



Hammer Operations Manual

“Follow Our Lead To A Solid Foundation”





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Thank you for choosing a **BAUER-PILECO-Diesel Hammer**. This machine will provide the utmost reliability with a minimum of effort and maintenance on your part.

Bauer-Pileco, Inc. has serviced the pile driving industry for more than 40 years with quality equipment. We appreciate your business and want to continue to deserve it.

**YOU CAN RELY ON US.
BAUER-PILECO, INC.**

***The instructions are inclusive of all BAUER-PILECO Hammers.
Operating Instructions are required to be on site for all workers to refer to.***

“Follow Our Lead To A Solid Foundation”

If you require further assistance please contact us
☎: **713-699-3000**
(24/7): **713-699-3000-1**



1. General Information

Education and Training for all workers is required prior to the start of work on this equipment.

A hazard analyst should check the site prior to start of work.

Prior to assembly

These operating instructions must be read prior to assembly and prior to putting the unit into operation. The operator's safety and operations manual must be reviewed and understood by the operator and any others that are required to have this knowledge such as but not limited to the following: Foreman, Signal Person, Superintendent, competent person and qualified person that has full knowledge of Off Loading, Assembly and start up operations. Also for disassembly. The operating instructions must be stored in a safe place for later use. Picking points as marked on this equipment must be used. Pre clearance for ground conditions including a call to "Dig Safe" or appropriate utility authorities is required. Confirm on the form enclosed in Appendix A4 that you have read and fully understand these operating instructions. Adhering to the safety instructions and information provided by Bauer-Pileco and any and all federal, state, local safety rules and regulations will prevent injuries and potential death.

These operating instructions:

- must be used by anyone who assembles, converts, disassembles, operates, maintains or repairs a Diesel Pile Hammer
- simplify all work in connection with a Diesel Pile Hammer
- inform you about some basics of the operating mode and use of Diesel Pile Hammers
- help you with the required calculations
- contain important information for the safe and proper handling and operation of the Diesel Pile Hammer

Inform the operators about the obligation to read the operating instructions.

Safety indicators

The following symbols are used in these operating instructions:

Please read these operating instructions carefully. The safety information must be observed and enforced.



Caution indicates a potentially hazardous situation which, if not avoided may result in **minor or moderate injury**.



Warning indicates a potentially hazardous situation which, if not avoided, could result in **death or serious injury**.



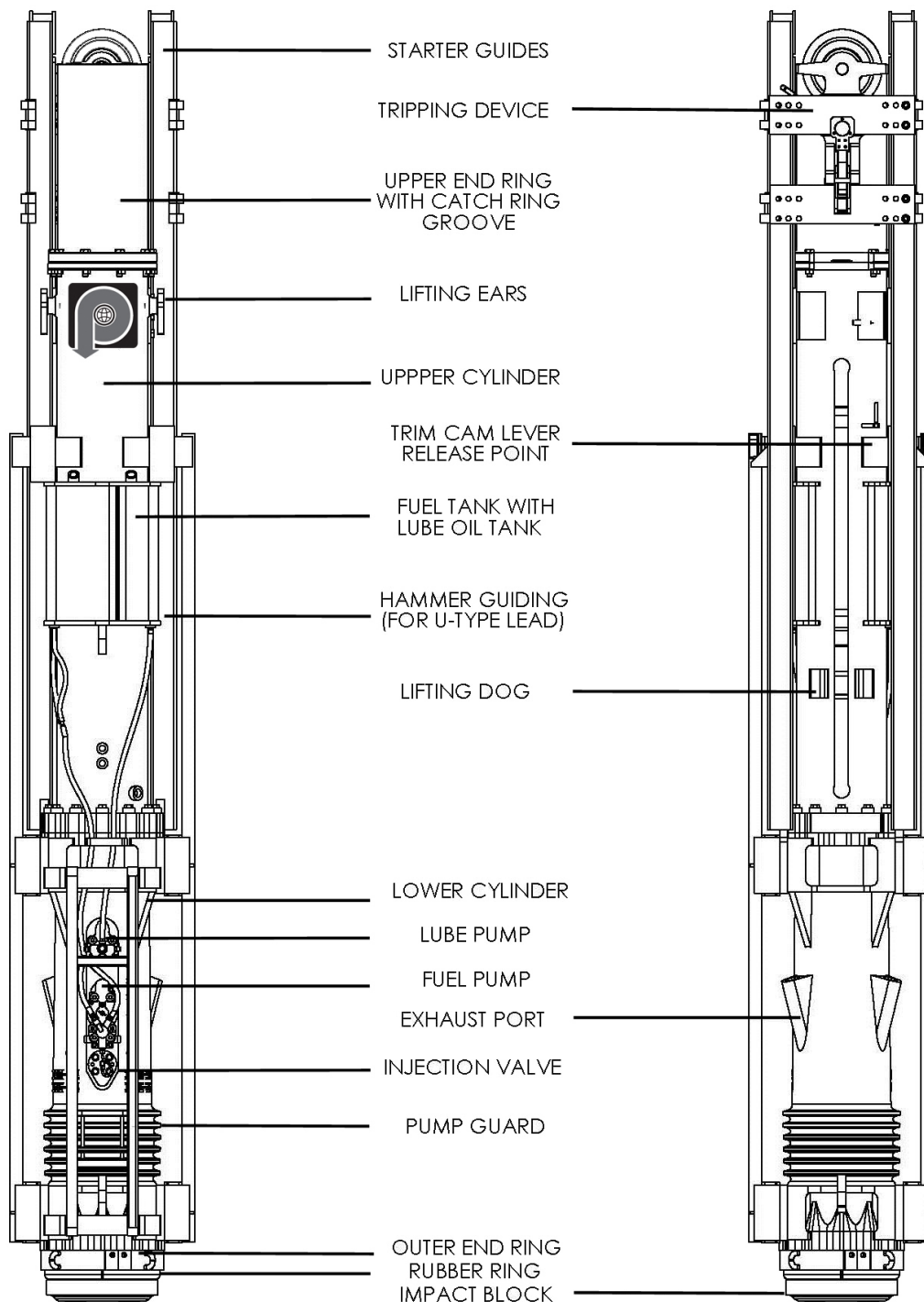
Danger indicates an imminently hazardous situation, which if not avoided will result in **death or serious injury**. This signal Word should be used in the most extreme situations.

General and special safety information is contained in Chapter 2 "Safety Regulations". Safety information in relation to a specific handling step is shown prior to the description of this handling step.

1. General Information

Components of Diesel Pile Hammer

The picture below should make you familiar with the Diesel Hammer components to understand the following safety information correctly.



Important: We do not guarantee pile helmets, striker plates and cushion material.



2. Safety Information

The safety information is provided to prevent injuries and / or death to workers and damage to property.

The employer is required to provide training to all operators, in accordance with United States Standards CFR (Code of Federal Regulation) Labor 1926.20 (b) (4) General Safety and Health Provisions.

A Lockout Tagout program is recommended prior to Hammer maintenance/repair or maintenance/repair of any associated equipment.

2.1 Proper and improper use

The proper use of Diesel Pile Hammers 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 Pile 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. DEATH OR SERIOUS INJURY MAY RESULT.



NEVER PLACE ANY PART OF THE BODY UNDERNEATH THE HAMMER. ALWAYS SECURE HAMMER BEFORE MOVING LEADS. ATTACH WARNING NOTICE SUPPLIED WITH HAMMER IN GOOD VISIBLE POSITION ON PILING RIG.

LIFT HAMMER WITH TRIP GEAR AGAINST THE LIFTING DOGS ONLY AS DESCRIBED IN OPERATING MANUAL. DO NOT LIFT TRIP GEAR AGAINST TOP OF THE STARTER GUIDES.



“WARNING: DO NOT LET TRIP REST ON THE LIFTING DOGS WHILE HAMMER IS OPERATING”



2. Safety Information

2.2 General Safety Information for the handling of the Diesel Pile Hammer

Safety is basically a matter of common sense and education. There are safety regulations that must be observed at all times. Beyond that, each situation exhibits peculiarities that cannot always be indicated in the safety regulations. Always watch for safety hazards and problems. Plan ahead and take care of problems as early as possible.

Please keep these operating instructions for Diesel Pile Hammers with the documents for the equipment carrier. Keep both at an easily accessible location. Inform the operators regarding the obligation to read these operating instructions and about the location where documentation is kept.

You must read every page of these operating instructions and understand its contents, prior to handling the Diesel Pile Hammer. Observe the safety information and instructions when working with the Diesel Pile Hammer. Failure to follow safety instructions may cause serious injuries or death.

The Diesel Pile Hammer shall be inspected prior to the first time that it is put into operation and then annually by an expert. Said thorough inspection must be carried out by persons that have participated in an extensive training program in our facilities. Such an expert inspection is also required after any structural change. The results of the inspections must be indicated in writing.

Prior to putting the unit into operation, it will be necessary to determine if the last expert inspection was carried out within the last 12 months.

Only properly trained and authorized personal of the employer shall work with the Diesel Pile Hammer.



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 emissions occurring during the operation of the Diesel Pile Hammer.

Obstacles in the work and transport areas, the load capacity of the soil as well as the safety barriers for public traffic areas must be taken into account. It is particularly important to pay attention to changing weather conditions, wind, decreasing visibility and changing soil conditions. Stop work for critical conditions (e.g. storms.). Visibility must be sufficient to allow proper operation of the pile-driving equipment by driver and operator without risk of life. Lights must be used for work carried out under poor visibility conditions or in darkness. The lighting fixtures must illuminate the work areas properly, see CFR Part 29 1926.56 "Illumination". For transports in darkness, moving equipment must be fitted with lights providing a distance light level of at least 10 lx (23 feet (7 meters) ahead of the equipment measured in the driving direction). Keep a safe distance from:

- Underground and overhead utilities
- Overhangs, edges, slopes and unsafe soil

A call to "Dig Safe" at 811 or an appropriate utility authority is also recommended.

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

All workers must be physically able to safely perform his or her assigned job. A worker shall not be allowed to work under the influence of drugs, alcohol, and medications which could affect the safe and effective operation of the Hammer.



2. Safety Information



PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task.

Reflective clothing should be worn at all times when working near the Diesel Pile Hammer. Ear plugs should also be worn when operating the Diesel Pile Hammer. A permanent hearing impairment may result otherwise (See Chapter 4 “Technical Specifications” for Sound Emission Data).

There should be at least 2 fire extinguishers within close distance of the pile hammer while in operation. The fire extinguishers:

- must have a minimum capacity of 13 pounds (6 kg),
- must be suited to extinguish oil and electric fires,
- must be placed on the same site as the pile-driving 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 Pile Hammers),
- must be attached such that they can be removed without tools.

Work on a diesel hammer shall be performed by workers (employees) trained to perform maintenance, repairs etc. Add Lockout Tagout program for any power source prior to any work on the hammer. Example CFR Part 29 Labor 1926.417 (a).

Familiarize yourself with the location and handling of the fire extinguishers prior to beginning work. Fire extinguisher training is required.

Maintain a minimum safe distance of 13 feet (4 meters) from the units to be driven during the operation of the Diesel Pile Hammer. Make sure that only the excavator operator, operator and the foreman in charge of the pile-driving work move

within an area of 1.5 times the lead height (or the height of the excavator/crane). Close this area off, if required.

Please 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 the combustion chamber. Maintain a safe distance and wear **safety glasses**.

Do not touch the Diesel Pile Hammer immediately after its operation as burns may result. Particularly the impact head, exhaust and components located adjacent to the combustion chamber must be allowed to cool for a sufficient period.

Diesel fuel and lubricants are very flammable and can explode under certain conditions. 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 the Diesel Pile Hammer must always be well ventilated. Under no circumstances will smoking or other activities with open flames or sparks be allowed during fueling or in storage areas of Diesel fuel, ether and lubricants. Diesel fuel, ether and lubricants should never be stored in improper containers.

Exhaust gases forming during operation are poisonous. Do not inhale exhaust gas. Danger to health.

Work on a Diesel Hammer (maintenance, repair, converting...) shall not be performed while the hammer is operating. The Diesel Pile Hammer must rest on the pile or ground or on the lower support device.

Avoid touching moving parts. Serious injuries may result.

Pay careful attention to any components that come loose and fall from the Diesel Pile Hammer, lead, impact head, pile guiding system or from the pile itself.

Keep the job site neat and orderly.



2. Safety Information

2.3 Safety information for the excavator operator

Use only excavators/leads/cranes that exhibit a sufficient load capacity for the Diesel Pile Hammer, pile helmet and piles being used.

Make sure the accessories are safely stored prior to converting the equipment. Secure all loose components. Keep the load as close as possible to the ground during the conversion stage. The qualified / competent person shall assure that the ground you have to travel over is safe to do so. Equipment with a swing radius shall be barricaded.

You must personally make sure that no persons will be placed into a dangerous situation with the moving of the equipment. Seek the assistance of a helper. Accept signals from a trained signal person only. In emergency anyone can STOP the operation. No more than one driver, please.

Lights must be turned on in darkness or in low visibility conditions.

Observe traffic signs and rules when driving on public roadways.

Do not hold onto the steering wheel column, control console or operating levers when entering or leaving the vehicle. This may cause accidental motions. **Accidents may result.**

Always work up or down a slope and not laterally to the slope. For any equipment traveling up or down a slope the equipment shall stay within the limits of the angle of degree that the equipment can safely maintain. Prevent any actions that could cause the equipment to overturn. When the equipment nevertheless begins to overturn or slide laterally, it will be necessary to immediately lower the equipment and point the vehicle down the slope.



Never exceed a safe operating speed on a down slope. Always change – to a lower gear prior to reaching the down slope. You may lose control of the vehicle otherwise.

Never leave the driver's seat when the vehicle is still moving or the Diesel Pile Hammer is still in operation. Never leave the vehicle unattended with the motor running.

Any equipment coming in contact with an energized power line:

- Do not leave the vehicle.
- Drive the vehicle out of the danger zone, if possible.
- Warn other persons not to come closer to or touch the equipment.
- Arrange for the power to be turned off.
- Leave the vehicle only after the power has been turned off.
- Any and all equipment attached to the contact equipment shall be re inspected by a qualified person to ensure the equipment is safe to continue work.

Familiarize yourself with the emergency exit through the front window.

Report all problems to the foreman in charge of the pile-driving work. Make sure the necessary repairs are carried out immediately.

Check the steel wire rope daily for wear and possible damage (see chapter 4.3).

Worn and damaged wire rope is to be replaced immediately.



2. Safety Information

2.4 Safety information for the excavator

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task when working with the Diesel pile hammer.

This reduces the risk of injuries and prevents permanent hearing and eye damage.

Proper training of the operating instructions for the Diesel Pile Hammer and its accessories shall be conducted prior to the unit operation. Make sure you have a complete set of operating instructions. Initiate Lockout Tagout Program for any power source prior to any work on the hammer. Example CFR Part 29 Labor 1926.417 (a).

The Diesel Pile Hammer shall be operated only by trained personnel that have been authorized by the foreman in charge of the driving work.

Operate the Diesel Pile Hammer only when it is in safe working condition. Carry out a thorough inspection prior to putting the equipment into operation.

Make sure all warning signs are in place on the hammer and easy to read. Do not operate a 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 starting the hammer.

You must take into account that the operation of the Diesel Pile Hammer causes blows, impact forces and vibrations in the whole pile hammer structure and in the immediate vicinity.

Never work under the Diesel Pile Hammer, suspended loads, leads or material to be driven. No one is to be allowed under a load at any time. Avoid standing in the area, in which the material to be driven touches the ground. Make sure repairs are carried out only by trained experts.



2. Safety Information

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 of age. The foreman should provide the operator with information ensuring safe execution of the work. You are responsible for the safety within in the work area of the Diesel Pile Hammer.

Please familiarize yourself with the operating instructions for the Diesel Pile Hammer and all of its accessories prior to putting the equipment into operation.

Make sure your operating instructions are complete.

Make sure the equipment and associated attached units are inspected daily by a competent or qualified person for obvious defects prior to putting them into operation. Make sure all warning signs are in place and legible. Defects are found most often in such as but not limited to the following components:

- Diesel Pile Hammer
- Tripping device
- Guiding components
- Support devices
- Pile helmet and pile guiding system
- Bridle and cable

The pile-driving work cannot be resumed with a defective unit. Inform the pile-driving personnel and the superintendent about the defects immediately. Have the defects remedied prior to putting the equipment into operation. Make sure only properly trained personnel carry out repair work. Do not operate the equipment until all defects have been fully remedied. Carry out a thorough inspection prior to putting the unit into operation.

Prior to putting the equipment into operations make sure all personal are clear of any danger zone.



Sound a horn to warn persons of the impending starting of the Diesel Hammer.

You must take into account that the operation of the Diesel Pile Hammer causes blows, impact forces and vibrations in the whole pile hammer structure and in the immediate vicinity.

Never work under the Diesel Pile Hammer, any suspended load, lead or material to be driven. Avoid standing in the area, in which the material to be driven touches the ground.



2. Safety Information

2.6 Assembly, conversion, disassembly, maintenance, repair

The Diesel Pile Hammer shall be inspected prior to the first time that it is put into operation and then annually by an expert. Said expert inspection must be carried out by persons that have participated in an extensive training program in our facilities.

Assembly, conversion, disassembly, maintenance and repair work shall be carried out only by qualified and authorized personnel.

The Diesel Pile Hammer must be shut off prior to carrying out any work on it. **Death or serious injury may result.**



Make sure another person cannot put the equipment into operation when work is being performed, as death may result.

The following must be observed for repair and maintenance work:

- At least two persons must be present. Both must be familiar with the operating instructions and must know how to address safety questions.
- One person shall be located where he or she is in a position to observe those performing the work. The Lockout Tagout Program must be in place to prevent any accidental start ups.
- One person must be located at the main operating station to monitor the safety of the other persons. Said person must have access to an **EMERGENCY** switch (or shutoff cable for the fuel supply) in all situations.
- An uninterrupted communication must be possible between the involved persons.
- The work area must be appropriately illuminated.

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



3. Technical Data

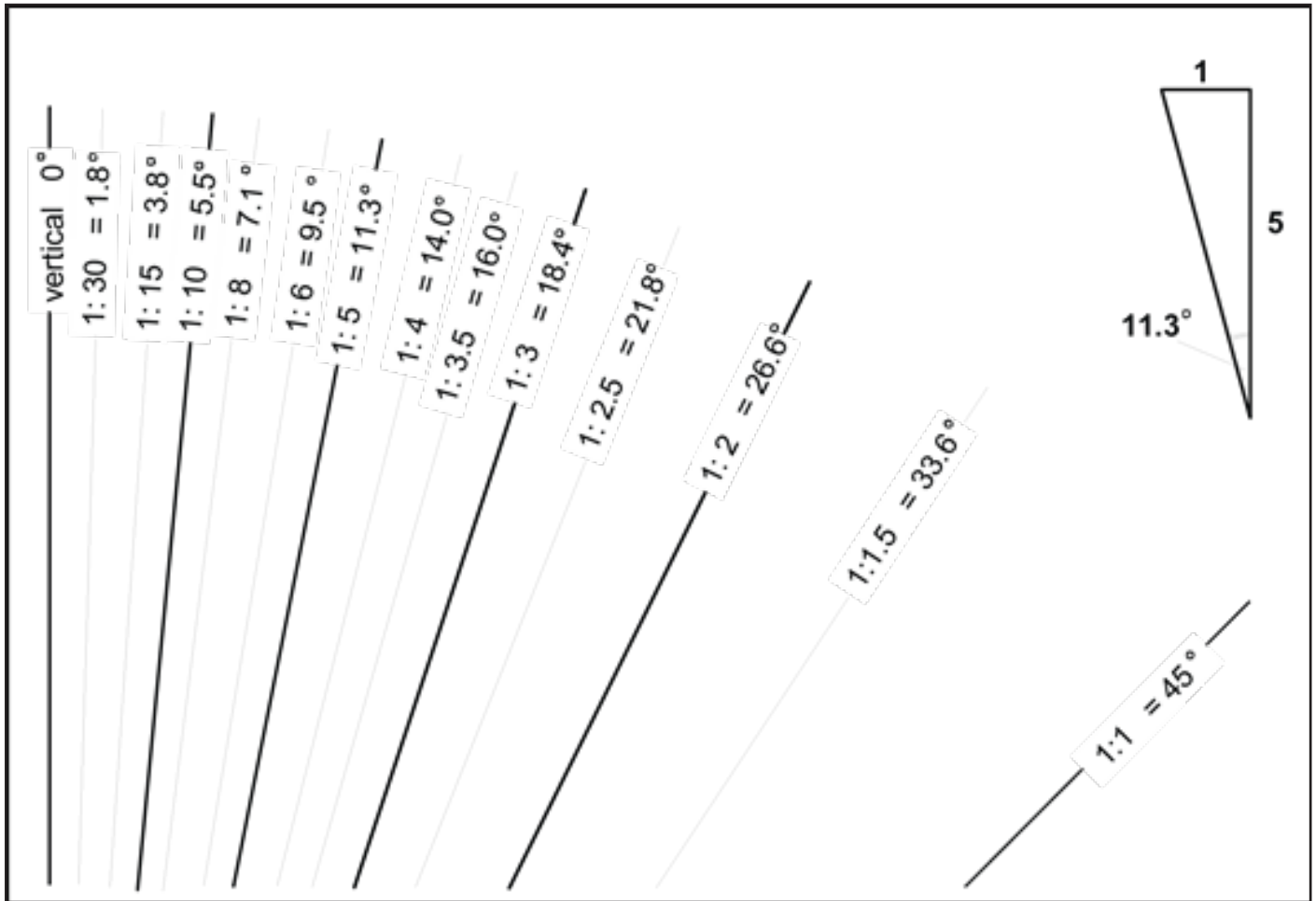
3.1 Conversion Factors

mass	1	t (metric)	=	1000	kg		1	kg	=	0.001	t (metric)
	1	t (metric)	=	1.102	t (US)		1	t (US)	=	0.9072	t (metric)
	1	kg	=	2.204	lbs		1	lbs	=	0.4536	kg
force	1	kN	=	102	kp		1	kp	=	0.0098	kN
	1	kN	=	220	Lbf (lb)		1	lbf	=	0.0045	kN
energy	1	Nm	=	0.102	kpm		1	kpm	=	9.81	Nm
	1	Nm	=	0.7375	ft.lbs		1	ft.lbs	=	1.356	Nm
distance	1	mm	=	0.0393	inch		1	inch	=	25.4	mm
	1	cm	=	0.3937	inch		1	inch	=	2.54	cm
	1	m	=	39.37	inch		1	inch	=	0.0254	m
	1	m	=	3.2808	ft		1	ft	=	0.3048	m
	1	m	=	1.0936	yd		1	yd	=	0.9144	m
area	1	cm ²	=	0.155	in ²		1	in ²	=	6.4516	cm ²
	1	ft ²	=	0.093	m ²		1	m ²	=	10.764	ft ²
volume	1	cm ³	=	0.061	in ³		1	in ³	=	16.38	cm ³
	1	l	=	1000	cm ³		1	cm ³	=	1.000	ml
	1	l	=	0.2642	gal		1	gal	=	3.785	l
	1	m ³	=	1000	l		1	m ³	=	264.17	gal



3. Technical Data

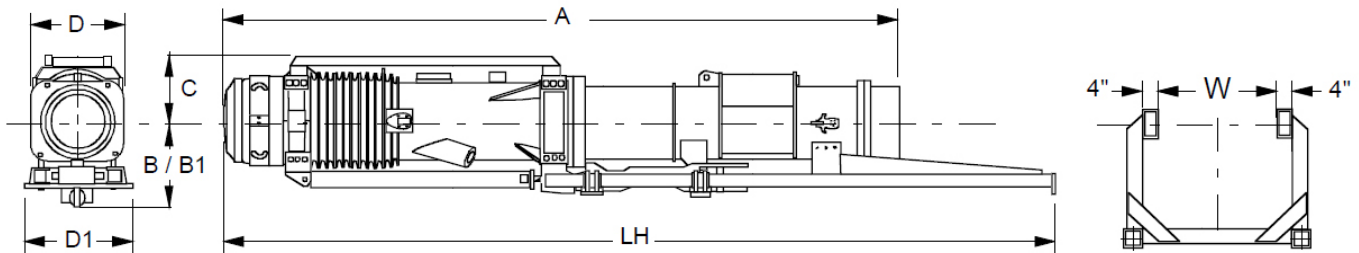
3.2 Angle Conversion





3. Technical Data

3.3 Diesel Hammer Data

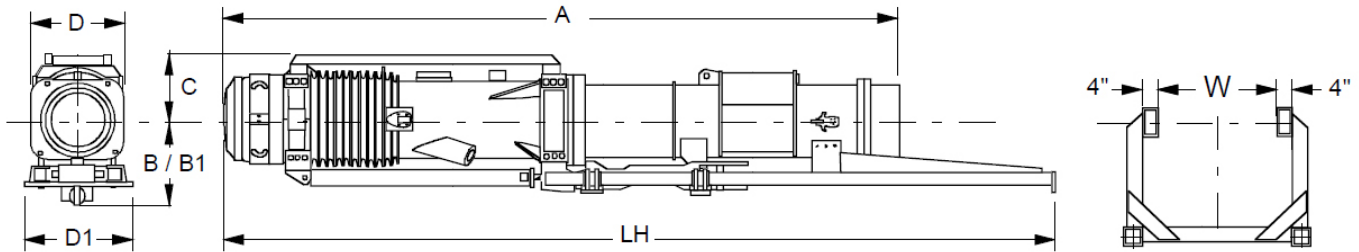


Model		D6-42 D8-42	D12-42	D19-42	D25-32 D30-32	D36-32 D46-32
App. piston weight	lbs.	1,320 /1,770	2,820	4,015	5,515 / 6,615	7,940 /10,145
Blows per min. 1)						
Minimum	bl./min.	39/37	37	37	37	37
Maximum	bl./min.	52	52	52	52	52
Energy per blow 2)						
Maximum	ft.lbs.	12,570	29,840	42,480	58,300	83,950
Minimum	ft.lbs.	18,760 7,090 9,480	15,000	21,510	69,925 29,510 35,400	107,280 42,500 54,320
Consumption 3)						
Diesel fuel	gal./hr.	0.96 / 1.00	1.2	2.00	2.11 / 2.64	3.04 / 4.23
Lubrication oil	gal./hr.	0.06 / 0.13	0.13	0.16	0.26 / 0.26	0.39 / 0.39
Capacity						
Diesel fuel	gal.	4.9 / 5.3	6.3	20.0	17.7	23.5
Lubrication oil	gal.	1.3 / 1.6	1.7	5.0	5.0	4.5
Weight 3)						
Hammer	lbs.	3,570	5,730	8,365	12,370	17,375
Hammer with standard guiding	lbs.	4,000 4,920 5,350	7,100	9,700	13,472 14,800 15,900	19,580 19,900 22,100
Dimensions						
A - Length	ft.	14.1 / 15.0	18.3	16.8	17.8	18.3
LH - Length, standard	ft.	18.0	19.2	19.2	21.3	21.3
- Length with hydr. start	ft.	-	19.2	19.2	22.5	22.5
B - Center t trip	inch	13.0	14.8	14.0	17.5	19.0
B1 - Center to trip cylinder	inch	-	19.5	22.0	24.0	26.0
C - Center to pump guard	inch	15.0	15.0	16.0	19.0	20.5
D - Width of hammer	inch	18.3 / 16.5	19.0	19.5	25.0	28.5
D1 - With of trip	inch	22.1 / 24.5	24.5	24.5	32.0	37.0
W - Min. lead width	inch	21	21	21	26	32

1. Depends on fuel pump setting, type of soil and type of pile
2. Potential energy calculated by multiplying piston weight and stroke. The stroke of the ram is a result of the blow rate
3. Consumption and weights are approximate, weight of guiding depends on type and size



3. Technical Data



Model		D6-22	D80-23 D100-13	D125-32 D138-32	D160-32 D180-32	D225-22 D250-22
App. piston weight	lbs.	13,670	17,640 / 22,045	27,560 / 30,420	35,275 / 39,680	49,612 / 55,050
Blows per min. 1)						
Minimum	bl./min.	35	36	36	36	36
Maximum	bl./min.	50	45	45	46	50
Energy per blow 2)						
Maximum	ft.lbs.	161,640	197,150	308,025	394,250	564,970
Minimum	ft.lbs.	79,200	126,180 157,685	197,135 217,600	241,470 271,650	292,811 331,903
Consumption 3)						
Diesel fuel	gal./hr.	5.28	6.60 / 7.93	9.5 / 10.2	11.9 / 13.1	16.9
Lubrication oil	gal./hr.	0.53	0.68 / 0.68	0.95 / 0.95	1.32 / 1.32	1.53
Capacity						
Diesel fuel	gal.	25.8	40.9	50	63	121
Lubrication oil	gal.	8.3	8.4	15.8	21.1	26.4
Weight 3)						
Hammer	lbs.	27,077	37,275	53,616	68,785	100,328
Hammer with standard guiding	lbs.	29,300	44,894 41,200 48,800	57,360 60,250 64,000	75,700 74,500 82,600	106,467 104,292 110,431
Dimensions						
A - Length	ft.	22.6	23.6 / 24.1	25.5 / 25.9	25.8 / 26.4	26.8 / 26.7
LH - Length, standard	ft.	24.8	28.1	27.8	25.8	26.8
- Length with hydr. start	ft.	25.8	28.1	27.8	25.8	26.8
B - Center t trip	inch	20.0	26.0	30.5	33.7	29.5
B1 - Center to trip cylinder	inch	27.0	33.0	31.0	33.7	29.5
C - Center to pump guard	inch	25.5	23.0	22.5	24.5	27.56
D - Width of hammer	inch	32.5	35.0	41.0	45.5	53.55
D1 - With of trip	inch	35.5	47.5	47.5	51.2	43.31
W - Min. lead width	inch	32	42*	42*	48*	54*

1. Depends on fuel pump setting, type of soil and type of pile
2. Potential energy calculated by multiplying piston weight and stroke. The stroke of the ram is a result of the blow rate
3. Consumption and weights are approximate, weight of guiding depends on type and size



3. Technical Data

3.4 Sound emission

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 is not usually the main source of noise. A noise reduction mantle would reduce the overall sound level 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, therefore 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, too, 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 (i.e.): 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 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
D12-32	102	76
D16-32	106	79
D19-42		
D25-32	110	84
D30-32		
D36-32	111	85
D46-32		
D62-22	114	86
D80-32	116	88
D100-13	119	92
D125 / D138	n.a.	n.a.
D160 / D180	n.a.	n.a.
D225 / D250	n.a.	n.a.

Screening the Diesel Pile Hammer and the pile can reduce the sound pressure somewhat, but is mostly uneconomical and reduces hammer performance.



3. Technical Data

3.5 Exhaust emission

For Diesel Hammers a reliable quantitative exhaust research does not exist. The following reasons don't allow any warranted statement:

- Fuel consumption depends on the driving conditions.
- The fuel burning depends on the climate conditions exactly.
- Measurements under job site conditions require a huge effort.
- Measurement results will be falsified by imperfect condition.

Calculated emission values based on fuel consumption are theoretical and don't consider any driving conditions neither climate nor fuel combustion conditions.

More environmental fuel types are suitable as replacement for diesel fuel with minor reduction of Diesel Hammer performance (see enclosure A2). Attention is required in some cases for the specification of the lubrication oil and additional maintenance.

