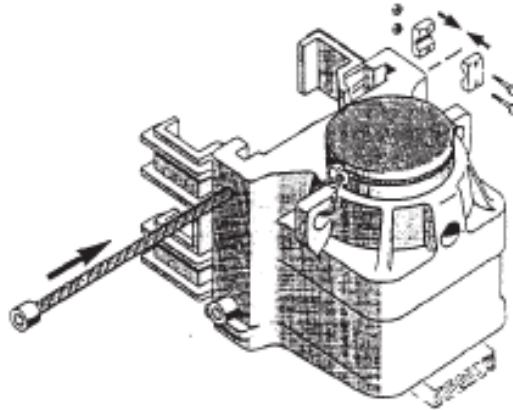
- Place the pile helmet cushion of the desired arrangement the pile helmet.



- Attach the pile helmet cushions to the pile helmet. Use a suitable steel cable and the appropriate clamps to clamp the steel cable.
- Guide the supplied cable section through the upper guide (this does not apply to pile helmets that are closed at the top).
- Secure the cable section with a clamp.



- Insert the guide from the bottom into the pile helmet.
- Insert the other supplied cable section in the lower guide.
- Secure the cable section with a clamp.



- Insert as many plates as it takes to have a spacing of not more than 2 mm between the lower cable section and the plates.
- Make sure all bolts are tight (retighten if required).



DANGER!

For operators

All bolted connections must be tight. Loose bolts can cause serious injuries and property damage.

An incorrect attachment of the pile helmet cushions with the steel cable at the pile helmet can cause the cushions to fall out. This will invalidate the warranty!

5.4 Guiding for the pile helmet

Always guide the pile helmet at the lead and never at the impact block of the Diesel hammer.



NOTE!

The pile helmet cannot be guided at the impact block of the Diesel hammer. Otherwise, lateral forces may cause damage to the impact block and the cylinder. This will invalidate the warranty!

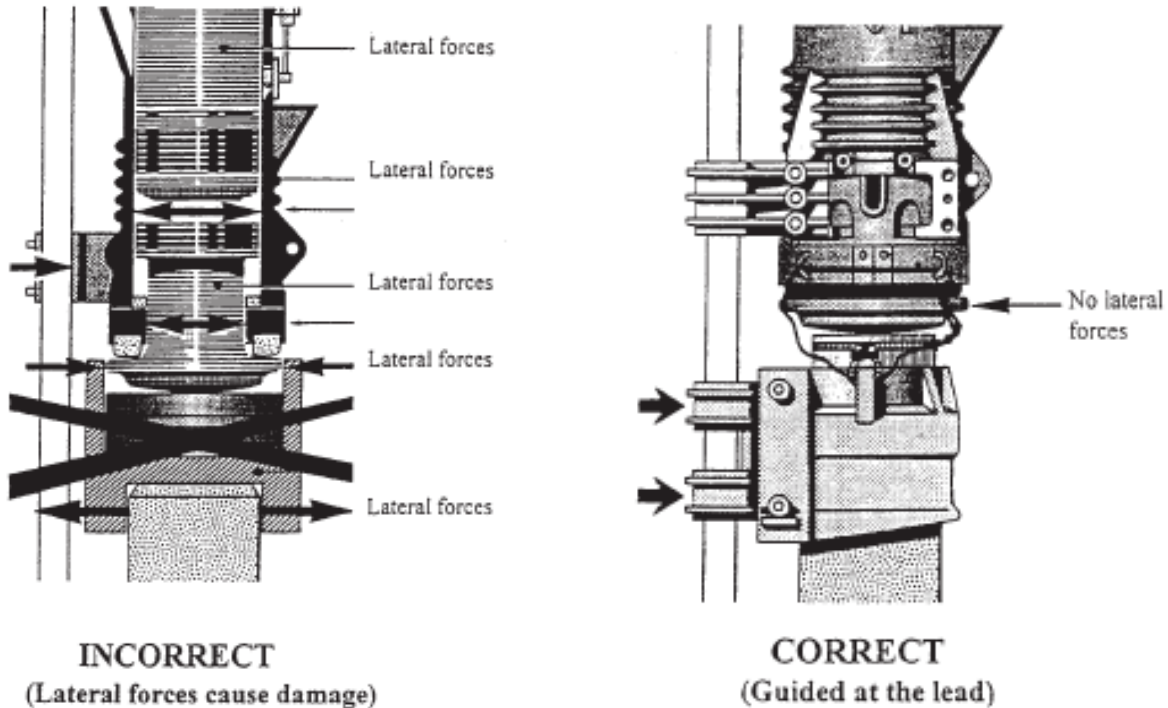



Fig. 10 – Guiding for the Pile Helmet

5.5 Bringing into the operating position of Diesel hammer and pile helmet



DANGER!

Carrier Equipment

Observe the operating instruction of the carrier equipment!

Use only approved steel cables in accordance with chapter " Transport, lifting and storage ". You must wear a hard hat, safety gloves, safety boots and suitable work clothes. A lifesaving jacket must be worn for work above a water surface.

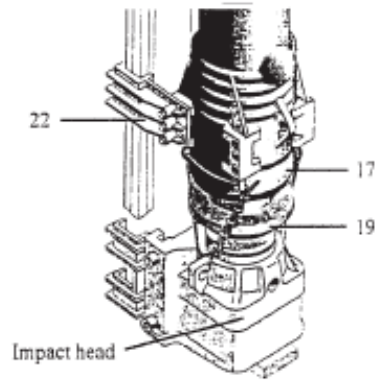
- Place the Diesel hammer in front of the lead.
- Loosen the bolts of the transport angles.
- Lift the Diesel hammer 30 cm in a horizontal position.
- Remove the transport angles.
- Place the Diesel hammer on wooden block (strong enough to support the weight).
- Remove the transport cables.

- Place the steel cable loops around the suspension plates (ref. 2 in Fig 1) and around the hook of the carrier equipment.
- Carefully pull the Diesel hammer to a vertical position and place it in front of the lead.

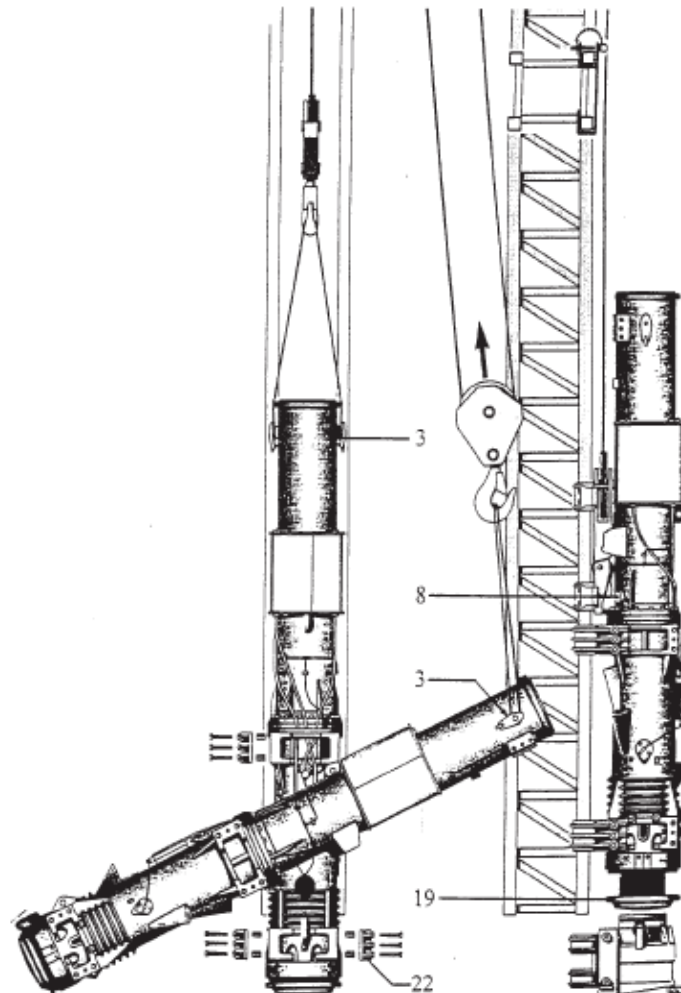


Fig 11 – Installation on Lead

- Install the two lower and one upper guide bracket.
- Lift the Diesel hammer 1 m. Place the guide bracket.
- Place the pile helmet below the Diesel hammer.
- Let the Diesel hammer rest on the pile helmet.
- Remove the locking screw (piston) and the impact block clamp.
- Pull the Diesel hammer upwards until the impact block is fully extended and hangs approximately 5 cm above the pile helmet cushion.
- Attach the pile helmet to the cylinder and ring as shown below. Use steel cables and steel clamps from the tool chest.



- Slowly lift the Diesel hammer while guiding the pile helmet through the lead.
- Let the Diesel hammer rest on an integral stop device of the lead.



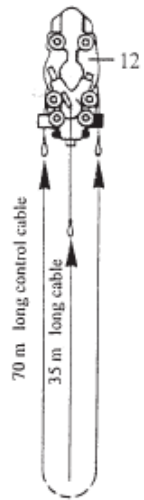


DANGER!

Safety device

The Diesel hammer shall be operated only with installed and operating safety devices. The Diesel hammer may suddenly fall when this is not observed.

- Remove the steel cable loops from the lifting plate and from the hook of the lifting equipment.
- Attach both ends of the 70 m long control cable (in the toolbox) to the eyelets for the control cable of the fuel control pump.
- Attach the 35 m long rope to the shutoff valve (center eyelet) of the fuel control pump.
- Fill the fuel with diesel oil. The filling nozzle of the tank indicates "Diesel".
- Fill the lubricant tank with lubricant. The filling nozzle of the lubricant tank shows "Oil".
- Remove the transport safety devices (protective hood, protective rail, exhaust cover, etc.).



5.6 Lifting of piles



DANGER!

Carrier Equipment

Observe the operating instruction of the carrier equipment!

Use only approved steel cable.

Observe the following information to prevent overturning of the unit and damage to the lead and material to be driven.

You must always wear hard hat and suitable clothes. Also, you must wear lifesaving vest when working above a water surface.



Never pull the material to be driven from the lead trip. This may cause an overturning of the carrier unit or may bend the lead end.

Always turn the unit in the direction of the impact point of the material to be driven. The inclined pulling force may cause the unit to overturn.

The material to be driven must always be lifted in such manner that:

- There is no permanent deformation.
- No cracks form in the material to be driven.
- The material to be driven hangs vertically after lifting it.

This achieves the following:

- The piles can be placed in an optimal manner,
- Sheet piles can be guided properly,
- The pile helmet is easy to place above the pile head.

Concrete piles and similar sensitive material to be driven must be treated with particular care.

The following illustrations show correct and incorrect ways to lift the material to be driven with one or two cables.

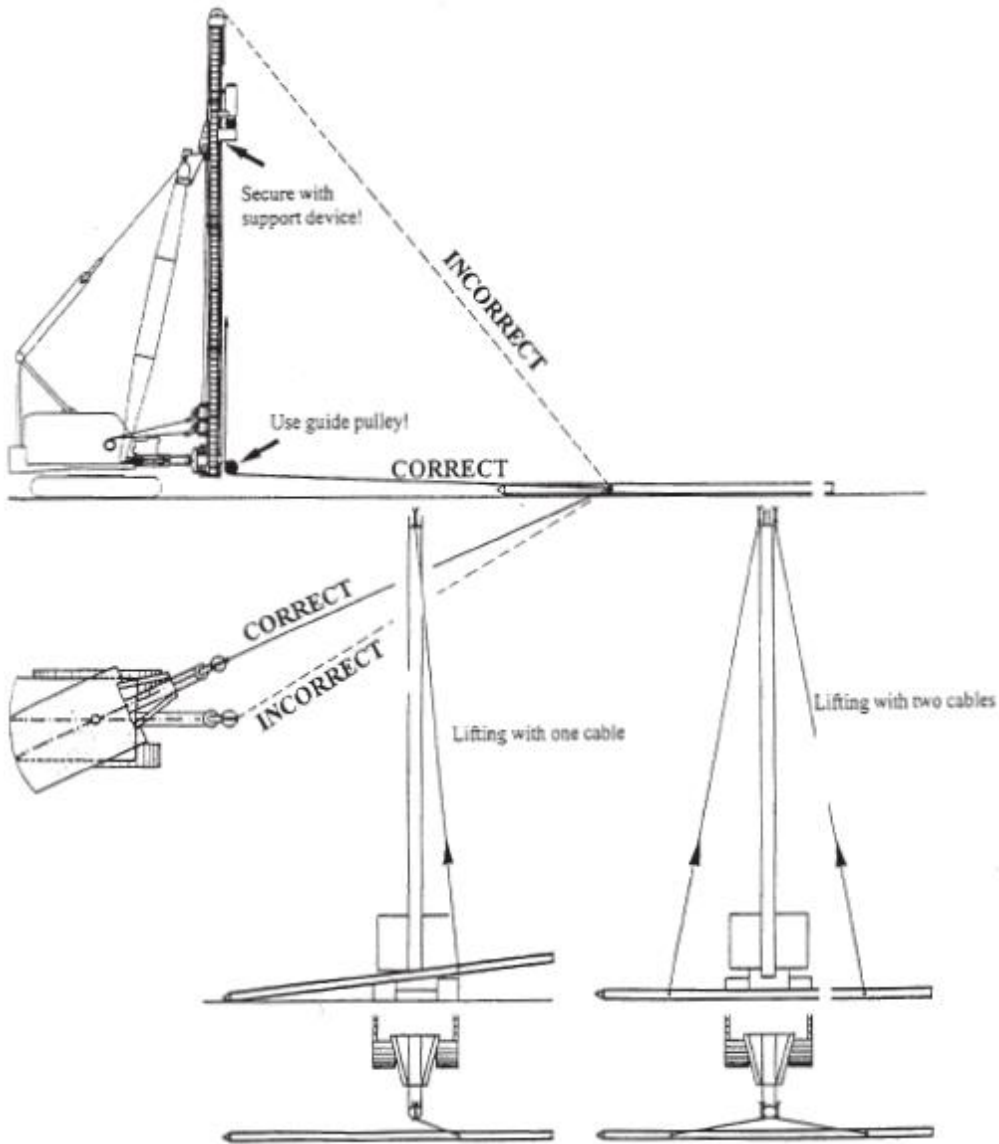


Fig. 12 – How to Lift the Pile

5.7 Operating mode

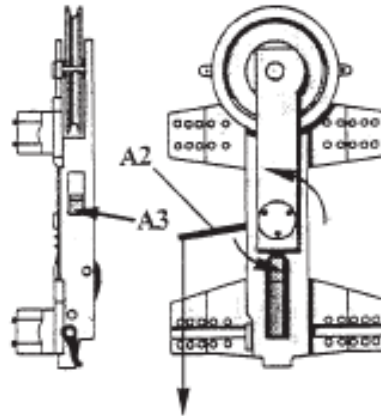


WARNING!

