

# IHC Hydrohammer®

*Pile driving equipment*

an IHC Merwede company

**The technology innovator.**

## *Pile driving equipment*

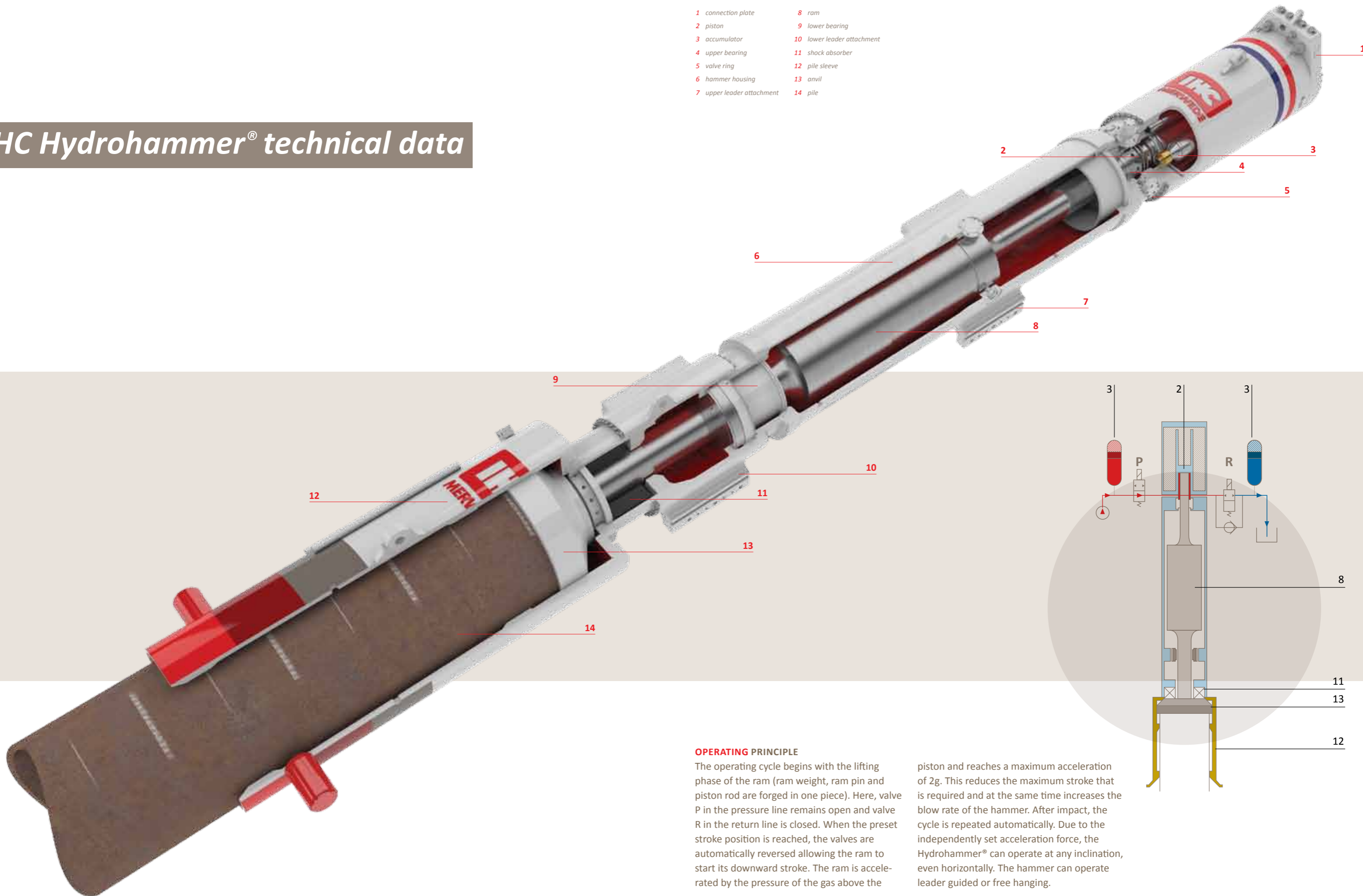
Since the inception of IHC Hydrohammer® technology, the IHC Hydrohammer® has found application in the offshore industry. The closed hammer housing, the excellent control options and reliability makes the hydraulic hammer eminently suitable for driving conductors, anchor piles, jackets, monopiles and start-up piles for pipe layers at sea. Nowadays, oil and gas have to be drilled for at ever increasing depths. Our solution: equipment that can operate deeper under water.

The demand for alternative sources of energy is increasing rapidly. Centuries old wind energy in its modern incarnation is a promising growth market. Wind turbines are technically very interesting meetings of elements and structures. They are exposed to adverse weather conditions, often with their bases submerged in water. The principal development being their increasing size. On land, out to sea and in the air. This requires larger diameter piles. IHC Hydrohammer® develops equipment to meet any demand.

*IHC Hydrohammer®  
Boundary breaking. Any time. Any how. Anywhere.*

# IHC Hydrohammer® technical data

- |                           |                            |
|---------------------------|----------------------------|
| 1 connection plate        | 8 ram                      |
| 2 piston                  | 9 lower bearing            |
| 3 accumulator             | 10 lower leader attachment |
| 4 upper bearing           | 11 shock absorber          |
| 5 valve ring              | 12 pile sleeve             |
| 6 hammer housing          | 13 anvil                   |
| 7 upper leader attachment | 14 pile                    |



## OPERATING PRINCIPLE

The operating cycle begins with the lifting phase of the ram (ram weight, ram pin and piston rod are forged in one piece). Here, valve P in the pressure line remains open and valve R in the return line is closed. When the preset stroke position is reached, the valves are automatically reversed allowing the ram to start its downward stroke. The ram is accelerated by the pressure of the gas above the

piston and reaches a maximum acceleration of 2g. This reduces the maximum stroke that is required and at the same time increases the blow rate of the hammer. After impact, the cycle is repeated automatically. Due to the independently set acceleration force, the Hydrohammer® can operate at any inclination, even horizontally. The hammer can operate leader guided or free hanging.