For information only in the table below the values of the Tier 2 exhaust emission standard are based on the theoretical horsepower (kW) of the Diesel Hammer.

Diesel Hammer type	Energy Output range (kW)	NMHC + Nox (g/kWh)	CO (g/kWh)	PM (g/kWh)
D8-22	24	7.5 (5.6)	5.5 (4.1)	0.6 (0.45)
D12-42	27	7.5 (5.6)	5.5 (4.1)	0.6 (0.45)
D16-32	30	7.5 (5.6)	5.5 (4.1)	0.6 (0.45)
D19-42	45	7.5 (5.6)	5.5 (4.1)	0.6 (0.45)
D25-32	48	7.5 (5.6)	5.0 (3.7)	0.4 (0.30)
D30-32	60	7.5 (5.6)	5.0 (3.7)	0.4 (0.30)
D36-32	69	7.5 (5.6)	5.0 (3.7)	0.4 (0.30)
D46-32	96	6.6 (4.9)	5.0 (3.7)	0.4 (0.30)
D62-22	120	6.6 (4.9)	5.0 (3.7)	0.4 (0.30)
D80-12	151	6.6 (4.9)	3.5 (2.6)	0.2 (0.15)
D100-13	181	6.6 (4.9)	3.5 (2.6)	0.2 (0.15)
D125-32	220	6.6 (4.9)	3.5 (2.6)	0.2 (0.15)
D138-32	250	6.4 (4.8)	3.5 (2.6)	0.2 (0.15)
D160-32	288	6.4 (4.8)	3.5 (2.6)	0.2 (0.15)
D180-32	325	6.4 (4.8)	3.5 (2.6)	0.2 (0.15)

4. Transport of the Diesel Hammer



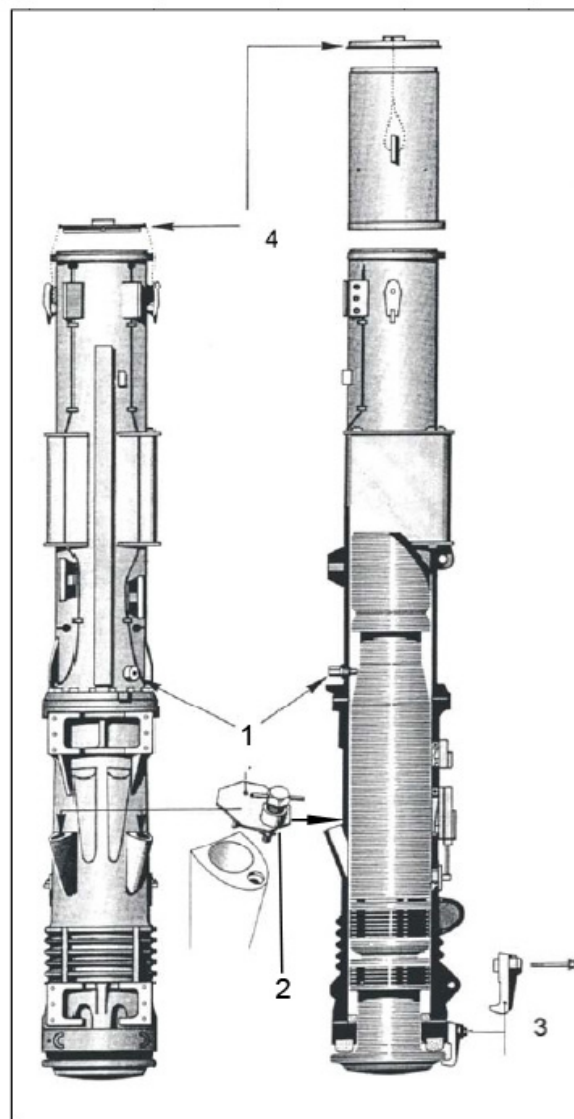
4.1 General preparation

The Diesel Pile Hammer shall only be transported with an installed locking screw (1) and impact block clamp (3). If this is omitted, a shift in the center of gravity could cause sudden movements of the Diesel Pile Hammer. Removal of transport safety devices before hammer is delivered and properly received could cause the piston and impact block to shift from one end to the other causing crushing and impact danger.

The Diesel Pile Hammer and its accessories must be packaged, loaded and transported carefully to prevent damage. Check the Diesel Pile 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 Pile Hammer:

1. **Locking screws.** These piston locking screws prevent shifting of the piston during transport. This prevents sudden shifts in the center of gravity of the Diesel Pile Hammer. Omitting the installation of these bolts may cause sudden movements as well as damages, e.g. to the catch ring. The piston safety screws must be screwed in fully and tightened. The piston must be in lowered position. Two piston safety bolts must be used for types D80-23 through D100-13.
2. **Exhaust cover.** The exhaust covers (2 pieces; 4 pieces for type D80 and above) prevent the entering of water, dust and foreign bodies. Screw the exhaust covers into the respective thread fitted at the exhaust.



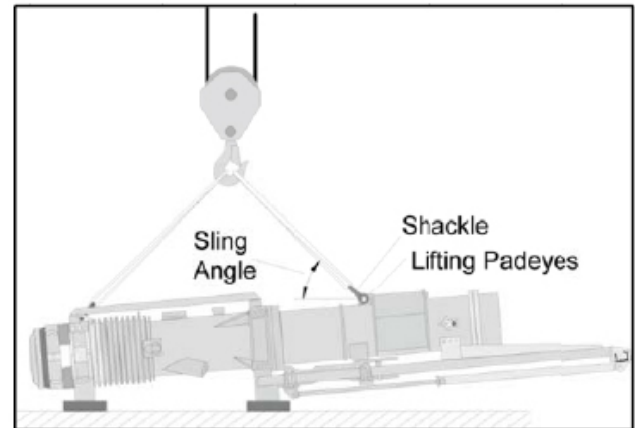
3. **Impact block clamp.** The impact block clamp prevents a shifting of the impact block during transport. Without the impact block clamp, the impact block may fall to the other end position. Install the impact block clamp as shown in the illustration.
4. **Protective cap.** The protective cap prevents the entering of water, dust and foreign bodies. Attach the protective cap with the help of the two chains. Attach the hook located at the end of each chain to the respective eyelet.

4. Transport of the Diesel Hammer

4.2 Lifting equipment and ground support



Prior to each use, the transport equipment must be inspected visually. Use only approved equipment to secure and transport the Diesel Hammer. Immediately remove and dispose of damaged lifting equipment. Use only wire rope that exhibit the proper load capacity and length. (see table below). Cable damage in accordance with DIN 15020, Sheet 2, Pages 4-4.



Never walk under suspended loads. Danger to life.

Minimum required wire rope diameters for lifting the Diesel Hammer

Type of Diesel Pile Hammer	Max. total weight (lbs.)	2 wire rope at sling angle sling diameter in (inch)	approx.min. sling length (ft.)	Shackle size	Eyelet Diam.
D 8-22	5,350	1./2" at 45°	5.75	17 ton	1.97"
D 12-42	7,100	9./16" at 45°			
D 19-42	9,700	5./8" at 45°			
D 25-32	14,800	7./8" at 45°	6.25	17 ton	1.97"
D 30-32	15,900	7./8" at 45°			
D36-32	19,900	1" at 45°	6.75	17 ton	1.97"
D 46-32	22,100	1" at 45°			
D 62-22	29,300	1-1./8" at 45°	7.75	17ton	1.97"
D 80-13	41,200	1-3./8" at 45°	9.00	25 ton	2.44"
D100-13	48,800	1-3./8" at 45°			
D125-32	53,600	1-1./2" at 45°	10.00	25 ton	2.90"
D138-32	64,000	1-1./2" at 45°	10.00	25 ton	2.90"
D160-32	68,800	1-3./4" at 60°	15.00	25 ton	3.22"
D180-32	82,600	1-3./4" at 60°	15.00	25 ton	3.22"
D200-42	121,650	2-1./2" at 60°	16.00	35 ton	3.94"
D225-22	104,292	2-1./2" at 60°	16.00	35 ton	3.94"
D250-22	110,431	2-1./2" at 60°	16.00	35 ton	3.94"



The Diesel Hammer must be placed on stable ground and proper cribbing. If you do not rest the Diesel Hammer on a concrete slab area, use 3" thick wood planks to prevent the hammer from sinking into the ground or tipping over.

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task.

4. Transport of the Diesel Hammer

4.3 Securing the Diesel Hammer for trailer transport

The responsibility for the secure transport of the Diesel Hammer or pile driving equipment shall be assumed by the contractor or trucking company.

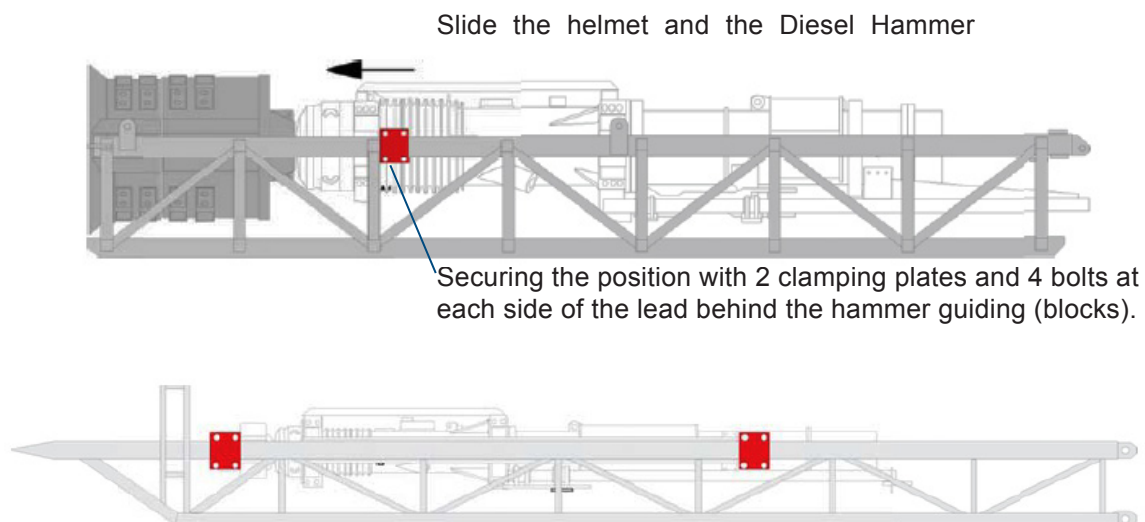
by falling off or shifting the load during sudden breaking or steering.



Unsecured or incorrectly secured equipment on transport trailers can cause deadly accidents

Improperly secured heavy equipment may shift during transport causing damage.

4.3.1 Securing the Diesel Hammer during transport inside the lead (provided by BAUER-Pileco)



For U-lead sections without welded on stop blocks use 4 sets of clamp plates and bolts to secure the Diesel Hammer and the helmet to the lead.

4.3.2 Securing the Diesel Hammer on a trailer

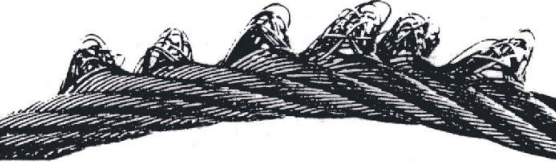
The pictures below are examples for securing the Diesel Hammer on the trailer. This is the responsibility of the transport company





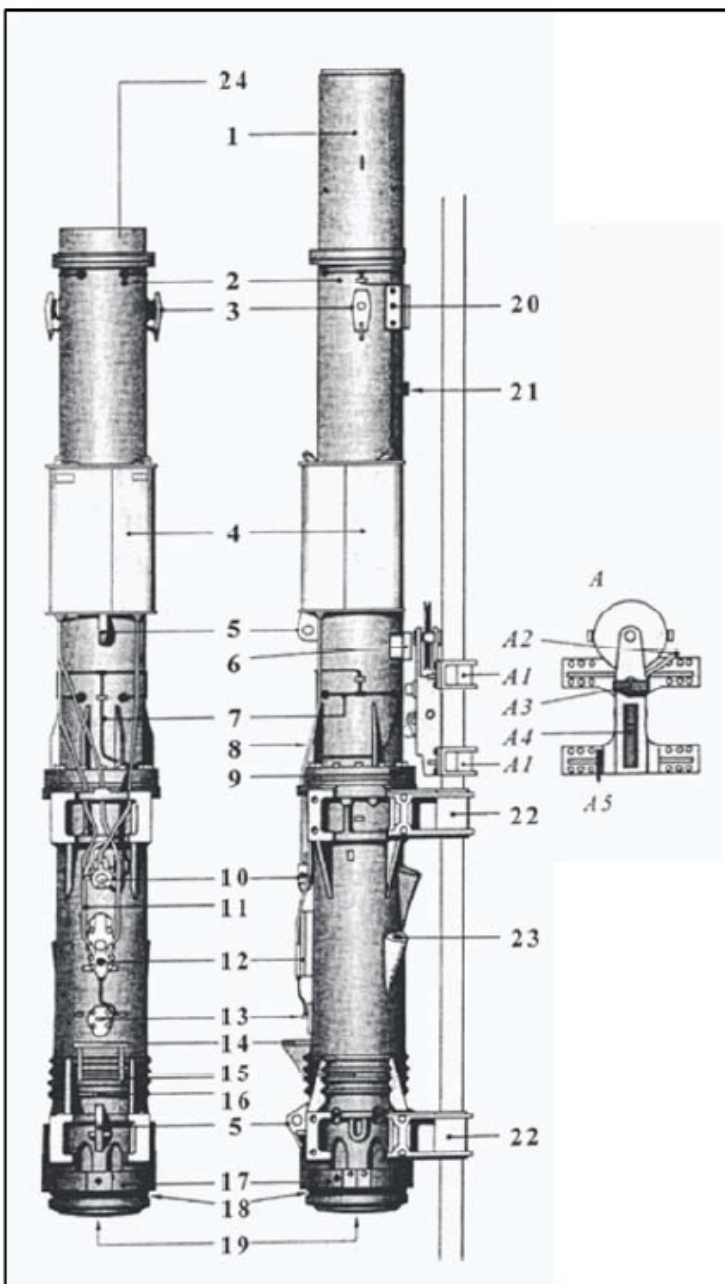
4. Transport of the Diesel Hammer

4.4 Possible Wire Rope damage

	Flattening caused by rolling over Flattening causes increased wire rope breaks which leads the rope to taken out of service
	Constrictions Replace wire rope exhibiting strong constrictions. Possible cable damage
	Knots Replace the wire rope, when many knots have formed
	Breakouts or "contracted slings" Replace rope
	Breaks and Kinks Replace cable
	Corkscrew-like configuration Replace the wire rope, when X (see illustration) is larger than or equal to 1/3 of the cable diameter at the worst damage location.
	Basket formation Wire rope must be replaced even when it exhibits only a small basket formation.
	Loop formation Replace the cable, when the loop formation of individual wires causes a substantial change in the cable structure
	Loosening of individual wires Replace the cable, when loose wires were caused by rust or wear. When the loosening effect is caused in another hammer, a decision regarding the replacing of the cable must be made on the basis of the wire breaks that are sure to follow.

5. Assembly and Mode of Operation

5.1 Components of Diesel Pile Hammer

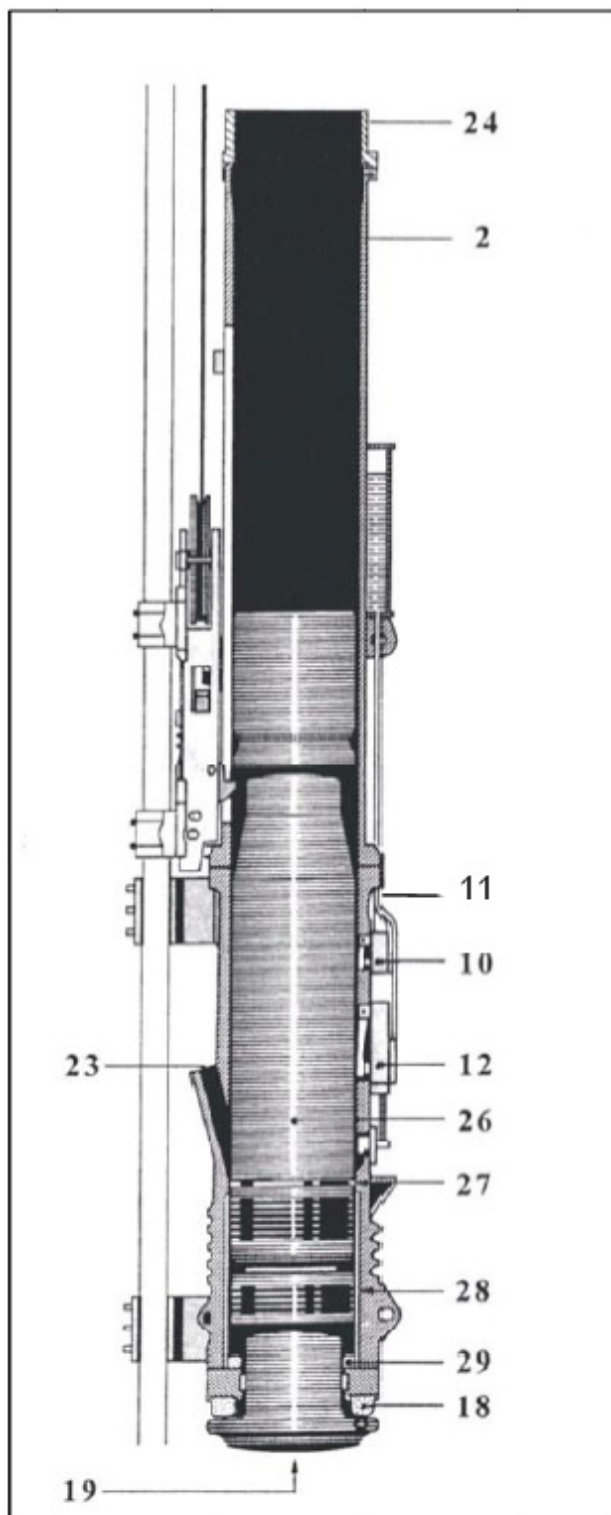


1. Upper cylinder extension with catch ring groove
2. Upper cylinder
3. Lifting ears
4. Fuel tank with integrated lube oil tank
5. Lifting pad eyes
6. Lifting dogs
7. Lubrication lines
8. Locking screw (piston)
9. Trip cam lever engaging point
10. Lubrication pump
11. Fuel / breather line
12. Fuel control pump
13. Injection valve
14. Pump guard
15. Lower cylinder
16. Blow out plug
17. Outer cylinder end-ring
18. Rubber ring
19. Impact block
20. Key plate bolts
21. Trip cam lever release point
22. Hammer guides (offset version)
23. Exhaust ports
24. Short upper end-ring with catch ring groove

- A – Tripping device
A1 – Guide gibes
A2 – Lever for activating driving pin
A3 – Driving pin
A4 – Trip cam lever

5. Assembly and Mode of Operation

5.2 Section View of Diesel Pile Hammer



- 2 – Upper cylinder
- 10 – Lubrication pump
- 11 – Fuel ventilation line
- 12 – Fuel control pump
- 18 – Rubber ring
- 19 – Impact block
- 23 – Exhaust ports
- 24 – Upper end-ring with catch ring groove
- 26 – Piston
- 27 – Piston catch ring
- 28 – Cylinder sleeves
- 29 – Inner damping ring

5. Assembly and Mode of Operation

5.3 Operating principle

Diesel Pile Hammers are used to drive piles into a supporting soil layer. The mode of operation is similar to that of a hammer used to drive a nail.

The piston activates the pump lever during its fall. The Diesel fuel is in that manner sprayed onto the surface of the impact block (1). The air in the cylinder is compressed as soon as the piston runs past the exhaust openings. The strongly increasing compression pressure drives the piston and the impact head below it on the material to be driven.

The following occurs when the hammer impacts (2):

- The pile is driven into the soil
- The Diesel fuel is atomized

The atomized Diesel fuel ignites, because the enormous compression causes a substantial increase in the air temperature of the cylinder volume (working principle of the Diesel engine).

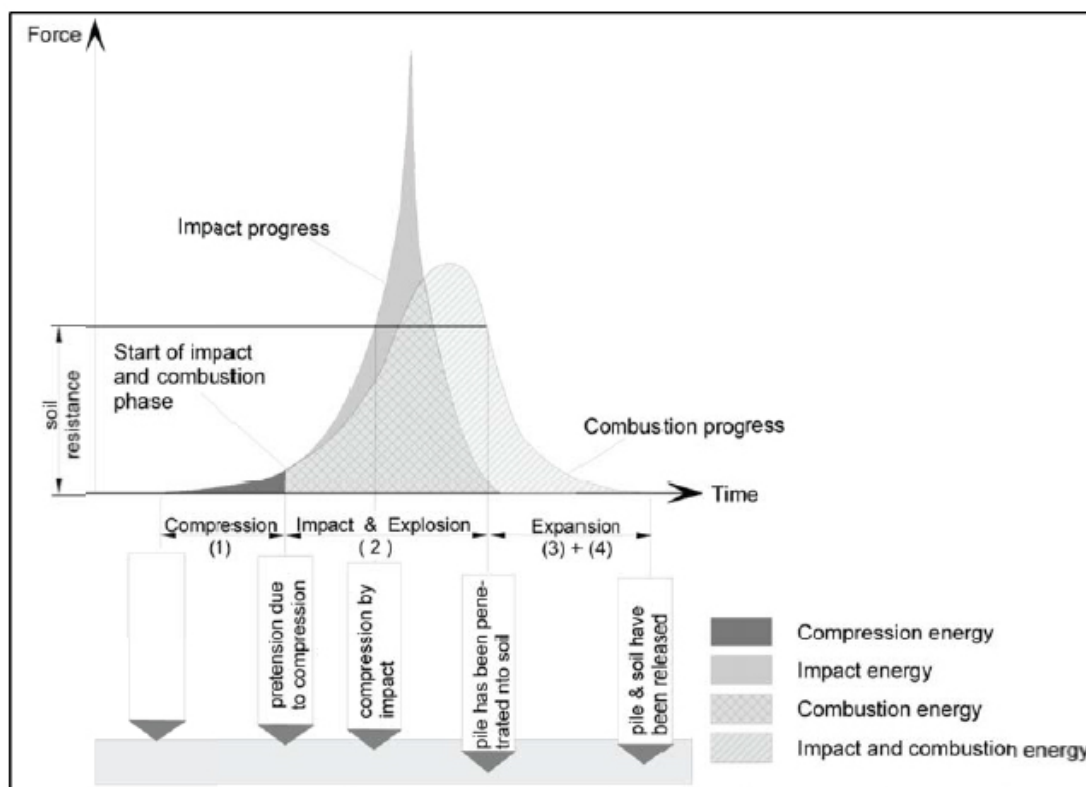
There is an explosion. The explosion causes the following:

- It drives the pile further into the soil.
- The piston is driven upward (stroke).

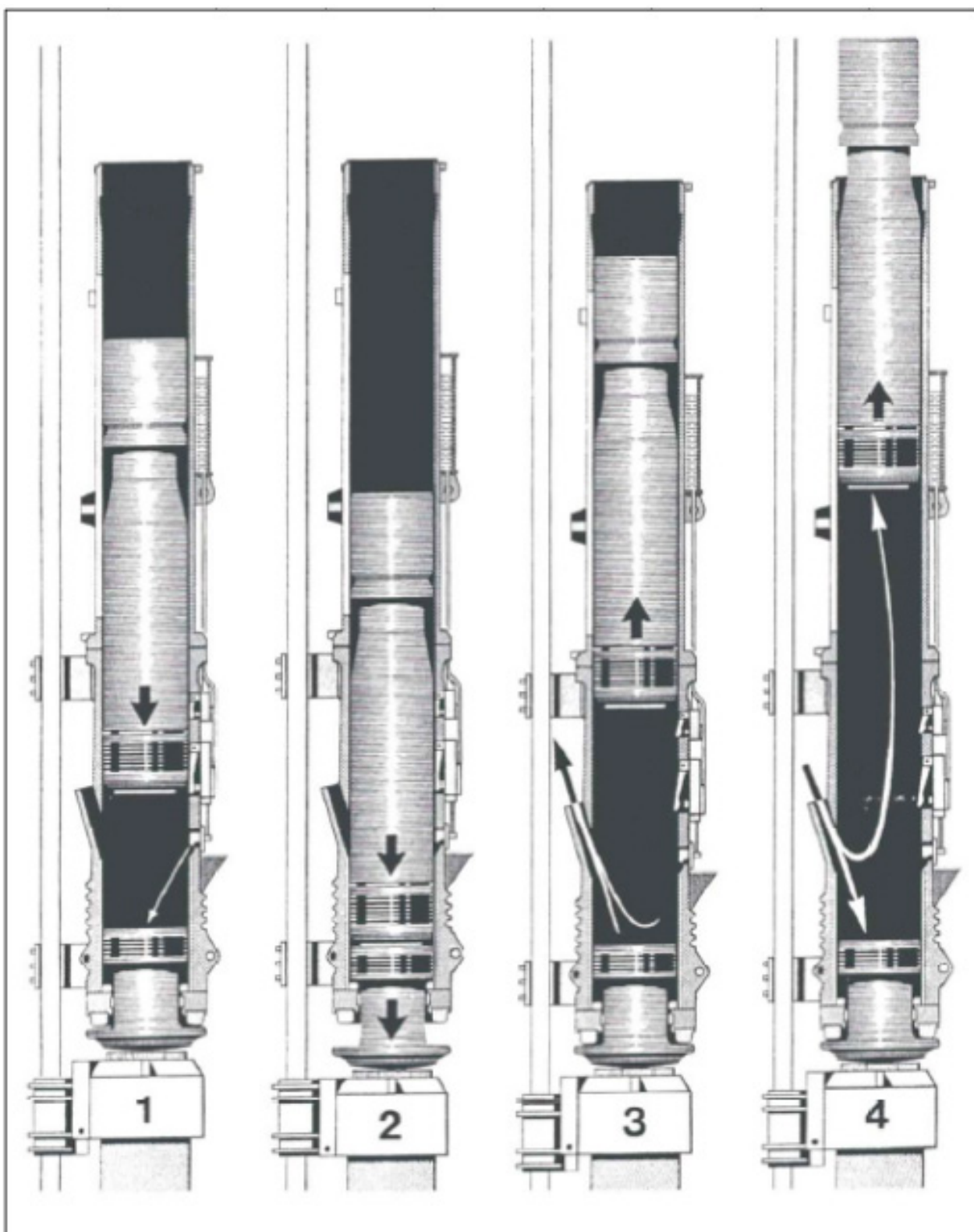
The exhaust openings become exposed with the upward driving of the piston. The pressure in the cylinder volume causes the exhaust gases to be pushed through the exhaust (3). This reduces the pressure in the cylinder to zero.

The piston continues to move upward. This causes a suction effect (vacuum) in the cylinder volume. Said vacuum ensures that fresh air is suctioned in to purge the cylinder volume (4). This is called scavenging.

The pump lever is released during the further upward movement of the piston. The pump lever returns to its original position. Diesel fuel is again supplied to the fuel control pump.



5. Assembly and Mode of Operation



5. Assembly and Mode of Operation

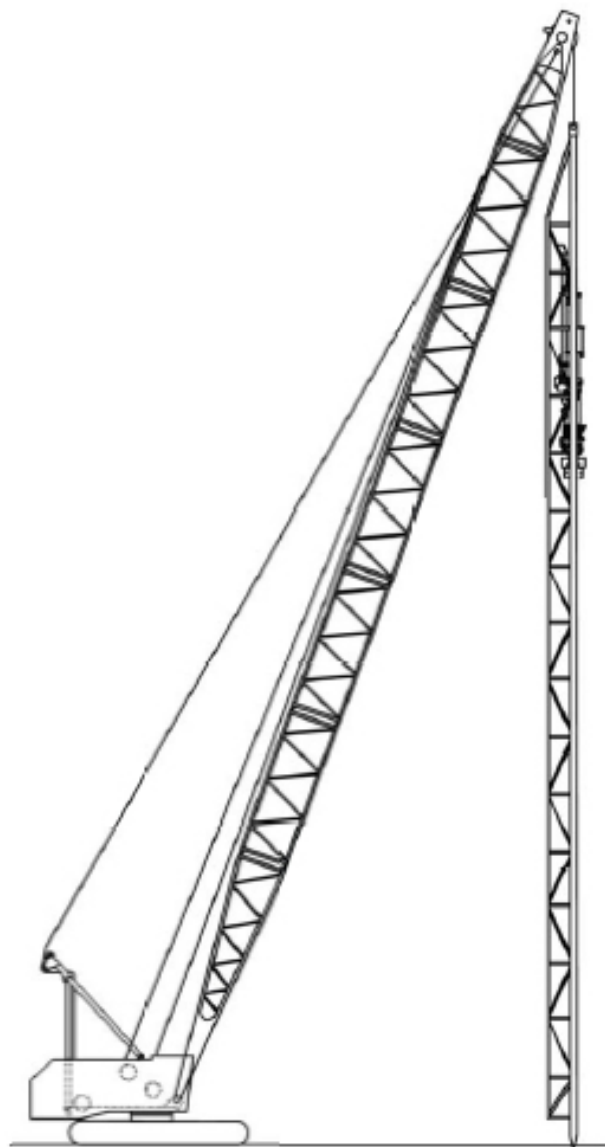
5.4 Pile driving equipment – general information

5.4.1 Lead systems - guiding options

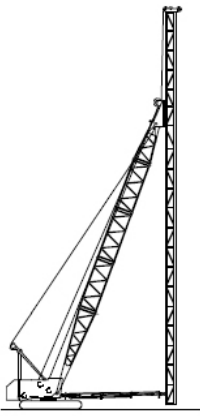
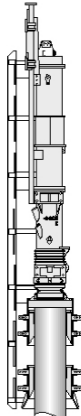
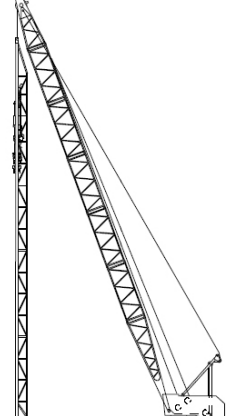
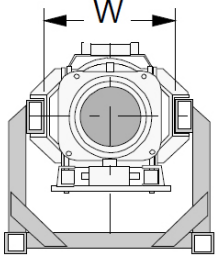
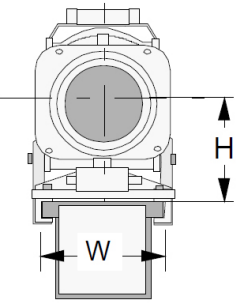
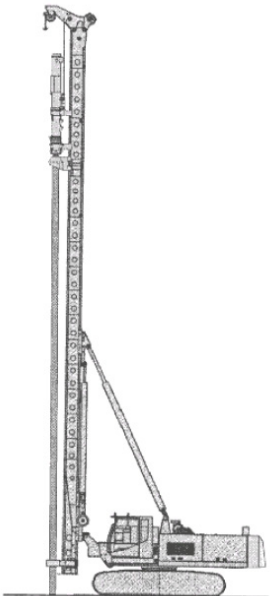
The following indicates and describes different possibilities to guide the Diesel Pile Hammer with a lead. You must consult with BAUER-Pileco Inc. should you decide on a different guiding system for the Diesel Pile Hammer.

Follow the operating instructions for the leads. Use only leads with sufficiently capacity and stability.

U-type lead systems are the most common and most economical solution for pile driving. Different U-type lead systems (see following page) manufactured by BAUER-Pileco accomplish different job requirements.