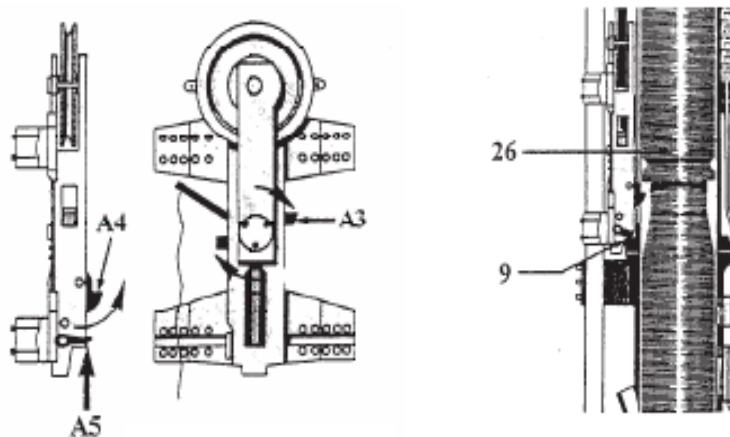
You must keep a distance of at least 4 m from the Diesel hammer, and wear a hard hat, ear plugs, safety goggles, safety gloves, safety boots and suitable work clothes. A lifesaving vest must be worn when working above the water surface.

5.7.1 Lowering the tripping device


- Pull the lever (ref. A2) down to the stop using the cable and keep it taut. This retracts the driving pin (ref. A3). The tripping device can move past the latches of the Diesel hammer.



- Lower the tripping device to the lower stop (ref. 9). The trip cam lever (ref. A5) is pushed upwards at the trip cam lever engaging point (ref. 9). Pawl (ref. A4) is thus pushed into the groove of the piston weight (ref. 26).



- Release the cable at the lever.



DANGER!

Danger of Fall!

The tripping device must always be lowered to lower stop to ensure that the latch projects fully and is locked. If this is omitted, the Diesel hammer may trip prematurely and kill someone!

The pulling cable must always hang free. Do not tie the pulling rope to the lead or other places. This may cause the Diesel hammer to crash down. Danger to life and risk to destroyed tripping device.

5.7.2 Lift/lower the Diesel hammer

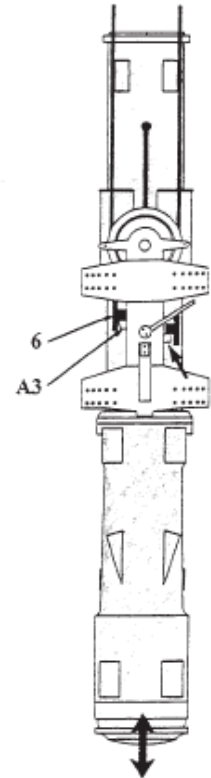
WARNING!



Piston position

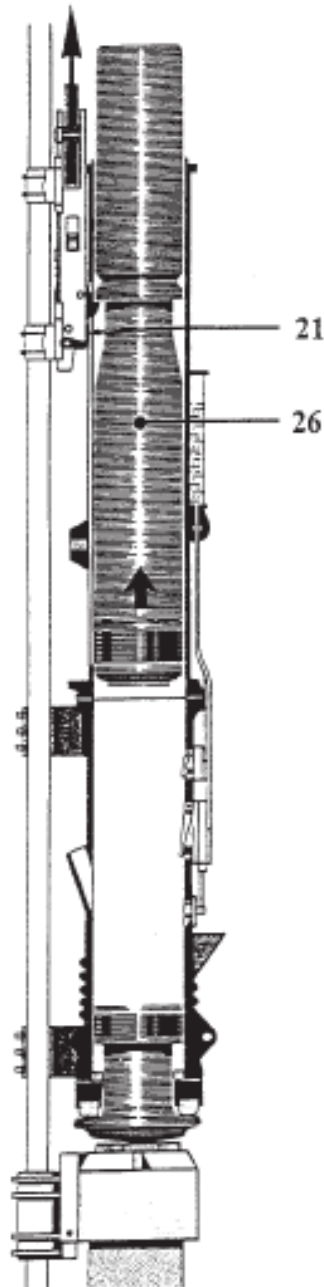
Pay attention to the fact that the piston has indeed fallen into a notch of the tripping device during the lifting of the Diesel hammer.

- Lower the tripping device as described above.
- Slowly pull the tripping device upward using the cable winch. Do not pull on the cable at the lever. During the lifting stage, the cams of rotating catch grasp below the catch (ref. 6) the Diesel hammer. It now hangs from the tripping device.
- Use the cable winch to place the Diesel hammer into the proper position.



5.7.3 Lifting the impact hammer

- Lower the tripping device as described above.
- Pull the lever down to the stop using the cable and keep the cable taut. This retracts the rotating latch.
- Use the cable winch to slowly pull the tripping device upwards. When pulling it upwards, the piston (ref. 26) is also pulled upward and automatically released the upper stop (ref. 21).



5.8 Fuel supply control

The fuel supply control pump determines the energy per blow and thus the drop height of the piston. The fuel control pump has five settings.

Position 1: lowest energy 48% -- 64% as a function of the type,

Position 4: highest energy 100%,

Position 0: as well as setting in this position the Diesel hammer shut off → no fuel supply.

Also, the fuel supply can be cut off with the shutoff valve.



5.9 Mode of operation



WARNING!

You must keep a distance of at least 4 m from the Diesel hammer, and wear a hard hat, ear plugs, safety goggles, safety gloves, safety boots and suitable work clothes. A lifesaving vest must be worn when working above the water surface.

5.9.1 Increase fuel supply

Jerk on the right rope to the stop and release the cable. This switches the fuel control pump to the next higher setting. Repeat this step until the desired setting has been reached (to a maximum setting of "4").

5.9.2 Decrease fuel supply

Jerk on the right rope to the stop and release the cable. This switches the fuel control pump to the next lower setting. Repeat this step until the desired setting has been reached (to a minimum setting of "0").

5.9.3 Fuel supply shut off

Pull on the center rope to the stop and keep the cable taut until the impact hammer is at rest. This has no effect on the setting of the fuel control pump.

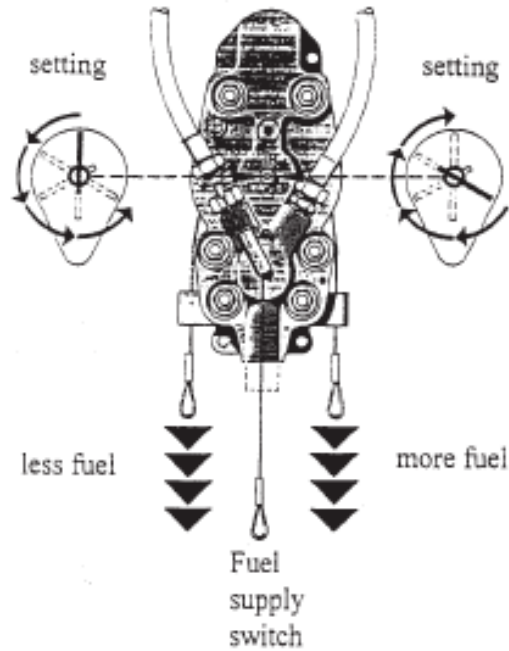



Fig 13 – Fuel Control Pump Setting

5.10 Bleed fuel control pump and injection valves

The fuel control pump and the injection valves must be bled:

- Prior to the first putting-into-operating,
- After repair work,
- When the Diesel hammer fails to operate due to a lack of fuel.

Take the following measures:

	WARNING!
	Danger of Fall!
	Use a height safety device to prevent a fall (mandatory at a lead height of above 5 m).

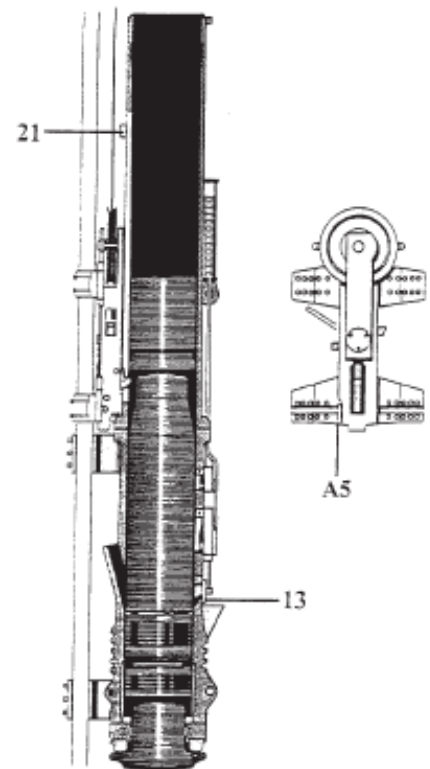
Let the Diesel hammer cool down fully prior to the bleeding (particularly in the event the Diesel hammer stopped working due to a lack of fuel). Danger of burn and fire!

WARNING!



You must wear a hard hat, ear plugs, safety goggles, safety gloves, safety boots and suitable work clothes. A lifesaving vest must be worn when working above the water surface.

- Pull the piston upward until the trip cam lever (A5 in picture 1) of the tripping device is located approximately 20 cm below the release point (ref. 21) the fuel flow to the fuel control pump will be blocked, when the impact hammer is too low. The impact hammer will be released automatically when the impact hammer is pulled too far upward.
- Set the fuel control pump to setting "4" (full load).
- Unscrew the swivel joint at the injection valves by approximately 2-3 turns. Do not fully unscrew the swivel joint.
- Activate the pump with the right control rope until a fuel without a bubble exits at all swivel joints.
- Keep the control rope taut and at the same time tighten all swivel joints.
- Release the control rope.
- Pull on the center rope for approximately 5 seconds. This opens the shutoff valve. Air can escape into the tank by way of the fuel lines,
- Release the center rope.
- Repeat steps 3 through 8 three times.



5.11 Cleaning of combustion chamber



WARNING!

Combustion Chamber

The combustion chamber must be cleaned each day prior to the first startup of the Diesel hammer. When this is omitted, the lubricant that has accumulated in the combustion chamber would also ignite during starting. The impact hammer may bounce to the catch groove (ref. 25) and cause damage.



DANGER!

Burns or Poisoning Risks!

The Diesel Hammer must rest on a pile or on the ground (with an appropriate support). It must never rest on a support device. If this is not observed, the support device will be destroyed and the Diesel hammer comes crashing down. Maintain a distance of at least 4 m from the Diesel Hammer. Never stand in front of it with an open combustion chamber bolt. Fuel, oil, dirt, and material residues will be ejected at a great pressure. This could cause injuries to the eyes or skin as well as burns and poisoning.

You must always wear a hard hat, safety goggles, safety gloves, safety boots and suitable work clothes.

Take the following step:

- Set the fuel control pump to "0". To do so pull the left control cable as often as required.
- Remove the locking screw (ref. 16 in Fig. 12)
- Maintain a safe distance from the Diesel hammer, since dirt and material residues will be ejected at a high pressure.

WARNING!



Never stand in front of the combustion chamber opening of the Diesel hammer. Always stand at side of it!

- Raise the piston five times using the tripping device and let the piston catch at the upper stop. These cold blows allow oil and dirt to escape from the combustion chamber.
- Screw the plug back in.

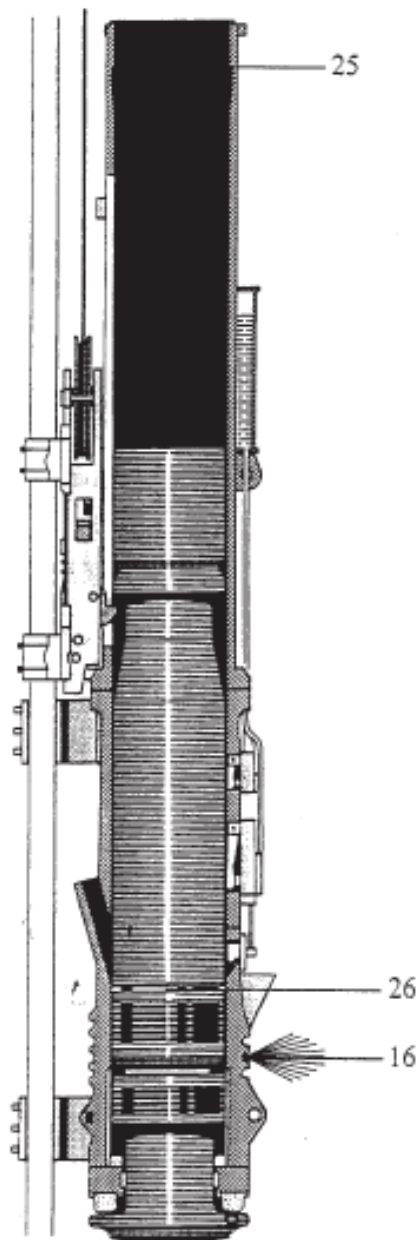


Fig 14 – Combustion Chamber Cleaning

5.12 Operational requirements of batter piling

During the operation of the batter piling, please follow the instructions given in this manual and the scope of the work.

The scopes of work of the batter piling of the Diesel hammer of all specifications are given in Fig. below.