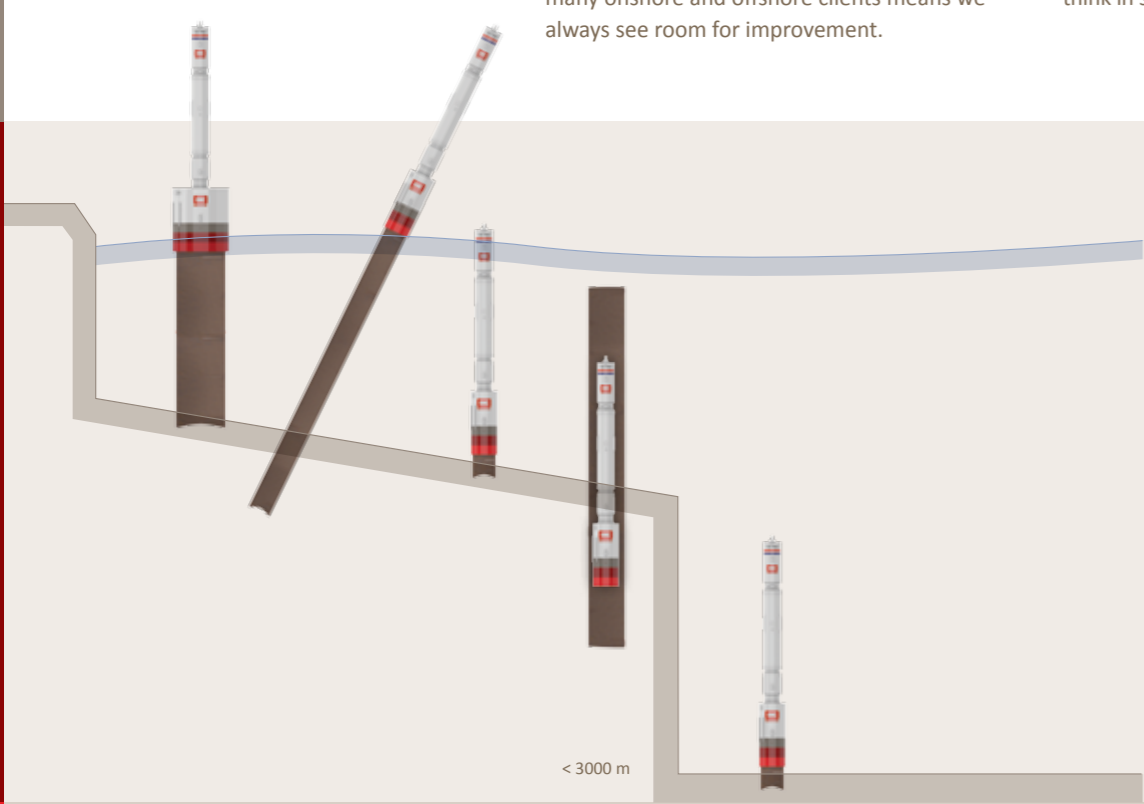
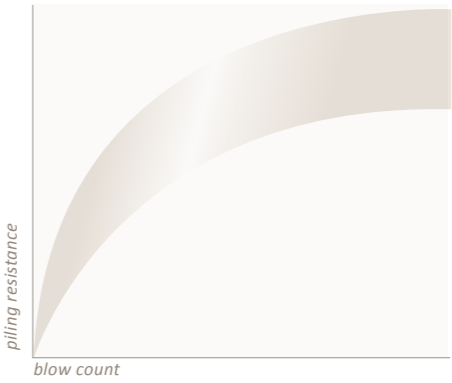
# Thinking possibilities

IHC Hydrohammer® is the global standard in the field of pile driving hammers. Why? Because we think in solutions. After all, in practice, every problem on the market demands its own, innovative solution. It is in our nature to think in opportunities. Our years of experience, our empirical approach and - in particular - our intensive cooperation with many onshore and offshore clients means we always see room for improvement.

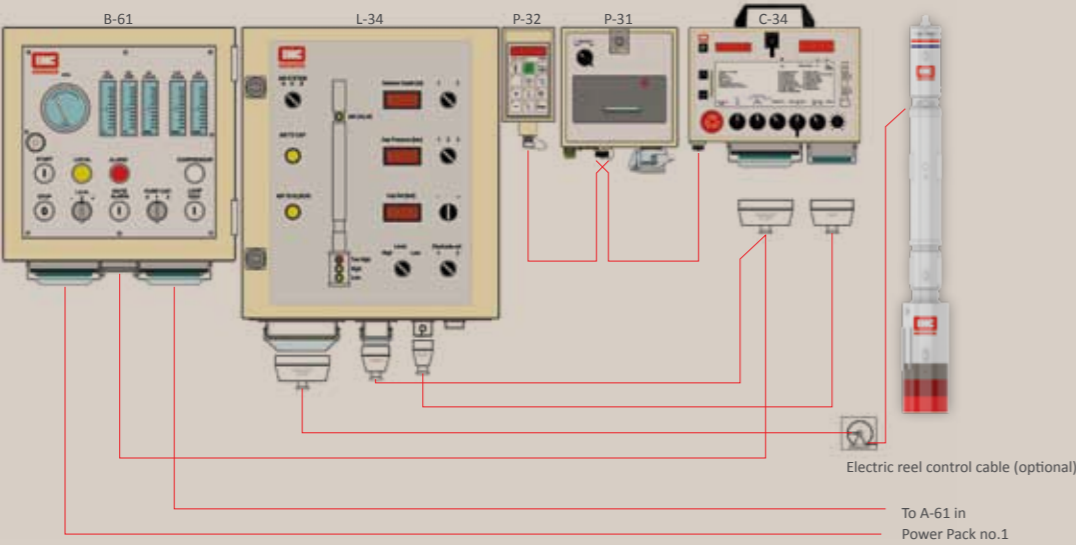
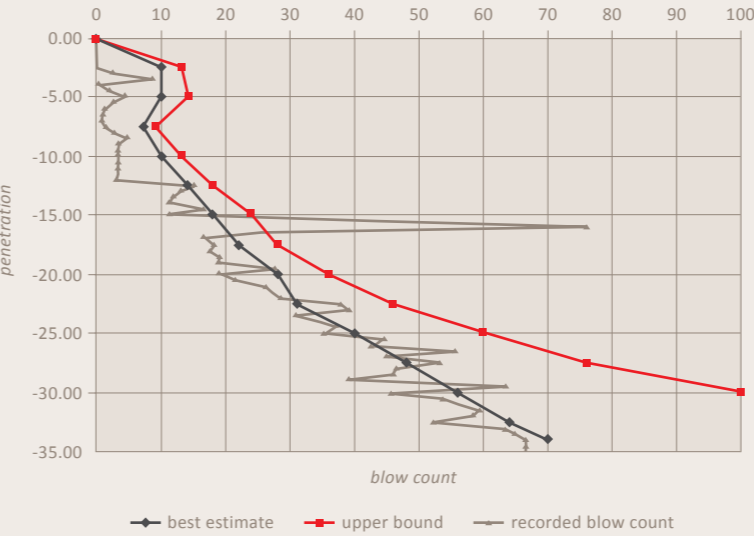
For example, in recent decades we have broadened our horizons. On the one hand, by not compromising and only being satisfied with the best. On the other, by entering into joint ventures and partnerships with users. Elevating each other, creating opportunities and sub-sequently capitalising on them. Success starts with the right attitude. It makes you think in solutions.