5. Assembly and Mode of Operation

U-type lead systems			
			
Fixed lead	Caisson-type / Offshore lead		Swinging lead
 BAUER-PILECO U-leads	Type	W inch	max. suitable Diesel Hammer size
	U21 U26 U32 A104-36 A104-42 A104-48 A104-60	21-1/2 26-1/2 32-1/2 42-1/2 48-1/2 54-1/2 66-1/2	up to D19 up to D30 up to D62 up to D138 up to D180 up to D180 up to D180
Box lead or Pogo lead-type			
 European style lead or drilling rig masts • hammer guiding is adaptable to various lead dimensions and lead profiles • starting device is directly guided at the lead profile	Guiding distance H from the center of the Diesel Pile Hammer to the front edge of the guide		
	Type of Diesel Pile Hammer	H inch	
	D8-22 D12-42 D19-42 D25 / D30-32 D36 / D46 –32 D62-22 D80 / D100-13 D125 D160	15 15 15 17-3/8 19-5/8 19-5/8 26 32 40	

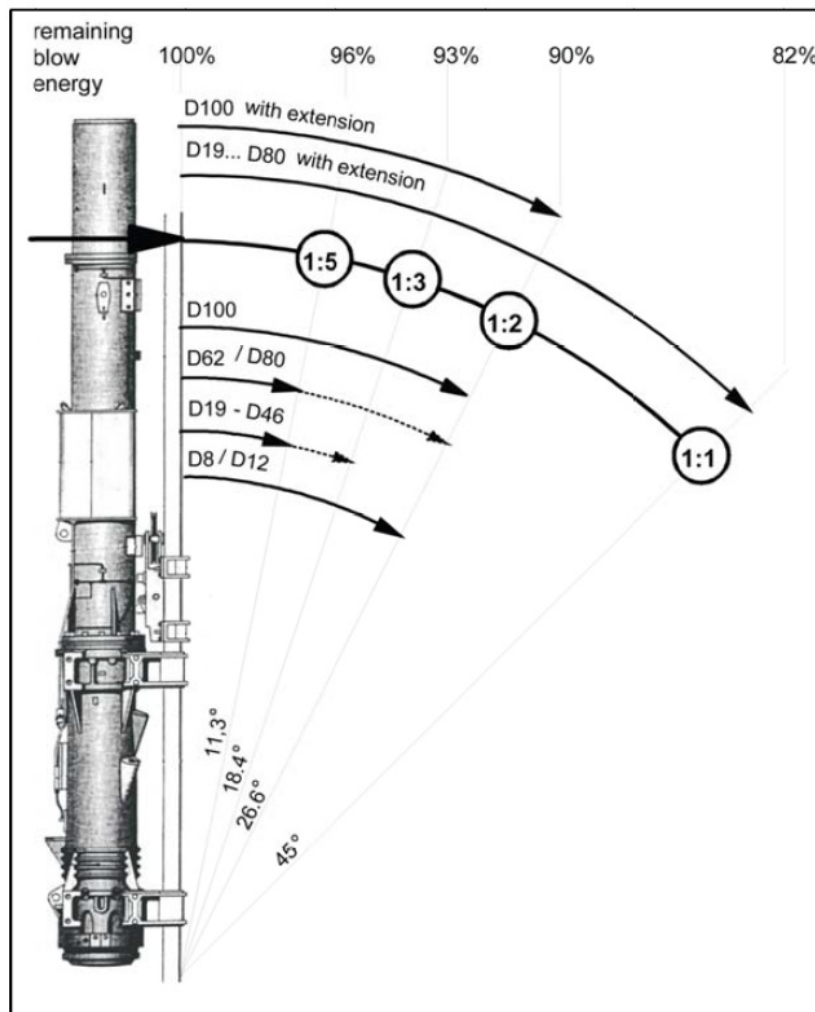
5. Assembly and Mode of Operation

5.5 Diesel Pile Hammer conversion for driving of batter piles

Driving batter piles with a larger inclination than shown below requires a upper cylinder extension. This upper cylinder extension replaces the short upper end-ring with catch groove bolted to the upper cylinder.

Calculate the required batter prior to putting the equipment into operation. Check following points using the diagram below:

- Is the available hammer suited for the required batter?
- Is it necessary to install the upper cylinder extension?
- Is the blow energy still at sufficient level?



Blow energy for driving batter piles

The increased friction of the piston and of the impact block causes a decrease in the blow energy when driving batter piles. The wear on the cylinder and the guiding components are also increased. The remaining blow energy can be calculated using the formula shown below.

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



5. Assembly and Mode of Operation

5.6 Assembly and disassembly of the upper cylinder extension

When required, the upper cylinder section of Diesel Pile Hammers D19-42 through D100-13 can be extended. For these Diesel Pile Hammers, such an extension is required for a batter of more than 1:5.



Conversion work can be carried out only on a safely supported Diesel Pile Hammer in the lower position within the lead, insuring that no movement is possible.

Use a height safety device, and fall protections is required when climbing up the lead.

Conversion work shall only be carried out by qualified, authorized and trained personnel.



PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task.

Work stages:

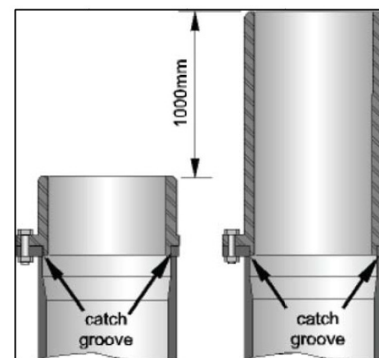
1. Disassemble the upper end-ring (24). To do so, unscrew all hexagonal bolts of the upper end ring. Remove the upper end-ring by lifting it upward.
2. Install the supplied extension for the upper cylinder section (1).
3. Bolt the extension of the upper cylinder section (1) to the upper cylinder section (2). Use the bolts of the upper end-ring. Solidly tighten the bolts (bolt torque values see chapter 10.3 "Screwed / bolted connections"). Replace missing or damaged bolts or nuts with new ones and make sure to use the specified torque chart.
4. Install the supplied extension for the lubricant line.

The disassembly of the extension is the reverse of the above.

Diesel Pile Hammers D12-42 through D180-32 shall be operated only with an installed upper end-ring or extension of the upper cylinder section.

If the upper end-ring is not mounted the piston can jump out of the cylinder when over-stroking.

The catch groove designed with the upper end-ring or the upper cylinder extension is the point where the piston catch ring can snap in to prevent falling out.



5. Assembly and Mode of Operation

5.7 Safety devices

5.7.1 Bridle

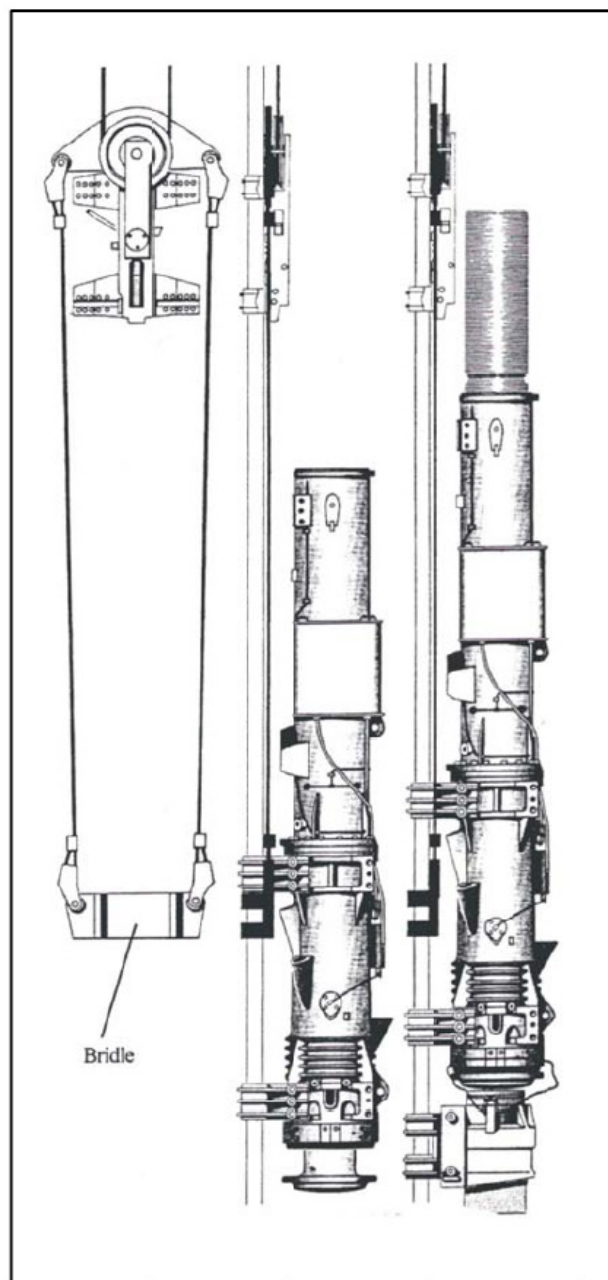
Unless a legislative or regulatory body specifically asks for a certain type of safety device, the Diesel Pile Hammer can be secured by other means such as a bridle.

For small hammers up to the D8 exists a solution which connects the tripping device with the upper hammer guiding clips, where a safety bridle like shown is not needed.



The bridle should never be used to lift the Diesel Pile Hammer. The Diesel Pile Hammer should only be moved upward using the tripping device. This is the only way to ensure safe conditions for the Diesel Pile Hammer.

The bridle must be positioned approximately at the center between the upper and lower guide prior to putting the Diesel Pile Hammer into operation. The bridle must be adjusted continuously to match the driving progress. The bridle will be destroyed otherwise.



6. Starting the Diesel Hammer



Carefully read and follow Chapter 2 “Safety measures” prior to putting the unit into operation.

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

6.1 Filling of fuel and lube tank

Diesel Hammers are not provided with any fuel/oil types. The fuel and lube tank of all Diesel Hammer is sized for several hours continuous running the machine at maximum performance. Please refer to chapter A2-1 for applicable fuel and lubrication types.

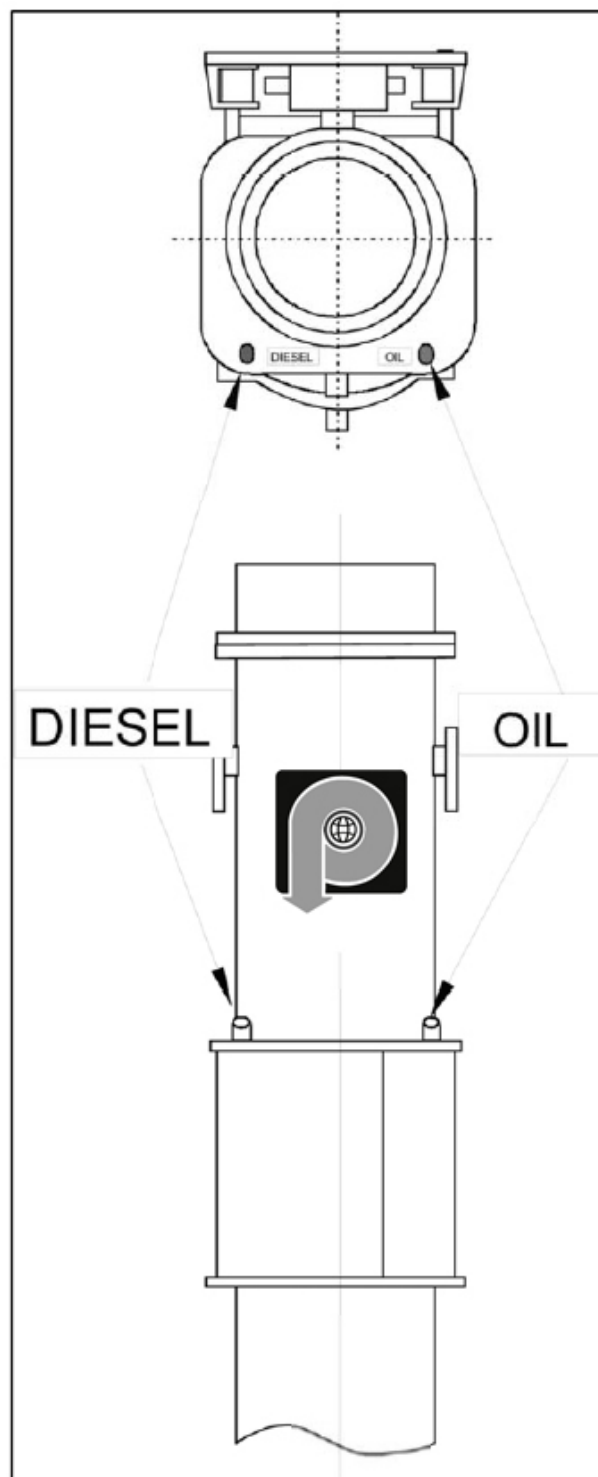
The 45° alignment of the tank studs allows filling of the fuel and lubrication tank the horizontal (transport) position or the vertical (working) position of the Diesel Hammer.



Tank should be filled with caution to insure spill is avoided.

The tank is labeled with FUEL and LUBE to prevent improper filling.

The filler caps have ventilation holes to allow free flow of fuel and lube out of the tank.





6. Starting the Diesel Hammer

6.2 Filling of lubricant lines with oil



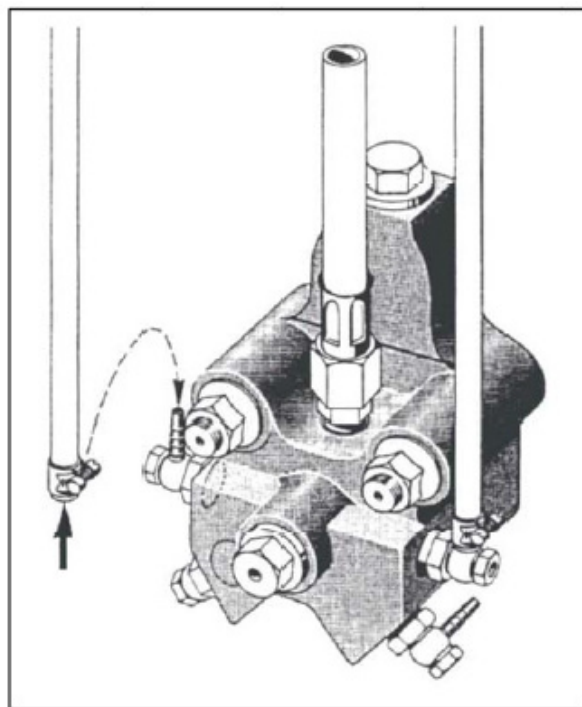
The lubricant lines of the lubricating system must always remain filled with lubricant. Failure to keep lubricant in the system will damage the Diesel Pile Hammer.

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task as injuries may result.

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

1. Lay the Diesel Pile Hammer down in a horizontal position (see chapter 4).
2. Remove the lubricant lines from the lubricant pump (note: D80 through D250 have two (2) lubricant pumps). To do so, loosen the lubricant clamps.
3. Subsequently pull the lubricant lines from the connection fitting.
4. Fill the lubricant lines with motor oil using a squirt can (EO 20, 40 or 50 as a function of the application temperature; see Chapter 11 "Maintenance"). Continue filling the lubricant lines from the bottom with oil, until oil exits at all connection nozzles.

5. Push the lubrication lines back on the respective connection fittings.
6. Tighten the lubricant clamps again. Make sure all lubricant lines are solidly attached to the connection fittings (retighten, if necessary).
7. Put the Diesel Pile Hammer into a vertical position (See Chapter 5 "Transport").
8. Check the lubricant level in the lubricant tank. The tank must be full.



Use motor oil SAE 20W or SAE 40W for lubrication or see chapter 9 for special cases.

6. Starting the Diesel Hammer

6.3 Assembly of pile helmet cushions

The pile helmet cushion transfers the impact from the impact block to the material to be driven. A targeted assembly can dampen the impact to a certain degree (see chapter A 3.3 “Reduction factors for different pile helmet cushions”).

BAUER-Pileco recommends a combination plate pile cushion material for several sizes consisting from:

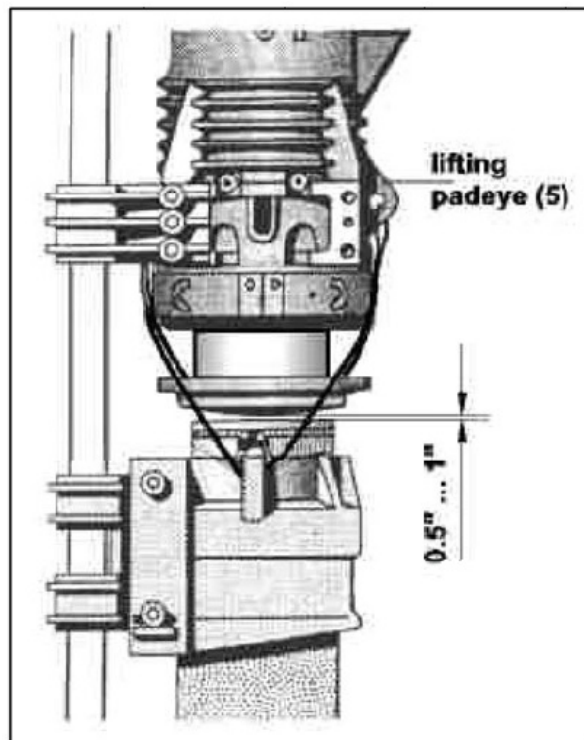
- ½" aluminum cushion
- 1" phenolic cushion
- ½" aluminum cushion

The function of the aluminum plate is taking out the heat from the phenolic cushion plate caused by the impact.

Typical BAUER-Pileco helmet assemblies and helmets you find in chapter A 1.1.

Assembly

1. Place the pile helmet cushion of the desired arrangement in the pile helmet. Different cushion material has different dampening properties. Consult BAUER-Pileco if you intend to modify the cushion material.
2. Set the steel striker plate on top of the cushion. Make sure the contact area of the cushion plate is flat and not bowed, otherwise your cushion material will wear out rapidly.
3. Guide the supplied cable section through the striker plate padeyes and the padeyes of the helmet.
4. Tighten the cables and secure them with a suitable cable clamp.
5. If using a primary helmet set the required pile insert in the receptacle.
6. Slide the helmet or primary helmet in the lead and attach to the Diesel Hammer like shown.



The wire rope connection between the helmet and the Diesel Hammer lifting padeyes (5) must be loose to ensure free movement of the impact block. When the hammer is lifted up the impact block moves out of the cylinder until the inner damping ring stops. In that situation there should be clearance of 0.5" ... 1" between the impact block and the striker plate.



Never use the lifting eyes of the outer end-ring to connect the helmet to the Diesel Hammer. The lifting eyes should only be used for handling the outer end-ring.

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

An incorrect attachment of the pile helmet cushion with the wire rope at the pile helmet can cause the striker plate and cushion to fall out. Danger of an accident may result.

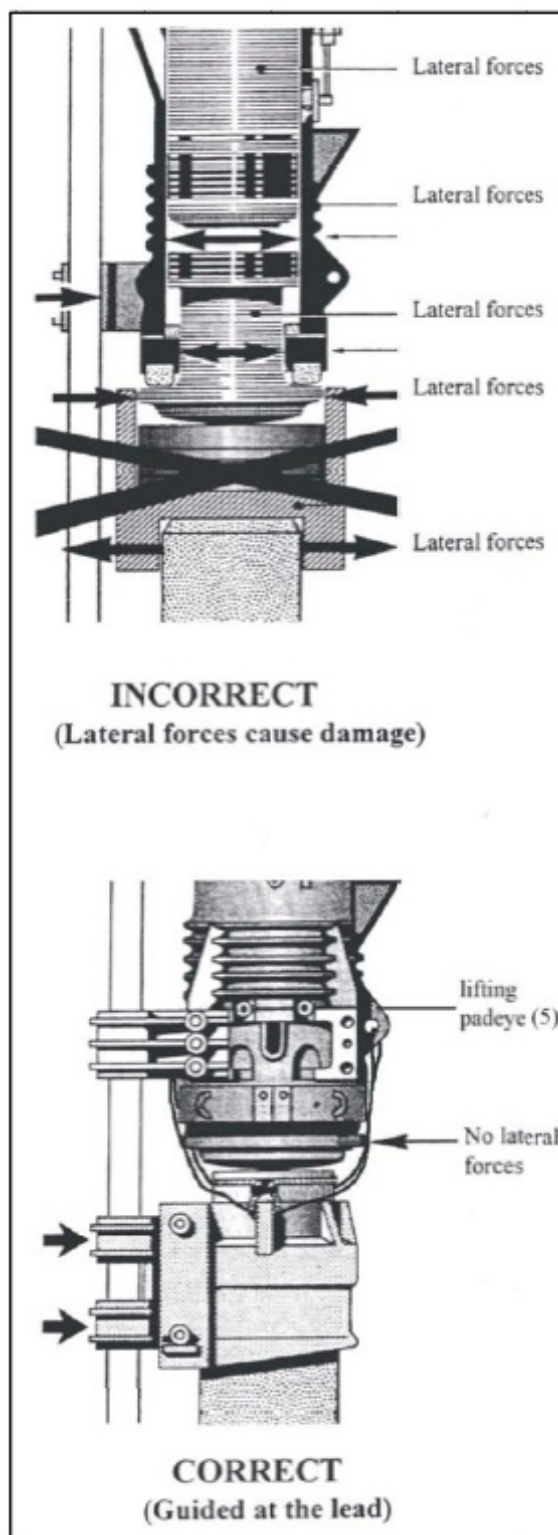
6. Starting the Diesel Hammer

6.4 Guiding for the pile helmet



The pile helmet cannot be guided at the impact block of the Diesel Pile Hammer. Otherwise, lateral forces may cause damage to the impact block and the cylinder.

- Do not wire rope the helmet to the padeyes of the outer end-ring. The outer end-ring padeyes are designed only for lifting of the end-ring itself during assembly and is not safe for lifting helmets.
- Leave the wire rope long enough to ensure that the impact block can move out completely without tensioning the cable.



6. Starting the Diesel Hammer

6.5 Lifting of piles



Follow the operating instructions of the carrier equipment.

Use only approved wire rope in accordance with Chapter 4.2 "Transport cables".

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

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task. You must wear a life vest when working over water surfaces.

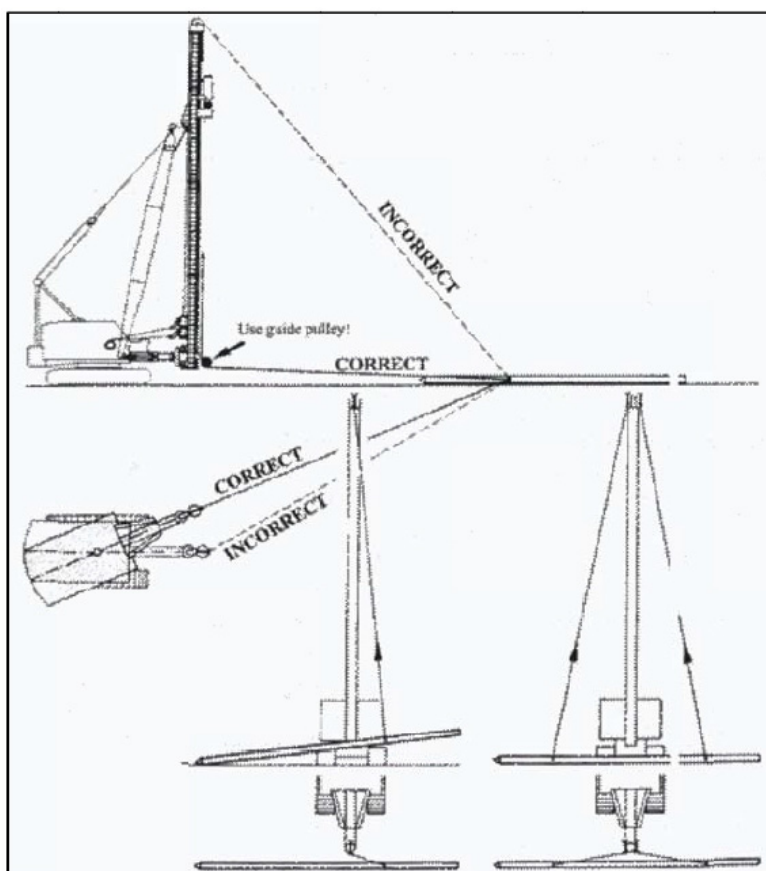
Never pull the material to be driven from the lead tip. This may cause an overturning of the carrier unit or may bend the lead end.

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 a 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.

Never lift piles attached to the hammer using only one line. Always use a separate pile line.



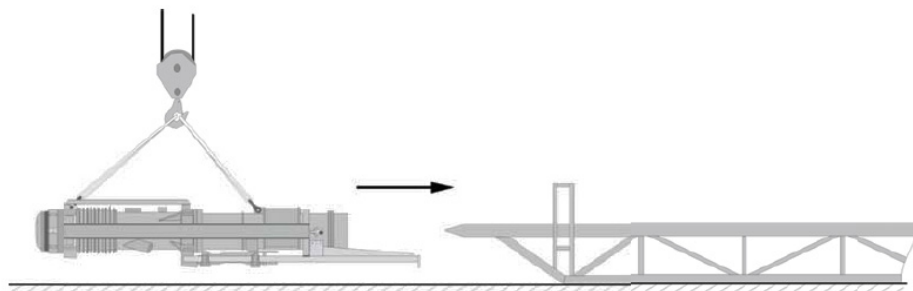
6. Starting the Diesel Hammer

6.6 Bringing the Diesel Pile Hammer and pile helmet into operating position



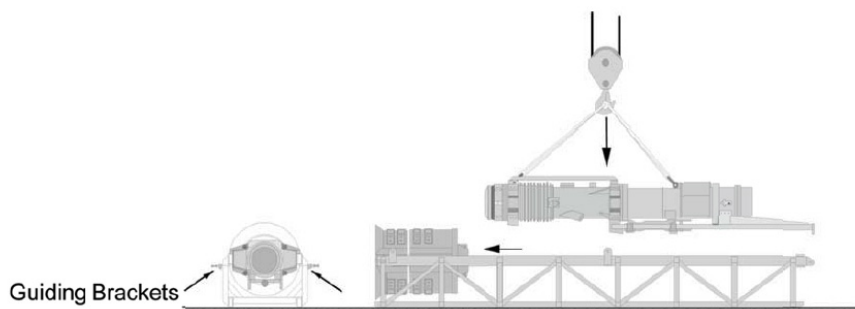
Observe the operating instructions of the carrier equipment.

Equipment to tie down any and all equipment being transported shall be provided by the transport company and be of such to prevent movement of equipment or damage. PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task. Make sure to read 1926.106 (a) (b) (c) (d) when working over or near water.



6.6.1 Placing the Diesel Hammer in swinging lead – lead laying on the ground

- Diesel Pile Hammers up to the D62 can be equipped with channel guiding
- The hammer must be slid in the lead from one side
- Before raising up the lead the starting device and the hammer lifting ears must be connected to the crane hoist line



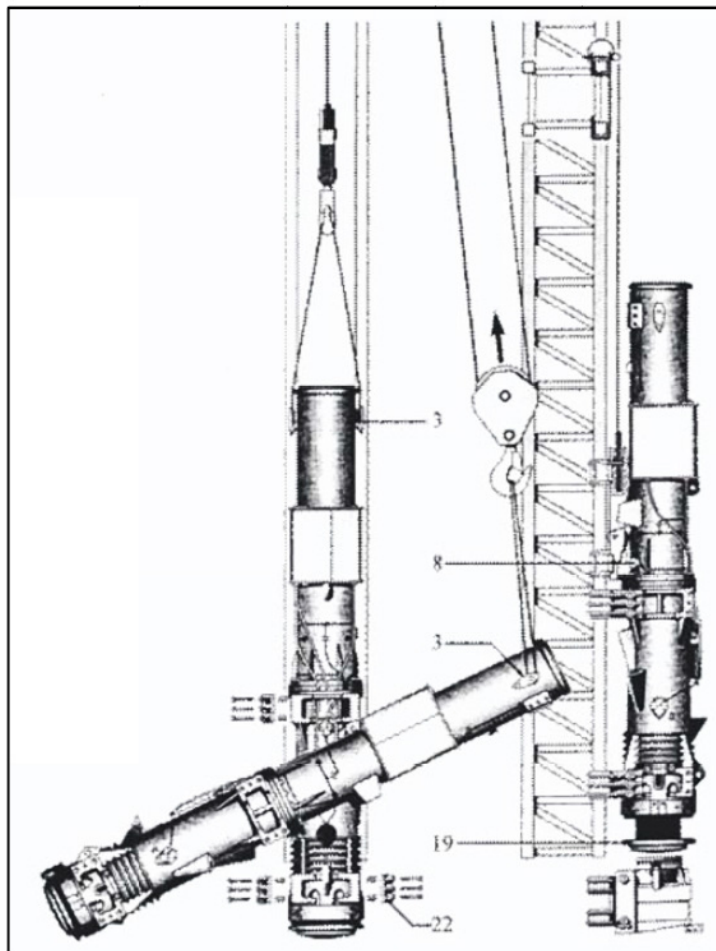
6.6.2 Placing the Diesel Hammer in an offshore lead – lead laying on the ground

- When setting the hammer into the lead pay particular attention to slide the lead guiding carrier and the hammer complete to the guiding bell to prevent uncontrolled sliding when raising the hammer and lead system to upright position
- After setting the hammer into the lead the backside guiding brackets must be bolted on

6. Starting the Diesel Hammer

6.6.3 Placing the Diesel Hammer in fixed lead – lead in vertical position

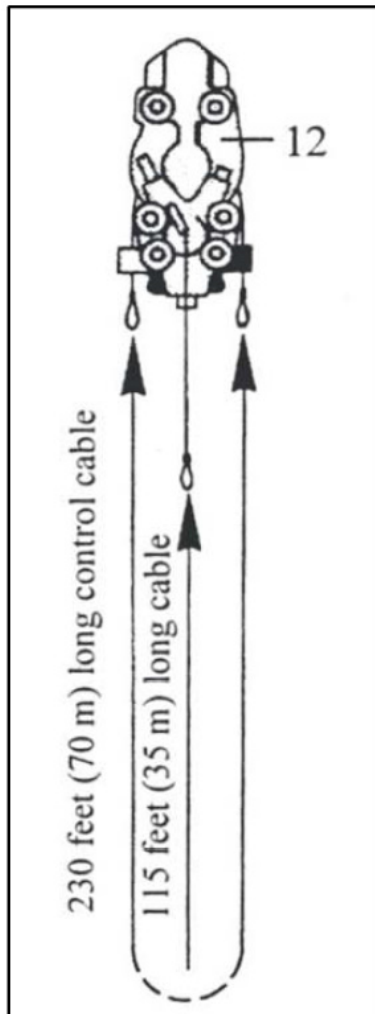
1. Mount the tripping device (see chapter 8.4.6) to the lead if not guided directly at the hammer starter guides attached to the hammer.
2. Lift up the tripping device approx. 10ft (3m).
3. Place the Diesel Pile Hammer in front of the lead (horizontal position, see chapter 4.).
4. Place the Diesel Pile Hammer on wooden blocks.
5. Remove the transport securing equipment.
6. Place the appropriate slings around the lifting plates (3) and around the hook of the carrier equipment.
7. Carefully pull the Diesel Pile Hammer to a vertical position and place the Diesel Pile Hammer in front of the lead.
8. Install the two lower and one upper guide bracket (22).
9. Lift the Diesel Pile Hammer 3ft (1m). Place the guide brackets (22).
10. Install the second upper guide bracket (22).
11. Place the pile helmet below the Diesel Pile Hammer.
12. Let the Diesel Pile Hammer rest on the pile helmet.
13. Remove the locking screw(s) (piston) and the impact block clamp (See Chapter 4.1 “Transport safety devices”).
14. Pull the Diesel Pile Hammer upward until the impact block (19) is fully extended and hangs approximately 2 inches (5 cm) above the pile helmet cushion.
15. Attach the pile helmet to the lower cylinder lifting pad eyes (5) as shown in the illustration. Use the wire rope and wire rope clamps from the tool box.
16. Slowly lift the Diesel Pile Hammer using the tripping device while guiding the pile helmet through the lead.





