

# The Use of Piling Equipment Health and Safety Information

Foundation equipment and especially pile driving hammers are designed to transfer extremely high energy ratings from the pile driver to a pile and the soil beneath. The forces generated, either through impact or through vibration are so high that without proper maintenance and skilful operation the equipment has to be considered as:

## Self Destructive

Piling should only be carried out under the supervision of an appropriately qualified and experienced person who can assess that the work is carried out safely.



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# General Health & Safety Information for Method Statements

## Significant risks and important procedures

CONDITIONS UNDER WHICH THE HAZARD CAN OCCUR	
1	IN TRANSPORTATION TO AND FROM THE WORK SITE
2	IN RIGGING AND DISMANTLING ON THE WORK SITE - INCLUDING MOUNTING AND DISMOUNTING ONTO THE PILE ELEMENT BEING DRIVEN
3	IN SERVICE ON THE WORK SITE
4	WHEN TRANSPORTING AROUND THE WORK SITE - INCLUDING MOVEMENT BETWEEN PILE ELEMENT POSITIONS EXCLUDING (2) OF ABOVE
5	OUT OF SERVICE ON WORK SITE
6	IN STORAGE AT PLANT DEPOT OR ON THE WORKS SITE

Remember APE can only state details of hazards, as opposed to risk assessments, since the later is determined by usage, over which we have no control.






Piling Equipment should only be used by those workers and operators competent to do so.

Never allow young or inexperienced worker to operate piling equipment.







The Shoring Technology Interest Group of the CPA, has produced a publication, Safety in Shoring, which provides substantial information on products. The CITB is also offering a 3 day training course into the use of shoring and piling equipment. For more details please see the last two pages of this document, or alternatively contact APE on 01543 277680.

## Danger Area






This is an area defined as being within a 15m radius of the hammer. Personnel are at risk when within this area from:-

-  Falling piles - should the pile be handled incorrectly
-  Liquids or compressed air under high pressure and associated components
-  Mechanical failures of equipment components
-  Noise - wear noise PPE when inside this area
-  Unexpected overturning of the excavator or lifting gear.

## Always

-  Watch the hammer in operation. Some parts might unexpectedly fail, falling down and injuring personnel. Stop operation IMMEDIATELY before the situation gets from bad to worse.
-  Stop the hammer for a check should you expect the above could happen shortly.
-  Pay attention to irregular or unusual noises and analyse where they come from
-  Let the hammer cool down before starting maintenance or repairs on the hammers
-  Remove all tools and electrical cords before starting the hammer
-  Warn colleagues when you feel uncomfortable with the way that the hammer is functioning.

## Never

-  Adjust or repair the unit whilst in operation
-  Run the hammer in a horizontal position
-  Stand in close proximity to a working hammer
-  Continue operations when service inspection is due, or when repairs are necessary
-  Continue operation when it is known that one of the safety provisions is out of order or not working properly

APE's duty does not remove or reduce the hirers duty in accordance with current legislation. Authorised agents of the hirer, who are in charge of, or responsible for, the use and maintenance must ensure that the hammer and all it's auxiliary equipment remain in the good condition that they arrive at site. On arrival, should the unit be damage, do not accept or use a damaged unit.



## General Health & Safety Information for Method Statements

### Responsibility for the work equipment and imposed duty of regulation



Aldridge Piling Equipment's duty under the Health and Safety at Work Act and The Provision of Work Equipment regulations as amended - PUWER 98 Regulation 3 paragraph 3, is only to the extent that we have control over the equipment that we hire. i.e.

- To provide equipment that is suited to the task,
- To provide information and instruction on safe methods of work and residual hazards.
- The equipment being supplied has been inspected and maintained.

APE has no control over how the hirer uses the equipment, or any deterioration of the equipment that may occur during the hire. The principal hazards to be aware of include:

The lifting equipment operator must ensure that his communications are clear, understood, and followed by those on the ground. During piling he/she must watch out for any potential hazards.

Piling Equipment in general are highly stressed work equipment being designed to exert either vibration and/or impact. Both of which are known to:-

-  **reduce the strength or increase the loosening of fittings, which hold the assembly together**
-  **and accelerate structural deterioration.**

Therefore whilst the work equipment has been design and maintained to have superior robustness to suit its application, deterioration can still occur during normal use. This is exaggerated in situations were the equipment is being abused. Should the hammer appear damaged or its behaviour has become erratic or non functional, you must notify APE immediately for assessment and remedial action.