## DRIVEABILITY

A proper choice for a hammer can only be made after careful interpretation and assessment of the properties of the soil. To support its users IHC Hydrohammer® has a staff of experienced civil engineers to assist them with pre- and post-pile driving analyses. These driveability studies are carried out using the most sophisticated computer programs (IHCWAVE and TNOWAVE). These programs are also used to enable IHC Hydrohammer® design engineers to optimize hammer components.

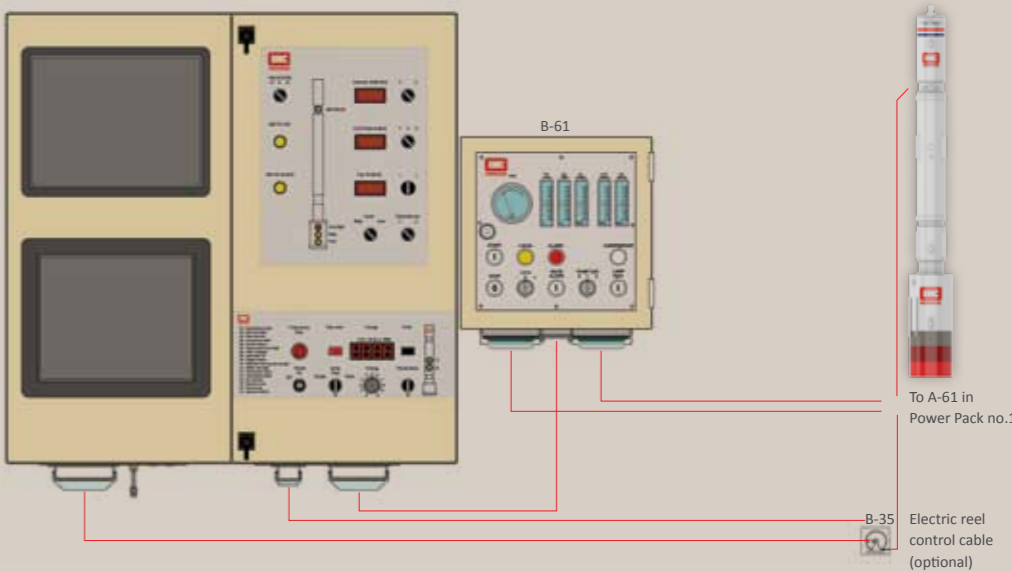


## FIELD RECORDS



## HAMMER CONTROL & MONITORING

All hydraulic functions of the hammers are electronically controlled and monitored. This ensures optimum control of the energy, blow rate and an optimum transfer of the energy into the pile head. Safety features are built into the controls. They include protection against running out of the ram stroke, too high level and incorrect hammer/pile positioning. The electronic signals from the hammer sensors and from the power pack controls are fed into a single control box. In the event of a malfunction the control box software assists in solving the problem. The piling data can be printed on site or stored in a data logger. The data logger option facilitates information transfer to a PC, allowing engineers to conduct detailed analysis of the driving operation.

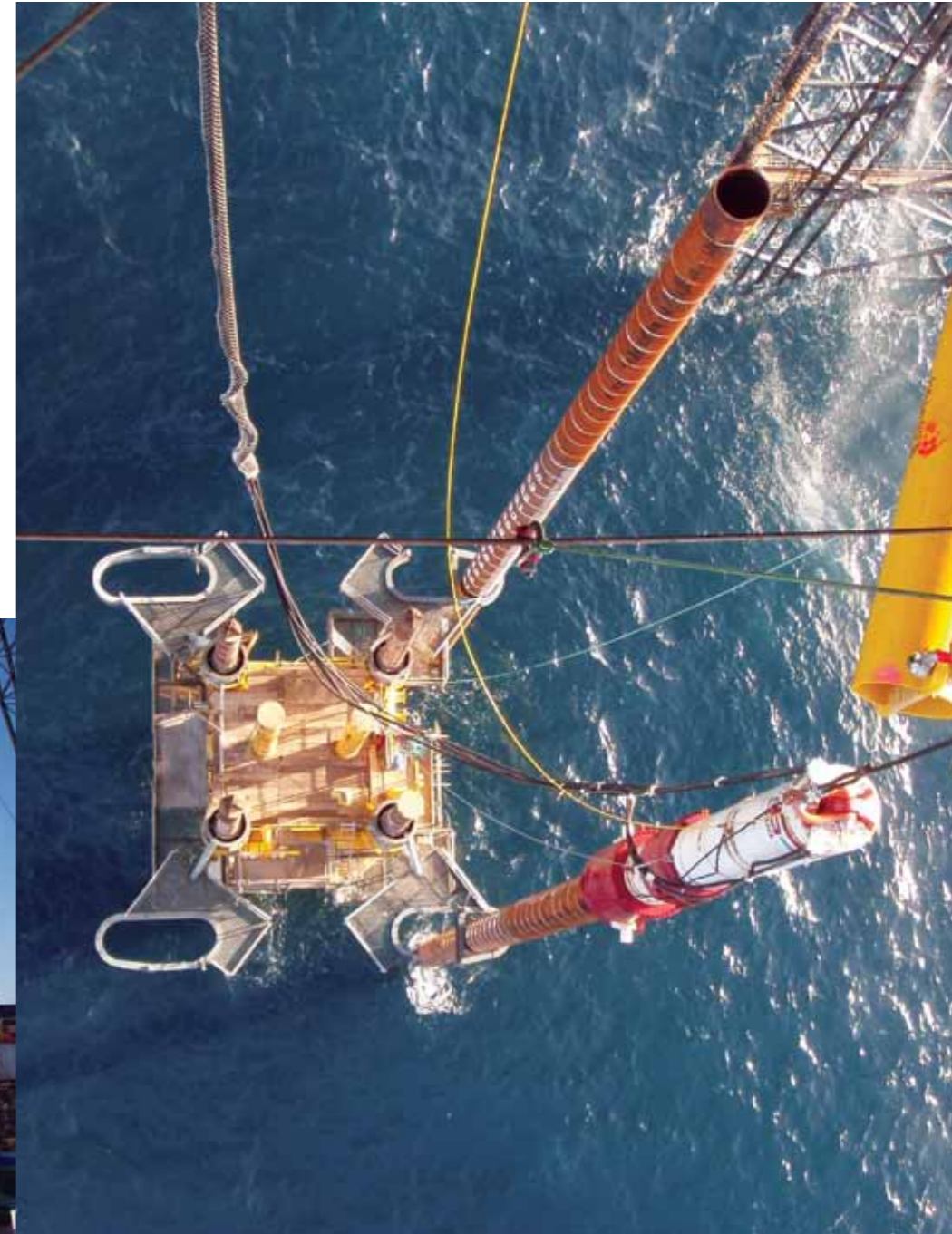


## Vertical pile driving

IHC Hydrohammer's® unique design makes it suitable for all types of piling and foundation works, both leader guided or freehanging, above and under water.