6. Starting the Diesel Hammer

17. Remove the wire rope slings from the lifting plates (3) and from the hook of the lifting equipment.
18. Attach both ends of the 230 feet (70 m) long control rope (in the tool box) to the eyelets for the control rope of the fuel pump (12).
19. Attach the 115 feet (35 m) long rope to the shutoff valve (center eyelet) of the fuel pump (12).



20. Fill the tank with Diesel fuel (See Appendix A2 "Usable fuels" for alternate fuels). The filling nozzle of the tank indicates "Diesel".

It is important to use a fuel that is suited for the ambient temperature conditions (see the following table). If this is ignored, the unit may be difficult to start and the fuel lines may become clogged.

Mixing ratio Diesel fuel / regular gasoline or engine oil		
outside temperature	Summer Diesel fuel	Winter Diesel fuel
above -10°C 14°F	90% / 10%	100% / 0%
-10°C to -14°C 14°F to 7°F	70% / 30%	100% / 0%
-14°C to -20°C 7°F to -4°F	50% / 50%	80% / 20%
-20°C to -30°C -4°F to -22°F	-	50% / 50%

Note: regular gasoline tends to pre-ignite

6.7 Tripping device

The tripping device is an auxiliary means:

- to lift the Diesel Pile Hammer at the lead,
- to lower the Diesel Pile Hammers at the lead,
- to lift the piston when starting the Diesel Pile Hammer.

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



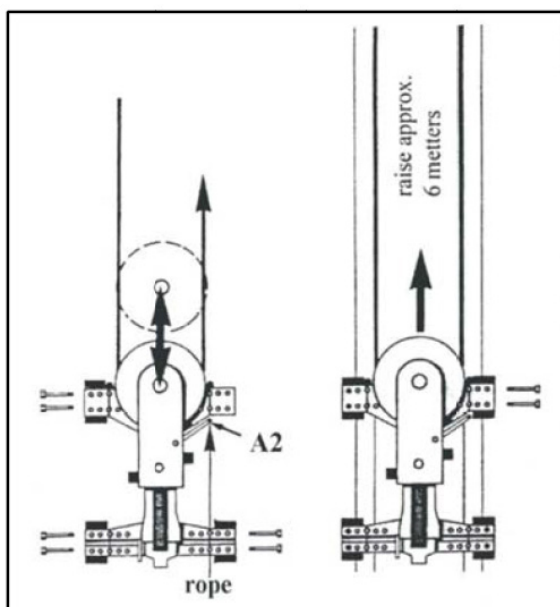
Check the tripping device for damage prior to its installation. Use only the tripping devices that are in good working condition.

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task. You must adhere to proper job regulations.

6. Starting the Diesel Hammer

Installation of the tripping device

1. Attach the lower and one upper guide gibs to the tripping device. In U- type leads the tripping device is guided directly at starter guides mounted to the Diesel Pile Hammer (see page 1-2).
2. Place the wire rope in the rope sheave or for smaller hammer types connect the wire rope directly to the sheave pin. To do so, you must remove the sheave pin and install it again when the wire rope is positioned. Secure the sheave pin with the safety screw or cotter pin.
3. Lift the tripping device upward and make sure it is smoothly sliding.



4. Attach the rope (in the toolbox) to the lever (A2).

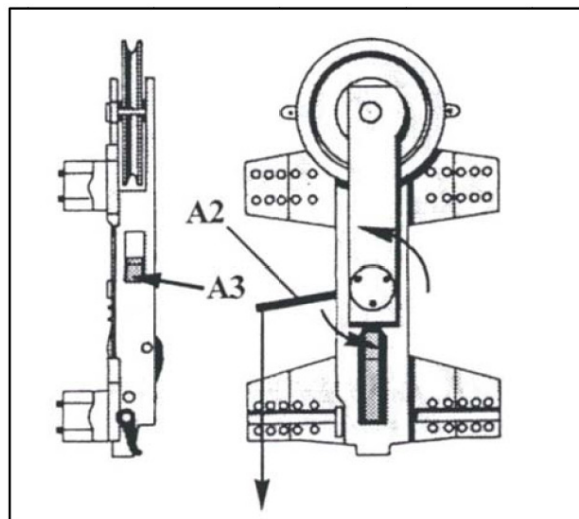
Operating mode



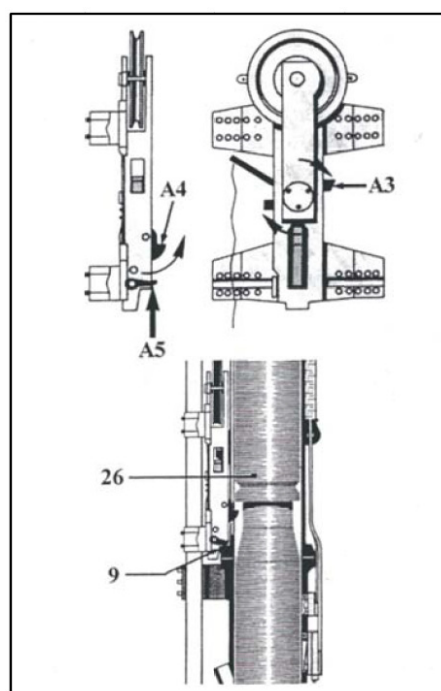
You must keep a distance of at least 13 feet (4 meters) from the Diesel Pile Hammer.

Lowering the tripping device

1. Pull the lever (A2) down to the stop using the rope and keep it taut. This retracts the driving pin (A3) in a vertical position. The tripping device can move past the lifting dogs (6) of the Diesel Pile Hammer.



2. Lower the tripping device to the lower stop (9). The trip cam lever (A5) is pushed upward at the trip cam lever engaging point (9). Pawl (A4) is thus pushed out and into the lifting groove of the piston weight (26).



6. Starting the Diesel Hammer

3. Release the cable at the lever (A2).



The tripping device must always be lowered to the lower stop to ensure that the pawl projects fully and is locked. If this is omitted, the Diesel Pile Hammer may trip prematurely.

The pulley rope must always hang free. Do not tie the pulley rope to the lead or other places. This may cause the Diesel Pile Hammer to fall uncontrollably. Danger to life and risk of a damaging tripping device.

Lift / lower Diesel Pile Hammer:

1. Lower the tripping device as described above.
2. Slowly pull the tripping device upward using the wire rope hoist. **Do not** pull on the rope at the lever (A2). During the lifting stage, the surfaces of the driving pin (A3) grasp below the lifting dogs (6) of the Diesel Pile Hammer. The Diesel Pile Hammer now hangs from the tripping device.

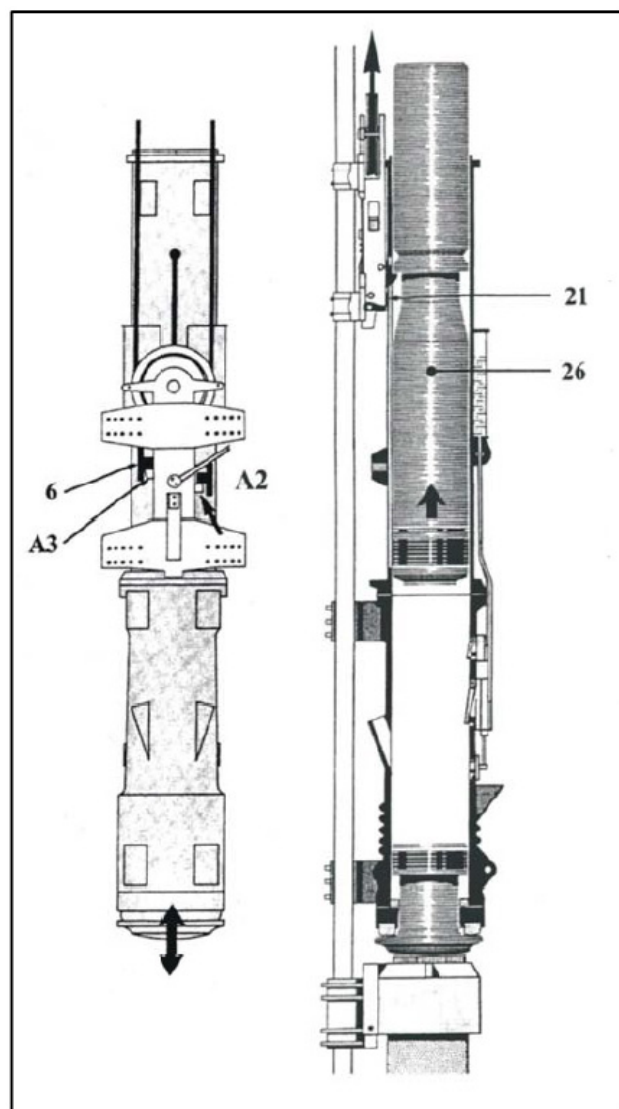


Please be sure the pawl of the starting device is locked under the lifting groove of the piston during lifting of the hammer.

3. Use the hoist to place the Diesel Pile Hammer into the proper position.
4. Set the hammer with helmet assembly on top of a pile.

Lifting the piston – start the hammer

1. Lower the tripping device as described above.
2. Pull the lever (A2) down to the stop using the rope and keep the cable tight. This retracts the driving pin (A3) in vertical position to pass the lifting dogs. After the tripping device passing the lifting dogs the lever A2 can be released to its normal position.
3. Use the hoist line to slowly pull the tripping device upwards. When pulling it upwards, the piston (26) is also pulled upward and automatically released at the upper stop (21).





6. Starting the Diesel Hammer

6.8 Control of fuel supply

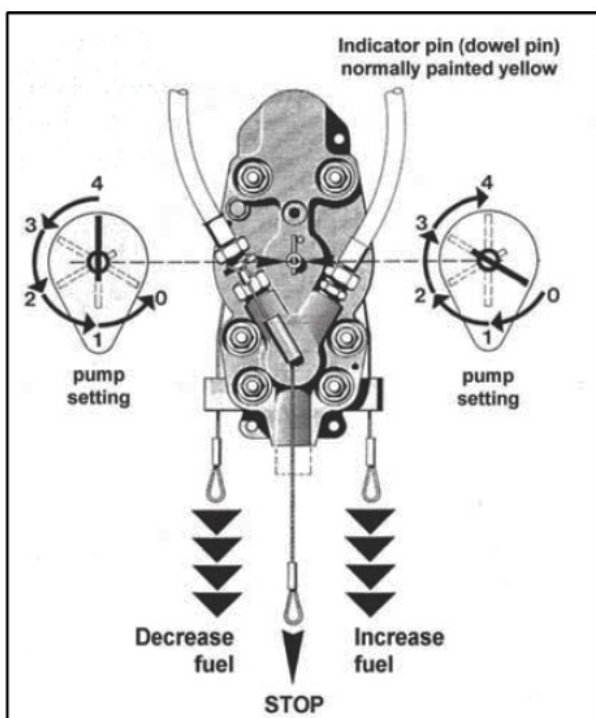
The fuel pump determines the energy per blow and thus the drop height of the piston. The fuel pump has five settings:

	Indicator pin position	fuel supply
setting I	6 o'clock	49...64%
setting II	8 o'clock	66...77%
setting III	10 o'clock	83...90%
setting IV	12 o'clock	100%
setting 0	4 o'clock	Shut off

The settings can be adjusted by three ropes attached to the fuel pump. For easier use at night identify the ropes with single knots and double knots.

Inspect these ropes carefully as you may need to depend on them to shut down the hammer in the case of an emergency.

The fuel setting can be determined by the position of the dowel pin on the switch shaft of the fuel pump. This dowel pin is normally painted yellow for identification (see chart below).



Mode of operation - Increase fuel supply

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

Decrease fuel supply

Pull on the left 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 maximum setting of "0").

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 pump.

Should this rope break, you can successfully shut down the hammer in two alternate ways:

- Adjust the fuel pump to the "0" position.
- While in the position "4" (12 o'clock) pull and hold tight the right rope until the impact hammer is at rest. The dowel pin will go to the 2 o'clock. This position is spring loaded. Releasing the rope will cause the fuel pump to return to position "4" (12 o'clock).

Bleed fuel pump and injection valves

The fuel pump and the injection valves must be bled:

- prior to the first putting-into-operation
- after repair work
- when the Diesel Pile Hammer fails to operate due to a lack of fuel



Let the Diesel Pile Hammer cool down fully prior to the bleeding in the event the Diesel Pile Hammer stopped working due to a lack of fuel. Burns and fire may result.

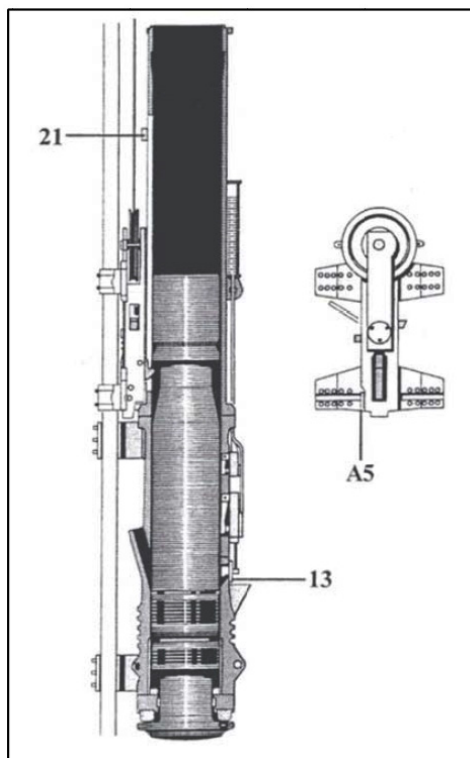


6. Starting the Diesel Hammer

1. Pull the piston upward until the trip cam lever (A5) of the tripping device is located approximately 8 inches (20 cm) below the release point (21).

The fuel flow to the fuel pump will be blocked, when the piston is too low. The fuel flow is released automatically if the piston is above the pump lever and thus is released.

2. Set the fuel pump to Setting "4" (full load).
3. Unscrew the swivel joint at the injection valves (Pos. 13, Type D5 through D30: only one injection valve) by approximately 2-3 turns. Do not fully unscrew the swivel joint.
4. Activate the pump with the right control rope (dowel pin position 2 o'clock) until fuel without bubbles exits at all swivel joints.
5. Keep the control rope taut and at the same time tighten all swivel joints.
6. Release the control rope.
7. 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.
8. Release the center rope.
9. Repeat steps 3 through 8 three times.



6.9 Cleaning of combustion chamber

The combustion chamber must be cleaned each day prior to the first startup of the Diesel Pile 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 (25) and cause damage.

Take the following steps:



The Diesel Pile 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 Pile Hammer will fall uncontrollably to the ground. Maintain a distance of at least 13 feet (4 meters) from the Diesel Pile Hammer.

Never stand in front of the Diesel Pile Hammer 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. Proper PPE (Personal Protective Equipment) is necessary.

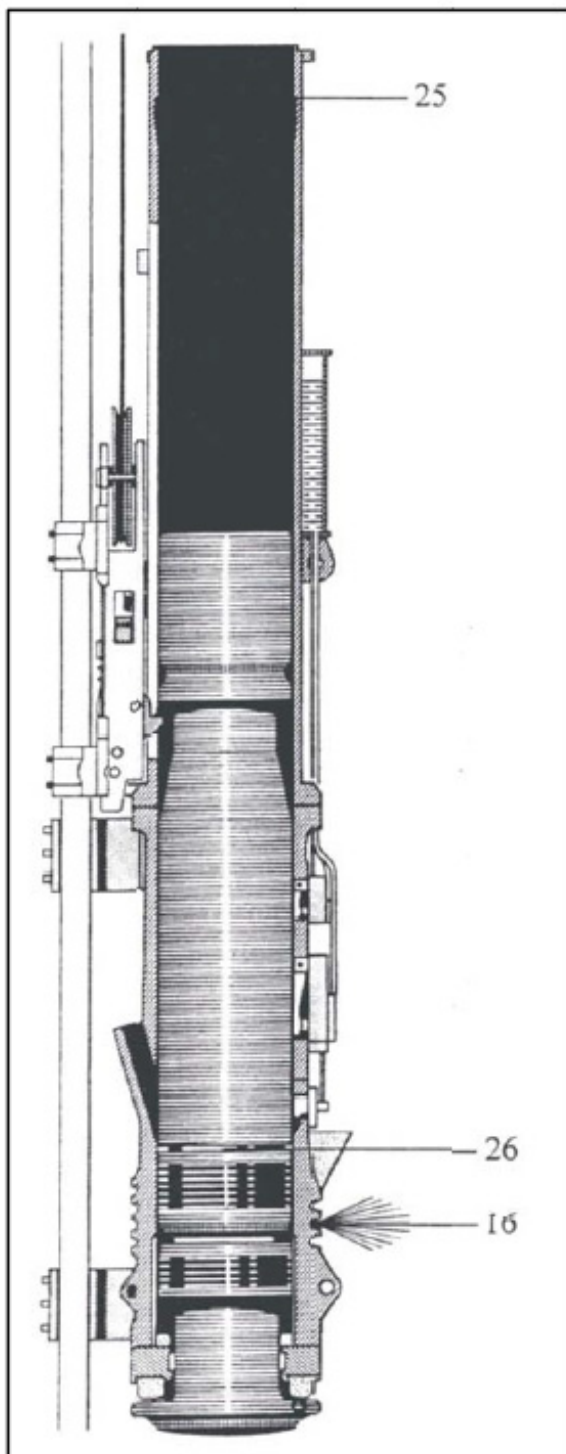
1. Set the fuel pump to the setting "0". To do so, pull the left control cable as often as required.
2. Remove the blow out plug (16). (See page 6-13)
3. Maintain a safe distance from the Diesel Pile Hammer, since dirt and material residues will be ejected at a high pressure.



Never stand in front of the combustion chamber opening of the Diesel Pile Hammer. Always stand to the side of it.

6. Starting the Diesel Hammer

4. Raise the piston five times using the tripping device and let the piston drop from the release point. These cold blows allow oil and dirt to escape from the combustion chamber.
5. Screw the plug (16) back in.



6.10 Start and Control



A thorough inspection by a competent/qualified person of the whole driving equipment system prior to putting it into operation. Check the unit for loose screws and bolts, cracks, wear, leaks and possible damage. Check the stability of the unit. Make sure all damages are repaired immediately. Operate the equipment only after all damages have been repaired (See chapter 9 "Maintenance").

With the exception of the excavator operator, operator and the foreman in charge of the pile driving, make sure no other person stands within a distance of 1.5 times the lead height, when possible. Sound a horn to warn others of the impending starting of the unit.



The piston should not bounce into the catch groove (25). The Diesel Pile Hammer must be shut off immediately in this case. Thereafter, operate the Diesel Pile Hammer only:

- after checking or replacing the screws used to fasten the upper end ring or upper cylinder extension.
- after checking the catch groove.
- after checking the catch (piston) ring.

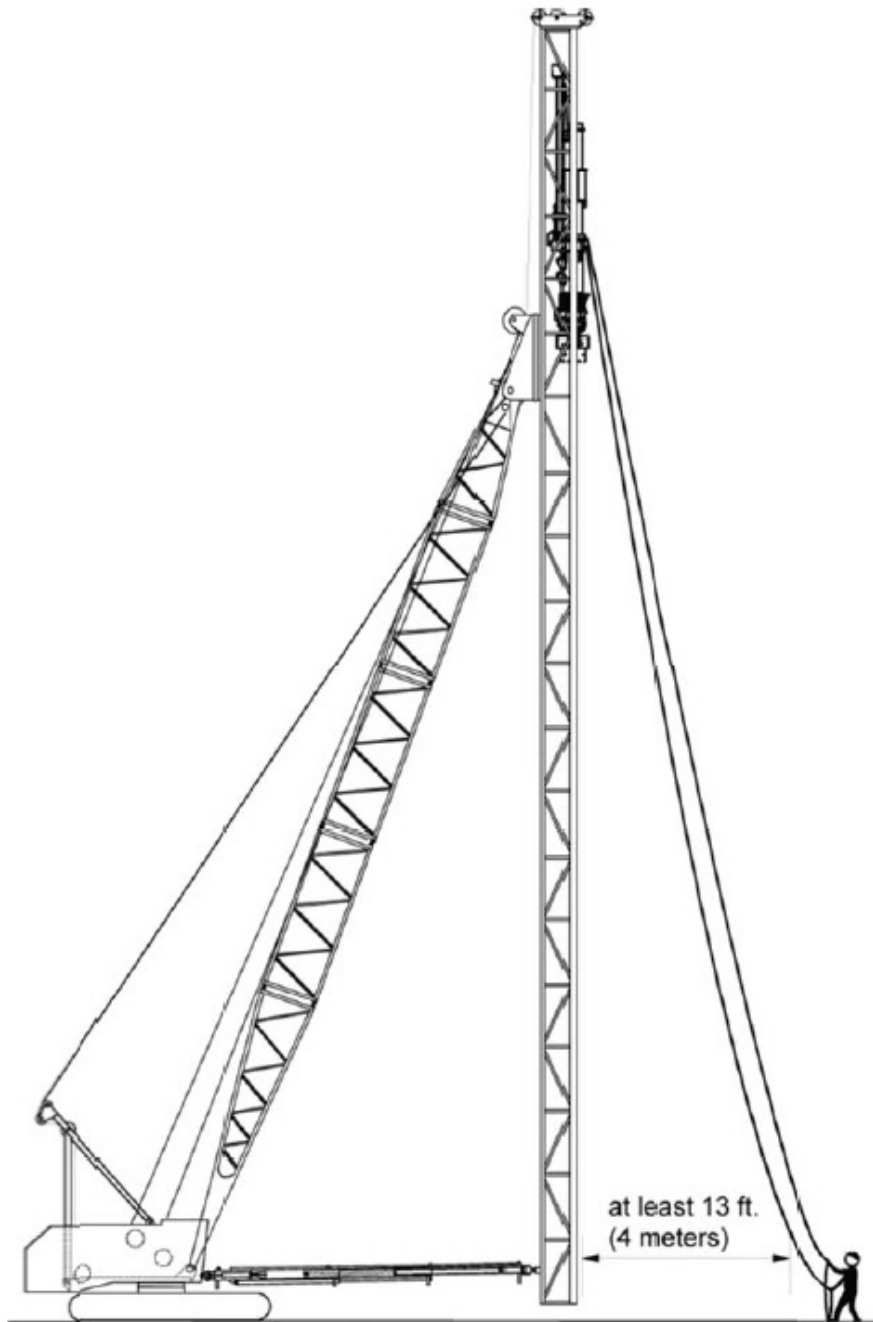
You must keep a distance of at least 13 feet (4 meters) from the Diesel Hammer.

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task.

6. Starting the Diesel Hammer



Prodcedure



1. Set the fuel pump to the setting "0". To do so, pull on the left control rope as often as required.
2. Using the tripping device, pull the piston upward and release it.
3. For a pre-driven pile: Set the fuel pump to the setting "2" after the first blow. To do so, pull 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, pull the right control cable three times.
4. Continuously adjust the fuel injection quantity by pulling the control cables. Do not increase the injection quantity faster than one step per stroke.



7.1 General Information

Follow all safety measures described in Chapter 3. Operate the Diesel Pile 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.

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task.

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 Pile Hammer only after the dangerous situation has been taken care of.

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



1. Never start the Diesel Pile Hammer unless it is resting on a pile or a specially prepared test stand.
2. Never start the Diesel Pile Hammer with the impact block hanging out. The impact of the piston will transmit directly to the cylinder outer end-ring resulting in damage of outer end-ring and lower cylinder. A stuck impact block prevents the cylinder from freely dropping on the impact head unit (possibly due to defective damping rings).
3. Never start a Diesel Pile Hammer which has been disconnected from the lead or which is resting on a skid, etc. The support device will be destroyed and the Diesel Pile Hammer will come crashing down causing an accident.

4. Never drive piles eccentrically. This may cause damage to the cylinder and guide components as well as damage and vibrations to the material to be driven. The center line of the material to be driven must be in line with the center line of the Diesel Pile Hammer. This is necessary to avoid jarring blows. Jarring blows could cause such as but not limited to the following:

- cracks in and deformation of the cylinder,
- vibrations in and damage to the material to be driven,
- directional deviation for the material to be driven.

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 blow energy (See Chapter 9.2 “Blow energy stages” and Appendix A3-1 “Reduction factors for different impact head cushions”). 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.

5. Increased wear in the guide components, is caused by rebounding impacts. This is caused by driving eccentrically. Very hard driving of relatively elastic piles (H-beams, spiral welded thin wall pipe piles) will lead to damage of the Diesel Pile Hammer especially the rubber rings.
6. Stop the Diesel Pile Hammer if the penetration rate is higher than 240 blows per foot. Higher blow rates are possible, but it causes higher wear of the Diesel Pile Hammer. BAUER-PILECO cannot warranty parts if it is obvious that the chosen hammer for the job was too small.
7. The piston should not bounce into the catch groove. If so this may damage the catch ring piston, catch groove and attachment screws. The safety of the Diesel Pile Hammer is thus no longer ensured.



7. Operation

8. The combustion chamber must be cleaned each day by a trained worker prior to the first startup of the Diesel Pile 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 and cause damage.
9. Make sure the allowable batter is not exceeded when driving batter piles (See Chapter 5.7 "Conversion to drive batter piles"). Make sure the Diesel Pile Hammer is maintained regularly and properly.
10. When using a bridle, the bridle must be adjusted continuously to the pile driving progress. The bridle will be destroyed otherwise. The safety against a fall is no longer ensured.

Deviations from the original directions of the material to be driven can also occur under the best conditions. 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 tight until the piston is completely at rest.

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



7. Operation

7.2 Blow energy

7.2.1 Standard fuel pump

The blow energy is adjusted to the respective blow conditions by controlling the fuel supply.

The blow energy of the respective type at different settings can be taken from the table shown below.

Type	Injection Quantity at setting 4 100% ±10%	Injection quantity (%) and blow energy* Nm (ft. lbs.)			
		setting 4 100%	setting 3 83...90%	setting 2 66...77%	setting 1 49...64%
D8-22	1.75 cm ³ /stroke	25,400 Nm 18,760 ft. lbs.	21,080 Nm 15,570 ft. lbs.	16,890 Nm 10,350ft. lbs.	12,853 Nm 9,480 ft. lbs.
D12-42	2.10 cm ³ /stroke	40,460 Nm 29,840 ft. lbs.	33,580 Nm 24,760 ft. lbs.	26,700 Nm 19,690ft. lbs.	20,470 Nm 15,100 ft. lbs.
D19-42	3.10 cm ³ /stroke	57,600 Nm 42,480 ft. lbs.	47,810 Nm 35,260 ft. lbs.	38,015 Nm 28,035 ft. lbs.	29,160 Nm 21,510 ft. lbs.
D25-32	3.90 cm ³ /stroke	79,040 Nm 58,300 ft. lbs.	71,136 Nm 52,470 ft. lbs.	58,490 Nm 38,830 ft. lbs.	40,010 Nm 29,510 ft. lbs.
D30-32	4.70 cm ³ /stroke	94,890 Nm 69,990 ft. lbs.	85,400 Nm 62,990 ft. lbs.	70,220 Nm 51,790 ft. lbs.	48,040 Nm 35,435 ft. lbs.
D36-32	5.65 cm ³ /stroke	113,820 Nm 83,950 ft. lbs.	94,470 Nm 69,680 ft. lbs.	75,120 Nm 55,410 ft. lbs.	57,620 Nm 42,500 ft. lbs.
D46-32	7.15 cm ³ /stroke	145,450 Nm 107,280 ft. lbs.	120,720 Nm 89,040 ft. lbs.	96,000 Nm 70,805 ft. lbs.	73,650 Nm 54,320 ft. lbs.
D62-22	8.70 cm ³ /stroke	219,150 Nm 161,640 ft. lbs.	181,895 Nm 134,160 ft. lbs.	145,735 Nm 107490 ft. lbs.	107,380 Nm 79,200 ft. lbs.
D80-23	10.50 cm ³ /stroke	267,300 Nm 197,150 ft. lbs.	239,770 Nm 176,840 ft. lbs.	196,730 Nm 145,100 ft. lbs.	171,080 Nm 126,180 ft. lbs.
D100-13	12.50 cm ³ /stroke	334,060 Nm 246,390 ft. lbs.	299,650 Nm 221, 010 ft. lbs.	257,895 Nm 190,210 ft. lbs.	213,790 Nm 157,685 ft. lbs.
D125-32	15.5 cm ³ /stroke	384,860 Nm 283,860 ft. lbs.	338,670 Nm 249,800 ft. lbs.	288,645 Nm 212,895 ft. lbs.	230,910 Nm 170,310 ft. lbs.
D138-32	17.0 cm ³ /stroke	460,900 Nm 340,000 ft. lbs.	410,300 Nm 302,600 ft. lbs.	354,900 Nm 261,800 ft. lbs.	274,800 Nm 217,600 ft. lbs.
D160-32	21.0 cm ³ /stroke	502,100 Nm 370,350 ft. lbs.	441,850 Nm 325,910 ft. lbs.	376,575 Nm 277,760 ft. lbs.	301,260 Nm 222,510 ft. lbs.
D180-32	24.0 cm ³ /stroke	601,300 Nm 443,500 ft. lbs.	535,200 Nm 394,700 ft. lbs.	463,000 Nm 341,500 ft. lbs.	368,300 Nm 271,640 ft. lbs.

Theoretical values based on blows per minute without considering loss of energy by compression and friction.

You must be aware of the following:

- The given values are measured values. Deviations are possible between Diesel Pile Hammers of the same type.
- The given blow energy is obtained only for vertical driving work. For batter piles, the blow energy is reduced as a function of the batter (See Chapter 5.7 "Conversion for batter piles").
- The injection quantity is not exactly proportional to the blow energy, because the fuel is burned at different degrees of efficiency. For example: 50% of the injection quantity does not reduce the blow energy by exactly 50% but for simplification purpose this assumption can be done.

7. Operation

7.2.2 Hydraulic controlled fuel pump

The hydraulic controlled fuel pump on the Diesel Hammer is continuously adjustable from zero to maximum injection volume. The maximum injection volume is the same as the conventional injection pumps.