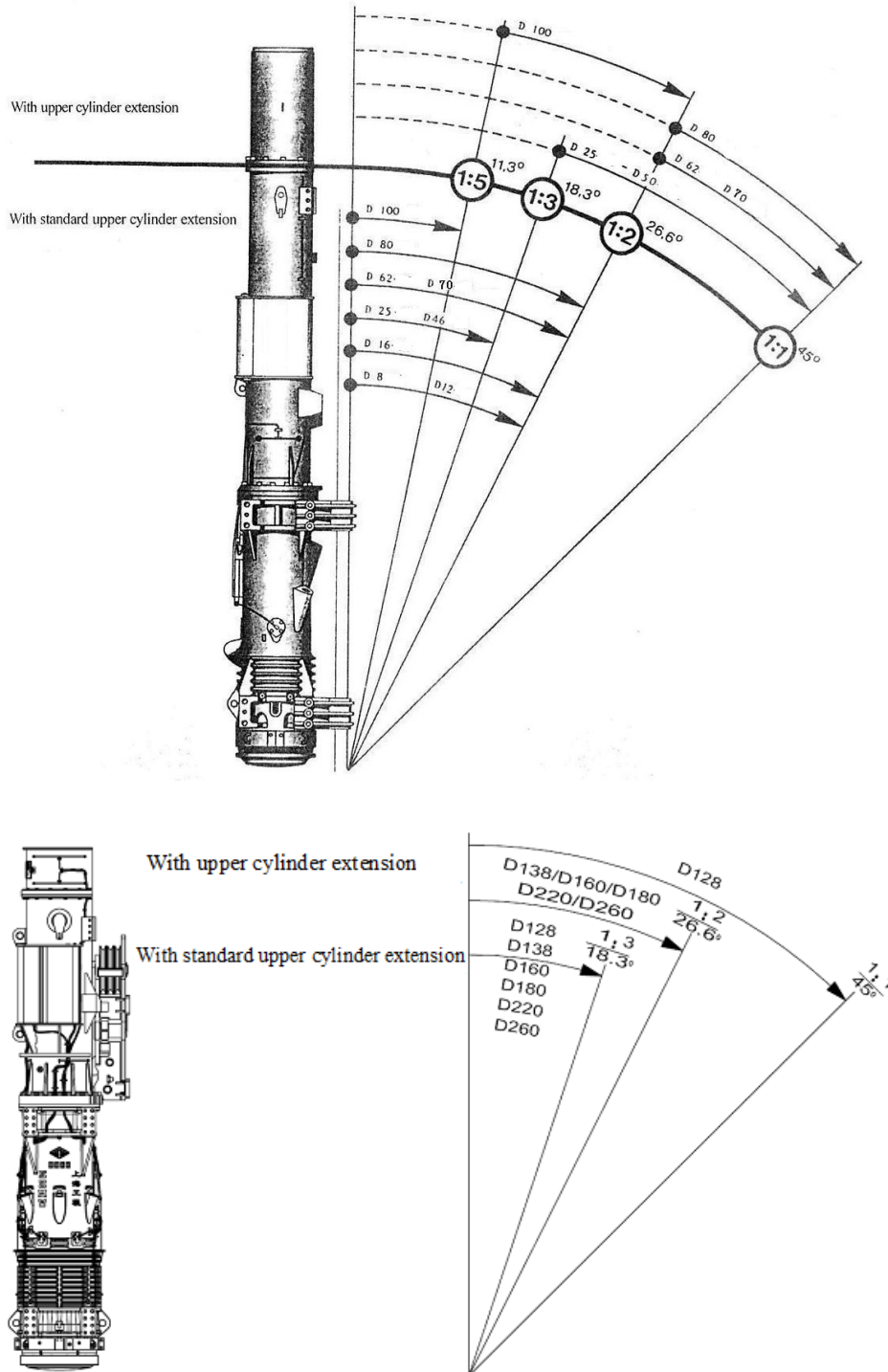



Fig. 15 – Operating Range of Batter Piling



5.13 Start and adjust

	<p style="text-align: center;">WARNING!</p> <p style="text-align: center;">Start up</p> <p style="text-align: center;">Follow all safety measures described in chapter 2.</p>
-----------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Thoroughly inspect the whole driving equipment system prior to putting it into operation. Check the unit for loose screws and bolts, cracks, wear, leaks, and damages. Check the stability of the unit. Make sure all damages are repaired immediately. Operate the equipment only after all damages have been repaired.

All the operator and the foreman in charge of the pile driving make sure no other person stands within 1.5 times the lead height. Sound a horn to warn others of the impending putting-into-operation of the unit.

Immediately halt the driving process in the event of a dangerous situation. Place a sign "attention: Diesel hammer is out of order" then resume work only after the dangerous situation has been taken care of.

5.13.1 Procedure

- Set the fuel control pump to "0". To do so, pull on the left control rope as often as required.
- Using the tripping device, pull the impact hammer and release it.
- ◆ For a pre-driven pile: set fuel control pump to "2" after the first blow. To do so, jerk the right control rope twice.
- ◆ For a newly placed pile: set the fuel control pump to the setting "3" after the first blow. To do so, jerk the right control rope three times.
- Continuously adjust the fuel injection quantity by jerking the control cables. Do not increase the injection quantity faster than one step per stroke.

5.13.2 Operating hints of the variable delivery-fuel pump

- The energy per blow (piston stroke) is governed by the variable delivery-fuel pump. Actuation of the fuel setting device is by pulling the regulating rope. At each pull of the rope, with is limited by a stop, the setting device moves one step forward or backward depending on whether the left- or right-hand rope has been pulled.

- When pulling the right hand-ropes, switching from (stop) position 0 to 1-2-3 up to 4 (maximum).
- When pulling the left hand-ropes, switching from position 4 (maximum) down 3-2-1 to 0 (stop).
- Switching should only be carried out when the pistons resting on the impact block or hitting the block when in operating.

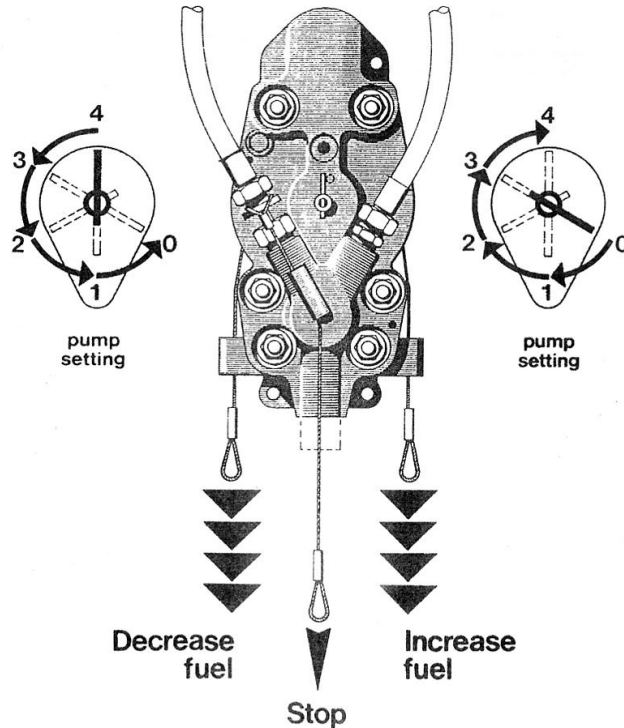


Fig. 16 – Adjusting Schematic Drawing of the Fuel Pump



NOTE!

The position of the setting device can be checked on the dowel sleeve at the regulating shaft.

5.13.3 Bleeding of variable delivery fuel and injection valves

- Only required on new hammers, after repairs or in case of stoppage due to lack of fuel. The bleeding must be performed while the piston is raised as only then the pump lever is reloaded, and the pawl of the trip gear is about 20 cm below the catch of the upper cylinder.



- Set fuel pump on position 4, loosen swivel joint on the injection valve (do not remove completely) only 2-3 turns then pump by pulling the regulating rope till bubble free fuel flows from the swivel joint and only then release rope. Open stop valve with its rope, so the air is released through the fuel line and tank. Keep the stop valve app. 5 seconds open and then close it. This must be repeated 3 times.

5.13.4 Cleaning of the combustion chamber

- Once daily, immediately before the first start, the lube oil accumulated in the combustion chamber must be removed. Otherwise, it is possible that the combustion of the additional lube oil will cause the piston to travel as high as the safety catch groove Set fuel pump to "0". Remove plug.
- Raise and drop piston five times (cold blows), so that the oil can escape through the threaded opening. On completion replace plug.

5.13.5 Starting-up

- When starting, set the variable delivery fuel pump to "0" for the first blow.
- For the second start, the setting should be stage "3". Switch to stage "4" when the pile hammer is running.
- The amount of fuel injection to meet the prevailing piling conditions; and be varied by pulling the fuel regulating rope (refer to point 1 as well as "angle of energy per blow within the regulation possibility")
- Set variable delivery fuel pump to position "4" when pumping between blows. Vividly pull the right-hand rope when the piston is at its top dead center.

5.13.6 Stopping

- Interrupt fuel supply by pulling the rope of the stopping valve. Hold rope until the piston has come to rest on the impact block.



NOTE!

This measure may only be taken on piles with large set per blow.

- Set variable delivery fuel pump by pulling the left-hand rope to position "0".



DANGER!

Emergency Stop !

In case of any abnormal situation during the operation, please pull the steel rope to stop the Diesel hammer.



5.14 Range of energy per blow within the regulation possibility

When the variable capacity fuel pump is at the different shift location, the impact force of the Diesel hammer may be different and the details are given in table below.

Table: Range of Energy per Blow

D8-42	D16-52	D19-52	D25-21
Pumping setting	Pumping setting	Pumping setting	Pumping setting
Position 4: 23940 J	Position 4: 53460 J	Position 4: 57585 J	Position 4: 78970 J
Position 3: 20400 J	Position 3: 47950 J	Position 3: 50675 J	Position 3: 71190 J
Position 2: 16700 J	Position 2: 35818 J	Position 2: 38582 J	Position 2: 58560 J
Position 1: 12790 J	Position 1: 25585 J	Position 1: 27641 J	Position 1: 39975 J
D30-52	D36-26	D46-52	D50-52
Pumping setting	Pumping setting	Pumping setting	Pumping setting
Position 4: 94765 J	Position 4: 113720 J	Position 4: 145305 J	Position 4: 157940 J
Position 3: 85350 J	Position 3: 94388 J	Position 3: 120603 J	Position 3: 131090 J
Position 2: 70045 J	Position 2: 75055 J	Position 2: 95901 J	Position 2: 104240 J
Position 1: 47970 J	Position 1: 55450 J	Position 1: 70850 J	Position 1: 77010 J
D62-52	D70-52	D80-42	D100-42
Pumping setting	Pumping setting	Pumping setting	Pumping setting
Position 4: 218960 J	Position 4: 238000 J	Position 4: 266830 J	Position 4: 333540 J
Position 3: 186000 J	Position 3: 197540 J	Position 3: 239365 J	Position 3: 299200 J
Position 2: 148800 J	Position 2: 157080 J	Position 2: 196420 J	Position 2: 257650 J
Position 1: 107050 J	Position 1: 116620 J	Position 1: 171085 J	Position 1: 213860 J
D128 (A)	D138 (A)	D160 (A)	D180 (A)
Pumping setting	Pumping setting	Pumping setting	Pumping setting
Position 4: 426500 J	Position 4: 459800 J	Position 4: 533000 J	Position 4: 590000 J
Position 3: 382570 J	Position 3: 412400 J	Position 3: 478000 J	Position 3: 529200 J
Position 2: 329300 J	Position 2: 355000 J	Position 2: 411500 J	Position 2: 455500 J
Position 1: 273400 J	Position 1: 294700 J	Position 1: 342000 J	Position 1: 378190 J
D220	D250	D260	
Pumping setting	Pumping setting	Pumping setting	
Position 4: 733000 J	Position 4: 833000 J	Position 4: 866000 J	
Position 3: 657500 J	Position 3: 747000 J	Position 3: 777000 J	
Position 2: 566000 J	Position 2: 643000 J	Position 2: 668500 J	
Position 1: 470000 J	Position 1: 534000 J	Position 1: 550000 J	



**Range of energy per blow is the theoretical value, but its actual value can be deviated possibly due to the different geological conditions and soil.*

5.15 Instructions for adjustment of variable-delivery fuel pumps

- Only applicable to variable delivery fuel pumps and fuel injection devices with the order numbers given in the table.
- The check dimension of variable delivery fuel pumps must be checked from time to time to assure proper operation of the Diesel hammers.
- This dimension (clearance between pump seating face and highest point of pump lever when set pump on position 4) determines the stroke of the pump element and thus the fuel delivery rate.
- Wear, e.g., on the pump lever or guide sleeve of pump element reduces the fuel delivery rate. This wear can be made good by changing the shim(s) in the thrust pin.



NOTE!

This measure may only be taken on piles with large set per blow. Never grind the pressure piece or mushroom.

Please ensure that only original APE fuel lines are used and the valve piston in the injection valves run smoothly and seal properly.



Table: Check Dimension and Fuel Delivery Rate of the Fuel Pump

Diesel hammer		Injection valve complete	Pump element complete diameter	Check dimension	Fuel delivery rate at full load (pump on position 4)
		quantity	.mm	mm	cm ³ /stroke
D8-42		1	14	53.5+0.3	1.75
D16-52		1	16	53.5+0.3	2.4
D19-52		1	18.7	53.5+0.3	3.1
D25-21		1	20	54.5+0.3	3.90
D30-52		1	22	54.5+0.3	4.40
D36-26		2	24	53.5+0.3	5.65
D46-52		2	27	54.5+0.3	7.15
D50-52		2	27	54.5+0.3	7.15
D62-52		2	31	53.5+0.3	8.70
D70-52		2	35	53.5+0.3	11.1
D80-42		4	32	55.0+0.3	10.50
D100-42		4	35	55.5+0.3	12.50
D128	Single pump	4	40.5	58+0.3	16.5
	Double pumps	4	28.5	58+0.3	8.2
D138	Single pump	4	43.5	58+0.3	19.3
	Double pumps	4	31	58+0.3	9.65
D160	Single pump	4	46	58+0.3	21.6
	Double pumps	4	33	58+0.3	11.1
D180	Single pump	4	48	58+0.3	23.5
	Double pumps	4	35	58+0.3	12.5
D220	Double pumps	4	40.5	58+0.3	16.5
D250	Double pumps	4	42.5	58+0.3	18.4
D260	Double pumps	4	43.5	58+0.3	19.3

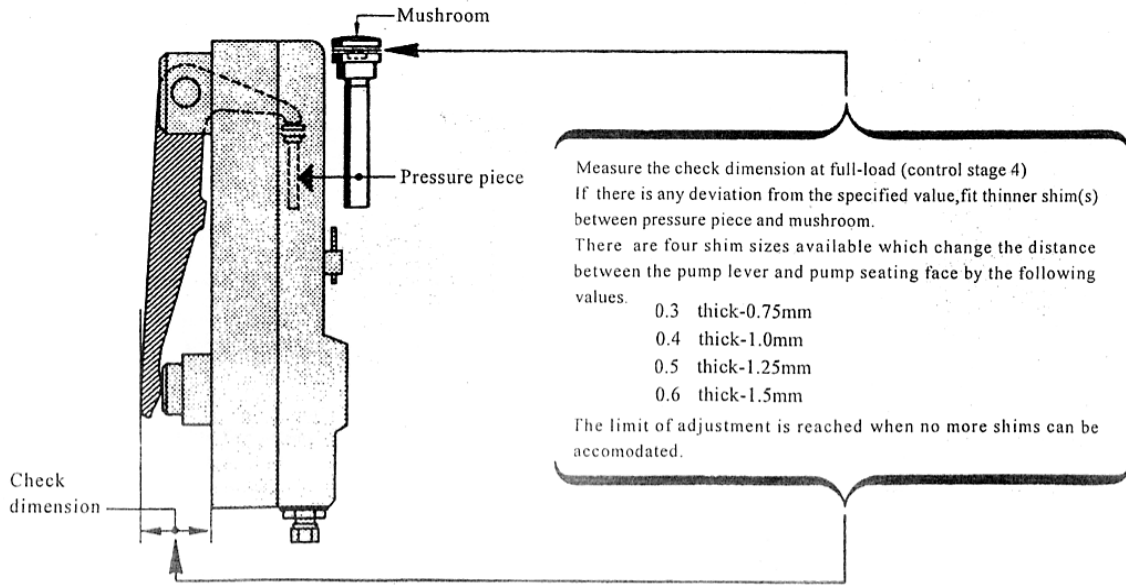


Fig. 17 – Check Dimension of the Variable Delivery-Fuel Pump

5.16 Oils

5.16.1 Fuel oil used for Diesel hammer

- The use of diesel oil unsuitable for the respective season of the year will cause starting difficulties. Therefore, always be sure you buy Diesel oil suitable for the respective season.
- When using normal summer diesel oil during the cold period at temperatures of -8 to -10°C. Paraffin is separated and prevents the proper feeding of the fuel pump. At even lower temperatures the fuel supply to the pump can be blocked completely.
- Winter diesel oil which during the cold season is available at filling stations can be used at temperatures as low as -30°C provided it contains at least 50% fuel additives.
- The following fuel additives should be used: Motor petroleum, Tractor fuel, Regular gasoline.