*Suitable for all types of piling and foundation works*

- Subsea structures
- Pre- & postpiled jackets/tripods/tripiles
- Monopiles
- Mooring piles
- Conductor piles



# Raked Pile Driving

By adjusting the gas pressure above the ram's piston head, the ratio between the energy delivered by gravity and by gas can be adjusted. When driving raked piles the gas pressure is increased to compensate for the

loss of gravity energy. Battered piles up to a rake of 1:1 (45 degrees) can be driven at full energy. It is even possible to drive horizontally. In this case it is only the gas pressure which accelerates the ram to full energy.



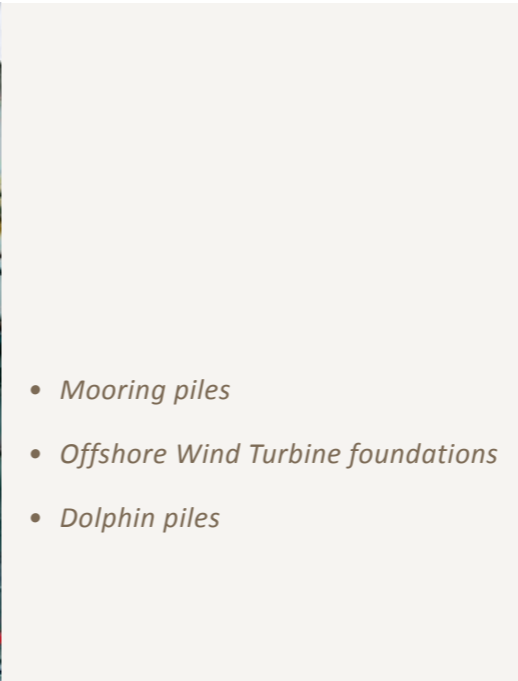
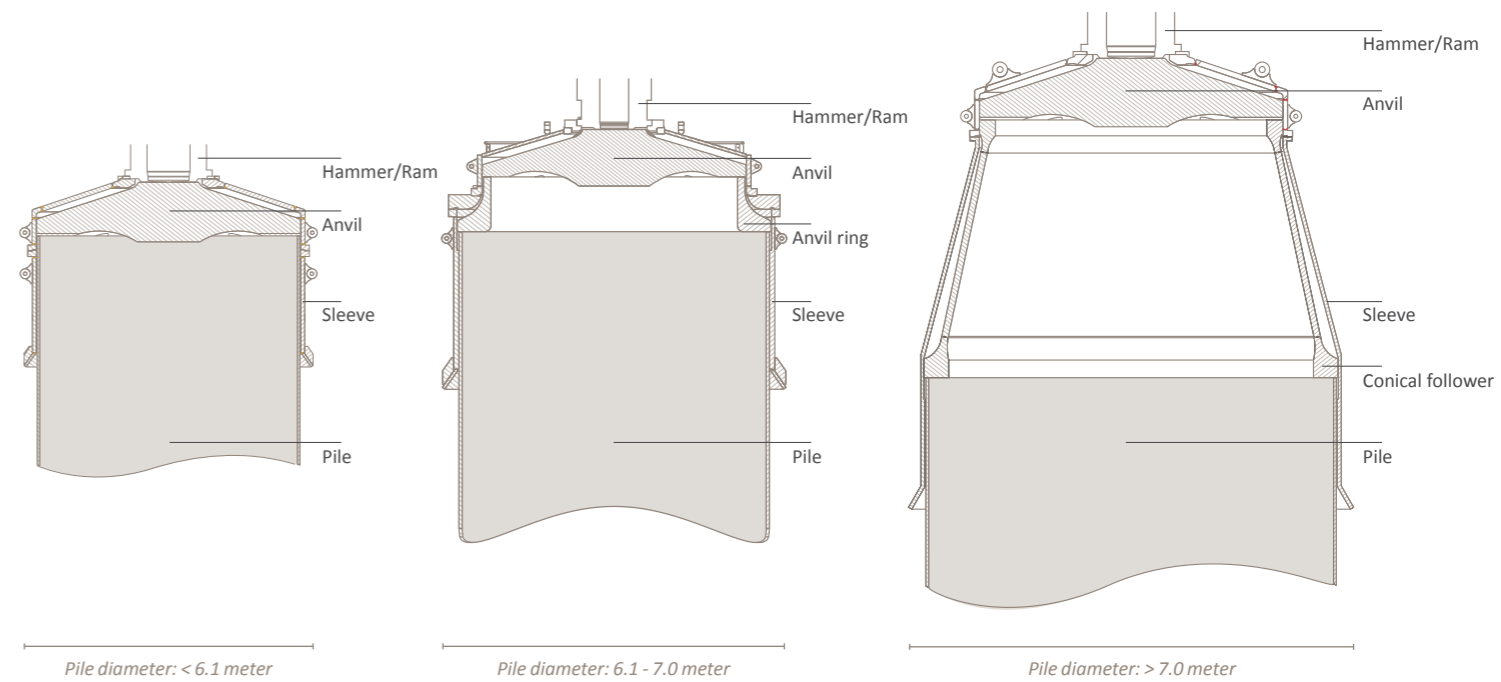
*Piles can be driven at any rake with full energy*

- Jackets/Tripods
- Jetties
- Bridges



# Large pile diameters

When large diameter piles have to be installed, powerful and reliable tools are required to deliver the amount of driving energy. IHC Hydrohammer® is specialized in piling jobs where large diameter piles have to be driven. Due to the anvil design, sleeves can be adjusted to suit any pile diameter.