The system consists of:

- Hydraulic control cylinder inside the fuel injection pump
- Hydraulic hose
- Hydraulic hand pump with reservoir, pressure gauge and quick relief valve

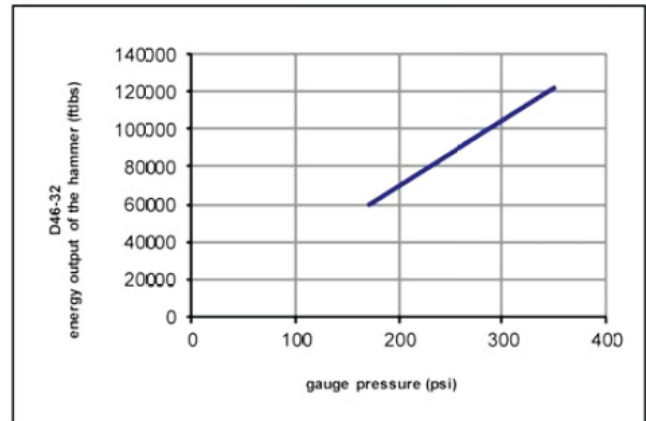
Applying hydraulic pressure to the control cylinder inside the fuel pump adjusts the fuel injection volume to a larger amount. With a hydraulic hand pump pressure of 275 to 375 psi the maximum hammer performance should be reached.

That depends on:

- length and diameter of used hydraulic hose
- pile type, pile driving and soil conditions
- outside temperature and weather conditions

Shutting off the Diesel Pile Hammer can be obtained by:

- pulling the line of the shut off valve at the fuel pump.
- opening (or pushing) the quick relief valve at the hydraulic hand pump.



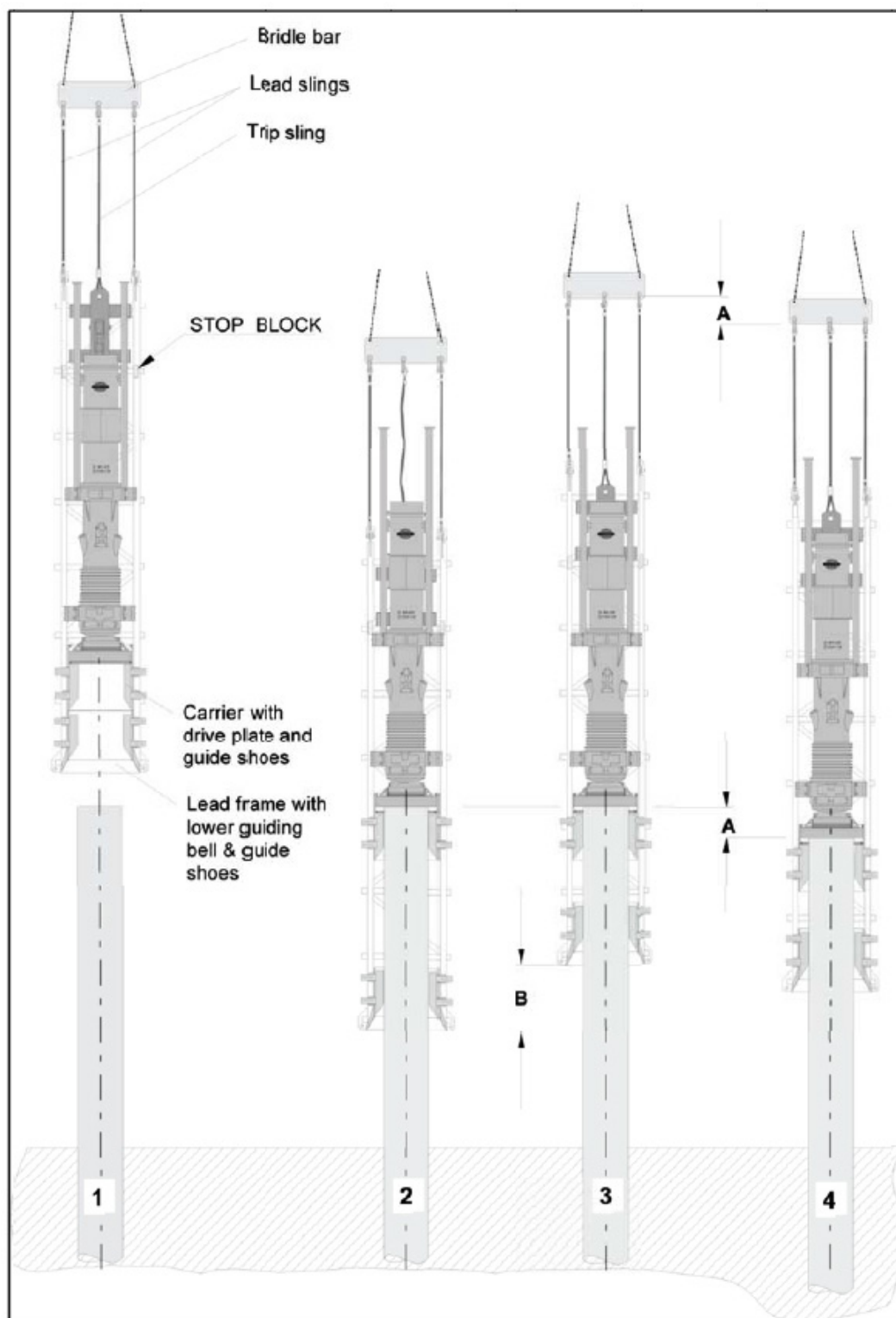
The shown values for a D46-32 are based on a max. blow count of 35 min⁻¹.



7. Operation

7.3 Start of Diesel Pile Hammer

7.3.1 BAUER-Pileco Offshore Lead with bridle bar and trip sling



7. Operation

An economical solution for jobs where fixed or swinging leads cannot be used is the BAUER-Pileco offshore type lead system.

Requirements are:

- pre driven piles or piles guided in a template or jacket.
- The lead size must be chosen to the pile and hammer size, within a range the lead can adapt to the pile size with guide shoes.

Procedure for starting the hammer using bridle bar and trip sling:

1. Lift the lead with hammer over the pile.
2. Lower the lead down until the hammer guides run against the stop block at the lead rails. Lower the lead further down until the trip is slid down to the lower position at the hammer and the trip lever engages.
3. Lift up the lead by distance B. The trip will slide up at the starter guides until it reaches the release point where the piston is released and the Diesel Hammer starts.



The minimum distance never should be less than 1 ft., otherwise there is a risk of damaging the lead. The pile can “run” and the Diesel Pile Hammer impact can be transferred directly to the lower guiding bell, the lead frame and also to the crane boom.

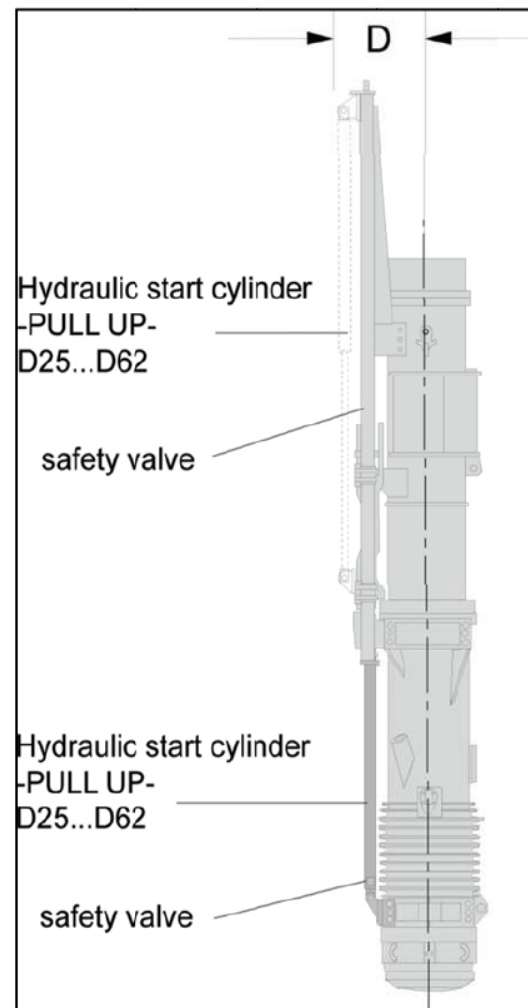
The wire rope length for lead and tripping device are designed in a way that keeping the minimum distance is possible.

4. As soon as the Diesel Pile Hammer is started the lead must be lowered continuously with the progress of the pile penetration (A) to keep at least the minimum required distance (1ft) between carrier and lower guiding bell.

7.3.2 Procedure for starting the hammer using a hydraulic start cylinder

BAUER-Pileco offers the solution for a hydraulic starting device for all Diesel Pile Hammers allowing a better controlling of the start procedure. The hydraulic start is a common attachment for Diesel Hammers to enable an easy start. The advantage of the hydraulic start is especially with heavy Diesel Hammers is preventing the back slash into the crane boom when releasing the piston weight.

The hydraulic cylinder can be mounted to the starter guides or the lower cylinder of the Diesel Hammer. A safety valve ensures that **the tripping device stays in the upper position while running the Diesel Hammer.**



7. Operation

PULL UP-Version

After positioning the lead and the Diesel Hammer on the pile (3) the hydraulic cylinder must be extended completely to lower the tripping device completely down and engage. Retracting the hydraulic cylinder will lift the piston of the Diesel Pile Hammer up to the release point.

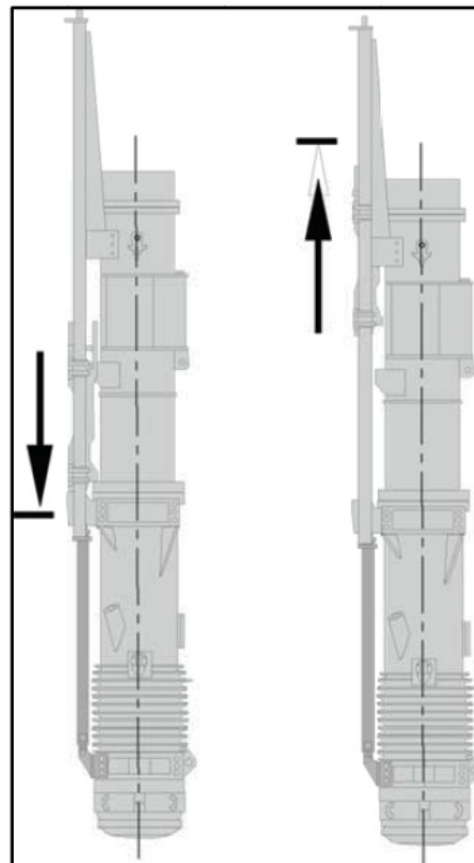
CONTINUE TO RETRACT THE HYDRAULIC CYLINDER TO THE END POSITION.

After starting the Diesel Pile Hammer the tripping device must remain in the upper position. Switch off the power pack to prevent accidentally lowering the tripping device.

A safety valve ensures the position of the tripping device if ever a hydraulic hose should burst.



Lowering the tripping device while running the Diesel Hammer will cause major damage to the Diesel Hammer.



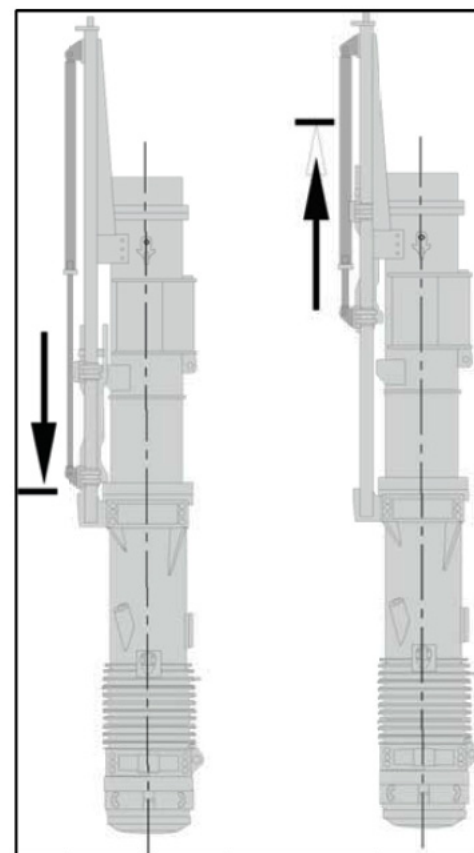
PUSH UP-Version

After positioning the lead and the Diesel Hammer on the pile (3) the hydraulic cylinder must be retracted completely to lower the tripping device completely down and engage. Extending the hydraulic cylinder will lift the piston of the Diesel Pile Hammer up to the release point.

CONTINUE TO EXTEND THE HYDRAULIC CYLINDER TO THE UPPER END POSITION.

After starting the Diesel Pile Hammer the tripping device must remain in the upper position. Switch off the power pack to prevent accidentally lowering the tripping device.

A safety valve ensures the position of the tripping device if ever a hydraulic hose should burst.



8. Shutting down and storage

8.1 Shutting down and leaving in lead



The Diesel Hammer may be left in the lead for a temporary shutoff. Always - let the Diesel Hammer rest on the material to be driven or set to the ground.

Make sure the carrier unit exhibits sufficient stability. Take into account a change in the weather (rain, storm, etc.). Overturning may result.

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

PPE as required performing the job safely. You must wear a life vest when working above a water surface.

Barricade the danger zone of 1.5 times the lead height, when possible. Use warning signs to prevent anyone from entering this zone. Observe local regulations for the barricading of job sites.

8.2 Removal from the lead

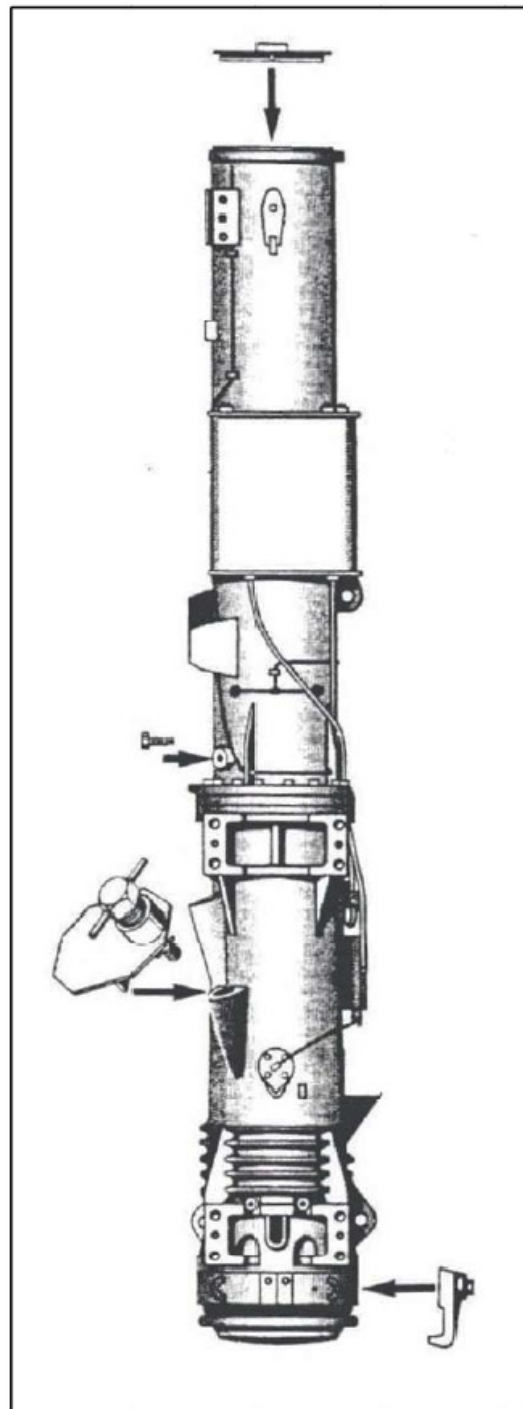
When the Diesel Pile Hammer will not be operated for several days, it will be necessary to remove it from the lead.

Follow the operating instructions of the carrier equipment. Do not touch the Diesel Pile Hammer after operation. Danger of burns. Let hot components cool down for a sufficient period.

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task.

Proceed as indicated below:

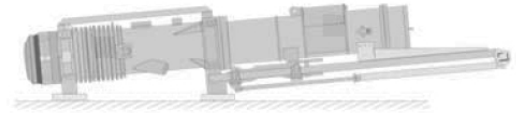
1. Let the Diesel Pile Hammer rest on stable material to be driven or on the ground.
2. Let the Diesel Pile Hammer cool down completely.





8. Shutting down and storage

3. Install the piston locking screws, impact block clamp, protective cap and exhaust covers (See Chapter 4.1 "Transport safety").
4. Remove the ropes from the fuel control pump.
5. Take the hammer out of the lead. Put the hammer aside in reverse procedure like described in chapter 6.5.
6. Set the hammer on stable ground, if necessary use 3" thick wood planks.
7. Remove the wire rope slings from the lifting ears (3).
8. Put the carrier equipment out of operation (See operating instructions for the carrier equipment).
9. Secure the job site in accordance with local regulations for barricaded job sites.





8. Shutting down and storage

8.3 Storage



Let the Diesel Pile Hammer completely cool prior to storage. Burns and fire may result.

You must wear PPE as required performing the job safely. Proper respiratory equipment should be used, when required.

The following points must be observed when storing the Diesel Pile Hammer:

1. Check the Diesel Pile Hammer for damages and wear. Have the necessary repairs carried out immediately. This prevents the work from being forgotten.
2. Check the tanks and lines of the Diesel Pile Hammer for leaks and a solid fit.
3. Drain the tanks (fuel, oil). Fuel and lubricants are extremely flammable and explosive under certain conditions. 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.
4. Clean the filters.
5. Close the drain openings of the fuel pump with a rubber plug.
6. Remove and clean the piston, impact block, upper and lower cylinder section. Check all connection elements for a solid fit.

7. Clean and check the tripping device as well as the guide components of the Diesel Pile Hammer and of the tripping device for damage and wear.

8. Clean and check the pile helmet, attachment cables, pile helmet cushion and accessories (bridle, support devices) for damage and wear. Pile helmet cushions made of wood do not store well and are thus not to be stored for long periods of time.

9. Check the tool box 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 pump for damage and wear (replace, if necessary).

10. Check the condition and completeness of protection devices and personal safety equipment:

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task.

11. Prepare the Diesel Pile Hammer for storage (See “Laying-up”).

12. Protect the Diesel Pile Hammer against the effects of the weather. Cover the Diesel Pile Hammer and all accessories (Do not use plastic foil or other coated materials). If possible, store the Diesel Pile Hammer in an unheated and dry room exhibiting minimal temperature changes. Do not store the Diesel Pile Hammer in direct sunlight.



8. Shutting down and storage

Laying-up – long time storage

The protective effect is very much a function of the thickness and viscosity (ductility) of material used. We recommend the use of Moly Grease 126 EP#2; it is a thick grease that you can apply with a rag or brush.

1. Disassemble the Diesel Pile Hammer. Observe the installation information indicated in Chapter 10 "Servicing and troubleshooting".
2. Remove all dirt and rust from all components. Replace worn or damaged parts.
3. Touch up the paint. Let the fresh paint dry.
4. Run a corrosion protection oil through the fuel and lubricant pump.
5. Lubricate the tripping device and subsequently apply a rust protection oil to it by brush.
6. Apply a rust protection oil by brush to the guide parts of the Diesel Pile Hammer and the tripping device.
7. Spray the tank inside with a rust-inhibiting oil. Then solidly close the tanks.
8. Carefully apply grease such as Moly Grease 126 EP#2 by brush to all unpainted parts (including the holes in the end-ring, upper and lower cylinder).
9. Assemble the Diesel Pile Hammer and all transport safety devices. Follow the assembly information in Chapter 10 "Servicing and Troubleshooting" as well as Chapter 4 "Transport of the Diesel Hammer".
10. Apply a rust-inhibiting oil to all metal tools in the tool box.



9. Maintenance

Maintenance work must be carried out by qualified authorized personnel.



Do not touch the Diesel Pile Hammer after operation. Danger of burns. Let hot components cool down sufficiently.

PPE that is required to perform any and all work shall be provided by your employer to safely perform this task.

Place the Diesel Pile 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. Death or serious injury may result.

Recommended lubricants

Lubricant for:	Specification	Temperature range / comment
Lube tank / pump	CD motor oil SAE 20W-20	-10°C to +15°C
	CD motor oil SAE 40	+25°C to +50°C
	CD motor oil SAE 50	-10°C to +50°C
	Synthetic 2 cycle engine oil BAUER-Pileco	for use with kerosene fuel
Grease nipples	Special lubricant BAUER-Pileco part No. 93551 BelRay Molylube 126 EP#2	all year
Guide parts	Multipurpose grease containing MoS2	all year

Maintenance work	Lubrication intervals					
	Daily prior start up	Daily after shut down	Every 30 minutes	Every hour	Every 2 hours	When required
Lubricate:						
Guide rails on starter guides and leads	●					
Impact block and cylinder end ring (generally 5 strokes ea. grease nipple with the provided grease gun, 10 strokes required ea. for heavy driving work)			●			
Tripping device, see page 10-8 (5 strokes ea. grease nipple with the provided grease gun)	●					
Upper cylinder				●		



9. Maintenance

9.1 Daily maintenance

As with all equipment / machinery the Diesel Pile Hammer does require minor daily inspections to ensure that all bolts and nuts are tightened securely. Since the hammer and its accessories are subject to excessive shock and vibration while in use, it is possible that loosening of certain bolts can occur. Daily inspection procedures are listed below:

- Filling of diesel fuel and oil tanks should be performed after machine is put into upright position. Be sure that only clean filtered diesel (#2) fuel is used and a good quality high detergent motor oil are added to the tanks. If contamination from dirt or water is suspected, flush tanks thoroughly and refill. Filling the tanks will reduce the possibility of condensation in the fuel and lubrication oil.
- Check the bolts securing the guide clamps / side guides of the hammer. (torque values see A4-2)
- Check nuts securing the fuel pump & lube pump at the lower cylinder. (torque values see A4-2)
- Check bolts securing the injection valve at the lower cylinder. (torque values see A4-2)
- Check bolts securing the upper and lower cylinder together. (torque values see A4-2)
- Check hollow bolts on lubrication points of upper and lower cylinder.
- Check guide gib bolts at the tripping device. (torque values see A4-2)
- Lubricate the Diesel Hammer like described in the table.
- Check for wear at guiding parts.
- Check for wear of rubber ring.
- Check all cables (connected to the hammer, the tripping device, the helmet).
- Clean the combustion chamber. (see chapter 6.8.)



9. Maintenance

9.2 Weekly maintenance

Weekly inspection of the Diesel Pile Hammer should include the following but not limited to:

Remove and inspect the rubber ring (2 pieces) by a competent person trained to perform inspections. This ring prevents the impact block from striking the outer end-ring / lower cylinder of the hammer while running. This ring also is instrumental in regulating the amount of air volume the machine scavenges, therefore affecting the compression. If damaged, please advise BAUER-Pileco, Inc.

Check the bolts securing the outer end-ring to the lower cylinder. The tightness of these bolts should always be uniform. Running the Diesel Pile Hammer with loose or stretched bolts will result in damage to the other bolts, the end-ring and the lower cylinder.

Catch groove and catch piston ring. When the pile meets strong resistance, piston travel can increase so much that the catch ring may hit the catch groove in the upper cylinder. If this occurs, immediately reduce fuel injection by lowering the fuel pump setting. Thus shutting off the hammer. Catch groove and catch piston ring must always be in perfect condition, otherwise there is a risk of accident. The catch groove edge can be remachined by taking off the upper end-ring.

Testing the compression



Only test the compression if the hammer rests on a driven pile, otherwise there is a danger of accident.

Fuel pump is set on "off" (dowel pin at 4 o'clock position).



Raise the piston and trip up to the release point and release the piston. There is sufficient compression if the piston after hitting the impact block is thrown upwards through the compression and falls back onto the impact block after three (3) additional up and down movements on the air cushion. If there is less compression the piston rings need to be checked.

If a Diesel Pile Hammer is continuously used with worn out piston rings the piston face will be damaged and there is a high risk of piston cracks, because the piston will hit the impact block harder with higher velocity than designed to do so.



9. Maintenance

9.3 Monthly maintenance

- Empty fuel and lube oil tanks.
- Remove fuel and lube oil lines.
- Remove and clean filter nozzles.



10. Servicing and Troubleshooting

10.1 General



Maintenance and repair work must be carried out by qualified, authorized and trained personnel.



Place the Diesel Pile Hammer out of operation prior to carrying out any maintenance and repair work. Make sure the Lockout Tagout is in place to prevent unit from being put into operation by

other persons during maintenance and repair work. Death or serious injury may result. Do not touch the Diesel Pile Hammer after operation. Danger of burns. Let hot components cool down sufficiently.

PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task.

10.2. Troubleshooting

Problem	Possible cause	Symptoms	Fault / Remedy
Diesel Pile Hammer does not start	Compression too low	Impact block drops quickly when lifting the Diesel Pile Hammer	Defective or stuck piston rings Insufficient lubrication at impact head or piston (maintain lubrication intervals as indicated in chapter 9)
		Strong blowing effect at impact block	
		After dropping and without a fuel supply, piston does bounce only one or two times and then sink slowly	
		Wear grooves in lower cylinder below the exhaust openings	Replace defective or worn parts or have repairs made by a BAUER-Pileco authorized repair shop
		Damaged cylinder sleeves	
		Lower cylinder is out of round	
	Low soil resistance	Soft soil, light or pointed or narrow material to be driven, Pile runs	Drop piston several times (cold blows) until there is a sufficient penetration resistance
	Oil grease or water in combustion chamber	Dull sound, when piston impacts the impact block	Clean combustion chamber, and flush fuel tank
		Black smoke (oil or grease in the combustion chamber)	
		White smoke (water in the fuel)	



10. Servicing and Troubleshooting

Problem	Possible cause	Symptoms	Fault / Remedy
Diesel Pile Hammer does not start	Fuel problems	Dull sound, when piston hits the impact block	Leaking relief valve (replace relief valve, clean combustion chamber)
		Black smoke (→ too much fuel)	- Air in fuel pump - Selected setting of fuel control pump is too high - Fuel pump is not working properly - Pump element installed in reverse position, supply opening must be at the top position
		No smoke or little gray smoke (→ too little fuel)	- Sticking pump element, pump lever or guide sleeve or setting - - value of the pump lever has been changed - Defective pump element in fuel pump - Clogged ventilation in diesel tank plug screw - Defective check valve, suction valve, injection valves or shut off valve (replace) - Damaged or clogged fuel lines (replace or clean) - Dirty fuel tank (clean) - Dirty fuel filter
		White or black smoke (→ water or dirt in fuel)	Water in fuel (clean fuel tank, fuel filter and fuel lines, clean combustion chamber)
	Lack of lubrication	Impact block gets stuck in cylinder or end-ring	Too little or incorrect lubricant type
Diesel Pile Hammer does not reach required stroke at batter position	Mechanical	Damage to impact areas of piston or impact block	Machine impact areas
		Stuck or broken piston rings	Replace defective or worn piston rings
	Lack of lubrication	Piston stroke is lower compared to vertical pile driving	- Lube pump faulty - Grease upper cylinder - Turn the hammer so that the fuel pump is located at the batter down side to compensate piston wear and reaching full stroke of the fuel pump



10. Servicing and Troubleshooting

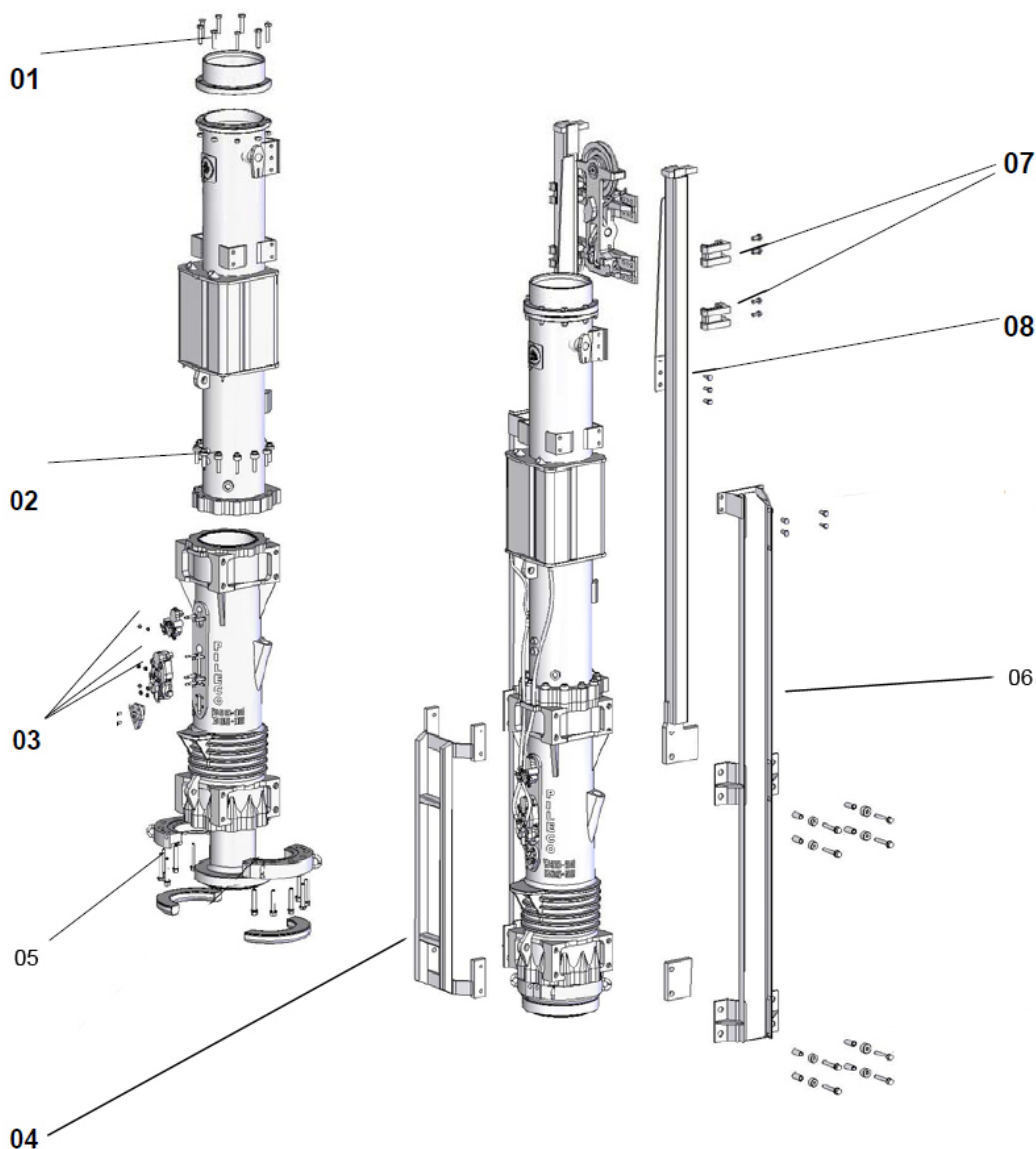
Problem	Possible cause	Symptoms	Fault / Remedy
Diesel Pile Hammer runs irregularly	Mechanical damage	Damaged or deformed upper cylinder / upper cylinder extension	Replace defective parts or have a BAUER-Pileco authorized repair shop carry out the necessary repair
		Worn cylinder (out of round) or piston is not round	
	Changing soil conditions	Material to be driven penetrates at different rates	Make adjustments during the pile driving by regulating the fuel control pump
	Diesel Hammer becomes too hot (above 600°F / 300°C)	Pre-ignition, lower stroke	Check the blow rate (If the blow rate is higher than 150 blows per foot penetration a larger pile hammer must be considered) Choose the right hammer size Check compression Check injection valve and fuel pump (leaking elements or valves can cause insufficient fuel burn)
Diesel Pile Hammer stops running after a short time	Fuel problems	Clogged fuel filter	
	Diesel Hammer becomes too hot - Insufficient combustion	Damaged piston rings Damaged injection valve Pump element jams	
Tripping device does not lift the piston	Piston is not latched	Broken dowel pins at trip cam lever	Replace defective or worn parts
		Bent trip cam lever	
		Damaged bearings of trip cam axis	
	Piston is not lifted	Rounded edges at piston lifting groove or pawl	
		Bent or broken leaf spring at tripping device	
		Loose leaf spring bolts	Tighten bolts
		Worn guide strips or guide sleeves	Immediately replace worn guide parts
Tripping device does not lift the Diesel Pile Hammer	Cam of the tripping device does not grasp below the lifting dogs at the Diesel Pile Hammer	Lack of lubrication at the latch of the tripping device	Lubricate (lubrication intervals maintenance chapter 9)
		Broken torsion spring on the driving pin of the tripping device	Replace broken or worn out part

10. Servicing and Troubleshooting

10.3 Screwed / bolted connections

The fasteners used for the Diesel Hammer are **metric-dimensioned**, but some guiding parts are mounted with **inch-dimensioned** fasteners.