Table: Mixing ratio Diesel / Regular Gasoline or Engine Mineral Oil

outside temperature	summer diesel fuel	winter diesel fuel
above -10°C	90% / 10%	100% / 0%
-10 to -14°C	70% / 30%	100% / 0%
-14 to -20°C	50% / 50%	80% / 20%
-20 to -30°C	----	50% / 50%

5.16.2 Lubricating oil / grease used for Diesel hammer

Filling of lubricant lines with oil



NOTE!

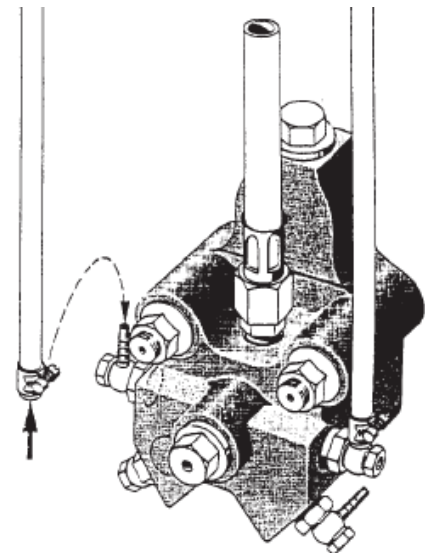
Lubricant Oil

The lubricant lines of the lubricant system must always remain filled with lubricant. Otherwise, the Diesel hammer will be supplied with the lubricant only after some times has passed. This will damage the Diesel hammer.

You must wear a hard hat, safety gloves, safety boots and suitable work clothes.

The lubricant lines of the lubricant system must be replenished prior to the first putting-into-operation and after repairs to the lubrication system:

- Lay the Diesel hammer down in a horizontal position.
- Remove the lubricant lines from the lubricant pump. To do so, loosen the lubricant clamps. Subsequently pull the lubricant lines from the connection fitting.
- Fill the lubricant lines with motor oil using a squirt can. Keep on filling the lubricant lines from the bottom with oil, until oil exits at all connection fittings.
- Tighten the lubricant clamps again. Make sure all lubricant lines are solidly attached to the connection fittings (retighten if necessary).
- Put the Diesel hammer into a vertical position.
- Check the lubricant level in the lubricant tank. The tank must be full.



Vertical pile driving

Reliable lubrication of the upper cylinder part is ensured by the lube oil pump. The addition of lube oil additives is to be recommended (1L additive to 20L lube oil). Grease impact block and cylinder end ring every 20 minutes of operation time with special grease (5-10 pump strokes per nipple from the grease gun).

The lubrication points are identified. Do not lubricate when impact block is hanging out.



The trip gear must be lubricated with special grease (5 strokes per nipple with grease gun) every week.

Lubricate the guide tubes of the lead once per week. (Multi-purpose grease containing MoS₂ or similar)

Piling under Batter or Inclination

Reliable lubrication of the upper cylinder part is ensured by the lube oil pump. In addition to greasing the impact block and cylinder end ring every 20 minutes of operation time by using a grease gun (5-10 pump strokes per nipple) it is necessary to grease the upper cylinder part as well.

It is necessary to add lube oil additive, ratio 1:20, when batter piling at inclinations larger than 1:10.

Lubricant additives

The lubricant additives include BEL -RAY Moly lube Friction Modifier (in USA: Moly-lube Modifier AO-2).

Lube oil

Should use specific brands of regular lube oil, include summer and winter. (See table below)

Table: Type of Lube Oil

Summer	Winter
Motor oil SAE 40/50	Motor oil SAE 20
Motor oil CC 40/50	Motor oil CC 20

Special greases

Should use specific brands of regular special greases, include the following species:

- ◆ Schaeffer Moly EP 274
- ◆ Bel Ray Molyube Extreme Pressure AC 2



5.17 Examination during the working process of the Diesel hammer

- The movement, swing, lifting piles and lifting hammers shall not be worked together. After lifting the pile, the pile frame shall not have the round-trip swing or movement.
- The pile frame is forbidden to lift the pile from the side face and towing the pile from a far distance. When lifting the pile right head, the distance from the prefabricated concrete piles should not exceed 4m and the distance to the steel pipe pile shall not exceed 7m and the collision between pile and leader shall be avoided.
- Before the start of the Diesel hammer, the center line of the pile hammer, the pile helmet and the pile should be in the same axes line to avoid eccentric piling.
- When piling in the soft soil, the oil fuel pump should be turned off. When the penetration is less than 100mm, the Diesel hammer can be started.
- When the Diesel hammer starts, the trip gear should be lift. During the piling process, the distance between the trip gear and the top of the upper cylinder of the Diesel hammer can't be less than 2m.
- When the Diesel hammer is working, the height of the piston should be measured with eyes. The instruction should be strictly followed. Once it reaches the specified height, the diesel oil should be reduced and controls the stroke of the piston.
- During the process, pay attention to the change of soil horizon and operation of the pile hammer. If any abnormal event occurs, take the effective measures immediately.
- In case of the pre-ignition, the work should be stopped and follow the instruction.
- For trouble-free pile driving, it is of paramount importance that the impact surface of the pile head should be square and level. The center line of the pile must be accurately aligned with the center line of the pile hammer and must have the same line of travel. If this basic rule is not observed the pile hammer may rebound, which could cause the cylinder to crack and/or buckle, Moreover, rebounding impacts will also cause the pile to vibrate, misaligning it and possibly even destroying it if it is made of concrete.
- Use a suitable pile helmet guided on the lead. However, even the use of a pile helmet cannot always prevent the pile from deviating slightly from its original line. The pile foreman must keep a constant check on the work in progress and must correct the lead immediately if the pile shifts out of line.
- If the pile helmet is not guided on the lead the pile, etc., must be held to the lead with one or more pile guides.

- Should think to replace the Diesel hammer which has being bigger striking energy according to the actual working condition if the pile sinks less than 50mm per 10 impacts. Shut down the pile hammer immediately if the pile sinks less than 20mm per 10 impacts.



NOTE!

Slower penetration is possible, but it leads to more rapid wear of the pile hammer.

- If pile penetration is slow, check for excessive piston "rebound". Ensure that it does not strike the arrester groove in the upper cylinder. Regulate the pile hammer and shut it down in time.
- To avoid accidents, keep clear of the pile hammer while it is in operation.
- Frequently checks are necessary to ensure that the guide clamps and guides are firmly attached.
- Replace worn or buckled guide clamps and gibs immediately. Otherwise, the hammer may jump out of the guide and cause an accident.



NOTE!


The maximum clearance between the guide clamps or gibs and the guide tubes of the lead must not exceed the allowable values. Please check constantly.

- Don't use a lead if buckled or worn seriously, it may cause an accident.
- Never exceed the permitted batter for the pile hammer being used when batter piling.
- If damage to the pile-driving equipment or the pile is discovered or predictable, stop all work immediately for examination.
- Always make sure that all parts are properly lubricated.
- The verticality of pile should be corrected after Inserting pile. When the pile has been 3m into the soil, pile movement or swing shall be avoided.
- When batter piling, the pile frame should be vertical. Hang the pile and make it lean back retroversion. When the angle of inclination is 18.5°, the Diesel hammer can't be lifted.
- Every fastening piece and motive parts should be checked whether they are loose or flexible during the process.

5. Shutdown

The Diesel Hammer may be left in the lead for a temporary shutoff. There are two possibilities to safely support the machine:

- Let the Diesel Hammer rest on the material to be driven,
- Let the Diesel Hammer rest on the lower support device.

	<p style="text-align: center;">WARNING!</p> <p style="text-align: center;">Danger of Fall!</p> <p style="text-align: center;">Use a height safety device to prevent a fall (mandatory at a lead height of above 5 m).</p>
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Make sure the carrier unit exhibits a sufficient stability. Consider a change in the weather (rain, storm). Danger of overturning!

Do not touch the Diesel Hammer shortly after operation. Danger of burns! Let hot components cool for a sufficient period.

All the operator and the foreman in charge of the pile driving make sure no other person stands within 1.5 times the lead height. Sound a horn to warn others of the impending putting-into-operation of the unit.

Proceed as follows:

- When resting on the pile: drive the pile to at least half the depth,
- When resting on the support devices: let the Diesel Hammer rest on the lower support device,
- When resting on the pile: bring the Diesel Hammer to rest on the pile. You may turn the fuel supply off during the driving phase and wait until the piston has come to a complete halt.
- Let the Diesel hammer cool down completely.
- Install the protection hood, protection rail and exhaust covers.
- Take the carrier unit out of operation (see specific instruction).
- Secure the carrier unit. (Activate locking brake, remove ignition key, close doors, windows and hatches, lock doors)
- Secure the danger zone of 1.5 times the lead height in accordance with local regulations for the blocking off the job sites.

6.1 Removal from the lead

When the Diesel hammer will not be operated for several days, it will be necessary to remove it from the lead.

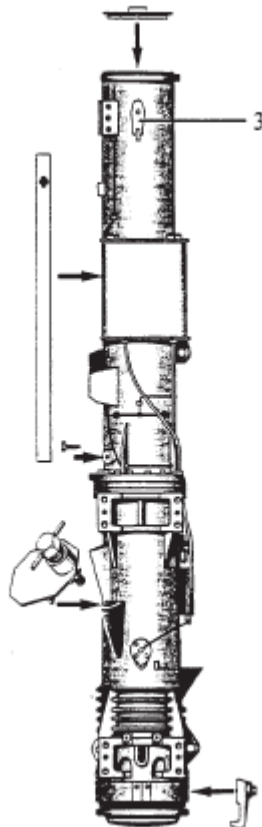


WARNING!

Danger of Burns!

Do not touch the Diesel hammer shortly after operation. Let hot components cool down for a sufficient period.

- Procedure for removal
 - ◆ Let the Diesel hammer rest on the material to be driven or on the ground.
 - ◆ Let the Diesel hammer cool down completely.





- ◆ Install the piston locking screws, piston safety, protective hood, protection rail and exhaust covers.
- ◆ Remove the ropes from the fuel control pump.
- ◆ Place the steel cable loops around the lifting ears (ref. 3 in Fig 1) and on the hook of the carrier unit.
- ◆ Lift the Diesel hammer approximately 10 cm with the lifting equipment.
- ◆ Remove all four hammer guides of the Diesel hammer.
- ◆ Install the transport angles. Then place the Diesel hammer horizontally on wooden blocks.
- ◆ Remove the steel cable loops from the lifting plates and from the hook of the carrier unit.
- ◆ Put the carrier equipment out of operation (see its instruction).
- ◆ Secure the carrier unit: activate locking brake, remove ignition key, close doors, windows and hatches, and lock doors.
- ◆ Secure the job site in accordance with local regulations for the blocking off jobsites.

6. Transport, lifting and storage

7.1 Transport safety lock device



DANGER!

Crash and Impact danger

The Diesel hammer shall only be transported with an installed locking screw (piston) and impact block clamp. If this is omitted, a shift in the center of gravity could cause sudden movements of Lift the Diesel hammer! The piston and impact block may accidentally crash to the other end position.



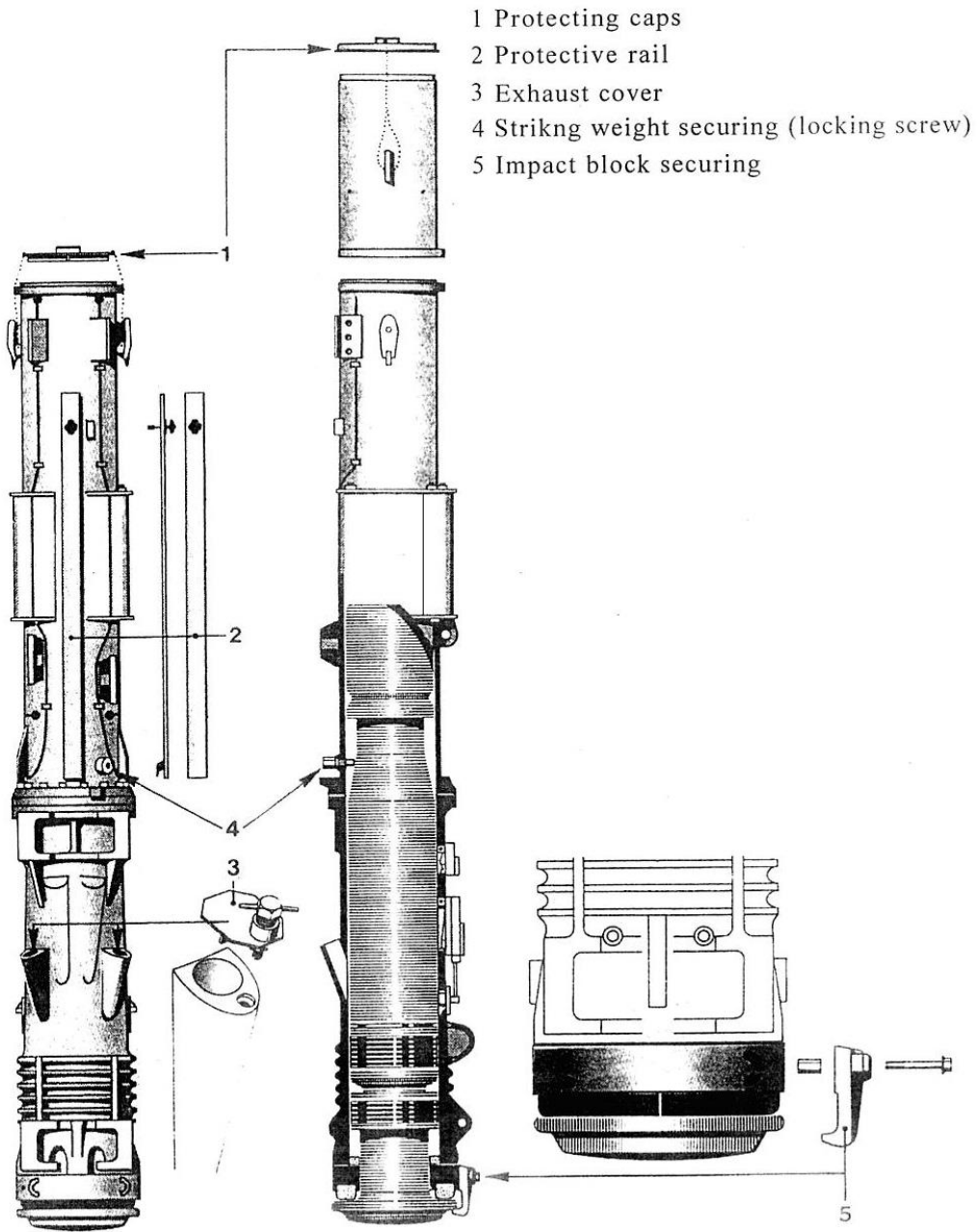
NOTE!