- Mooring piles
- Offshore Wind Turbine foundations
- Dolphin piles



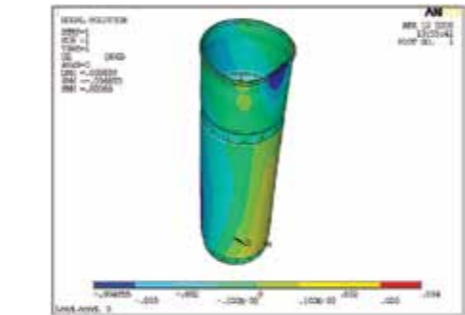
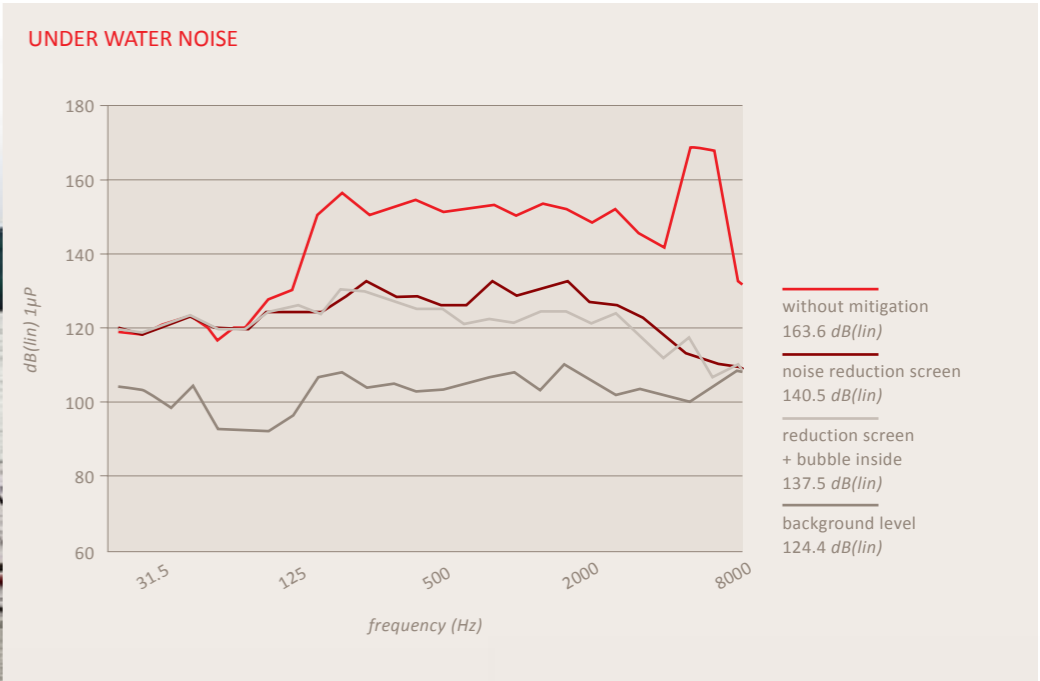
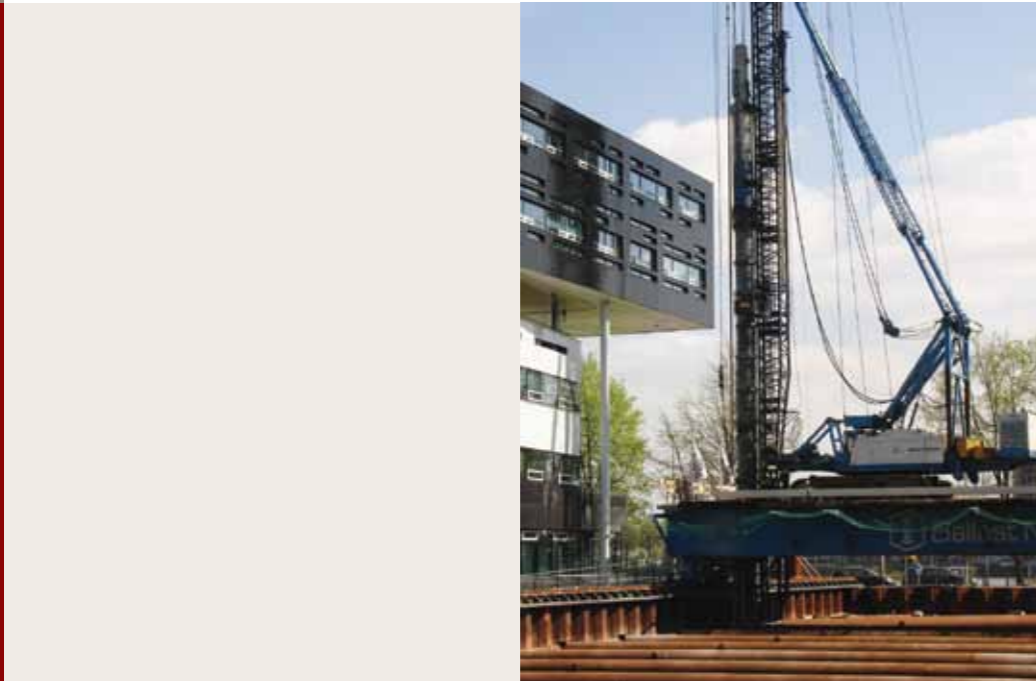
# Noise mitigation methods

A new feature of the Hydrohammer® is the possibility to equip the hammer with an offshore noise reduction package. This consists of an enclosure around the pile. The design was developed in collaboration with the Dutch Research Institute TNO.

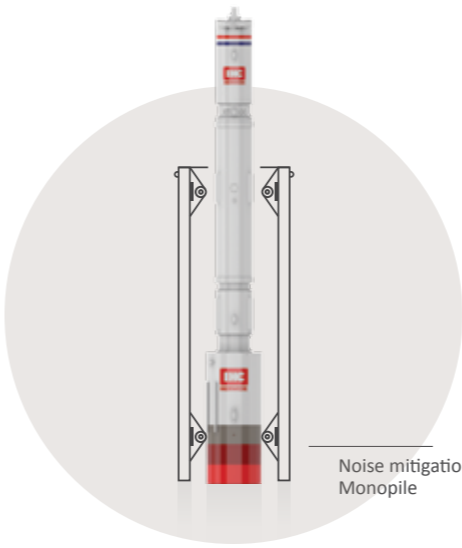
Under water noise levels can significantly be reduced, which is a great improvement in noise emission levels for today's offshore building sites.