The required bolt torque for special bolts (marked with *) is shown at the table at page 10-5. All standard bolts should be torqued by the value shown in table A4-1 and A4-2 depending on the bolt grade and lubrication condition.



Tighten all screwed or bolted connections prior to the pile-driving work at the:

- | | |
|--|---------------------------------|
| (01) Upper end-ring (cylinder extension) | (05) Outer cylinder end-ring |
| (02) Upper cylinder | (06) Hammer guides |
| (03) Lubrication pump & fuel pump | (07) Guide gibs |
| (04) Pump protection | (08) Starter guides – key-plate |



10. Servicing and Troubleshooting

			Grade	D8	D12	D19	D25 / D30	D36 / D46	D62	D80 / D100	D125	D160
01	hex cap screw		8.8	-	M16	M24	M24	M24	M24	M24	M24	M30
	socket head screw & nut		12.9	-	M16	M24	M24	M24	M24	M24	M24	M30
02	special hex cap screw	*	12.9	M24	M24	M24	M24	M24	M36	M36	M36	M36
03	stud bolt with lock nut	*	8.8	M16								
04	lock screw	*										
05	special hex cap screw	*	12.9	M24	M24	M24	M24	M24	M36	M36	M36	M36
06	special hex cap screw	*	12.9	-	-	-	-	-	-	M36	M36	M36
07	hex cap screw		5 or 8.8	7/8"-9	-	-	-	7/8"-9	7/8"-9	-	-	M30
	socket head screw		8	-	1"-8	1"-8	1"-8	-	-	1"-8	1"-8	-
08	hex cap screw		8.8	M24	M24	M24	M24	M24	M24	M30	M30	M30
09	hex cap screw		8.8	M24	M24	M24	M24	M24	-	-	-	-
	socket head screw		12.9	-	-	-	-	-	-	-	-	M30
10	hex cap screw		8.8	-	-	-	-	-	M30	-	-	-
	hex cap screw		10.9	M24	M24	M24	M24	M24	-	-	-	-
	special hex cap screw	*	12.9	M24	M24	M24	M24	M24	-	M36	M36	M36

* special bolts with larger head diameter



All replaced bolts or nuts should meet the specified torque chart.

The Diesel Pile Hammer cannot be operated safely with loose or stretched bolts.

Size	Grade	Part number	Torque for bolts lubricated with Mos ₂ ($\mu = 0.1$)		Torque for bolts not lubricated ($\mu = 0.14$)	
			Nm	ft.lbs.	Nm	ft.lbs.
M16	8.8	20189	170	130	220	160
	12.9	91939	300	220	370	270
M24	8.8	20174-CS	580	430	730	540
	12.9	20174	1000	740	1250	920
M30	8.8	91939	1160	850	1450	1070
	12.9	-	1990	1470	2480	1830
M36	12.9	103497	3470	2560	4350	3210
7/8"-9	5	-	420	310	520	380
1"-8	8	-	625	460	780	575

(see A4.1 to A4.2 for complete bolt torque information)

10. Servicing and Troubleshooting

10.4 Guides

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

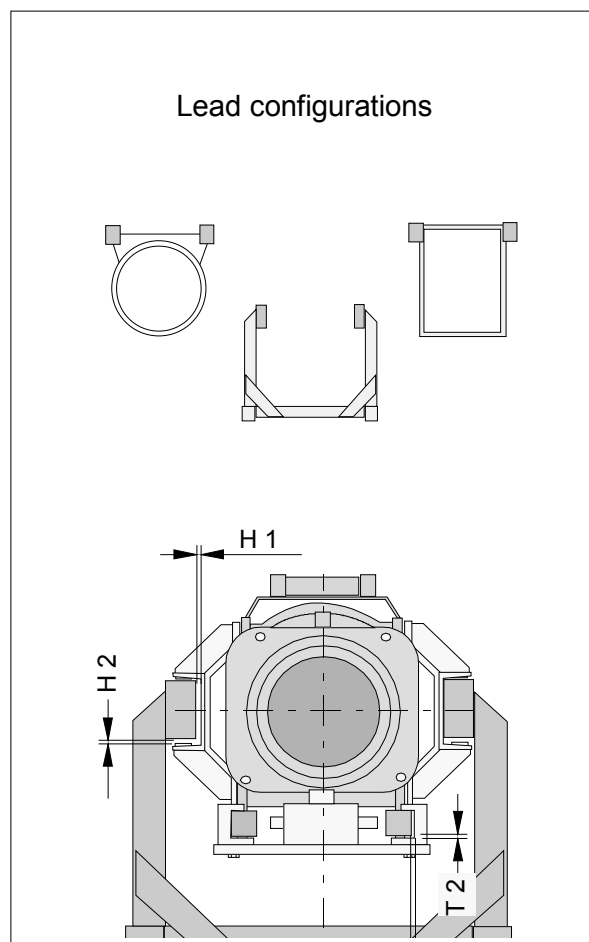
- guides of the Diesel Hammer
- guide gibs of the tripping device
- guides of the pile helmet
- wear strips along the whole lead length.

Lubricating the guide rails of the lead and the starter guides with a MoS_2 -containing multipurpose grease extends the lifetime of your equipment.



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 Pile Hammer, the helmet or the tripping device may fall out of the leads. Danger of accident.

Not only from a safety standpoint is it important to have a well guided hammer and pile helmet: The driving efficiency also depends on how the Diesel Hammer is in line with the pile. BAUER-Pileco Diesel Hammers have the longest possible channel-guiding. This accomplishes a good hammer guiding with a relatively large guiding clearance (which is sometimes necessary if slightly bent or worn out leads are used). Short distance hammer guiding needs a tighter fit to the lead (less guiding clearance).



Total guiding clearance		
Hammer channel guiding	H1	1/2"
	H2	1/4"
Hammer short guiding	H1	1/4"
	H2	1/4"
Starter guides	T1	1/4"
	T2	1/4"

10. Servicing and Troubleshooting

10.5 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 trip cam and the lifting mechanism of the tripping device
- the guiding clearance in the guides of the tripping device

Lubricate the tripping device weekly with Moly lube 126 EP#2 (5 strokes with a grease gun per grease fittings).

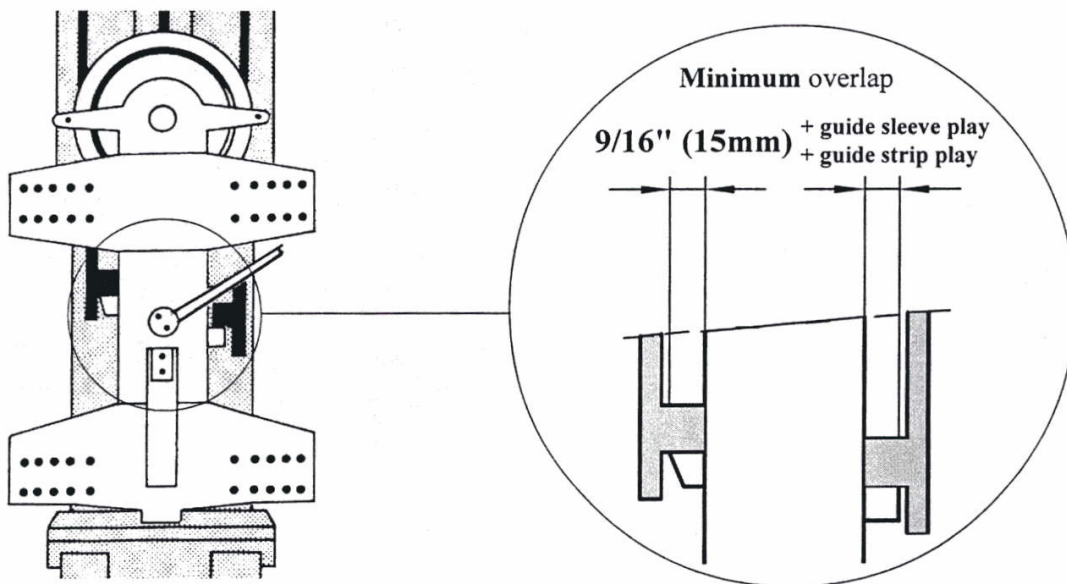
Use only Pileco supplied replacement parts. We cannot guarantee a proper functioning tripping device when other replacement parts are used.

Along the whole lead length, the overlap of the latches between the Diesel Pile Hammer and the tripping device must be at least 9/16" (15 mm) greater than the play of the guide strips.

The play of the guide strips must be less than 1/4" or 9/32" (6 mm or 7 mm). If this is not the case, the guide strips must be replaced immediately.



Do not operate the Diesel Pile Hammer, when the tripping device does not function properly or the overlapping distance between the Diesel Pile Hammer and the tripping device is too small. Accidents may result.

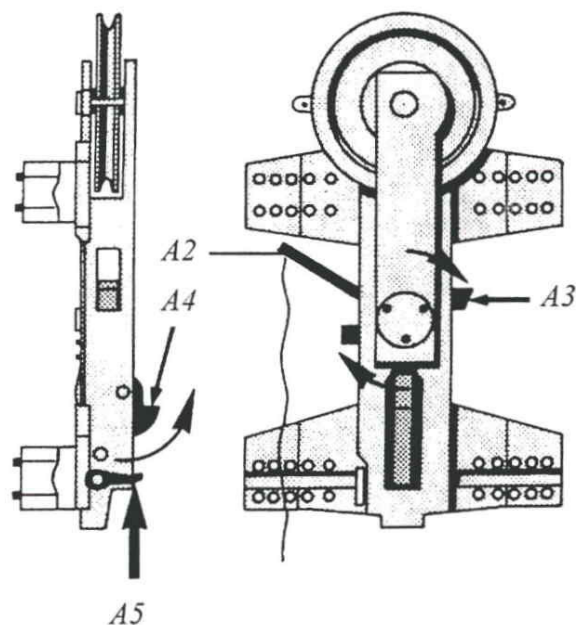
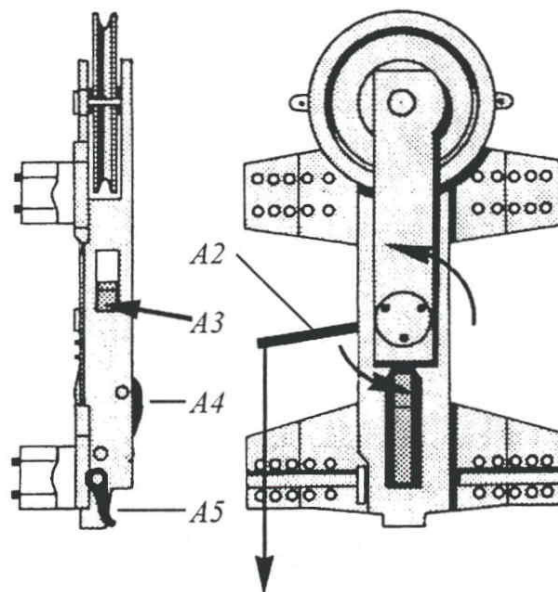


10. Servicing and Troubleshooting

Testing the proper operation

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

1. Lower the tripping device.
2. Make sure the trip cam lever (A5) is pushed up when the tripping device impacts the lower cylinder. At the same time, pawl (A4) must swing out fully and must lock.
3. Check the tension and the screw connection of the plate spring.
4. Pull down on the rope at lever (A2). The driving pin (A3) must fully reach its vertical position.
5. Release the rope at lever (A2). The driving pin (A3) must return to fully horizontal position.
6. Check the proper functioning of the wire rope sheave (if used).
7. Check the tripping device for wear. Particularly the pawl (A4) with lugs and joint bolts as well as the driving pin (A3) and the pawl (A4) should not be rounded or exhibit visible wear.





10. Servicing and Troubleshooting

10.6 Pumps



Problems with the fuel or lubricant system must be remedied immediately. Such problems pose an increased fire risk and may cause the destruction of the Diesel Pile Hammer. A proper fire extinguisher should be available in close proximity.

Use only Pileco supplied replacement parts. We cannot guarantee proper functioning of the pumps when other spare parts are used.

Disassembly and cleaning of pumps

The fuel control pump and lubrication pump shall be disassembled and cleaned when necessary (See spare parts list). 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:

1. Carefully remove any grease from the sealing surfaces as well as from the support surface between the fuel pump and the lower cylinder section. Use a suitable grease remover. Let the grease remover evaporate fully.
2. Use a high performance sealant (Hylomar) or similar (provided in the tool box) for sealing the pumps to the lower cylinder.
3. Install the pump.
4. Check for leaks.

Depending on the sealant the sealing surfaces can be separated several times without applying new sealing mass. No foreign material should be left on the sealing surface.

Lubricant pump

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

- Is the lubricant tank empty?
- Are the lubricant lines clogged or defective?
- Is the pump lever worn?
- Is the lubricant pump contaminated or defective?

Operate the Diesel Pile Hammer only after the problems have been remedied.

Use a motor oil for the appropriate motor temperature range.

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 Pile Hammer. Accordingly, there is the risk of the piston jumping into the catch groove. When the control dimension is too small (e.g. due to wear at the pump lever or guide sleeve), the fuel supply will be too low. The Diesel Pile 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.

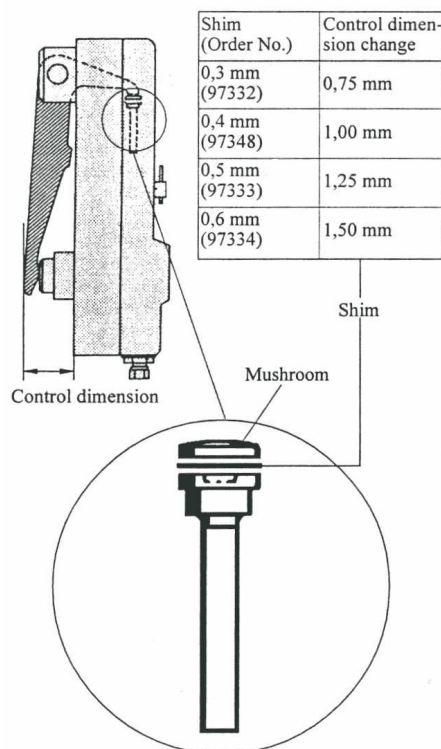
1. Set the fuel control pump to setting "4" (full load). To do so, pull on the right control ropes often as required.
2. Measure the control dimension (see pict.).
3. Compare the measured control dimension with the nominal dimension (see table below).
4. The control dimension must be reset, when the 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.
5. Check the injection valve. The pistons in the injection valves must move smoothly and close well. Replace the injection valves when this is not the case.

10. Servicing and Troubleshooting



Never grind the pressure piece or mushroom.

The supplied fuel quantity can be measured directly with the test unit for fuel pumps. (see A1-1)



Type	Control dimension (mm)	Stroke of pump lever (mm)	Supply quantity at full stroke (cm ³ /stroke)	Fuel control pump order number	Injection valve		Pump element	
					Quant.	Order No.	Diameter (mm)	Order No.
D8-22	53.5 ^{+0.3}	11.5	1.75	41865	1	104675	14	22903
D12-42	54.0 ^{+0.3}	12.0	2.10	122469			15	122470
D19-42	54.0 ^{+0.3}	12.0	3.10	170244			19	44027
D25-32	54.5 ^{+0.3}	12.5	3.90	108780			20	66522
D30-32		12.5	4.70	105172			22	66528
D36-32	54.5 ^{+0.3}	12.5	5.65	105731	2	63841	24	64804
D46-32	54.5 ^{+0.3}	12.5	7.15	105202			27	64813
D62-22	53.5 ^{+0.3}	11.5	8.70	100259	2	104675	31	67218
D80-23	55.0 ^{+0.3}	13.0	10.50	66948	4		32	67207
D100-13		13.0	12.50	103964	4		35	14655
D125-32	55.5 ^{+0.3}	13.0	15.5	DH125.04.01	4		39	125.04.01.03
D138-32	55.0 ^{+0.3}	13.0	17.0	DH135.04.01	4	DH160.04.07	41	135.04.01.03
D160-32	55.0 ^{+0.3}	13.0	21.0	DH160.04.01	4	DH160.04.07	45	160.04.01.03
D180-32	55.0 ^{+0.3}	13.0	24.0	DH180.04.01	4	DH160.04.07	48	180.04.01.03

10. Servicing and Troubleshooting

10.7 Filter

Follow the safety instructions indicated at the beginning of this Manual (chapter 2 “Safety Information” page 5).

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

1. Drain the fuel tank.
2. Pull the fuel line from the filter nozzle.
3. Unscrew the filter nozzle.
4. Clean the filter insert.
5. Screw the filter nozzle back in.
6. Push the fuel line on the filter nozzle and mount the hose clamp.
7. Fill the fuel tank.
8. Check the filter nozzle for leaks.
9. Clean the filter of the lubricant tank in the same manner.

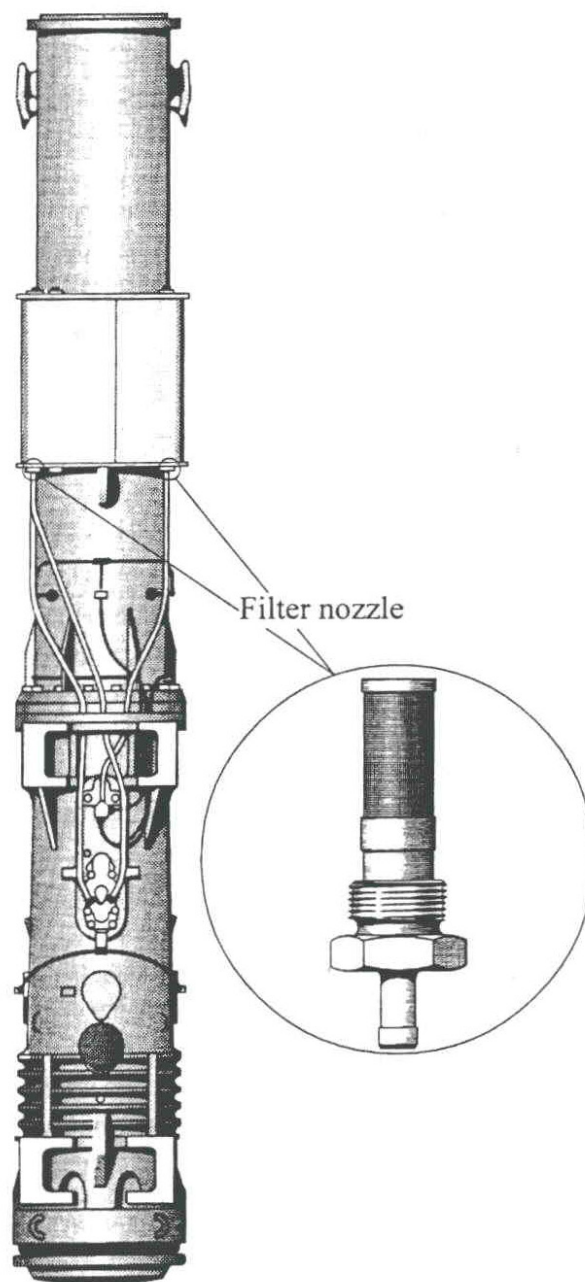
10.8 Grease Fittings



Be careful when working on a hot Diesel Pile Hammer. Do not touch hot components as burns may result.

The grease fittings and lubrication openings must be free of dirt and carbonization and must allow a free flow for the lubricant. Clogged grease nipples must be replaced.

Pump fresh grease again in the grease fittings of the impact block, cylinder end-ring and upper cylinder section after shutting off the Diesel Pile Hammer. This prevents a carbonization of the grease located in the hot grease fittings.

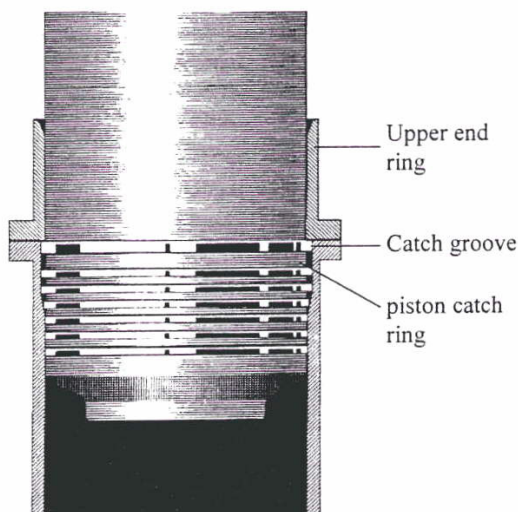


10. Servicing and Troubleshooting

10.9 Catch groove and piston catch 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 Pile Hammer must be discontinued immediately, when the catch piston ring has bounced into the catch groove of the upper cylinder section. Check the catch groove and the piston catch ring. Both must always be in perfect condition. Machine a damaged catch groove. Replace damaged catch piston rings.



10.10 Rubber rings

Rubber rings are components subject to wear. The service life of damping rings (operating hours to wear) can vary tremendously. The service life of the damping rings is a function of:

- the type of pile-driving work,
- the number of strokes per minute,
- the quality of the maintenance work,
- outside effects (weather, dirt...).

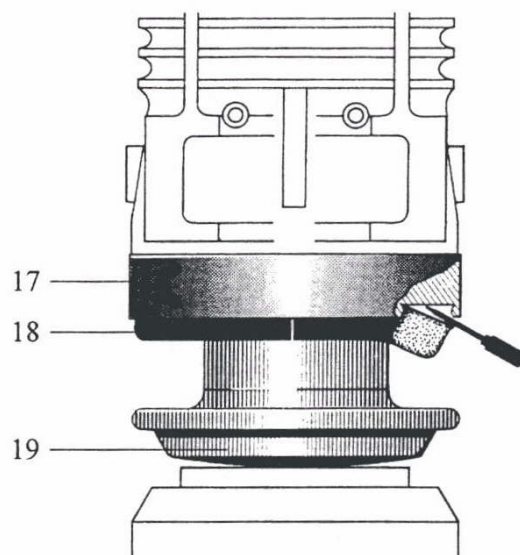
Worn or damaged damping rings shall be replaced as described below:



Follow the safety instructions indicated in chapter "10.1 General" Page 60.

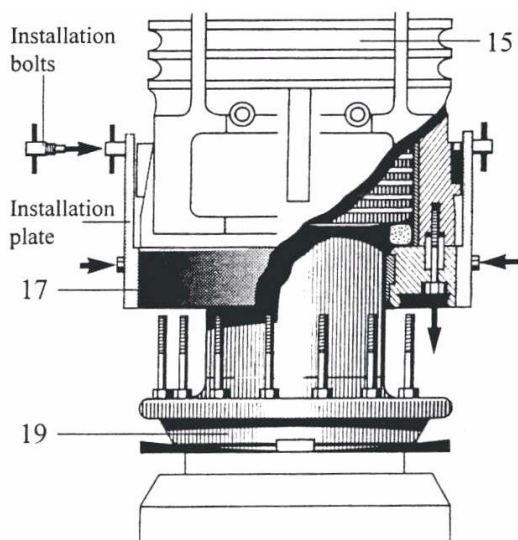
1. Let the Diesel Pile Hammer rest on the impact block (19).
2. Remove the impact block safety device, if present.
3. Lift the Diesel Pile Hammer until the impact block (19) is fully extended.

Secure the Diesel Pile Hammer from any movement:

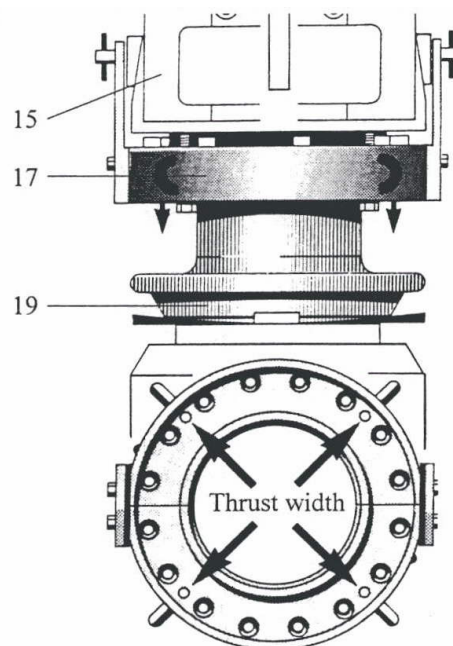


10. Servicing and Troubleshooting

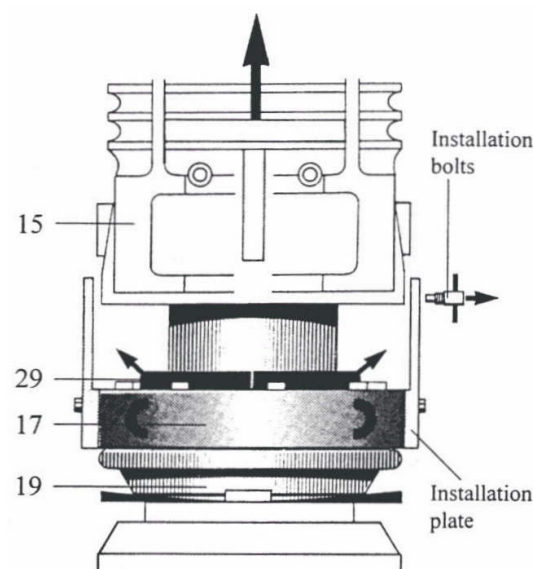
4. Using a screw driver, push the two-piece outer damping ring (18) out of the groove. Keep the loose metal guard for the later installation. Work steps 5 through 19 can be ignored, when it is necessary to replace only the two-piece rubber ring (19).
5. Secure the impact block (19) with wedges to prevent tilting toward the pile helmet.
6. Attach the supplied installation plates to the two-piece cylinder end-ring (17).
7. Screw the installation bolts in the lower cylinder section (15).
8. Unscrew all expansion screws of the cylinder end-ring (17). Keep the expansion screws in a safe place.



9. Remove the cylinder end-ring (17). To do so, screw four expansion screws in the respective threads (See illustration). The width is restricted by the installation bolts.
10. Let the Diesel Pile Hammer rest on the impact block flange.
11. Unscrew the installation bolts from the lower cylinder section (15).
12. Pull the Diesel Pile Hammer upward until the inner damping ring (29) is easy to replace.
Secure the Diesel Pile Hammer from any movement.



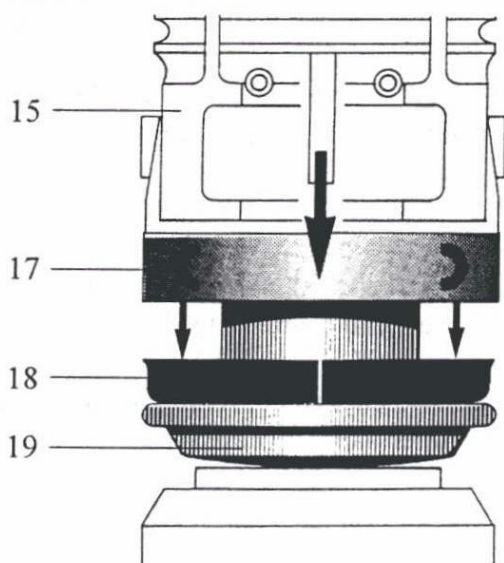
13. Replace the inner damping ring (29).
14. Let the Diesel Pile Hammer rest on the impact Block Flange (15).
15. Screw the installation bolts in the lower cylinder section (15).
16. Lift the Diesel Pile Hammer until the impact block (19) is fully extended.



10. Servicing and Troubleshooting

The piston rings remain in the cylinder. **Secure the Diesel Pile Hammer from any movement.**

17. Remove the four thrust screws.
18. Screw all expansion screws back in the cylinder end-ring (17). Follow the torque data.
19. Remove the installation plates.
20. Place a new two-piece rubber ring (18) on the impact block flange.
21. Place the metal guards indicated in work step 4 on the two-piece rubber ring (18).



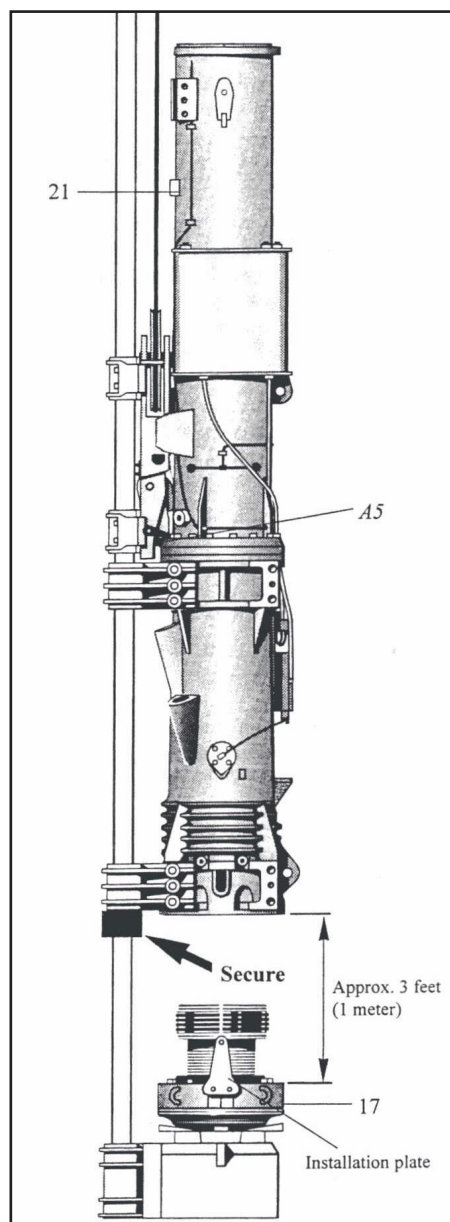
22. Lower the Diesel Pile Hammer. The weight of the Diesel Pile Hammer presses the two-piece rubber ring (18) into the groove.

10.11 Piston and impact block rings



Worn or damaged piston or impact block rings must be replaced as indicated below.

Follow the safety instructions indicated in chapter "10.1 General" Page 60.