### PUWER Regulation 10 - Compliance with Community requirements.

At present, not all work equipment is covered by a product directive; nor are product Directives retrospective. However, equipment which was provided for use in the European Economic Area before compliance with the relevant product Directive was required, may need to be modified to comply immediately with regulations 11 - 24 of PUWER 98.

In practice regulation 10 means that you will need to check, for example, that adequate operating instructions have been provided with the equipment and that there is information about residual hazards such as noise and vibration. More importantly, you should also check the equipment for obvious faults. Products should also carry a CE Mark and be accompanied by relevant certificates or declarations, as required by relevant product Directives.

In general this has been interpreted to mean - with confirmation from the HSE, that all equipment first provided for use after 31st December 1992 needs to be CE marked and hence match the criteria of regulations 11 - 24 of PUWER 98. Any equipment provided before that date has to comply with legislation at that time.

All work equipment first introduced into APE's hire fleet after 31st December 1992 is CE marked and Copies of declarations of conformity are available upon request.

In addition this type of equipment is not deemed lifting equipment or lifting accessories and therefore is covered by the provisions of PUWER 99 rather than LOLER 98.

This has been confirm to APE by the HSE and a copy letter is available on request. Further the FPS code of best practice states that hammers, extractors and vibrators are NOT considered to be lifting accessories as they are part of the load.



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Note that certain accessory items which may be supplied with the equipment are classified as lifting equipment and are subject the requirements of LOLER.

## General Health & Safety Information for Method Statements

### **PUWER Regulation 14, 15, 16, 17, 18, 18, 21 & 24.**

This type of equipment is used remotely (up in the air on top of the pile i.e. not hand held) to the operator and power source (Compressor or excavator). As a result it is considered an extension of the power source. These regulations refer to lighting and start stop controls, which are considerably more complex than the work equipment to which it would be applied. Therefore the controls based on the excavator or compressor are deemed to satisfy these requirements. The Compressor or excavator which is required to power the hammer must be selected to allow for this.

On smaller air hammers where the operator is within reach of the equipment, simple ball screw air cocks are supplied to provide isolation from the energy source. The alternative to this would be the incorporation of electronic components to allow for remote control or access equipment to permit the operator to access the controls. Both are undesirable as they introduce additional hazards, compared to using existing controls based on the compressor, which ultimately controls the hammer through supply of fluid power.

### **Suitability of work equipment with regards to location of use**

#### **Working Conditions**

Piling Equipment should only be operated and driven on firm ground with clear visibility of the working area. The hammer must stay upright and horizontal (at all times) to avoid personal injury.





#### **Working near underground obstacles**

Before the start of any piling work it is up to the contractor to find out if there is any underground obstacles within the working area which could be dangerous to personnel. In the case of unforeseeable contact or damage of an underground obstacle, then work must be stopped immediately and the person in charge informed.

#### **Working near overhead cables**

When piling near overhead cables, electrical or otherwise, then the recommended safety distances should be maintained between the equipment and the overhead cables. When approaching overhead cables, pay attention to the movement of the hammer and its auxiliary equipment. In windy conditions the overhead cables will move, reducing the distance between the hammer and the cables - arcing may result.

Other precautions to avoid arcing could be:-

-  shutting down the cable
-  moving the cable
-  covering the cable
-  restricting the working area of the hammer.



### Working near buildings - Piling Vibrations

You must evaluate if you have a potential vibration problem and address the appropriate standards. All piling equipment which performs its function by production of impact or vibration, will introduce vibrations into the environment.

Equipment must be selected that suits the location of piling. It is the hirers responsibility to ensure that the equipment hired suits the location, since APE are often remotely situated from site and unless notified of site conditions and the nature of neighbouring buildings cannot provide advice on this matter. We cannot help you solve your problem, if we are unaware that one exists. Likewise we cannot be held accountable for any damage such vibration may produce.