Package control

The Diesel hammer and its accessories must be packaged, loaded, and transported carefully to prevent damage. Check the Diesel hammer and all accessories regarding completeness and damages after delivery. Immediately notify the shipping agency or the appropriate dealer about problems.

The following transport safety devices must be installed prior to transporting the Diesel hammer:

1. Protective caps. It prevents the entering of water, dust, and foreign bodies. Attach the protective hood with the help of two chains. Attach the hook located at the end of each chain to the respective eyelet.
2. Protective rail. It prevents the entering of dirt, sand etc. in the combustion chamber. Attach the hook of the protective rail to the lifting slot of the upper section of the cylinder. Lock the protective rail with the clamp screw.
3. Exhaust cover. This cover prevents the entering of water, dust, and foreign bodies. Screw the exhaust covers into the respective thread fitted at the exhaust.
4. Striking weight securing (locking screw). These bolts prevent the moving of the piston during transport. These prevent sudden shifts in the center of gravity of the Diesel hammer. Omitting the installation of these bolts may cause sudden movement as well as damages. The piston safety bolt must be screwed fully. The piston must be in lower end position.
5. Impact block securing. It prevents a moving of the impact block clamp the impact block may accidentally fall to the other end position.
6. Transport angles. The transport angles allow a horizontal placing of the Diesel hammer. It could be damaged during a horizontal placing when the transport angles are not installed.



7.2 Transport cables



DANGER!

Risk of fall!

Prior to each use, the transport cables must be inspected visually. Use only approved cables to transport the Diesel hammer. Immediately remove and dispose of damaged cables.

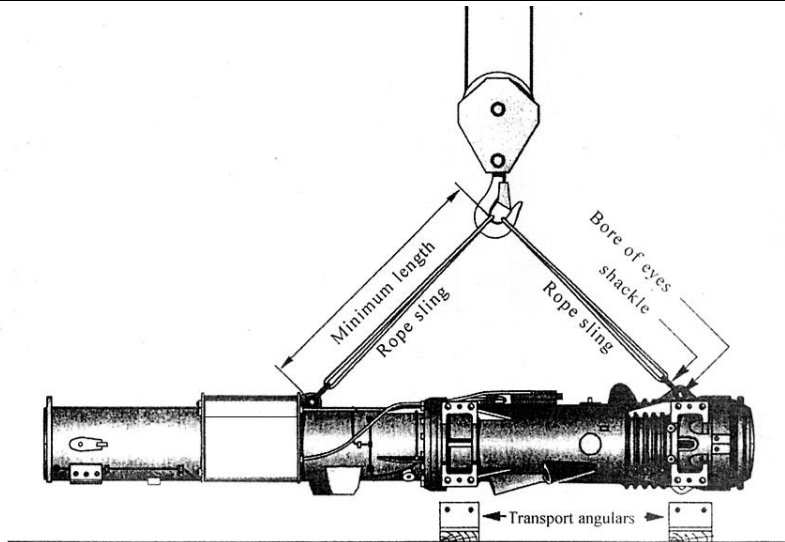


Table: Transport Requests

	D8-42				
	D16-52	D30-52	D46-52	D62-52	D80-42
	D19-52	D36-26	D50-52	D70-52	D100-42
	D25-21				
2 Wire rope slings (DIN3066)	Φ 13/3.5m	Φ 18/6.5m			Φ 32/5.5m
Minimum breaking strength of the single rope at 1600N/mm ² (2 rope slings=4×)	79700N	153000N			522000N
Minimum length If other ropes or chains are used, they must be strong enough to be the weight of the pile hammer safely.	1.7m	1.9m	2.0m	2.3m	2.7m
Bore of the transport	Φ 50mm	Φ 50mm			Φ 62mm
Shackles rate for	8 t	8 / 10t			16 t

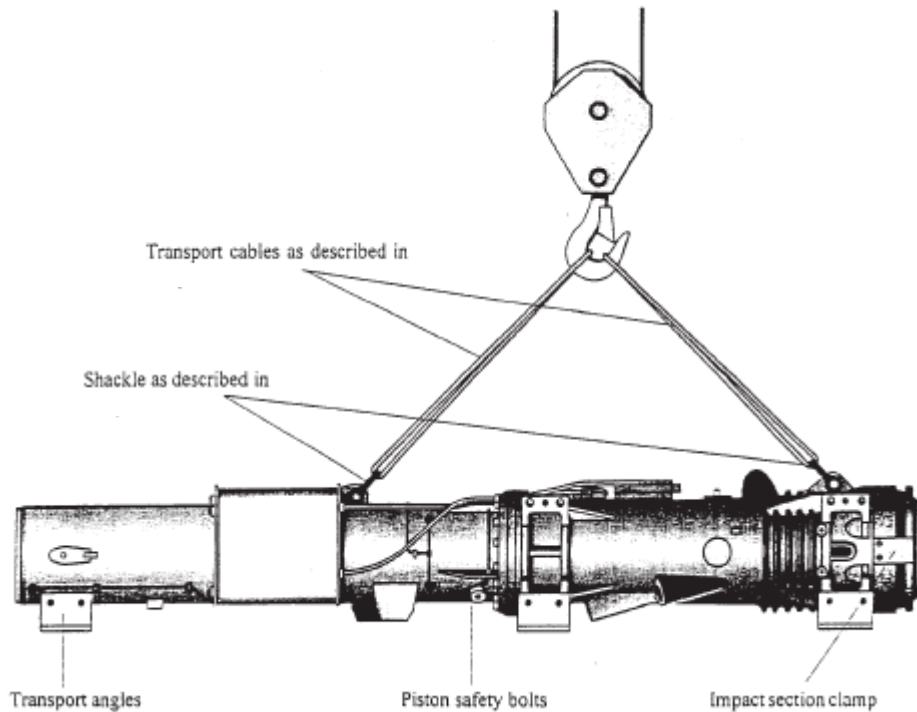


	D128 D138	D160 D180	D220 D260
2 Wire rope slings (DIN3066)	Φ 32/8m	Φ 36/8m	Φ 40/8m
Minimum breaking strength of the single rope at 1700N/mm ²	680000N	850000N	1070000N
Minimum length If other ropes or chains are used, they must be strong enough to be the weight of the pile hammer safely.	4m	4m	4m
Bore of the transport	Φ 75mm	Φ 85mm	Φ 95mm
Shackles rate for	32 t	40t	50 t

Never walk under suspended loads!

Use only lifting equipment that is in an excellent technical condition, exhibits a great stability and is designed to lift the applicable loads. Use only approved and suitable steel cables and shackles.

The Diesel hammer shall be lifted only with installed safety devices.



7.3 Storage



NOTE!

Burns and fire!

Let the Diesel hammer fully cool down prior to storage.

You must wear safety gloves, safety boots and suitable work clothes. A suitable breathing apparatus must be worn, when required.

The following points must be observed when storing the Diesel hammer:

- Check the Diesel hammer for damage and wear. Have the necessary repairs carried out immediately? This prevents the work from being forgotten.
- Check the tanks and lines of the Diesel hammer for leaks and a solid fit.
- When required: have the impact areas and catch groove machines and replace the damping rings.
- Drain the tanks (fuel, oil, ether).



DANGER!

Explosion and Poisonous!

Fuel, ether, and lubricants are extremely flammable and explosive under certain condition. Drain the tanks only in a well-ventilated area.

No smoking or work with open flames or sparks is allowed during the draining of the tanks and in storage areas for fuel, ether, and lubricants.

- Clean filters.
- Close the drain openings of the fuel pump with a rubber plug.
- Remove and clean the piston, impact block, upper- and lower-cylinder section. Check all connection elements for a solid fit.
- Clean and check the tripping device as well as the guide components of the Diesel hammer and of the tripping device for damage and wear.
- Clean and check the pile helmet, attachment cables, pile helmet cushion and accessories



(brindle, support devices) for damage and wear. Pile helmets cushions made of wood do not store well and are thus not to be stored for a long time.

- Check the tool chest and determine its completeness and the condition of the parts. Replace missing or unusable parts with new parts. Check the control cables for the tripping device and fuel control pump for damage and wear. (Replace if necessary).
- Check the condition and completeness of protection devices and personal safety equipment such as:
 - ◆ Protective clothing, hard hat, safety gloves and safety boots,
 - ◆ Safety goggles and ear plugs,
 - ◆ Lifesaving vest,
 - ◆ Height safety devices.

Personal Protection Equipment must meet local safety regulations.

- Prepare the Diesel hammer for storage.
- Protect Diesel hammer against the effect of the weather. Cover the Diesel hammer and all accessories. If possible, store the machine in an unheated and dry room exhibiting minimal temperature changes. Do not store the Diesel hammer in direct sunlight.



7.3.1 Laying up

The protective effect is very much a function of the thickness and viscosity (ductility) of the material used. We recommend the Moly Grease. It is thick grease that you can apply with a rag or brush.

To apply the grease:

- Disassemble the Diesel hammer. Observe the installation information.
- Remove all dirt and rust from all components. Replace worn or damaged parts.
- Touch up the paint. Let the fresh paint dry.
- Run corrosion protection oil through the fuel and lubricant pump.
- Lubricate the tripping device and subsequently apply rust protection oil to it by brush.
- Apply rust protection oil by brush to the guide parts of the Diesel hammer and the tripping device.
- Spray the tank inside with rust-inhibiting oil. Then solidly close the tanks. Close the fuel tank with accessory screw (without ventilation hole).
- Carefully apply grease such as Moly Grease by brush to all unpainted parts (including the holes in the end ring, upper and lower cylinder).
- Apply rust-inhibiting oil to all metal tools in the tool chest.



7. Maintenance and troubleshooting

Maintenance work must be carried out by qualified and authorized experts.

Place the Diesel hammer out of operation prior to carrying out any maintenance work. Make sure the unit cannot be put into operation by other persons during maintenance work.

Place the follow label in well visible place.

Use a height safety device to prevent a fall of the machine.

Do not touch the Diesel hammer after operation. Let hot components cool down sufficiently.

Do not carry out any repair or maintenance work on a moving Diesel hammer.

You must wear a hard hat, safety gloves, safety boots and suitable work clothes. You must wear a lifesaving vest when working above a water surface.



8.1 Catch groove and catch piston ring

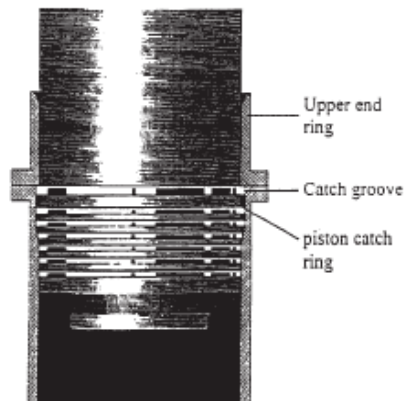
The material to be driven penetrates slowly in particularly solid soil or in the case of a very blunt pile. In such a case, the drop height of the impact hammer may continue to increase. You must, in a timely manner, reduce the fuel supply to prevent the piston catch ring from bouncing into the catch groove of the upper cylinder section.

The operation of the Diesel hammer must be discontinued immediately, when the piston catch ring has bounced into the catch groove and the piston catch ring. Both must always be in perfect condition. Machine a damaged catch groove. Replace damaged piston catch rings.



DANGER!

The Diesel Hammer must not be operated with a damaged catch groove.





- When the pile meets strong resistance. Piston travel can increase so much that the catch ring hit the catch groove in the cylinder upper part.
- If this occurs, immediately reduce fuel injection by diminishing fuel pump setting respectively shut off hammer and interrupt driving. Catch groove and catch piston ring must always be in a perfect condition.
- Immediately rework catch groove if latter is damaged as otherwise there exist Danger of accident!

8.2 Testing the compression

Starting difficulties may be cause by a compression that is too low. A major decrease in the compression during the pile-driving work will cause the piston to reach lower and lower heights. The Diesel hammer will stop in the extreme case.

The compression can be checked as described below:



WARNING!

You must wear a hard hat, ear plugs, safety goggles, safety gloves, safety boots and suitable work clothes.

- Place the Diesel Hammer on a hard pile or a test stand.
- Set the fuel control pump to "0", to do so jerk the left rope as often as required.
- Pull the piston upward until it trips.
- Watch the piston! Compression is sufficient when the piston bounces after impacting the impact head and comes to rest after at least another three upward and downward movements.

Causes for a compression that is too low:

- Defective or stuck piston rings.
- Insufficient lubrication of impact block or piston.
- Grooves in the lower cylinder section below the exhaust opening.
- Damaged cylinder bushings.
- Inside diameter of the lower cylinder section is not round.
- The pile "runs" (soft soil, light, pointed and narrow material to be driven).

Replace the defective components. Lubricate the impact block and piston in accordance with the maintenance schedule.

The following steps are helpful in case of a "running" pile:

Starting difficulties: let the piston drop several times with the fuel supply shutoff (cold blows) until the penetration resistance is sufficient for the starting.

8.3 Screw / bolt connections



NOTE!

Never check compression on hammer when same is secured on leads by means of the safety mechanism or safety fork.

- Important: When commissioning a new Diesel Hammer check all nuts and bolts for tightness after 1.5- and 10-hours' work.
- During piling operation regularly check all screw joints, especially the bolts of guide clamps on the hammer and the bolts of guide gibs on the trip gear.



WARNING!

Immediately replace over-tightened screws with new ones of the same strength. Diesel Hammer cannot be operated safely with loose or over-tightened screws.

8.4 Guides

Prior to the driving of piles, it will be necessary to check the wear of the

- Guide sleeves of the Diesel Hammer,
- Guide strips of the tripping device,
- Guides of the pile helmet,
- Wear strips along the whole lead length.

Prior to the driving of piles, the wear strips must be lubricated daily with MoS₂ containing multipurpose grease along the whole lead length.

WARNING!



