



Operating Instructions

ESF03 Piling Vibrators

These operating instructions include substantial health and safety information and as such are useful when compiling method statements and risk assessments.

THIS VIBRO HAS THREE HOSES TWO CONNECT VIA QUICK RELEASE THE THIRD, THE DRAIN LINE CONNECTS BY THREADED FITTINGS, PLEASE ENSURE THE DRAIN IS FITTED.

WHEN FINISHED PLEASE DO NOT WRAP HOSES ONTO A HOT POWERPACK, THIS WILL MELT THE BURST PROTECTION AND POSSIBLE DAMAGE THE HOSES.

Scope

This document pertains to our range of ESF Piling Vibrators, specifically the ESF03, these are piling equipment designed to clamp the sheet pile, and drive or extract using powerful vibrations. The ESF range can be excavator mounted (and subject to crowd force) or crane suspended. In common with other excavator mounted attachments, these piling vibrators can be powered off the excavator hydraulics, but preferably are supplied with their own independent power packs; independent packs ensure the optimum supply of uncontaminated hydraulic power.

ESF Piling vibrators are as used to drive and extract sheet piling, trench sheeting, pile cages, plastic piling, mandrels and driving caps. Compared to traditional piling and rig based methods; the length of pile driven is relatively short - 4 metres or less - typically limited by the reach of the excavator. In crane suspended mode, please ensure you do not exceed the maximum pile mass for a specific size of piling vibrator, this is typically equivalent to the total weight of the vibrator.

EMV's are available in different shapes and sizes to accommodate these different types of piling, and of course different excavator sizes. The scope of this document is also limited to the supply via Non-Operated Hire; where by the owner of the equipment has little to no control in how the equipment is used. Owner operators may seek alternative guidance direct from the manufacturers.



This equipment must be used by experience and competent operators and never by young trainees.

Avoid any personal contact with the hydraulic clamp cylinder - any use of this cylinder other than what it is intended for i.e. the clamping of the pile element, is inappropriate and extremely dangerous.

The ESF range are not designed to lift, carry or pitch piles, please ensure other means are used to locate the pile prior to attaching the vibrator and driving or extracting.

When extracting sheet piles, once the pile is loose by still stable, detach the vibrator and lift the pile out using plate grabs or quick release shackles.



Basic Safety Points

All pile driving equipment is technically self-destructive; abusive and inappropriate use will accelerate such damage and wear. Just because this type of equipment is capable of a task, does not warrant that it was intended or designed for that task. To use this equipment for anything, other than which it was intended for is equipment abuse and is dangerous. Piling vibrators are designed to drive and extract sheet piling, trench sheeting, pile cages, plastic piling, mandrels and driving caps. If in doubt as to the suitability of the equipment for a specific task outside this definition; call your hirer and seek clarification.

Examples of inappropriate use:

- Using the piling clamp of the vibrator as a retractable sling location.
- Using the piling vibrator as a grab.
- Using the piling vibrator to lift and carry objects, such as sheet piling, across site
- Using the vibrator in any position other than vertical.
- Driving excessively long and heavy piles that exceed the limits of the equipment
- Extracting piles installed using much larger, more powerful pile driving equipment
- Using the piling vibrator for excessive periods on refusal

When in use:

- There should be visual contact between the operator and slinger (spotter) at all times.
- Monitor the piling operation constantly and stop the process immediately if any danger occurs.
- Consider excavator stability at all times, unlike piling rigs excavators seldom operate from a purpose build working platform.
- The equipment should be checked for defects every day and before putting into service. The frequency of checks should increase as the task become more difficult.
- This equipment must be used only by experienced operators, and never young trainees.
- Operate an exclusion zone around the hammer when in movement or in use, never have anyone underneath the pile driver.
- Check condition of any associated lifting accessories and pay attention to the SWL at all times.
- The working area should be properly illuminated.
- The vibrator can become hot during operation, allow to cool and do not touch unless wearing appropriate protective clothing

Responsibilities

The Hammerman Equipment PPC is responsible for the provision of equipment in good condition, suited to the task (based upon information provided) and to provide suitable information on existing and residual hazards. The equipment supplied has been inspected prior to the hire and maintained. The Hammerman has no control over how the hirer uses the equipment, or any deterioration of the equipment that may occur during the hire.

The hire of non-operated plant carries more responsibilities for the hirer; it is often misconceived as a means of securing plant cheaper. The hire rate charged covers the use of the equipment, and in the event of a breakdown, occurring as a result of wear and tear (not abuse or neglect), for personnel to attend to this, either through repair at site, exchange of equipment or through the return to the plant hirer facilities.