Vibration forcing function	Typical range of structural response			
	Frequency range	Amplitude range	Particle velocity range	Particle acceleration range
	Hz	µm	mm/s	m/s <sup>2</sup>
Pile Driving	1 to 100	10 to 50	0.2 to 50	0.02 to 2

BS5228 states

V= Vibration level in peak particle velocity; C= Coefficient related to soil and hammer; W= Energy per blow or cycle; R= The horizontal distance from the piling operation to the point of interest.

$$V = \frac{1 \times \sqrt{W}}{r}$$

Building Type	No Cosmetic Damage
Max PPV below 50Hz	
Ruins and buildings of architectural merit	2mm/sec
Residential	5mm/sec
Light Commercial	10mm/sec
Heavy Industrial	15mm/sec

BS5228 part 4 relates to vibration caused by piling processes, and details threshold levels for distinct building types below known levels for cosmetic damage.

BS6472 relates to the human response to vibration, and possibilities of adverse comment - quite stringent since based at the level of complaint, rather than threshold for illness or property damage.

BS7385 provides threshold values in excess of the previous two standards, relating to levels likely to cause structural damage in building structures.

BS 7385-2:1993(ISO 4866) states

Minor damage is possible at vibration magnitudes greater than twice the above limits and major damage may occur at four times these tabulated values.

### General Notes

Vibration produced by pile drivers should not only be considered in terms of the physical shaking of a structure, but also in terms of possible settlement. Settlement of soils, can create voids beneath structures such as foundations or utility lines. If working near live gas pipes you should always seek advice from those responsible for the pipes. Whenever possible, have the supply disconnected.

In general impact hammers produce less vibration than vibrators, albeit at a lower frequency. Impact hammers have a far more localised effect.



Type of Building	Peak component particle velocity in frequency range of predominant pulse	
	4Hz to 15Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings	50mm/s at 4Hz and above	
Unreinforced or light framed structures Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15 Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

# General Health & Safety Information for Method Statements

## Noise

All piling products will produce quite high levels of noise, impact hammers typically more than vibrators. Specific noise data is available upon request, but generic information is included here. The noise output from using piling equipment is greatly determined by the type of piles driven, as often the piles will rattle when driven, creating high noise levels. Plastic piling is typically quieter than steel, with overlapping piles (allowed more movement) being the noisiest.

BS5528 provide guidance into the measurement of noise at a given site, as location, neighbouring buildings etc will affect the noise, through reflection.

You must always use hearing protection, typically one that is effective at absorbing noise at high frequency. Octave band analysis data is also available to aid with the appropriate selection of such protectors. Remember, the new noise at work regulations require you to not only assess and minimise the risk to workers, but also to monitor hearing levels.

### British Steel Publication - Noise and vibration in piling applications

In the table relating to a wide variety of piling hammers all air hammers are listed under the same generic levels, including the BSP No.200, BSP No.300, BSP 500N, BSP 600N and BSP 700N. The Leq at 10 metres is listed as 105 dB(A), and at 30 metres 95 dB(A). With a generic double acting air hammer stated as having a LWA of 134 dB(A).

### BSP International Foundations Limited (Air hammer manufacturer) 7/3/96

Has stated that all double acting air hammers produce a sound power level, when driving steel sheet piles of between 130 -145 dB(A). The Leq for the BSP No.300 at 15 metres being 107 dB(A), as there is a reduction of 6dB(A) for every doubling of the distance. Therefore the Leq would be 101 dB(A) at 30 metres.

### BS 5228: Part 4: Section 2, page 10

In the table relating to a wide variety of piling hammers two reference are made to an air hammer matching the specifications of the BSP 600N i.e Energy, power rating 415 Kgf.m. The Sound Power level LWA being 131 dB(A) and 134 dB(A). With both instances using the hammer to drive piles in sandy clay ground overlying boulder clay. The Activity equivalent continuous sound pressure level LAeq at 10 metres (1 cycle) being 103 dB(A) and 106 dB(A) respectively.

### HSE Noise in construction publication IBD(G)127L Revised

States that the likely noise exposure for a piling operator will be 84+ dBA) LEP,d that for a piling worker this level is increased to 100+ dB(A) LEP,d.

### Institute of Sound & Vibration Research at Bircham Newton 1976

A specific trial was arranged to assess the noise levels produced by a wide range of piling equipment

Equipment	Peak dB(A)	Leq (5 min) dB(A)
Double acting air hammer	107	107
Vibratory driver	78-95	80
Hydraulic Hammer	83+-3	72



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- using the right type of equipment for the job
- hiring the right amount of equipment
- working safely

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Safety in Shoring: The Proprietary Shoring and Piling Equipment Manual

# Safety in Shoring

## The Proprietary Shoring and Piling Equipment Manual



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