10. Servicing and Troubleshooting

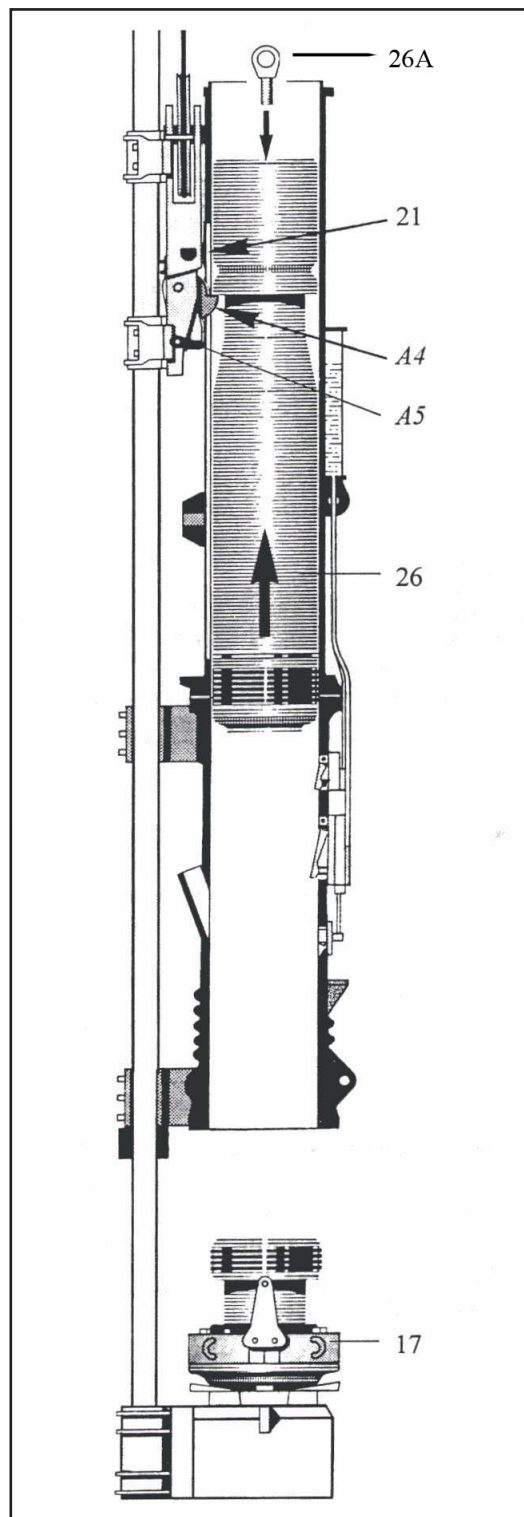
With the Diesel Hammers of the types D12 through D100, it will be possible to pull the piston upward and out after disassembling the upper end-ring. Work steps 18. and 23. Change accordingly.

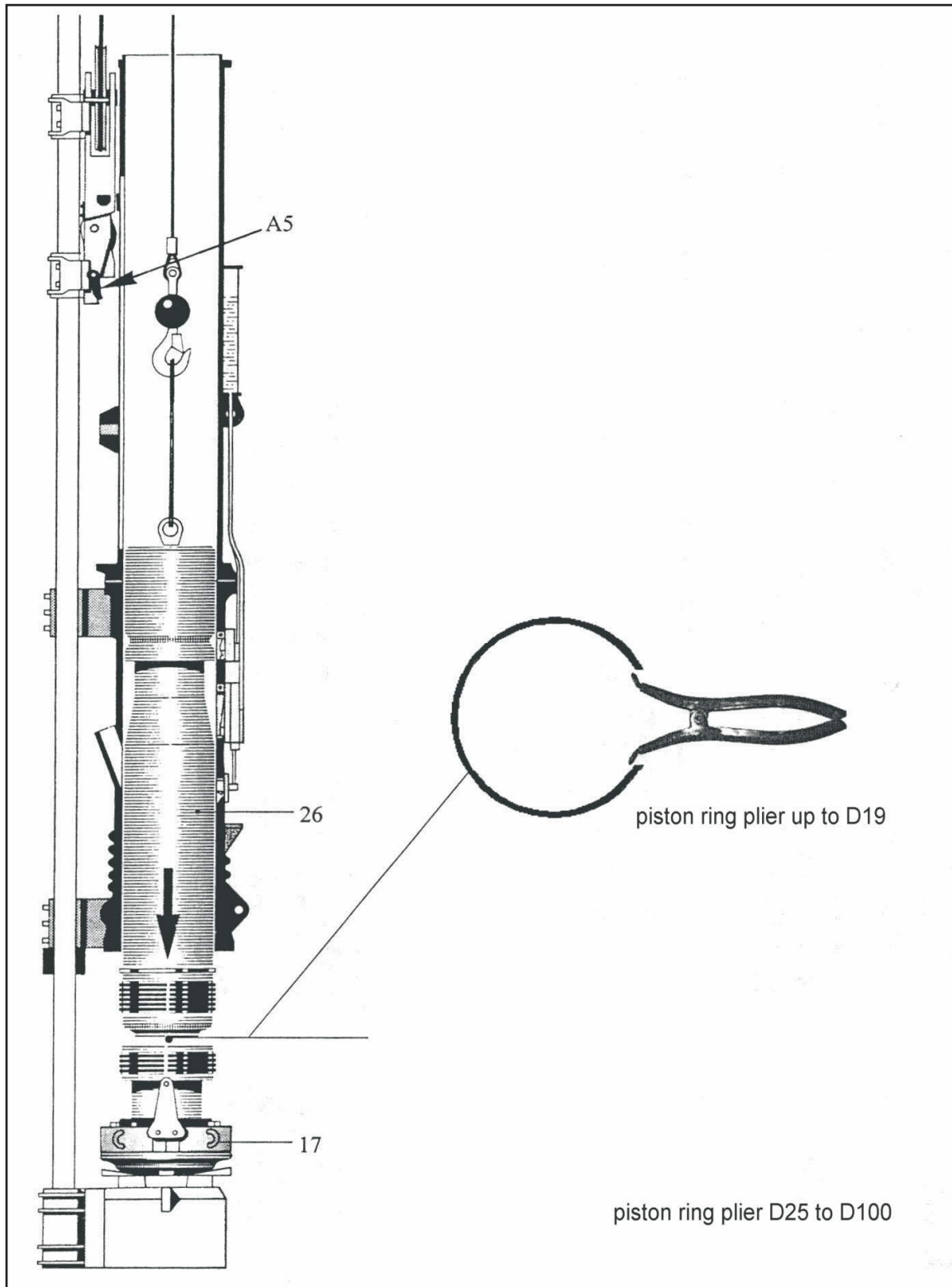
1. Proceed with **steps 1 through 11**, as described above.
12. Lift the Diesel Pile Hammer approximately 3 feet (1 meter). The cylinder end-ring (17) is kept together with the installation plates and remains on the impact head flange. **Secure the Diesel Pile Hammer from any movement.**
13. Pull the piston (26) upward with the help of the tripping device and stop just prior to reaching the upper stop (21).



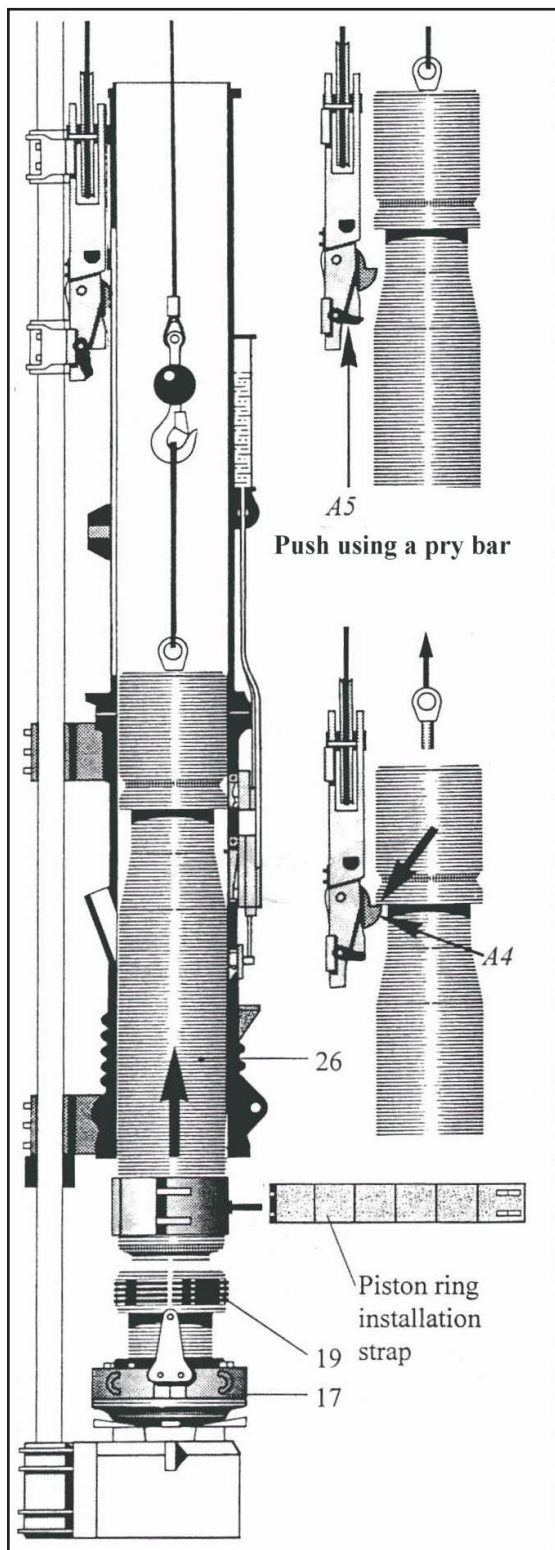
The catch lever (A5) must not touch the upper stop (21). This may cause a release of the piston (26) and it may cause a movement of the piston. Danger of an accident.

14. Screw the supplied ring screw into the piston (26 A).
15. Attach a suitable wire rope to the ring screw and the lifting equipment.
16. Lift the piston approximately 2 inches (5 cm).
17. Push the catch lever (A5) down using a pry bar.
18. Lower the piston until all piston rings are easily accessible.

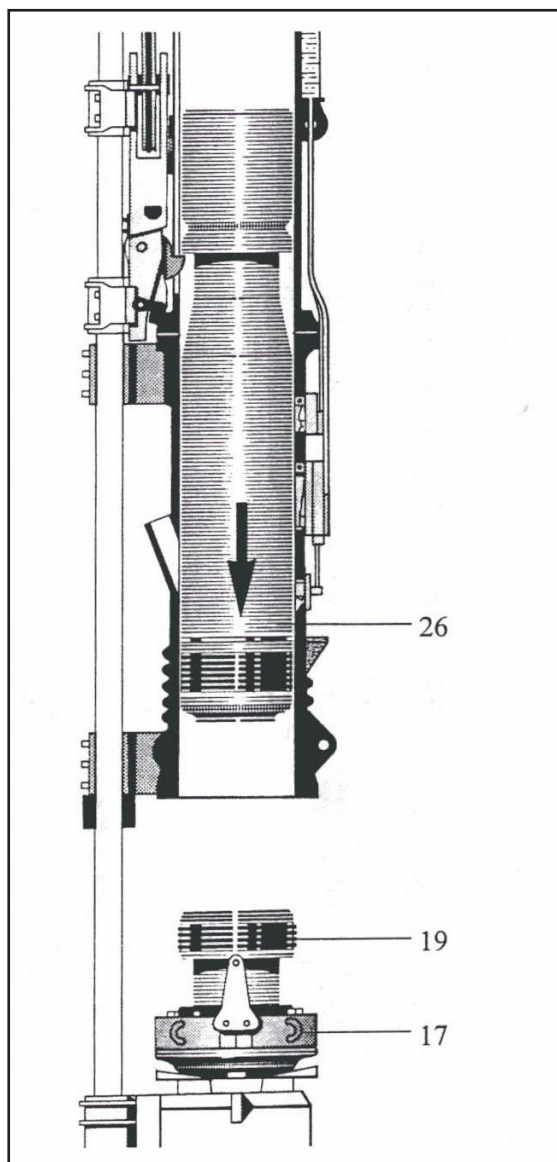




10. Servicing and Troubleshooting



19. Remove the piston and impact block rings using special piston ring installation pliers (included with the tool chest).
20. Carefully clean the piston and impact block ring grooves and apply the special grease.
21. Install the new piston and impact block rings using the special piston ring installation pliers (included in the tool box).



10. Servicing and Troubleshooting

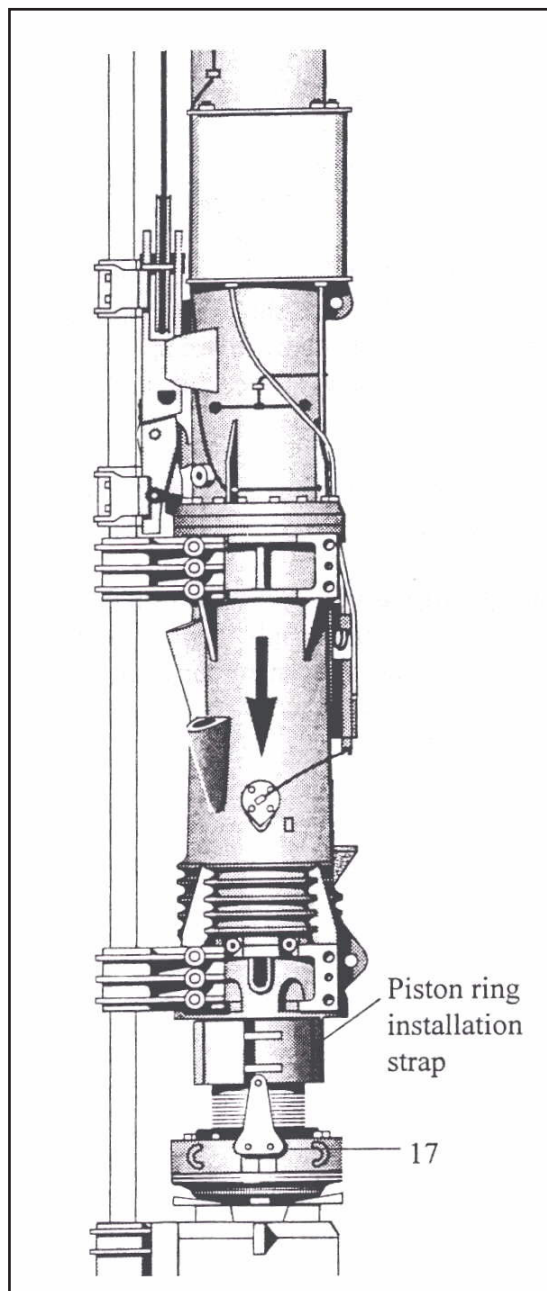
22. Place the supplied piston ring installation band around the piston rings.
23. Carefully pull the piston upward until you are able to push the pawl (A4) into the groove of the piston (26) by pressing the catch lever (A5) upward by hand.

Make sure the piston ring installation strap does not get stuck, when the piston (26) is lifted into the cylinder.

24. Let the piston (26) rest on the pawl (A4).
25. Remove the wire rope and ring screw from the piston (26).
26. Lower the piston (26) to the lower stop using the tripping device.
27. Place the piston ring installation strap around the impact block (19).
28. Slightly raise the Diesel Pile Hammer to unlatch the tripping device. Then lower the Diesel Pile Hammer. Guide the impact block (19) during said phase. Make sure the piston installation strap is not compressed on the cylinder end ring (17) (Stop the downward movement at the appropriate time).
29. Remove the piston ring installation band.
30. Install the inner dampening ring and rubber ring.



The Diesel Pile Hammers of the types D12 through D100 may be operated only with the upper end-ring or the extension of the upper cylinder section in place. Following these instructions will prevent accidents.





10. Servicing and Troubleshooting

10.12 Compression

Starting difficulties may be caused 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 heights. The Diesel Pile Hammer will stop in the extreme case.

The compression can be checked as described below:



PPE (Personal Protective Equipment) that is required to perform any and all work shall be provided by your employer to safely perform this task.

1. Place the Diesel Pile Hammer on a hard pile or a test stand.
2. Set the fuel control pump to setting "0". To do so, pull the left control rope as often as required.
3. Pull the piston upward until it trips.
4. Watch the piston. Compression is sufficient when the piston bounces after impacting the impact block and comes to rest after at least another three upward and downward movements.

Causes for 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 openings
- damaged inner (bearing) ring
- damaged cylinder bushings
- inside diameter of the lower cylinder is out of round or has grooves (worn out)
- 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.



If defective parts are not replaced and the Diesel Hammer runs continuously on low compression major damage on the piston can occur:

- the piston profile of the combustion area can deform
- the piston can break in the ring groove area caused by too high impact speed

Piston or impact block failure will be examined in every case by Pileco Inc. to determine a warranty claim.

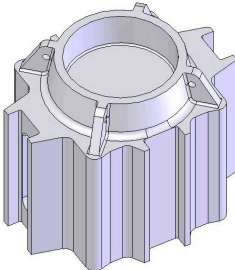
The following steps are helpful in case of a "running" pile (in soft soil):

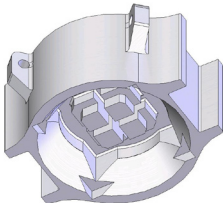
Starting difficulties: Let the piston drop several times with the fuel supply shutoff (Setting "0") (cold blows) until the penetration resistance is sufficient for the starting.

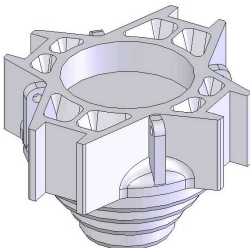


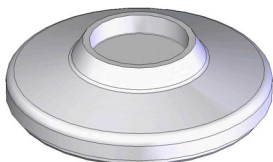
A1 Accessories

A1.1 Pileco helmets and drive cap systems

	Square Helmets for concrete piles				
		max. sq. pile size	cushion	U-lead size	weight lbs.
	500024-A	24"	Ø 23"	32.5" x 8"	5,620
	500024-B	24"	Ø 23"	32.5" x 8" 42.5" x 8"	7,056
	500030	30"	Ø 23"	42.5" x 11"	12,000
	500030-A	30"	Ø 23"	42.5" x 8" 42.5" x 11"	12,000
500036	36"	Ø 23"	42.5" x 8" 42.5" x 11"	14,000	

	Universal helmet for H-piles & pipe piles				
			cushion	cushion U-lead size weight lbs.	cushion U-lead size weight lbs.
	500000	Steel beams: 8", 10", 12" Steel pipe Ø: 10", 12", 14"	Ø 17"	21" x 8"	970

	Offshore Male type helmet					
		Pipe pile size		cushion	Pipe pile size cushion U-lead size weight lbs.	Pipe pile size cushion U-lead size weight lbs.
	410455	16" x 1" 20" x 1"	24" x 1-1/2" 30" x 1-1/2" 36" x 1-1/2"	Ø 23"	36.5" x 8" 42.5" x 8"	6,300
	410452	24" x 1" 30" x 1" 36" x 2"	42" x 2" 48" x 2"	Ø 27"	48.5" x 8" 54.5" x 8"	14,400
	410453	42" x 1-1/2" 48" x 1-1/2" 54" x 1-1/2"	60" x 1-1/2" 66" x 1-1/2"	Ø 37"	66.5" x 8" 68.5" x 12"	26,600

	Large diameter drive plates				
		up to 66"	Ø 27"	special lead frame	
	410454	up to 98-1/2" diameter guide shoes for: Ø 66", 72", 84", 96"	Ø 37"	special lead frame	38,400
	410456	up to 120" diameter male type drive plate, guide shoes for: Ø 72", 84", 96", 108"	Ø 37"	special lead frame	approx. 70,000



A1 Accessories

The Pileco primary helmet drive cap systems for U-type leads allows a quick adjustment to specified pile types and sizes. Various pile inserts

have the standard 17" square head which fits in different sizes of primary helmets.

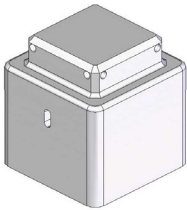
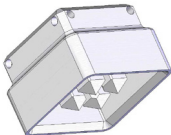
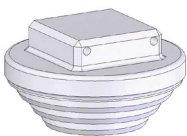
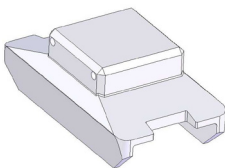
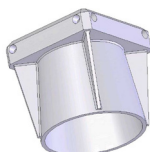
	Striker Plate:	Ø17" x 4"	200 lbs.	Ø27" x 12"	1550 lbs.
		Ø19" x 6"	380 lbs.	Ø37" x 12"	3080 lbs.
		Ø23" x 10"	950 lbs.		
	Hammer cushion	For Diesel Hammer and helmet protection			
		1" Mincarta & 2 x 1½" Aluminum • modulus of elasticity: 350 ksi • coefficient of restitution: 0.8			
	Primary helmet	Features • machined bottom receptacle for cushion and helmet insert for maximum energy transfer and lifetime • 17" standard square for inserts • integrated U-lead guiding			
	Helmet insert	Features • machined face of 17" square for max. energy transfer • inserts for concrete-, steelpipe-, sheet- and h-piles available			

Primary Helmets

500521 weight complete: 1050 lbs. striker plate: Ø 17" U-lead guiding: 21" x 8"	500526 weight complete: 2200 lbs. striker plate: Ø 23" U-lead guiding: 26" x 8"	500532 weight complete: 2750 lbs. striker plate: Ø 23" U-lead guiding: 26" x 8" 32" x 8"
5005232-HD weight complete: 2820 lbs. striker plate: Ø 23" U-lead guiding: 32" x 8"	500542 weight complete: 5400 lbs. striker plate: Ø 23" U-lead guiding: 42" x 8" (10") 36" x 8"	

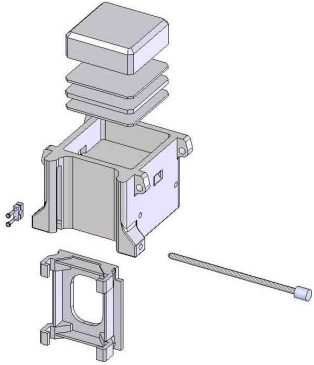
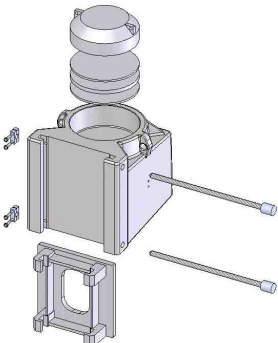
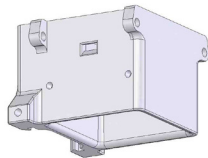
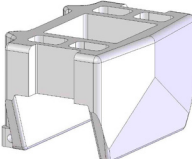
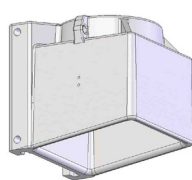
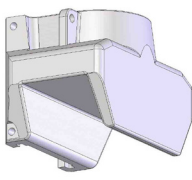


Helmet Inserts

	Inserts for concrete piles				
	500512-01	12" Square		1356 lbs.	
	500514-01	14" Square		1023 lbs.	
	500516-01	16" Square		1570 lbs.	
	500518-01	18" Square		1715 lbs.	
	500520	20" Square		1724 lbs.	
	Inserts for H-piles				
	500515	10", 12", 14" H-pile		890 lbs.	
	Inserts for pipe-piles				
	500508-C	up to 16" diameter		760 lbs.	
	500509-1	up to 24" diameter		1380 lbs.	
	500509-2	up to 30" diameter		2210 lbs.	
	Inserts for sheet-piles				
		length	width	min. U-lead size	weight
	500513	30.5"	13.5"	26.5" x 8"	870 lbs.
	500513-2	38"	16.5"	32.5" x 8"	1270 lbs.
	500513-4A	43" / 39"	19.6"	32.5" x 8"	2600 lbs.
	500513-5	51"	19"	42.5" x 8"	3550 lbs.
	Inserts for timber-piles				
	500506-1	up to 16" diameter		560 lbs.	



Pileco helmet drive cap systems for European-type leads

 Standard-version	This type of helmets is for use on leads where the helmet is guided in front (European style). The helmets have a machined slot in the backside to accept a guide insert. This special made guide insert can be made to adapt a variety of lead profiles and guiding distances. Locking wire rope with clamp allow multiple use of helmets and guiding inserts.		 HD-version
	pile size / opening	cushion size	weight lbs.
	for concrete piles, pipe piles, H-beams using Diesel Hammers up to D19-42		
	500016	square 16"	square 17" 1070
	for sheet piles, using Diesel Hammers up to D19-42		
	500013	30.5" x 13.25"	Square 13" 1360
	for concrete piles, pipe piles, H-beams using Diesel Hammers larger D19-42		
	500012HD	square 12"	diam. 13" 1250
	500014HD	square 14"	diam. 13" 1400
	500016HD	square 16"	diam. 17" 1700
	500020HD	square 20"	diam. 17" 2150
	for sheet piles, using Diesel Hammers larger than D19-42		
	500013HD1	30" x 12.5"	diam. 13" 1900
	500013HD2	38"x 14.5"	diam. 17" 3280
	500013HD5	52" x 19"	diam. 19" 4380

All Pileco helmets are made from quality cast carbon steel. The cushion receptacles and pile insert receptacles are machined flat for maximum energy transfer.

The U-lead guiding is machined to warrant the required guiding tolerance.

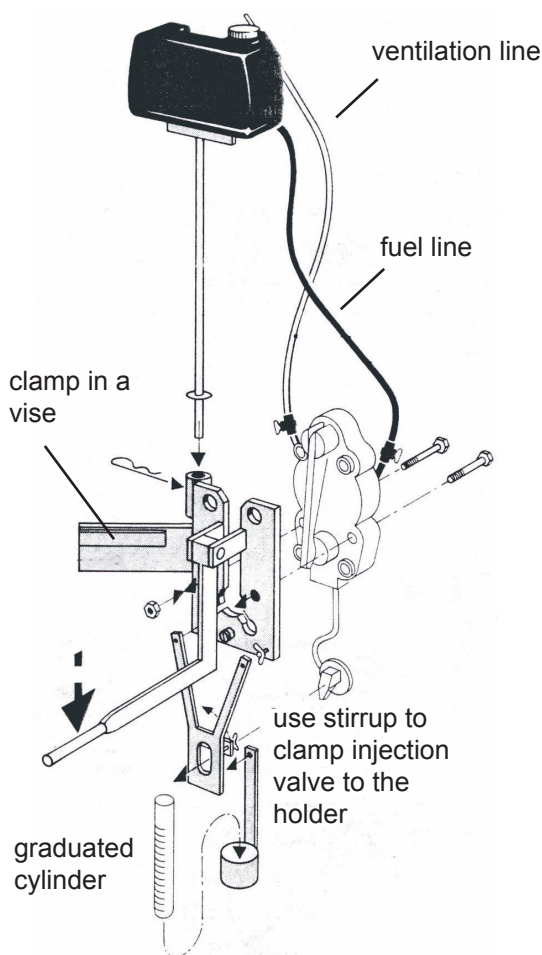


A1.2 Test unit for the fuel control pumps



Read and observe the operating instructions “Diesel Pile Hammer” as well as all safety instructions contained within.

Fuel must be handled carefully. Take appropriate measures to prevent spilling, igniting, inhaling and swallowing as well as contact with skin and eyes. Proper PPE is necessary.



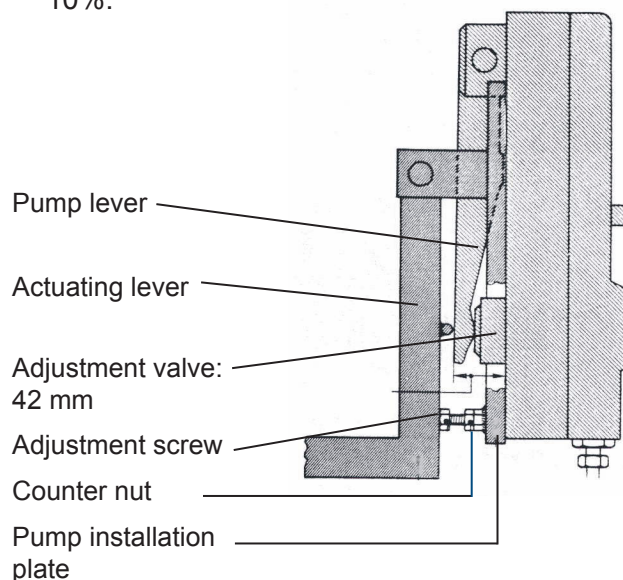
Mode of operation

This test unit for fuel pumps will enable you to accurately measure the fuel injection quantity per stroke. The procedure is more if you accurate proceed with 20 strokes and divide the measured volume by the number of strokes.

Operation

Observe the instructions and data indicated in chapter 10

1. Set the fuel control pump to setting “0”.
2. Press the pump lever down using the actuating lever.
3. Unscrew the adjustment screw until the adjustment value is 42 mm (1-5/8”).
4. Secure the adjustment screw with the counter nut.
5. Empty the graduated cylinder.
6. Push the actuating lever 20 times completely down to the stop.
7. Read the injection quantity at the graduated cylinder and divide by 20.
8. Compare the measured quantity with the nominal quantity.
9. Adjust the injection quantity by modifying the shim plate thickness if the deviation exceeds 10%.



A1 Accessories

A1.3 Saximeter

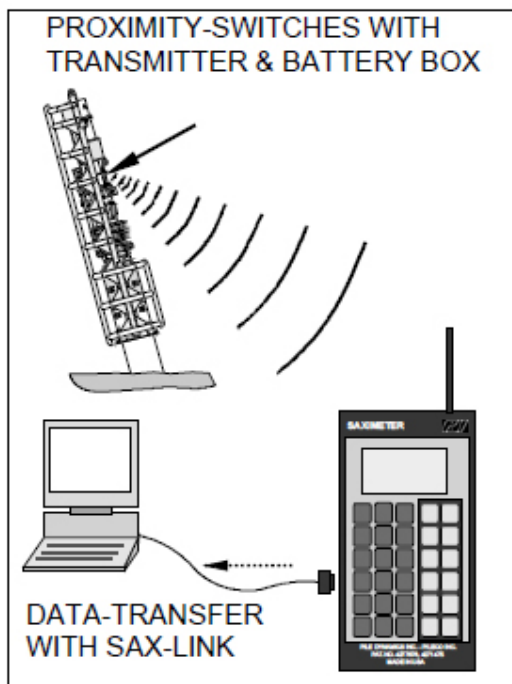
The **Saximeter** is a hand-held unit that uses sound recognition to automatically detect hammer blows. It determines the hammer operating rate in blows per minute. This is an important quality assurance parameter, since an excessive stroke can cause pile damage. Since hammers are often rated by energy, it is important to observe the actual available stroke or **potential energy** (stroke times ram weight).

The current saximeter versions are called **E-Saximeter** which stands for **energy** ...

The **E-Saximeter "A" version** is the further development of the Memory Saximeter. "A" stands for "audio". The saximeter works with sound recognition only. Automatically recording and processing information in MEMORY, enables the user to create driving logs quickly, professionally, and free from recopying errors. The data transfer can run directly in your office computer using an additional 9-pin cable.



The **E-Saximeter "P" version** has an additional option of computing hammer **kinetic energy**. This important parameter is calculated from measured hammer impact velocity. The "P" stands for "proximity" switches. Measurements are obtained by hammer mounted sensors that transmit data to the E-Saximeter.



```
PN D200.P4.0
LE 450.00ft
DT 1999-12-18,
03:49/04:07
PJ PRJ1
OW PILE_DYNAMICS
HN D200
HW 20.00kips
UN ENGLISH
START:03:49
PEN  BN  BPM
ft
1.00  52  37.2
2.00  18  36.5
3.00  15  36.9
4.00  15  36.8
5.00  14  36.8
6.00  15  36.8
7.00  13  36.8
8.00  13  36.8
9.00  15  37.1
10.00 13  36.7
11.00 13  36.7
12.00 12  36.7
```

Typical driving log created with the E-saximeter in some cases required for pile driving documentation.