## PRINCIPLES OF THE IHC HYDROHAMMER® NOISE MITIGATION SOLUTION

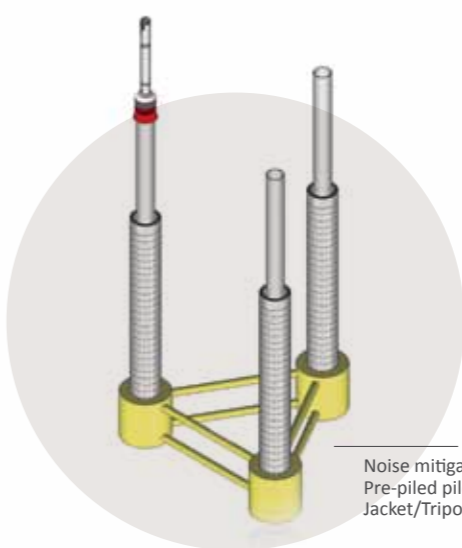
- 1 Achieve significant reduction (no 'optical' noise reduction);
- 2 Noise reduction at low frequencies;
- 3 Construction according DNV certification rules;
- 4 Workable, simple and reliable;
- 5 Seaworthy: current, waves, rough handling;
- 6 Handling to be designed according vessel and project conditions.



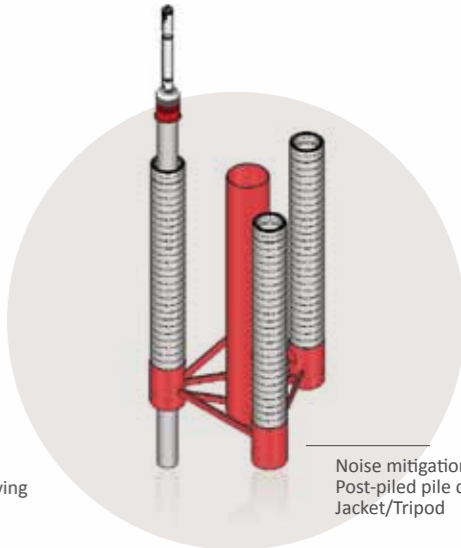
FEM analyses under offshore load conditions



Noise mitigation: Monopile



Noise mitigation: Pre-piled pile driving Jacket/Tripod



Noise mitigation: Post-piled pile driving Jacket/Tripod

# Conductor Piles

### OPERATING PRINCIPLE

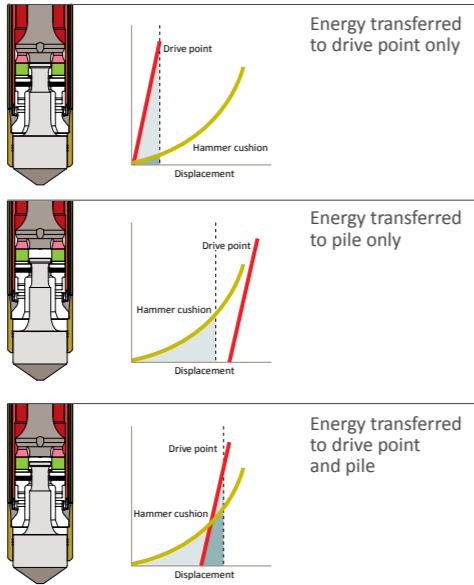
The technical novelty of the “Toe Drive System” (developed and patented), is the uncoupled drive point (closing element at the toe of the conductor/casing) and the conductor or casing itself. This system allows for an independent penetration of the drive point and the conductor/casing. The drive point assembly is part of the hammer and is retrieved out of the conductor/casing together with the hammer at the end of driving operations.

### THE CONFIGURATION OF THE DRIVE POINT ASSEMBLY CONSISTS OF THE FOLLOWING ELEMENTS

- **Drive point:** solid steel point which closes and seals the conductor/casing;
- **Drive bell:** transfers the energy from the hammer to the casing. The drive bell rests on a special drive shoulder at the toe of the conductor/casing;
- **Anvil:** placed immediately underneath the ram of the hammer and transfers the energy either to the drive point, or to the conductor/casing;
- **Cushion:** between striker plate and drive bell. To soften the blow to the conductor/casing.

### ADVANTAGES

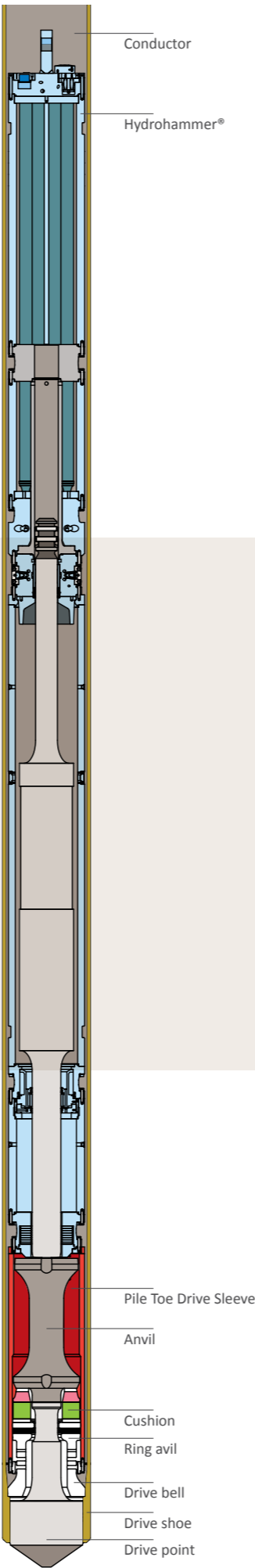
- 1 Independent energy transfer to drive point or casing;
- 2 Energy transferred to soil where soil resistance is the highest. Improved pile driving characteristics;
- 3 High friction resistance can be overcome in combination with a high toe resistance;
- 4 Higher static shaft resistance (bearing capacity) due to full displacement of the soil underneath the conductor;
- 5 Low overall centre of gravity (c.o.g) which ensures also a near to vertical conductor;
- 6 Conductor head can be kept under constant tension during the initial stages of driving. No requirement for a temporary seabed stability frame whilst maintaining verticality requirements;
- 7 Empty conductor/casing after driving;
- 8 In a special configuration the drive point can act as a boulder break-chisel;
- 9 Time and cost savings, depending on project conditions.