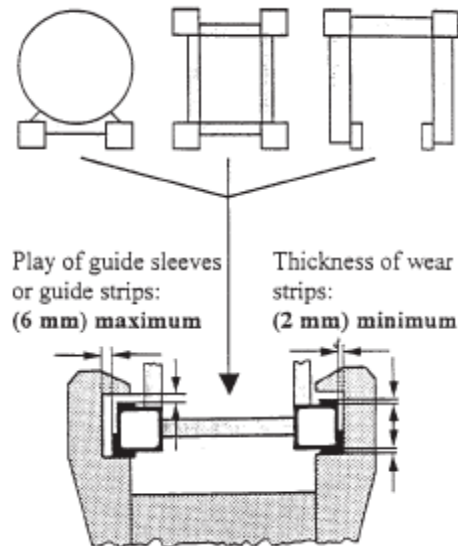
Danger of Crash!

Worn guide parts must be replaced immediately. Wear strips at the lead that are too thin must be reinforced immediately. If this is not done, the Diesel hammer, impact block or tripping device may jump out of the guides.

Use only original spare parts. APE cannot guarantee the safe operation of the Diesel Hammer when other spare parts are used.

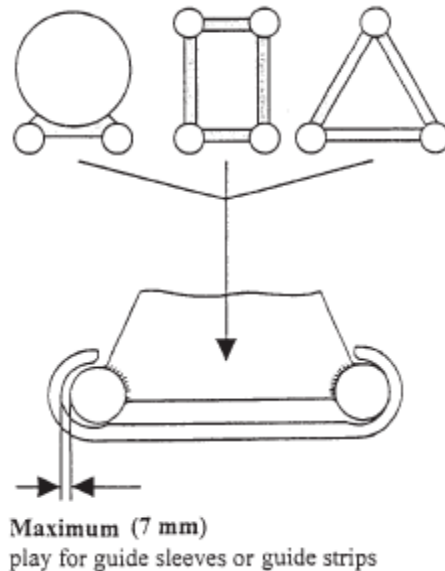
Follow the safety instruction.

The play for the guide sleeves and guide strips shall not exceed 6-7 mm.



When it exceeds the above values, the guide sleeves and guide strips must be replaced immediately.

The wear strips must have a minimum thickness of 2 mm along the whole lead length.



When they are thinner, the guide strips must be reinforced by welding flat bars to them.

8.5 Tripping device

The following items must be checked daily prior to the driving of the piles and when problems are suspected:

- The proper functioning of the latch and the tripping mechanism of the tripping device,
- The degree of overlapping between the Diesel hammer and the tripping device along the whole lead length,
- The play in the guides of the tripping device.

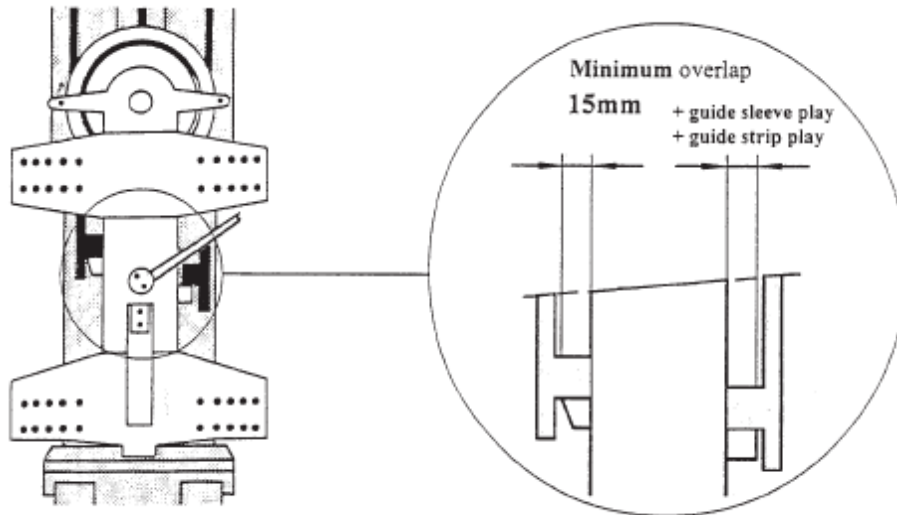
Lubricate the tripping device weekly with LUB-D (5 strokes with a grease gun per grease nipple).



WARNING!

Danger of Crash!

Do not operate the Diesel hammer, when the tripping device does not function properly or the overlapping distance between the machine and the tripping device is too short.



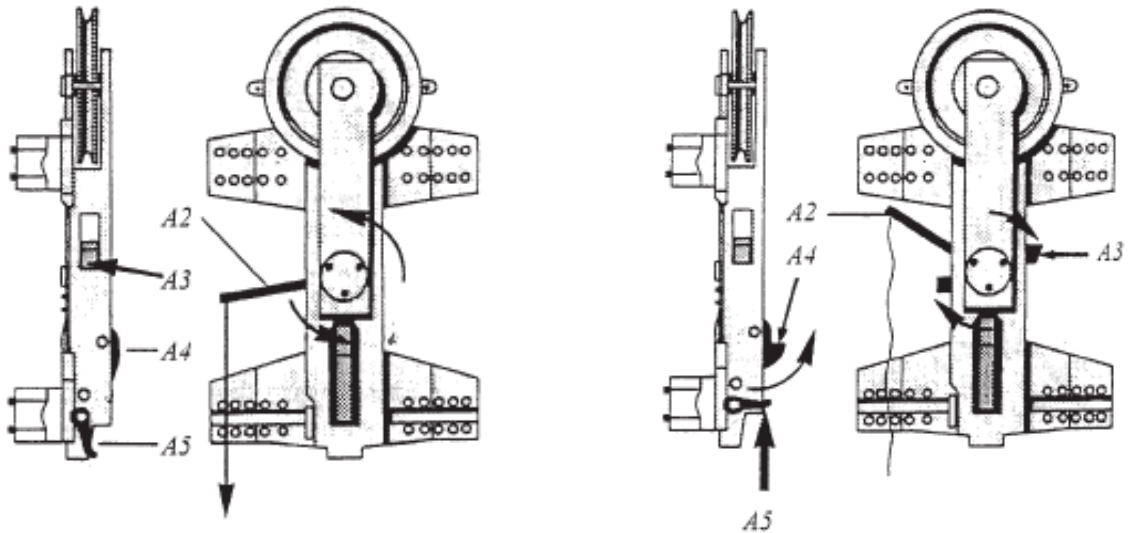
Along the whole lead length, the overlap of the latches between the Diesel hammer and the tripping device must be at least 15 mm greater than the play of the guide strips.

The play of the guide strips must be less than 6-7 mm. if this is not the case, the guide strips must be replaced immediately.

8.5.1 Testing the proper operation

The tripping device is considered inoperative, when one of the following criteria is not met:

- Lower the tripping device,
- Make sure the trip cam lever (A5) is pushed up when the tripping device impacts the lower support device. At the same time, pawl (A4) must swing out fully and must lock,
- Check the tension and the screw connection of the flat spring,
- Pull down on the cable at lever (A2). The driving pin (A3) must fully reach its end position,
- Release the cable at the lever (A2), the driving pin (A3) must swing out fully (horizontal position),
- Check the proper functioning of the guide pulleys,
- Check the tripping device for wear. Particularly the pawl (A4) with strips and bolts as well as the driving pin (A3) should not be rounded or exhibit visible wear.



8.6 Pumps and line complete



WARNING!

Problems with the fuel or lubricant system must be remedied immediately. Such problems pose an increased fire risk and may cause destruction of the Diesel hammer.

Use only original spare parts. APE cannot guarantee a proper functioning of the pumps when other spare parts are used.

8.6.1 Disassembly and cleaning of pumps

The fuel control pump and lubrication pump shall be disassembled and cleaned when necessary. Remove all paraffin and dirt residues. Make sure all moving parts move easily. Replace worn and defective parts. The following steps are needed to install the sealing surfaces:

- Carefully remove any grease from the sealing surfaces as well as from the support surface between the fuel control pump and the upper cylinder section. Use a suitable grease remover. Let the grease remover evaporate fully.
- Brush evenly on the sealing surfaces, leaving no bubbles.
- Let the sealing dry for approximately 10 to 15 minutes.
- Install the sealing surfaces.
- Check for leaks.
- The sealing surfaces can be separated and joined without applying a new sealing mass up to three times. No foreign material should be left on the sealing mass.

8.6.2 Lubricant pump

After each 30 minutes of pile-driving work, check that the upper cylinder section is properly supplied with the lubricant. The upper cylinder section must be covered with a uniform thin lubricant film. The following should be checked as well:

- Lubricant level into the tank,
- Clogged or defective lubricant lines,
- Pump lever is worn,
- Check for foreign material in the lubricant pump.

Operate the Diesel hammer only after the problems have been remedied.

Use motor oil for the appropriate temperature range.

8.6.3 Fuel control pump

The control dimension at the fuel control pump is significant for the fuel quantity supplied with each stroke. A dimension that is too long causes an excessive fuel supply to the Diesel hammer. Accordingly, there is the risk of the piston jumping into the catch groove. When the control dimension is too small, the fuel supply will be too low. The Diesel hammer is thus unable to reach the maximum blow energy.

Check the control dimension of the fuel control pump as required. Reset the control dimension when it deviates from the nominal dimension.

- Set the fuel control pump to "4" (full load). To do so jerk on the right control ropes often as required.
- Measure the control dimension
- The control dimension must be reset when the measured control dimension is not within the tolerance. This is achieved by changing the number and thickness of the shims between the pressure section and the mushroom. It is generally sufficient to remove one shim or to use a thinner shim. The pump lever is worn when it is no longer possible to remove shims. In that case, replace the pump lever and reset the control dimension.
- Check the injection valve. The piston in the injection valves must move smoothly and close well. Replace the injection valves when this is not the case.



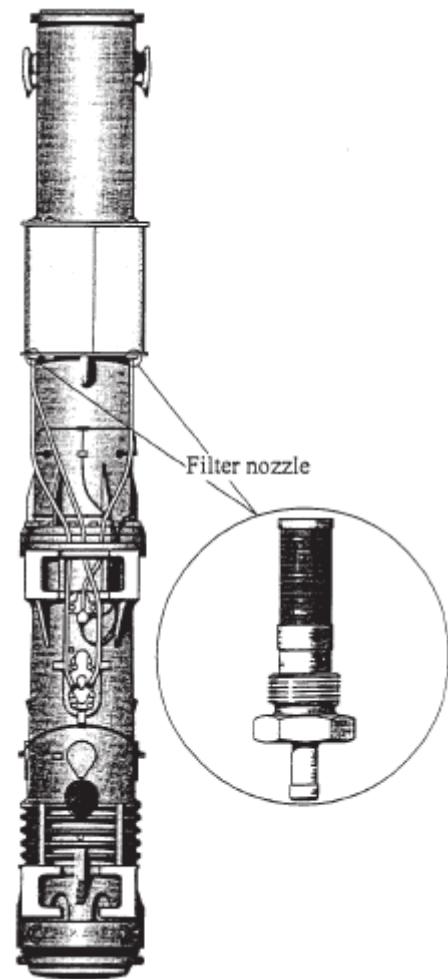
WARNING!

Never grind the pressure section or mushroom.

8.6.4 Filter

When required clean the filter of the fuel and lubricant tanks as described below:

- Drain the fuel tank.
- Pull the fuel line from the filter nozzle.
- Unscrew the filter nozzle.
- Clean the filter insert.
- Screw the filter nozzle back in.
- Push the fuel line again on the filter nozzle.
- Fill the fuel tank.
- Check the filter nozzle for leaks.
- Clean the filter of the lubricant tank in the same manner.



8.6.5 Grease nipple



WARNING!

Danger of Burns!

Be careful when working on a hot Diesel hammer. Do not touch hot components.

The grease nipples and lubrication opening must allow a free flow for the lubricant. Clogged grease nipples must be replaced.

Pump fresh grease again in the grease nipple of the impact head, cylinder end ring and upper cylinder section after shutting off the Diesel hammer. This prevents a carbonization of the grease located in the hot grease nipple.

8.7 Exchanging of rubber ring (damping ring)

- Set down hammer on pile helmet and remove impact block securing clamp.
- Raise hammer until impact block hangs out completely. Then press the two-part rubber ring out of the dovetailed groove by means of a screwdriver.
- Place the new rubber ring on the impact block flange. Lower hammer. The hammer presses the rubber ring into the dovetailed groove by its own weight.

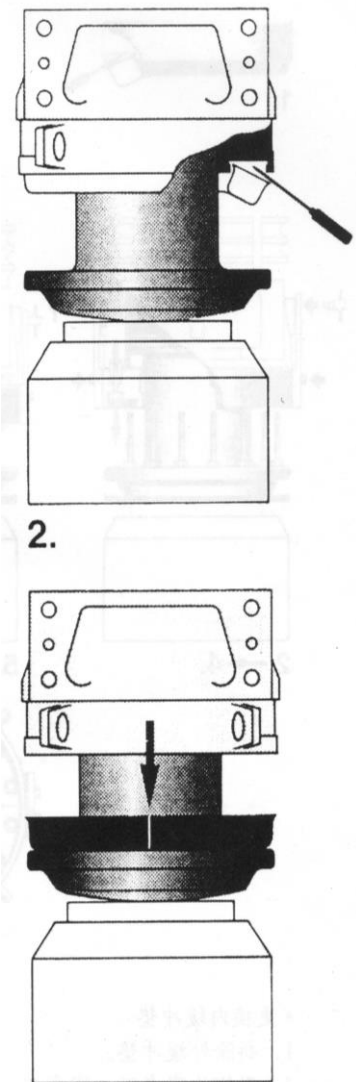


Fig. 18 – Exchanging of Rubber Ring

8.8 Changing inner rubber ring

- Remove rubber ring.
- Secure impact block with wedges against tipping over.
- Fit assembly plates to the two-part cylinder end ring and screw in assembly bolts.
- Remove all necked-down bolts from cylinder end ring.
- Squeezes off end ring from cylinder lower part by means of 4 necked-down bolts. (Squeeze-off distance is restricted by the assembly bolts which engage into cylinder lower part).
- Set down pole hammer on impact block flange. Remove assembly bolts.
- Raise hammer and secure it at a level just high enough to allow the rubber ring to be replaced without difficulty.
- Re-assemble in reverse order.