A1 Accessories

A1.4 Hydraulic starting device & power pack

Specification - Engine

- DEUTZ F3L1011F (air cooled)
- Output 55 hp at 2300 rpm
- Fuel capacity: 24 USgal (93 ltr.)

Specification - Hydraulic system

- single stage gear pump, P31 497 GE
- Max. oper. pressure: 2800 psi
- Oil flow see chart

Hydraulic reservoir

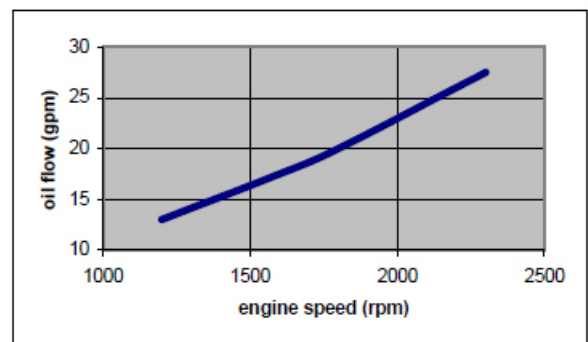
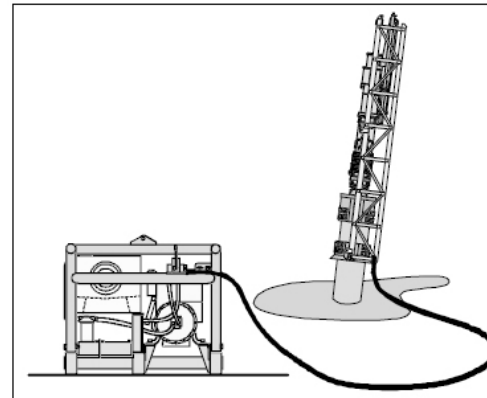
- approx. 40 USgal (approx. 150 ltr.)

Hydraulic valve

- directional control open center spool valve with pressure relief up to 3000 psi

Dimension length: 64"
 width: 52"
 height: 51"

Weight approx. 2200 lbs.



Technical data for hydraulic start of the Pileco Diesel Hammer

In the table below is shown the theoretical time to pull up the piston 80" (2m) and the time to move the tripping device back to start position.

The values are based on the max. oil flow (14 gpm) of the powerpack shown above. Larger powerpacks with increased oil flow allow a faster working cycle.

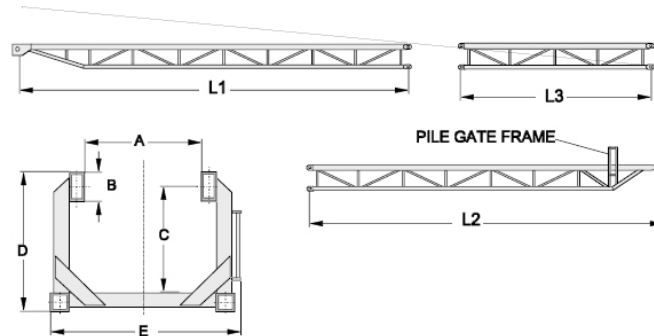
Time (s) for 80" stroke	D19 D62	D80 / D100		D125 / D160
	Pulling version	Pulling version	Pushing version	Pushing version
Trip upwards	14	35	42	51
Trip downwards	19	42	35	32



A1 Accessories

A1.5 Pileco U-Type leads

- The U26 to U48 leads utilize our proven pin connectors for quick field assembly (U21 leads are bolt connected as standard, pin connected as available).
- All lead sections are interchangeable in order to permit various length combinations.
- The leads can be furnished with side mounted auger tracks for installation of cont. flight auger drills.



	U-21	U-26	U-32	U-42	U-48
A	21.5"	26.5"	32.5"	42.5"	48.5"
B	8"	8"	8"	8"	8"
C (inside clear)	27"	30"	30"	34"	37"
D	35"	39"	39"	52"	58"
E	45.0"	51.5"	58.0"	68.5"	74.5"
L1 (Top Section)	40'	40'	40'	40'	40'
L2 (Stab Section)	20'	20'	20'	40'	40'
L3 (Intermediate)	20' , 40'	20' , 40'	20' , 40'	20' , 40'	20' , 40'
Section modulus Sx in3	170	301	301	564	641
Avg. Wt./ ft. *	85 lbs.	132 lbs.	145 lbs.	200 lbs.	225 lbs.
max. size of Diesel Hammer	D19-42	D30-32	D62-22	D138-32	D180-32

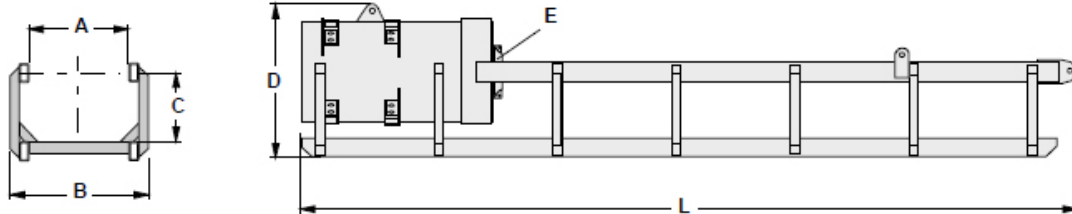
Head blocks for fixed lead systems

	Pile lines guided over fairleads (the shown dwg # can be modified to all lead sizes)			
	Pileco dwg.#	20367	20320	
	1. pile line	x	x	
	2. pile line	x		
	Auger line	x		
	Pile lines guided over rollers in fixed position (the shown dwg # can be modified to all lead sizes)			
	Pileco dwg.#	10007	20090	20288
	Hammer line	x	x	x
	1. pile line	x	x	x
	2. pile line		x	x
	Auger line		x	

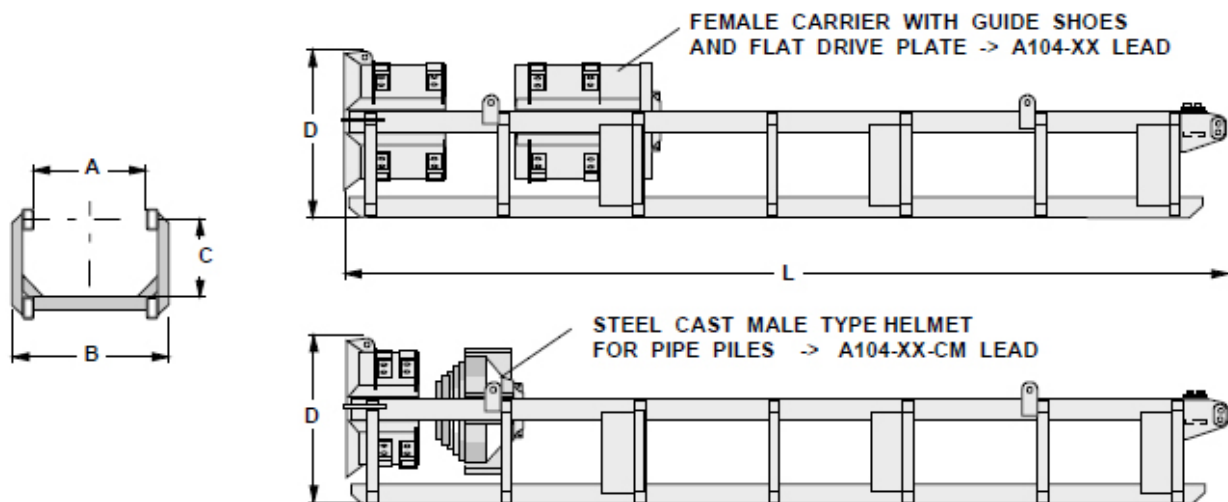
A1 Accessories

A1.6 Caisson type leads and special lead frames

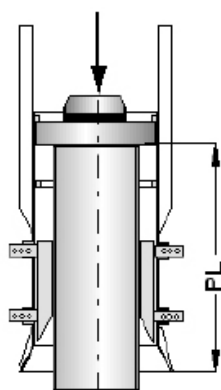
Pileco developed and introduced this system over 30 years ago. Through constant improvements our "Caisson Type" leads today are the most economical and efficient tools for installation of large diameter piling.



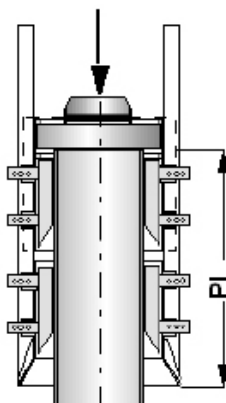
LEAD Type	A	B	C	D	E	L	max. size		weight
							Pile ø	Diesel H.	
OS 20-02	21-1/2"	36"	22"	47"	17"	24'7"	24"	D19-42	4920
OS 40-02	32-1/2"	36"	21"	53"	23"	23' 11"	36"	D30-32	8400



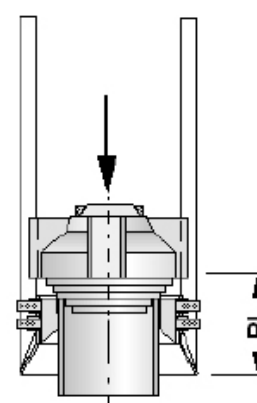
LEAD Type	A	B	C	D	L	E (cushion)	max. size		app. weight
							Pile ø	Diesel H.	
A104-36	42-1/2"	58-1/2"	29"	62-1/2"	27' 2"	23"	36"	D62-22	12,000
A104-36-CM	42-1/2"	58-1/2"	29"	62-1/2"	27' 2"	23"	42"	D62-22	15,000
A104-42	48-1/2"	66-1/2"	37"	72"	36'	27"	42"	D138-32	18,400
A104-42-CM	48-1/2"	66-1/2"	37"	72"	36'	27"	48"	D138-32	24,500
A104-48	54-1/2"	72-1/2"	37"	75"	36'	27"	48"	D180-32	22,500
A104-48-CM	54-1/2"	72-1/2"	37"	75"	36'	27"	48"	D180-32	28,500
A104-60	66-1/2"	84-1/2"	38-1/2"	84"	40'	27"	60"	D180-32	26,500
A104-60-CM	66-1/2"	84-1/2"	38-1/2"	85"	40'	27"	66"	D180-32	40,300
OS 200-60 (D200)	68-1/2"	60"	46-1/2"	97"	41'	37"	60"	D200-42	65,000



OS - Type

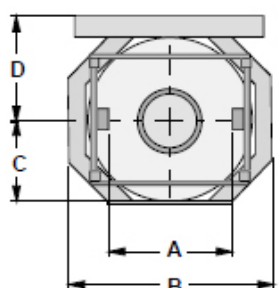
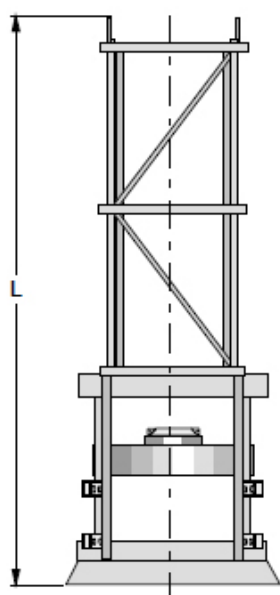


A104-xx



A104-xx-CM

The Pileco caisson type leads were developed during the last years to achieve longer lifetime, higher driving efficiency of pipe piles and longer lifetime of the equipment. The cast male type helmet enables driving the piles closer to the ground minimizing PL.



The Pileco lead frames are designed for driving cylinder piles larger than 60" diameter. The lead frames are designed in a way to enable driving a pile as close as possible in front of a wall or of a bridge.

Lead frame size max. diam.	66"	98"	120"
A (guiding rails)	42-1/2" x 8"	54-1/2" x 8" 68-1/2" x 12"	54-1/2" x 8" 68-1/2" x 12"
B	87"	123"	approx. 145"
C	35"	50-1/4"	approx. 62"
D	43"	61-1/2"	approx. 60"
L	23"	36' 8"	approx. 145"
Pile sizes with guide shoes	54", 48", 42", 36"	96", 84", 72", 66"	108", 96", 84", 72"
Largest size Diesel Hammer	D100-13	D200-42	D200-42
Approx. weight of lead frame with drive plate	25,600	61,400	n.a.



A2 Applicable fuel and lubrication types

A2.1 Applicable fuel types

It is quite common to operate the Diesel Pile Hammer with a mixture of summer diesel fuel, winter diesel fuel and additives (regular gasoline or engine petroleum) as a function of the temperature at the job site.

The possibility exists to use alternative fuels to conserve fossil fuels and reduce visible air pollution. The table shown below lists the most important properties of alternative fuels.

Fuel	Calorific value MJ/kg	Density at 60°F (15°C) Kg/ dm ³	Viscosity at 68°F (20°C) Kg/ dm ³	Boiling Temperature °F /°C
Diesel fuel	42.5	0.82...0.86	2.0...8.0	350...680 / 175...360
Soybean oil, refined	40.6	0.92	5.0...5.5	662 / 350
Rape oil, refined	37.7	0.92	67.0	392 / 200
Rape oil methyl ester	37.0	0.87...0.88	6.5...9.0	572 / 300
Methanol	19.7	0.80	0.7	149 / 65
n-butanol	33.1	0.81	3.6	244 / 118
Kerosene	43.5	0.77...0.83	4.0	338...500 / 170...260
Mixture of 50% diesel fuel 50% n-butanol	37.8	0.83	4.0	338...500 / 170...260

Rape oil, refined (Colza oil)

- Suitable as a replacement for diesel fuel
- Problem - free combustion in the Diesel Pile Hammer despite its higher viscosity
- Easy and problem-free starting. Starting difficulties only around the freezing point
- No conversion of the pump element is required
- Combustion, emission and output the same as for soybean oil

Esterized soybean oil or rape oil

- Suitable as a replacement for diesel fuel for short term running applications
- Lower viscosity than refined plant oils (suitable for lower temperatures)
- Output reduction of 10% in comparison with refined plant oil
- Slightly higher smoke emission than refined plant oil
- Operating temperature increases suddenly after approximately 1 hour of operation
- No conversion of the pump element is required
- Combustion, emission and output the same as refined plant oil

Soybean oil, refined

- Has been used in tests as a fuel for the combustion as well as lubricant to lubricate the piston
- Easy and problem-free starting. Starting difficulties only around the freezing point
- No problems during operation
- Barely measurable reduction in the output when compared to diesel fuel (a decrease of 1...2 blows per minute)
- Less and brighter smoke, Smoke emission increases after a continuous operation of four hours
- The maximum operation temperature is reached quicker than using diesel fuel
- No conversion of the pump element is required
- Diesel Pile Hammer gets contaminated sooner (soybean oil is deposited in the form of rubber like mass)

Material Safety Data Sheets (MSDS) are available from your supplier.



A2 Applicable fuel and lubrication types

Methanol

- Suitable as a replacement for diesel fuel
- Completely clean combustion (no smoke, no residues), lowest emission values (smoke, carbon dioxide, ozone, nitrogen oxide)
- Consumption twice that of diesel fuel, requires conversion work to install a larger diameter pump element
- Requires high performance 2 cycle engine oil for lubrication
- An ignition promoter with a corrosion inhibitor must be used due to its low ignition power (MSDS)



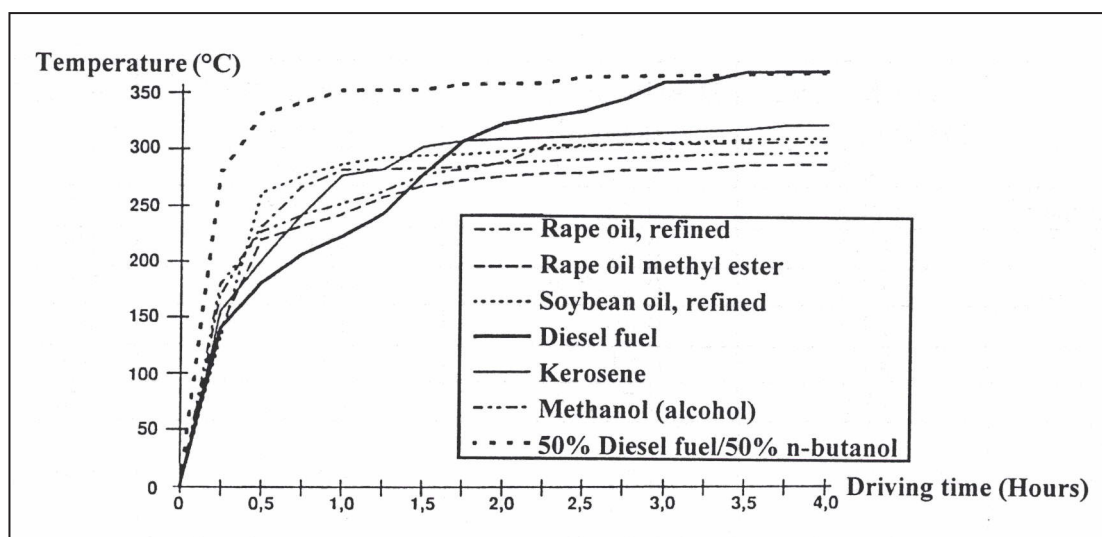
Please note that most ignition promoters are poisonous. Follow the respective instructions issued by the manufacturer.

Kerosene

- Suitable as a replacement for diesel fuel #2
- Lower smoke emission than diesel fuel
- Same output level than diesel fuel
- Requires high performance 2 cycle engine oil for lubrication
- No conversion of the pump element is required

Mixture of n-butanol and diesel fuel

- **Not suitable** as a replacement for diesel fuel
- Most favorable mixing ratio is 1:1
- Diesel Pile Hammer starts well when cold, fuel is burned almost with no residues
- Temperature increases rapidly, major decrease in the output, strong increase in emission
- Requires high performance 2 cycle engine oil for lubrication



The temperature of a Diesel Pile Hammer never should raise over 650°F / 350°C. The lifetime depends on the temperature the Diesel Pile Hammer is used during operation. At high temperature every material ages faster and the strength becomes lower, cracks can occur faster.

If the Diesel Pile Hammer over heats a cooling period is required. A more effective cooling will be accomplished if the piston is pulled out of the cylinder. Spraying the cylinder with water must be done very carefully not to cause any cracks in the lower cylinder.

A3 Summaries and calculation aids

A 3.1 Terms

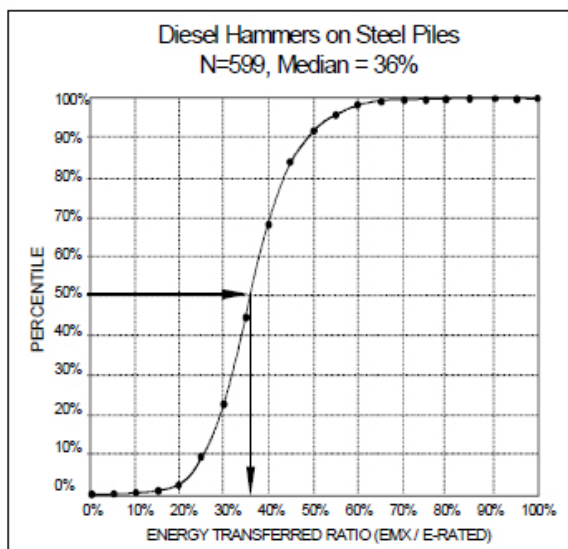
Rated Energy

The Diesel Hammers and air / steam hammers rated energy is potential energy, calculated by the ram weight times the drop height. The Diesel Hammer drop height of the ram weight depends on pile type soil and hammer condition. The maximum energy in the hammer specifications can be reached under optimum driving conditions but it is not necessarily always achievable.

Hammer efficiency

Is the factor or term applied to a hammer's actual produced energy compared to it's potential energy. Divide the kinetic energy by the potential energy to determine the hammer efficiency. The Diesel Hammer efficiency typically averages 0.8. In Diesel Hammers, energy losses are typically caused by:

- pre-compression, which transfers some energy into the pile
- friction between ram and cylinder
- impact and inertia losses of the impact block
- pre-ignition, if the hammer is poorly maintained or overheated
- misalignment hammer - helmet – pile



GRL case studies show the Enthru (transferred energy into the pile) by percentage of tested units. 50 percentile of Diesel Hammers tested show 35% Enthru-energy referring to rated energy. 92 percentile show less than 50% Enthru-energy.

Driving efficiency or transfer efficiency

Is the factor or term applied to the amount of the energy put into the pile (Enthru-energy) compared to the rated energy of the hammer. The samples below show Enthru at the end of driving. Smaller steel normally show a higher transferred energy than larger ones because they are more elastic. Enthru-energy depends on the type of hammer used, size & type of pile and soil conditions. Smaller steel pipes show a higher Enthru energy compared to large and much stiffer steel piles. Concrete and timber piles show a lower transferred energy compared to steel piles.

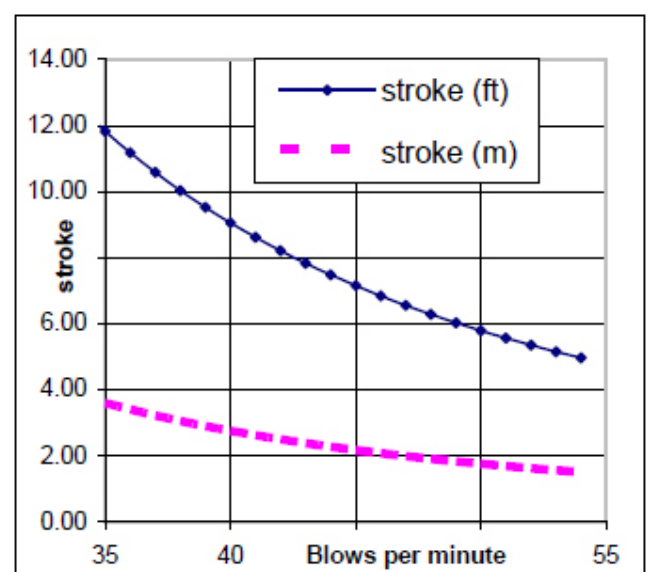
A 3.2 Correlations

The correlation between the number of blows (per minute) and the drop height of the piston is shown in the diagram.

The formulas below do not apply for batter piles, only for vertical piles:

$$\text{Drop height (m)} = \frac{4415}{(\text{Number of blows})^2}$$

$$\text{Drop height (ft)} = \frac{14485}{(\text{Number of blows})^2}$$





A3 Summaries and calculation aids

A 3.3 Pile capacity and hammer determination

Before the use of computers became common the pile driving industry worked out many different formulas for pile capacity or hammer determination. All these formulas are based on assumptions and they are not valid in general.

The common procedure today is to perform a **WEAP analysis** calculation using a computer program. Pileco, Inc. provides WEAP-analysis as a service to our customers at no charge to estimate hammer size and drive ability. Based on following customers information a calculation can be done:

- pile size (diameter, length)
- pile type (pipe pile, concrete, timber..)
- required penetration or pile capacity
- soil information (soil layers: depths, type, strength, SPT-N values)

Allowable pile stress during pile driving can be calculated by following formulas:

Pile material	Allowable Tension stress	Allowable Compress. stress
Steel	$0.9 \times f_y$	$0.9 \times f_y$
Pre stressed concrete psi	$F_{PE} + 3 \times f_{C'}^{1/2}$	$0.85 \times f_{C'} - f_{PE}$
Pre stressed concrete MPa	$F_{PE} + 0.25 \times f_{C'}^{1/2}$	$0.85 \times f_{C'} - f_{PE}$
Regular reinforced concrete	$0.7 \times f_y / A_C$	$0.85 \times f_{C'}$
timber	$3 \times f_A$	$3 \times f_A$

With following values:

F_y – yield strength of reinforcement as a force (kips or kN)

f_y – yield strength of steel (ksi or MPa)

A_C – concrete area of the pile

F_{PE} – effective pre stress

$f_{C'}$ – concrete strength as stress (MPa or psi)

F_A – allowable static timber stress

The **ENR-formula** always used in past is a more simple way for an estimation of pile capacity or determination of Diesel Pile Hammer size. Pileco Inc. provides a slide ruler where the formula practically is “programmed”.

$$R = \frac{2 * E_n}{S + 0.1}$$

- E_n – potential energy of the Diesel Pile Hammer in ft.lbs.
- S – number of blows needed to drive the pile 1 ft into the ground
- R – pile capacity in tons

Because the formula only works with the potential hammer energy and the blows per foot (pile penetration) the result is not very accurate and the safety factor is relatively high.

A 3.4 Hammer and pile cushion properties

Cushion material	Elastic modulus WEAP (ksi)	CoR WEAP
Aluminum	10 000	0.8
Aluminum / Micarta	350	0.8
Bongossi wood	290	0.75
Conbest	280	0.8
Micarta	225	0.8
Blue Nylon	175	0.92
Oak parallel	750	0.5
Oak (transverse)	60	0.5
Plywood	30	0.5
Wire rope	150	0.8

The elastic modulus for combined cushion material can be calculated by:

$$E_{EQUIV.} = \frac{E1 \times E2 \times (s1 + s2)}{s1 \times E2 + s2 \times E1}$$

with:

$E1, E2$ – elastic modulus

$s1, s2$ – thickness of the cushion



A3 Summaries and calculation aids

Bolt torque depends on:

- Bolt size, type and grade
- Lubrication (a low friction factor must be considered with MoS₂-based grease)

The given bolt torques are based on the 90% of the bolt yield strength

SIZE -metric-	GRADE	Friction factor $\mu = 0.1$ (MoS ₂)			Friction factor $\mu = 0.14$		
		Torque Nm	Torque ft.lbs.	Pre Tension kN	Torque Nm	Torque ft.lbs.	Pre Tension kN
M8 x 1.25	8.8	20	15	17.9	25	18	16.5
	10.9	30	22	26.3	37	27	24.3
	12.9	35	26	30.8	43	32	28.4
M10 x 1.5	8.8	40	30	28.5	50	40	26.3
	10.9	60	40	41.8	70	50	38.7
	12.9	70	50	49.0	90	70	45.3
M12 x 1.75	8.8	70	50	41.5	90	70	38.4
	10.9	100	70	61.0	130	100	56.4
	12.9	120	90	71.4	150	110	66.0
M14 x 2	8.8	110	80	56.8	140	100	52.5
	10.9	160	120	83.4	200	150	77.2
	12.9	190	140	97.6	240	180	90.3
M16 x 2	8.8	170	130	78.5	220	160	72.7
	10.9	250	180	115.3	320	240	106.8
	12.9	300	220	134.9	370	270	125.0
M18 x 2.5	8.8	240	180	95.1	300	220	88.1
	10.9	350	260	139.7	430	320	129.3
	12.9	410	300	163.5	510	380	151.3
M20 x 2.5	8.8	340	250	122.5	420	310	113.6
	10.9	500	370	180.0	620	460	166.8
	12.9	580	430	210.6	720	530	195.2
M22 x 2.5	8.8	460	340	152.7	570	420	141.7
	10.9	670	490	224.3	840	620	208.1
	12.9	790	580	262.4	990	730	243.5
M24 x 3	8.8	580	430	176.5	730	540	163.6
	10.9	860	630	259.2	1070	790	240.2
	12.9	1000	740	303.3	1250	920	281.1
M27 x 3	8.8	850	630	231.6	1070	790	214.9
	10.9	1250	920	340.1	1570	1160	315.7
	12.9	1460	1080	398.0	1830	1350	369.4



A3 Summaries and calculation aids

M30 x 3.5	8.8	1160	860	282.0	1450	1070	261.6
	10.9	1700	1250	414.2	2120	1560	384.2
	12.9	1990	1470	484.7	2480	1830	449.6
M36 x 4	8.8	2020	1490	412.2	2530	1870	382.6
	10.9	2970	2190	605.4	3710	2740	561.9
	12.9	3470	2560	708.5	4350	3210	657.5
M42 x 4.5	8.8	3230	2380	567.0	4050	2990	526.5
	10.9	4750	3500	832.8	5950	4390	773.2
	12.9	5560	4100	974.6	6960	5130	904.9

Bolt torque depends on:

- Bolt size, type and grade
- Lubrication (a low friction factor must be considered with MoS₂-based grease)

The given bolt torques are based on the 90% of the bolt yield strength

SIZE -metric-		GRADE	Torque Nm	Torque ft.lbs.	Pre Tension kN	Torque Nm	Torque ft.lbs.	Pre Tension kN
1/4	20	5	8	6	2.0	10	7	1.8
	20	8	12	9	2.8	14	10	2.6
5/16	18	5	17	13	3.3	21	15	3.1
	18	8	24	18	4.7	29	22	4.3
3/8	16	5	30	22	5.0	37	27	4.6
	16	8	43	31	7.0	52	38	6.5
7/16	14	5	48	36	6.9	59	44	6.3
	14	8	68	50	9.7	83	62	8.9
1/2	13	5	74	54	9.2	90	67	8.5
	13	8	104	77	13.0	128	94	12.0
9/16	12	5	106	78	11.9	131	96	11.0
	12	8	150	110	16.8	185	136	15.5
5/8	11	5	146	108	14.8	181	133	13.7
	11	8	207	152	20.9	255	188	19.3
11/16	11	5	200	148	18.6	248	183	17.2
	11	8	283	209	26.2	351	259	24.3
3/4	10	5	260	191	22.1	322	237	20.4
	10	8	366	270	31.1	454	335	28.8



A3 Summaries and calculation aids

7/8	9	5	418	308	30.6	519	383	28.3
	9	8	590	435	43.2	732	540	40.0
1	8	5	626	462	40.2	778	574	37.2
	8	8	884	652	56.7	1099	810	52.5
1-1/8	7	5	773	570	44.0	960	708	40.8
	7	8	1253	924	71.4	1557	1148	66.1
1-1/4	7	5	1087	802	56.4	1358	1001	52.3
	7	8	1763	1300	91.4	2202	1624	84.7
1-3/8	6	5	1427	1053	66.9	1778	1311	61.9
	6	8	2315	1707	108.4	2883	2126	100.5
1-1/2	6	5	1891	1394	81.9	2364	1744	76.0
	6	8	3066	2261	132.8	3834	2827	123.2
1-5/8	5	5	2347	1731	92.9	2921	2154	86.0
	5	8	3807	2807	150.6	4737	3493	139.5
1-3/4	5	5	2984	2200	110.5	3726	2748	102.4
	5	8	4838	3568	179.1	6043	4456	166.1
2	4.5	5	4482	3305	145.6	5604	4133	135.1
	4.5	8	7267	5359	236.1	9088	6702	219.0



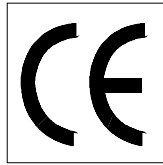
A4 Signature form

Form : “Operating instructions have been read and understood”

I hereby declare that I have received instructions about the Diesel Hammer prior to starting work.
I have read and understood the operating instructions, particularly the safety instructions.

[illegible]

When any questions arise concerning instructions or safety related matters please call the appropriate manufacture for assistance.



EC Conformity Statement

Within the scope of EC guidelines for equipment 89/392/EEG, Appendix II A for equipment.

The equipment manufacture of following types Diesel Pile Hammers

D6-42	D125-32
D8-42	D138-32
D12-42	D160-32
D19-42	D180-32
D25-32	D138-32
D30-32	D160-32
D36-32	D180-32
D46-32	D225-22
D62-22	D250-22
D80-23	D800
D100-13	

confirms that the design and fabrication is in accordance with the EC-guidelines 89/392/EEG under the sole responsibility of:

Company

**BAUER-Pileco Inc.
111 Berry Road
Houston, TX 77022**

Signature

Description of use:

The Diesel Pile Hammer is used to drive foundation piles of various shapes and materials into supporting soil layers