Pile Toe Drive representatives:

NeoDrill

GeoDrive Technology

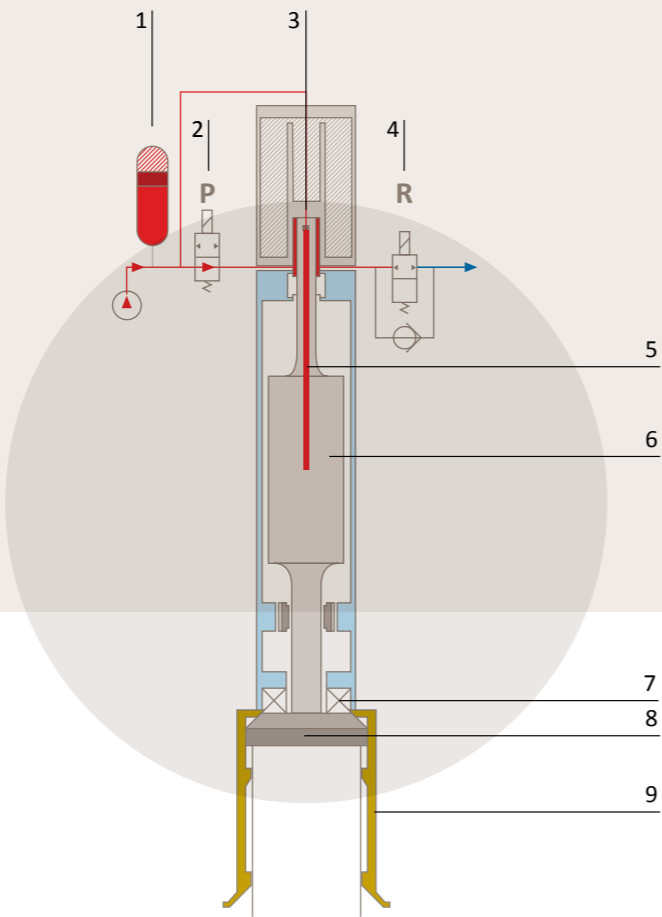


# IHC Waterhammer®

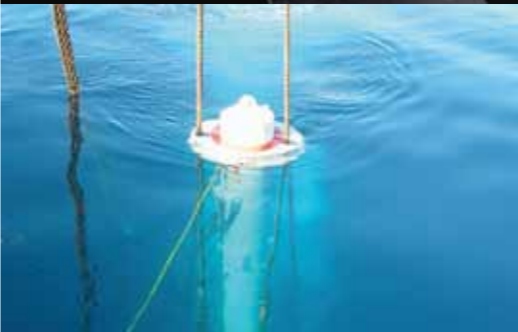
The IHC Waterhammer® was developed by IHC Hydrohammer® for use in ultra deep water. It is controlled by a radical hydraulic system that uses sea water instead of oil. This addresses the practical issue of it being technically very hard to pump oil to and from such depths, while of course there is no shortage of sea water around the structure. There are also environmental benefits in that this solution removes the risk of accidental oil leaks.

Over the next few decades, the IHC Waterhammer® will add a complete new dimension to technology and safety in the field of underwater pile driving.

- ADVANTAGES OF THE IHC WATERHAMMER®**
- 1 Reliable technology;
  - 2 Simple umbilical;
  - 3 No high voltage cable;
  - 4 Simple control/ wireless;
  - 5 Water as power transmission medium:
    - no hydraulic oil/ no oil spills
    - single hose (no return hose)



- |                        |                  |
|------------------------|------------------|
| 1 accumulator          | 6 ram            |
| 2 valve                | 7 shock absorber |
| 3 piston               | 8 anvil          |
| 4 return valve         | 9 pile sleeve    |
| 5 acceleration plunger |                  |



# IHC Merwede Offshore Equipment

IHC Merwede has a rich history of designing, constructing, assembling, commissioning, delivering and maintaining offshore equipment. This varies from single part product fabrication to complete integrated systems ranging from hydraulic-operated shackles to complete multi-functional integrated offshore vessels.

The capability to combine our wide range of in-house technology into complete packages, being fully in accordance with customer operating requirements, makes IHC Merwede unique in the world of offshore. This uniqueness is carried in our self-positioning motto as *The technology innovator*, indicating our focus on the continuous development of technologically advanced equipment.



## Offshore Piling Equipment



**Piling equipment**

- Hydrohammers



**Piling equipment**

- Pile Handling Equipment
- Jacket Pile Grippers
- Pile Anti Running Clamps



**Piling equipment**

- Fast Frames

## Offshore Vessels



**Pipelay Vessels**



**Multi-Purpose offshore support Vessels**



**Heavy Lift Vessels**

## Offshore Equipment



**FPSO Equipment**

- Tie-back Systems
- Riser & Mooring Chain Pull-in System
- Offloading Hose Reels
- Tandem Mooring Systems



**Handling Equipment**

- Installation frames
- Offshore Load Tension System
- Up-ending tools



**Pipe & Cable Equipment**

- Carousels
- Plough Systems
- S Lay Systems
- J Lay Systems
- Hydraulic Cylinders



**Well Intervention**



**Electrical/ Control Systems**



**Heavy Lifting & Deep Water Lowering**

- Lifting Tools
- Skidding systems
- Pile Stacking Frames
- Deep Water Lowering
- Jacking Systems
- Pin Release Systems
- Fixation Systems
- Leveling Equipment

Less is more...

UNIVERSAL AND UNIQUE

There are no compromises in the design of the hydraulic Hydrohammer® where reliability, efficiency, possibilities and safety are the focus. A design forged from billions of hammer strikes, both onshore and offshore.

The Hydrohammer® combines a solid one-piece ram with a fully enclosed hammer housing. The result is an elegant yet robust and reliable hammer. IHC Hydrohammer®'s unique design makes it suitable for all types of piling and foundation work, ranging from piling impact sensitive concrete piles, to piling large and long offshore caisson piles. The hammer can even be used to break rock (also under water).

MORE RELIABILITY

- Solid piece Ram.** The ram weight, ram pin and piston rod are forged in one piece, which means there is no risk of the parts separating.
- Materials.** The forged alloy steel guarantee durability. This also allows unlimited piling on steel using full power.
- Shock absorber.** The robust and tested construction and the materials used sustainably resist the reaction forces from the pile.
- Bearings.** The ram is guided above and below by lubricated bearings. This reduces ram wear to a minimum.
- Limited parts.** The use of a limited number of parts leads to lower risk of failures and fewer spare parts.

MORE POSSIBILITIES

- Enclosed hammer housing.** The energy supplied by the Hydrohammer® is the same both above and below water.
- Tools.** The hammers can be equipped with rock chisels, noise bellows and sheet piling and pile guides in all sizes.
- Sleeve design.** Due to the flat anvil, the sleeves can be adjusted to suit any pile diameter.
- Free hanging.** The Hydrohammer® can operate leader guided and free hanging (fitted with a pile sleeve).
- Clamp system.** A special clamp system rigidly connects the pile head and the hammer housing. As a result, only one Hydrohammer® is needed to drive and to extract piles. This makes the Hydrohammer® ideal for the installation of cast-in-situ (vibro) piles.

- Acceleration energy.** In addition to piling vertically, the Hydrohammer® can also operate at full power horizontally and at any other inclination. Thanks to the acceleration energy, it has a relatively low weight and a high peak force to overcome soil resistance.
- Forged pieces.** Due to the high-quality forged and alloyed parts, the Hydrohammer® is suitable for driving steel on steel.