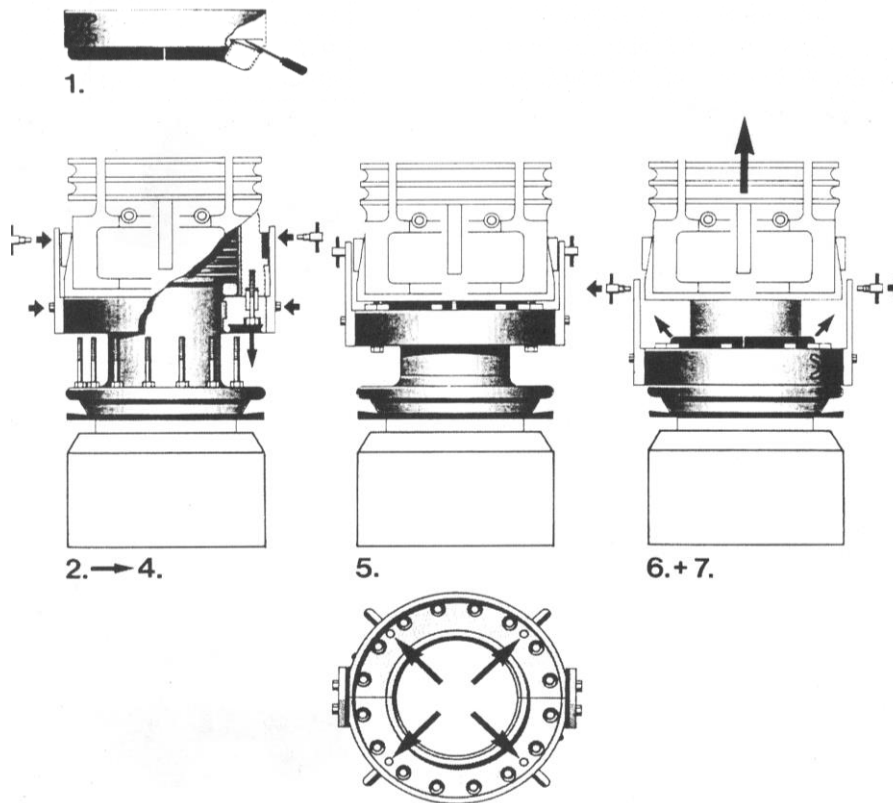


Fig. 19 Exchanging Inner Rubber Rings



8.9 Changing piston rings

- Method of disassembly is the same as that for replacing inner rubber ring.
- After removing assembly bolts raise hammer approx. 1m and secure it. The cylinder end ring held together by the assembly plates remains on the impact block flange.
- Raise piston and stop rising shortly before the carrier.



WARNING!

Pawl lever must not touch the carrier as otherwise the piston will be disengaged.

Danger of accident!

- Screw in ring screw into piston, attach pile rope to it and raise piston approx. 5cm (2"). Push down pawl lever by hand lower piston far enough so that all piston rings can be reached easily.
- Exchange piston rings only by means of the piston ring installing pliers (to be found in toolbox). Apply special grease.
- Apply piston ring installing band.
- Raise piston carefully until pawl can be inserted into piston groove by pressing the pawl lever upwards.



WARNING!

Hold piston ring installing band in place to prevent it sliding down when piston slides into the cylinder.

- Set down piston onto pawl remove pile rope and ring screw.
- Lower piston by means of the trip gear down to the lower carrier.
- Place piston ring installing band around impact block. Slightly raise hammer and remove catch fork. Then slowly lower over the impact block. Watch out that the piston ring installing band is not tossed on the cylinder end ring. Stop downward movement in time. Take-off installing band.
- Fit inner rubber ring.
- Set down cylinder lower part on cylinder end ring. Screw in assembly bolts.
- Raise hammer so that cylinder end ring can be screwed on.
- Take off assembly plates. Place two-part rubber ring on impact block flange. Lower hammer and press rubber ring into the dovetailed groove.
- Fit impact block securing clamp. Remove wedges from underneath the impact block.

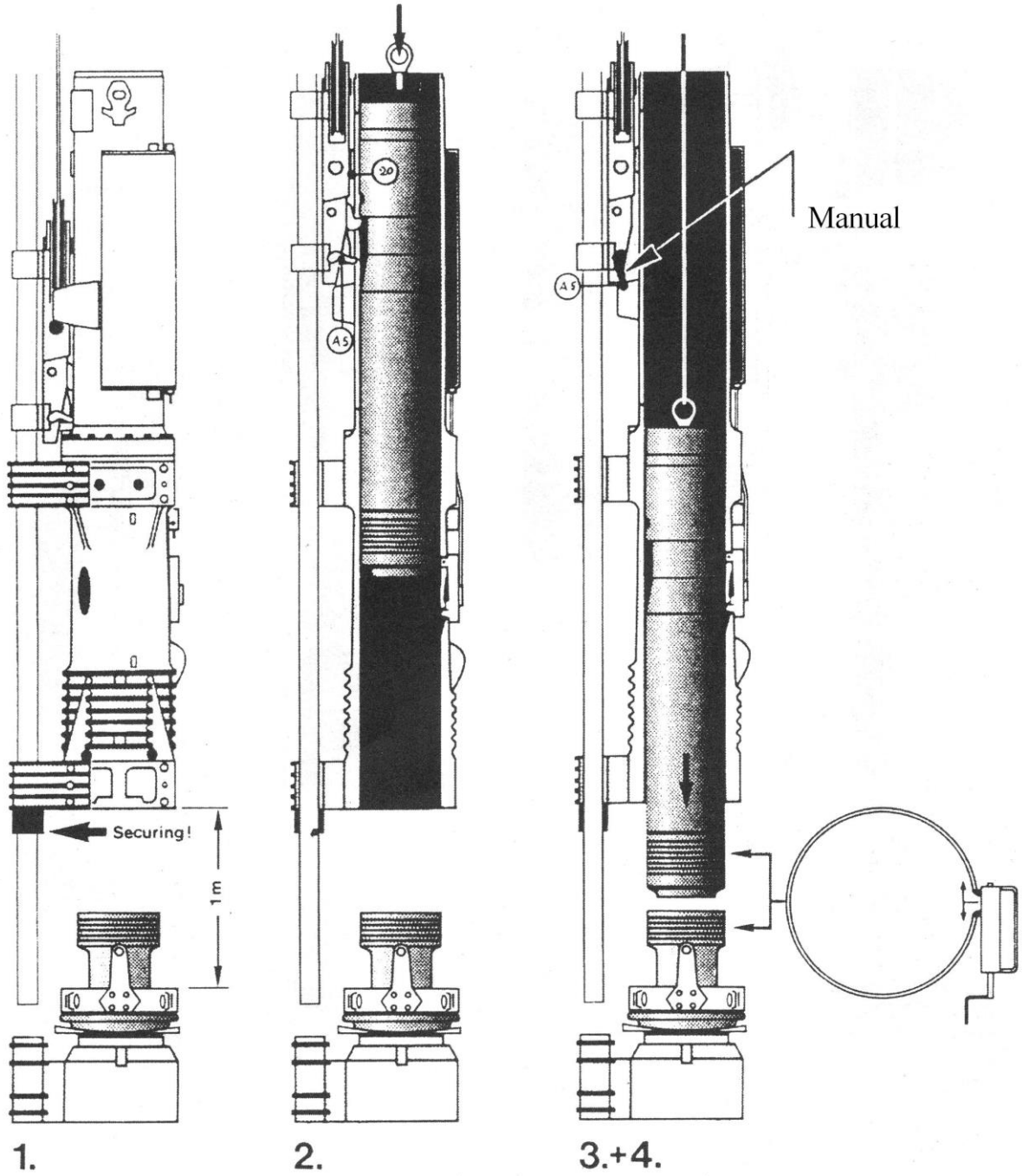


Fig. 20 – Changing Piston Rings (1)

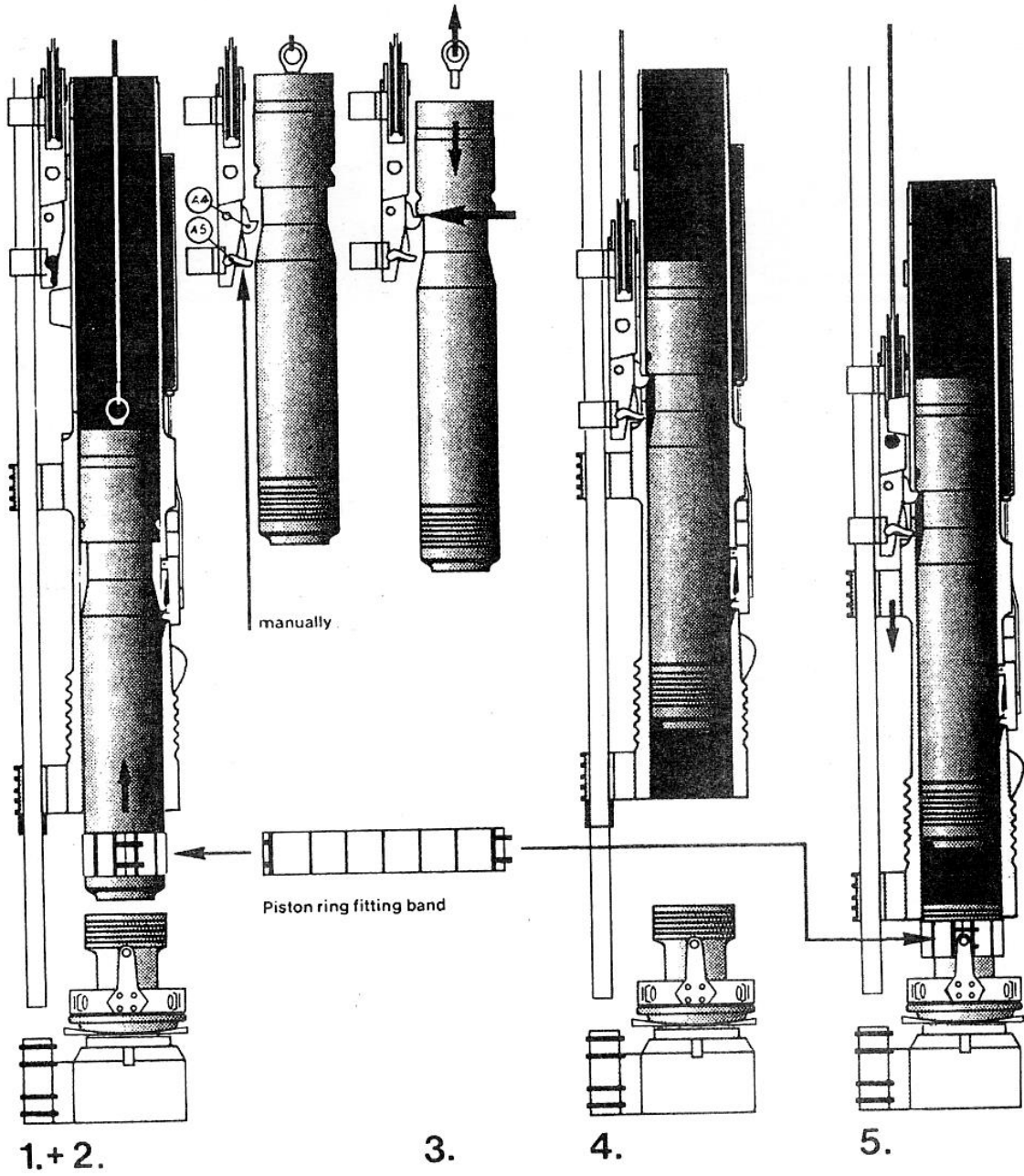


Fig. 21 – Changing Piston Rings (2)

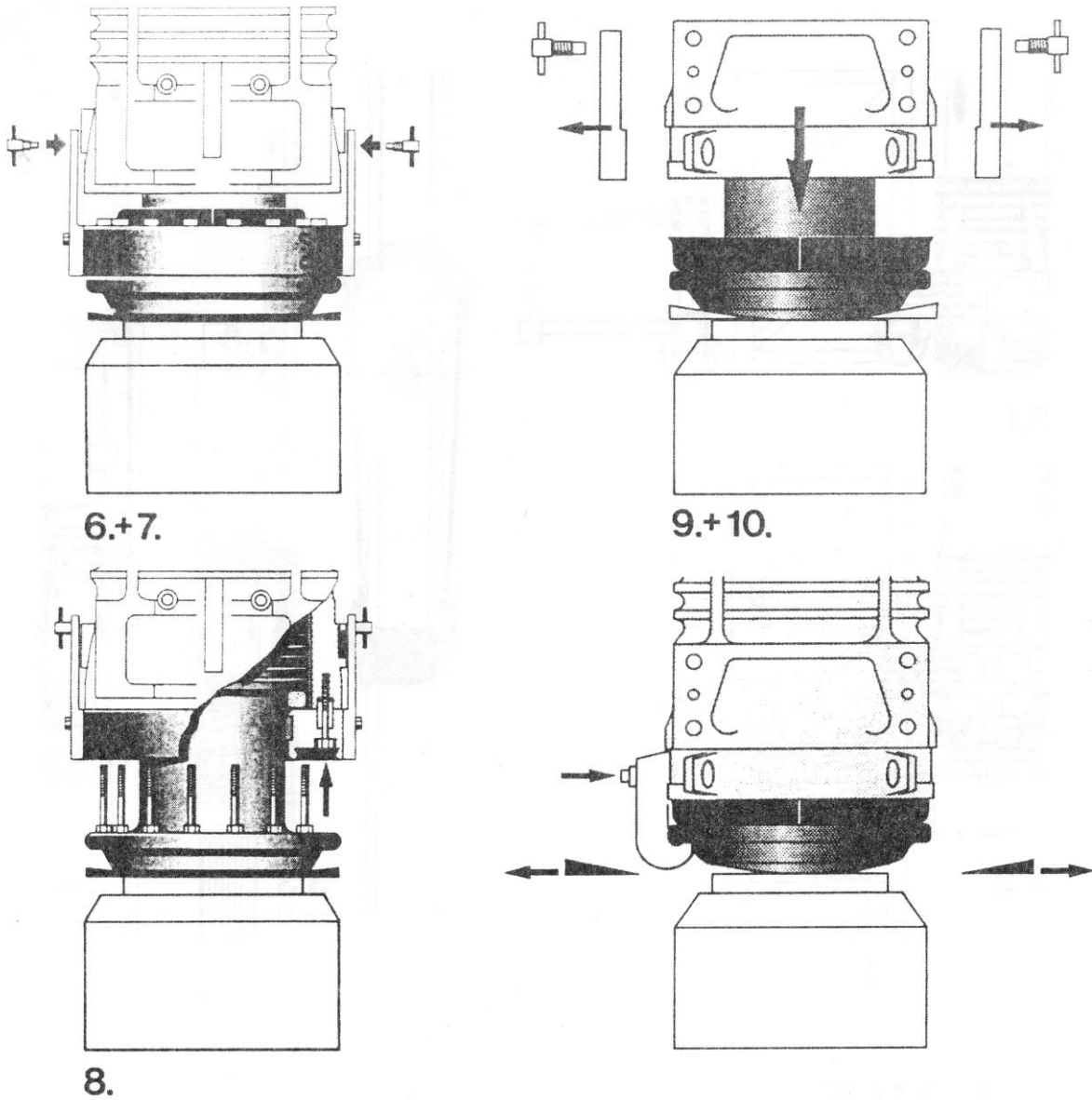


Fig. 22 – Changing Piston Rings (3)



8.10 Periodic table of maintenance operations

Maintenance work	Material	Maintenance interval							
		Daily prior to start-up	Daily after shutoff	*Every 20 minutes	Every hour	Every 2 hours	Once a week	Once a month	When required
Tightening of all screws and bolts on the cylinder and ring and upper cylinder section, fuel control pump, lubricant pump, injection valve cover, guide sleeves and guide strips.		◆				◆			◆
Check for wear at guide sleeves for the Diesel hammer, guide strips of the tripping device and guides for the pile helmet.		◆							
Check for wear at damping rings.		◆							
Check for wear at wear strips on the leads. Weld a flat bar as reinforcement, when the thickness of the wear strips is less than 2 mm.		◆							
Check the opening mode of the tripping device.		◆							◆
Lubricate the wear strips on the leads.	Multipurpose grease containing MoS ₂	◆				◆			
*Lubricate the impact block and any cylinder end ring (generally 5 strokes per grease nipple with a grease gun, 10 strokes or heavy pile-driving work). Impact block must be in place.	LUB-D	◆	◆	◆					
Lubricate the tripping device (5 strokes per grease nipple with a grease gun).	LUB-D						◆		





Lubricate the upper cylinder section (10 strokes per grease nipple with a grease gun).	LUB-D	◆	◆		◆				
Check the degree of overlapping of the catch between the Diesel hammer and the tripping device over the whole lead length.		◆							◆
Check the reference value for the fuel control pump.									◆
Check the upper cylinder section for a uniform oil film.						◆			
Check all cables (driving cables, pile cables, pile helmet cables, pulling cables for fuel control pump and tripping device) for damage and replace if required.		◆							◆
Clean the fuel and lubricant filters.									◆
Clean the combustion chamber.		◆							◆
Clean the Diesel hammer and attached components.									◆
Disassemble and clean the fuel control and lubricant pumps.									◆
Replenish the fuel tank.	Add Fuel Oil	◆							◆
Replenish the lubricant tank (with each refilling of the gas tank)	Add Lubricating Oil	◆							◆





8.11 Troubleshooting

Some failure may arise for the Diesel Hammer during use and the regular failure phenomenon, reasons and elimination methods are listed in the following table for reference.

Regular Failure	Reasons of Failure	Elimination Methods
Diesel Hammer being unable to be started	Soil texture being soft, resistance force of piles being small	Set fuel pump to position "0" and conduct empty striking for several times on that pile Hammer
	External temperature is low	Set fuel pump to "0" and conduct empty striking for several times to improve the temperature of combustion chamber Adopt fuel oil containing much cetane
	Water in the combustion chamber	Dismantle locking screws of lower cylinder, close accelerator and conduct empty striking for several times, eliminate moisture inside the cylinder and then install locking screws properly
	Fuel oil having such impurities as water and dust	Release fully the fuel inside the fuel tank and add fresh fuel oil
	Fuel Supply System having air	Conduct venting for fuel supply system
	Oil filter blocking, fuel being unable to be supplied	Clean oil filter and pipeline and remove sundries
	Oil pump not supplying oil, being damaged and not work	Check and clean pump element inside oil pump and repair or replace the damaged components



Regular Failure	Reasons of Failure	Elimination Methods
	Air leakage due to over abrasion of piston ring of either piston or impact block, not reaching the required compression ratio or piston ring being fractured and snapped	Disconnect to conduct inspection and replace damaged or invalid piston ring
	injection vale complete blocking	Clean the injection vale complete
Operation of Diesel Hammer being abnormal	Fuel oil having impurities, the combustion being incomplete	Replace fuel oil
	Fuel oil having air	Conduct venting
	Oil line and filters blocking	Disconnect to clean
	Quantity of oil being too large, producing backfire (fire emitting at air outlet)	Decrease the position of delivery fuel pump
	Insufficient oil supply of fuel pump	Check the height dimensions of pump lever Clean pump element complete
	Temperature of cylinder being excessively high	Stop hammer immediately and lift upper piston to cool
	Insufficient lubrication	Check lubrication system
	Abrasion of piston, piston ring and cylinder being excessively large, causing air leakage and fuel oil being unable to burn completely	Replace piston ring Check piston and cylinder and replace if necessary
Sudden stop of Diesel	No fuel oil	Fill up fuel oil



Regular Failure	Reasons of Failure	Elimination Methods
hammer	Oil line blocking	Check oil line and remove sundries
	Oil pump being damaged	Check oil pump and replace damaged components
	Piston getting stuck	Check whether the piston ring is fractured or not and replace if necessary
Oil leakage for fuel pump, lubricating oil pump and oil Line	Joints being loose or sealing ring being damaged	Screw up joints and replace seal ring
	Weld joint of fuel tank being vibrated and fractured	Weld well fissure
	Oil pipe being damaged	Replace oil pipe
Collision sound inside Diesel hammer	Sundries falling into cylinder	Check and clean sundries and repair damaged parts
	Piston ring being fractured	Take out fractured piston ring, clean ring slot and replace piston ring
Piston jumping up too high	Quantity of oil injection being too much	Regulate quantity of oil supply and check oil pump
	Resistance force of piles being too great	Check whether degree of effective penetration exceeding stipulation and stop immediately if exceeding stipulation
Smoking around cylinder lower part	Cylinder lower part cracked	Replace cylinder lower part
	Bolts of oil injection vale complete and plug screw of	Screw up fasteners



Regular Failure	Reasons of Failure	Elimination Methods
	cleaning hole not been screw up	
Smoking between Flange below cylinder lower part and impact block	Abrasion of piston ring on impact block being too great or fractured	Check and replace damaged piston ring
Malfunction of trip gear	Gap between guide clamp and guide rail being inappropriate	<p>Check the guide clamp and if abrasion is too great, then it shall be replaced</p> <p>Check the guide rail and if abrasion is too great, then it shall be repaired</p>



8. Warranty

9.1 Warranty period and scope

In case the customer has follow the safety rules, operation, maintenance, transport and lift of the instruction and the machine is found unable to work properly due to the manufacturing defects within six months since the delivery of the product, we'll be responsible for the free maintenance or replacement of the defective parts. (Except for the spare parts listed in the wearing parts list.)

9.2 Exclusion

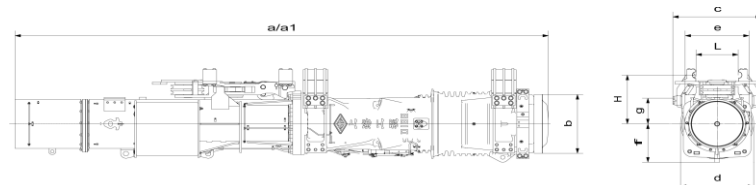
- Equipment failure and inappropriate consequences caused by the improper geological setting and formation conditions or construction site conditions.
- Equipment failure caused by failure to follow the safety rules, operation, and maintenance instruction.
- Equipment failure caused by unauthorized alteration of the spare parts.



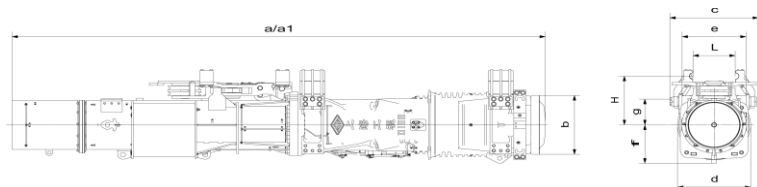
9. Technical data

10.1 Technical data

Description		Unit	D8-42	D16-52	D19-52	D25-21	D30-52	D36-26	D46-52	D50-52	D62-52	D70-52	D80-42	D100-42
Batter piling inclination up to			1:2	1:2/1:1	1:2/1:1	1:3/1:1	1:3/1:1	1:3/1:1	1:3/1:1	1:3/1:1	1:2/1:1	1:2/1:1	1:2/1:1	1:5/1:2
Impact weight (piston)		kg	800	1600	1820	2500	3000	3600	4600	5000	6200	7000	8000	10000
Energy per blow		J	≤23940	≤53460	≤57585	≤78970	≤94765	≤113720	≤145305	≤157940	≤218960	≤238000	≤266830	≤333540
Number of blows		/min	≥38	≥36	≥37	≥37	≥37	≥37	≥37	≥37	≥36	≥36	≥36	≥36
Force of explosion pressure on pile max.		kN	505	686	686	686	1304	1304	1695	1695	1800	1800	2600	2600
Suitable for driving piles, up to (The date mentioned refers to average values mainly valid for concrete piles. Depending on the soil conditions deviations are possible.)		kg	2500	5000	6000	7000	8000	10000	15000	16000	25000	26000	30000	40000
Permissible rope diameter for deflector sheave of tripping device max.		mm	Φ20	Φ20	Φ20	Φ20	Φ22	Φ22	Φ38	Φ38	Φ38	Φ38	Φ30	Φ30
Consumption	Diesel oil	l/h	4	5.5	6.6	8.0	10	11.50	16	16	20	20	25	30
	Lubricant	l/h	1.0	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.3	2.3	2.9	2.9
Capacity	Diesel oil tank (for vertical piling)	l	20	32	32	32	67	67	89	89	98	98	155	155
	Lubricant oil tank	l	6.0	9.0	9.0	9.0	19	19	17	17	31.5	31.5	32	32
Weights	Diesel hammer approx. /including extension	kg	1950	3250/3395	3550/3695	4200/4350	5830/6110	6780	8800/9190	9200/9590	11870/12280	12670/13080	16365/16900	19820/20360
	Tripping device approx.	kg	100	100	100	100	180	180	400	400	400	400	750	750
	Transport bracket/cradle approx.	kg	11	11	11	11	20	20	31.5	31.5	72	72	135	135
	Transport guard approx.	kg	15	15	15	15	23	23	25	25	34	34	220	220
	Toll box approx.	kg	75	75	75	75	100	100	100	100	125	125	125	125
Dimensions	Length of Diesel hammer (a/a1)	mm	4954	4984/5570	4984/5570	4984/5570	5514/6260	6310	5540/6285	5555/6310	6164/6910	6164/6910	6454/7200	6612/7358
	Outer diameter of impact block (b)	mm	350	440	440	440	560	560	660	660	710	710	820	820
	Overall dimensions measured over fastening screw of the guide jaws (c)	mm	560	560	560	560	780	780	880	880	828	828	1110	1110
	Width of Diesel hammer (d)	mm	410	485	485	485	640	640	785	785	800	800	890	890
	Width for connection of guide jaws (e)	mm	320	320	320	320	540	540	640	640	560	560	800	800
	Center of Diesel hammer up to pump guard (f)	mm	315	345	345	345	405	405	445	445	490	490	550	550
	Center of Diesel hammer up to center of threaded hole for fastening screws of the guide jaws (g)	mm	245	280	280	280	235	235	275	275	380	380	350	350
	Standard distance from center of Diesel hammer up to lead (H)	mm	405	440	440	440	500	500	530	530	560	560	720	720



Description		Unit	D128(A) (1:3/1:1)	D138(A) (1:3/1:2)	D160(A) (1:3/1:2)	D180(A) (1:3/1:2)	D220 (1:3/1:2)	D250 (1:3/1:2)	D260 (1:3/1:2)
Impact weight (piston)		kg	12800	13800	16000	18000	22000	25000	26000
Energy per blow		J	≤426500	≤459800	≤533000	≤590000	≤733000	≤833000	≤866000
Number of blows		/min	≥36	≥36	≥36	≥36	≥36	≥36	≥36
Force of explosion pressure on pile max.		kN	3600	3900	4500	5000	6200	7000	7000
Permissible rope diameter for deflector sheave of tripping device max.		mm	Φ32	Φ32	Φ37	Φ37	Φ42	Φ42	Φ42
Consumption	Diesel oil	l/h	36.6	40.5	46	54	70	80	82
	Lubricant	l/h	2.9	2.9	4.5	4.5	6.5	6.5	6.5
Capacity	Diesel oil tank (for vertical piling)	l	200	200	240	240	360	360	360
	Lubricant oil tank	l	28.6	28.6	40.3	40.3	100	100	100
Weights	Diesel hammer approx. /including extension	kg	26300	27300	35000	37500	45400	49000	51500
	Tripping device approx.	kg	770	770	1700	1700	2400	2400	2400
	Transport bracket/cradle approx.	kg	950	950					
	Toll box approx.	kg	125	125	125	125	125	125	125
Dimensions	Length of Diesel hammer (a/a1)	mm	7600	7600	8020	8150	7900	8020	8020
	Outer diameter of impact block (b)	mm	960	960	1070	1070	1200	1200	1200
	Overall dimensions measured over fastening screw of the guide jaws (c)	mm	1260	1260					
	Overall dimensions measured (c')	mm	1200	1200	1400	1400	1480	1480	1480
	Width of Diesel hammer (d)	mm	1040	1040	1160	1160	1300	1300	1300
	Width for connection of guide jaws (e)	mm	910	910	1020	1020	1100	1100	1100
	Center of Diesel hammer up to pump guard (f)	mm	625	625	700	700	820	820	820
	Center of Diesel hammer up to center of threaded hole for fastening screws of the guide jaws (g)	mm	420	420	465	465	500	500	500
Standard distance from center of Diesel hammer up to lead (H)		mm	795	795					





10.2 Screw or bolt tightening torque

When the screws or bolts of the Diesel hammer are being tighten, please refer to the tightening torque in the table below.

Table: Tightening Torque of Screws or Bolts

			D8~ D46	D62 D70	D80~ D138	D160 D180	D220~ D260
①	Cylinder end ring	Nm	750	1500	1500	1500	2000
②	Cylinder lower part	Nm	750	1500	1500	1500	2000
③	Variable delivery fuel pump Lube oil pump Injection valve cover	Nm	280	280	280	280	280
④	Guide clamps	Nm	750	1000	1500	1500	2000
⑤	Guide gibs (trip gear)	Nm	750	750	750	1000	2000

Ft - Lbs - Table: Tightening Torque of Screws or Bolts

①	Cylinder end ring	Ft Lbs	553.17	1106.34	1106.34	1106.34	1475.12
②	Cylinder lower part	Ft Lbs	553.17	1106.34	1106.34	1106.34	1475.12
③	Variable delivery fuel pump Lube oil pump Injection valve cover	Ft Lbs	206.51	206.51	206.51	206.51	206.51
④	Guide clamps	Ft Lbs	553.17	737.56	1106.34	1106.34	1475.12
⑤	Guide gibs (trip gear)	Ft Lbs	553.17	553.17	553.17	737.56	1475.12

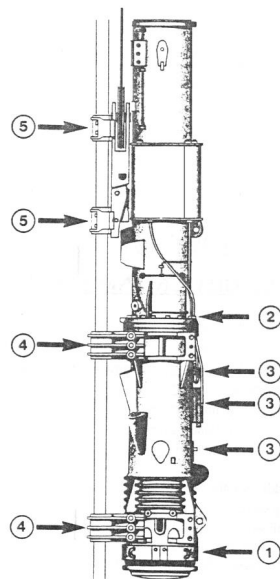


Fig. 23 – Tightening Screws or Bolts

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