MORE EFFICIENCY

- Hammer control.** All hydraulic functions of the Hydrohammer® are electronically controlled and monitored. This contributes to allowing the optimal blow energy to be set.
- Modular structure.** All parts that could possibly need attention between major services are easily accessible from the outside.
- Oil flow.** Due to the accelerated ram weight, it is possible to realise a high blow count at a relatively low oil flow.
- Real time monitoring.** The piling data are directly printed on site or stored in a data logger. This allows a detailed analysis of the driving operation to be conducted.

INCREASED SAFETY

- Safety provisions.** Signals from the hammer sensors are centrally processed in the control box. If the length of the ram stroke is too long or too short, the hammer is stopped. If the hammer/pile positioning is incorrect, the hammer cannot be started.
- Environmentally friendly.** The Hydrohammer® can use biodegradable oil. Noise reduction is optimised by fitting the Hydrohammer® with the available noise reduction packages.



HAMMER S SERIES		S-30	S-40	S-70	S-90	S-120	S-150	S-200	S-280	S-500	S-600	S-800	S-900	S-1200	S-1400	S-1800	S-2000	S-2300
OPERATIONAL DATA																		
Max. blow energy on the pile	kNm	30	40	70	90	120	150	200	280	500	600	800	900	1200	1400	1800	2000	2300
Min. blow energy on the pile	kNm	3	4	7	9	12	15	20	28	50	60	80	90	120	140	180	200	230
Blowrate at max. blow energy (1)	bl/min	65	65	50	46	48	44	45	45	45	42	38	38	38	40	35	35	30
WEIGHTS																		
Ram	ton	1.6	2.2	3.5	4.5	6.2	7.5	10	13.6	25	30	40	43	60	69	90	100	115
Hammer with ram in air (2,3)	ton	3.9	4.7	8.3	9.7	14.3	16.2	25.8	30.5	57.5	64	83	120	140	148	210	225	242
DIMENSIONS																		
Length hammer (4)	mm	6100	6850	7400	8055	8166	8900	9095	10390	11943	12715	14610	12795	14297	16090	16510	17335	18290
HYDRAULIC DATA																		
Oil flow	l/min	175	175	250	250	460	460	800	800	1600	1800	1800	2400	2400	3600	4400	4400	4800
POWER PACK TYPE																		
Recommended		P-175	P-175	P-250	P-250	P-460	P-460	P-800	P-800	on request								

HAMMER SC SERIES		SC-75	SC-110	SC-150	SC-200
OPERATIONAL DATA					
Max. blow energy on the pile	kNm	75	110	150	200
Min. blow energy on the pile	kNm	8	11	15	20
Blow rate at max. blow energy (1)	bl/min	50	45	45	45
WEIGHTS					
Ram	ton	5.7	7.9	11	13.6
Hammer with ram in air (2,3)	ton	9.8	14.1	18.7	26.5
DIMENSIONS					
Length hammer (4)	mm	6245	5755	6630	5730
HYDRAULIC DATA					
Oil flow	l/min	250	460	460	800
POWER PACK TYPE					
Recommended		P-250	P-460	P-460	P-800

POWER PACK TYPE		P-175	P-250	P-460	P-800
OPERATIONAL DATA					
Max. pressure	bar	350	350	350	350
Max. oil flow (5)	l/min	175	250	460	800
Power	kW	110	168	387	565
DIMENSIONS					
Length	mm	2613	3500	4030	4500
Width	mm	1200	1540	1545	1800
Height	mm	1775	2044	2225	2520
WEIGHTS					
Net. weight	ton	2.4	3.5	5.4	7.8
Weight incl. fuel and oil	ton	3.8	4.5	7.4	9.7

- |                |                          |
|----------------|--------------------------|
| Pile sleeves   | Printers                 |
| Sleeve inserts | Monitoring equipment     |
| Anvils         | Noise reduction packages |
| Pile cap       | Control cabins           |
| Winches        |                          |

NOTES

- 1 When using recommended power pack.
- 2 Hammer weight without anvil/pile cap and pile sleeve.
- 3 Sleeve and anvil dimensions and weight depend on application. Information on request.
- 4 Transport length.
- 5 All hamers and power packs can be operated using bio-degradable oil.



All data approximate and depend on final design and layout



## Head Office - The Netherlands

Sliedrecht

## Shipyards - The Netherlands

Hardinxveld-Giessendam  
Heusden  
Kinderdijk  
Krimpen aan den IJssel  
Sliedrecht

## Shipyard - P.R. of China

Dalian

## Shipyard - Serbia

Belgrade

## Sites - The Netherlands

Alblasserdam  
Apeldoorn  
Delfgauw  
Dordrecht  
Emmeloord  
Goes  
Hardinxveld-Giessendam  
Kinderdijk  
Sliedrecht

## Sites - P.R. of China

Shanghai

## Sites - Europe

Aberdeen - United Kingdom  
Blandford Forum - United Kingdom  
Komarno - Slovakia  
Riding Mill - United Kingdom  
Rijeka - Croatia  
Verberie - France

## Sites - USA

Houston, TX  
Wayne, NJ

## Sites - South Africa

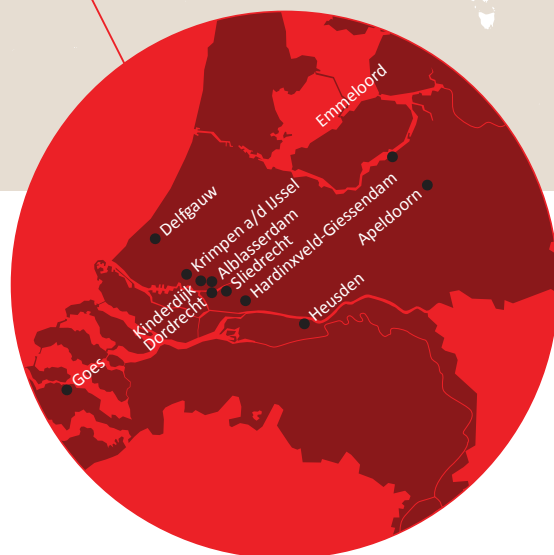
Cape Town

## Representative offices

Beijing - P.R. of China  
New Delhi - India  
St. Petersburg - Russia

## Regional IHC organisations worldwide

Dubai - United Arab Emirates  
Kinderdijk - The Netherlands  
Lagos - Nigeria  
Mumbai - India  
Singapore - Republic of Singapore  
Tianjin/Tanggu & Guangzhou - P.R. of China



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**The technology innovator.**