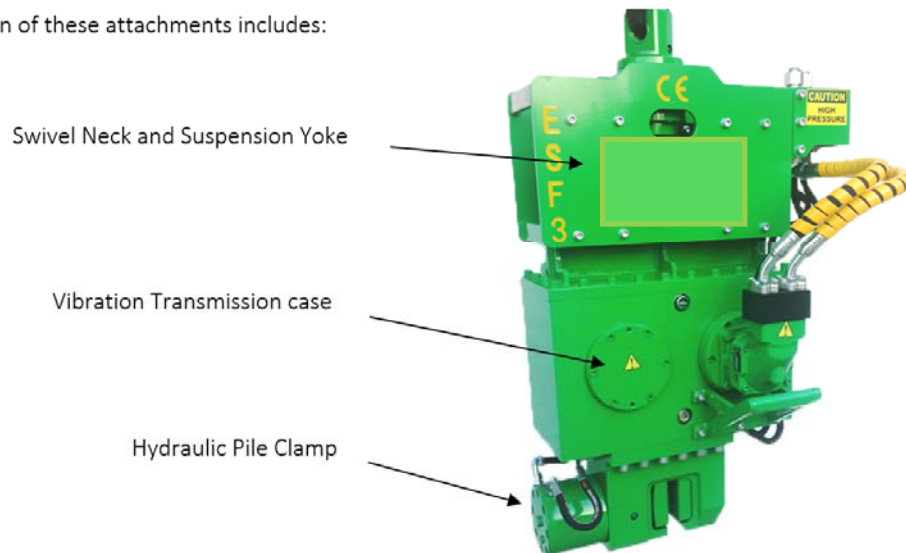
The rate does not cover basic checks and maintenance as this is the hirers' responsibility. These are outlined below and specifically within the operating instructions provided by the owner/supplier/manufacturer.

Key responsibilities for the hirer

- To provide a trained and competent person to operate the equipment safely and within its limits.
- Ensuring that the equipment is not abused and used safely, in accordance with the operating instructions.
- Daily, weekly and pre-use checks on the equipment as detailed in the operating instructions, and outlined here. Thereby, monitoring the condition of the equipment, to ensure that it is, and remains in, a condition fit and safe to use.
- Ensuring all nuts, bolts, hoses and connections are tight. The vibrations produced by the pile driver, will always serve to loosen couplings. You must therefore ensure that the operator is equipped to tighten nuts, cap screws etc. Where the owners' representative have to return to site to tighten fittings on hoses or the unit – this should be chargeable.
- Keeping all accessory items in good condition.

Component Identification

The basic design of these attachments includes:



Fitting and Operation when connected to an Independent Powerpack

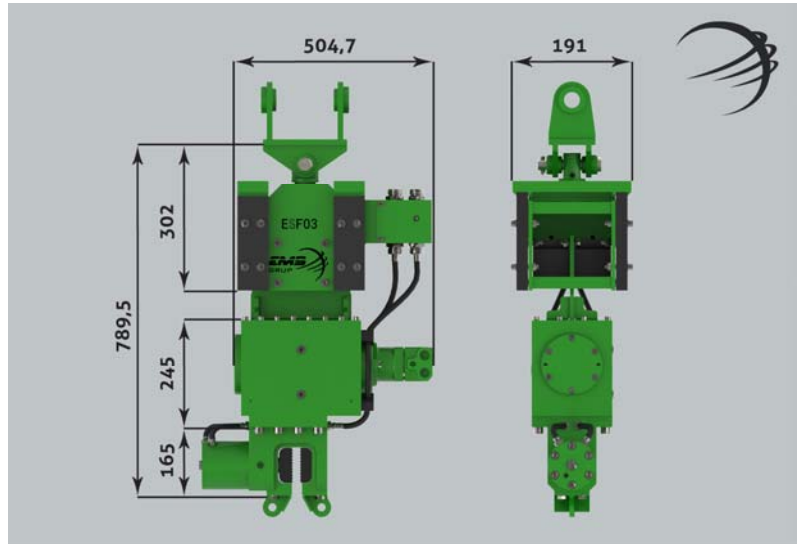
The ESF 03 & 1 units are all available with bespoke power packs, these will power the unit to its optimum, and prevent cross contamination and dirt ingress.

The ESF03 is supplied with a 20 - 44 lpm powerpack, modified for a directional control valve, three hoses, a feed return and direct drain to the hydraulic tank. The pressure and return hoses fit through manual directional control valve and so it will not matter which is connected to the P or T line on the unit, as it will simply reverse the operation. In the standard configuration moving the joystick to the left will close the clamp and start the unit vibrating. To maintain vibration you must keep the joystick in this position. If you release the joystick, it will return to a centre position which will stop the flow, resulting in the vibration stopping, but the clamp will remain closed. Moving the joystick to the right will open the clamp, again if you release the joystick the centre position will cut of the flow and so in this instance the clamp will remain open.



Vibrator Specifications

Model		03
Centrifugal force	kN	33
Eccentric Moment	kgm	0.33
Frequency	rpm	3000
Amplitude	mm	5.5
Total Weight	kg	160 - 190
Dynamic Weight	kg	120
Power	kW	8.8
Flow	l/min	30
Pressure	bar	150
Max crowd force (Push)	kN	10
Max Line Pull	kN	15



The hammer weight varies according to whether or not the ballast weights are added to the unit. These additional weights (30kgs) are required as reaction mass.

Powerpack Specifications

Engine	Vanguard V-Twin	Hydraulic Oil	ISO 32 or equivalent
Fuel Tank Capacity	8.5 Litres	Connections	1/2" BSP Flat Face P T and 1/2" BSP Drain
Fuel Type	Unleaded	Length	910mm
Power	13.4 kW	Width	600mm
Flow lpm	40lpm + 10%	Height	760mm
Working Pressure	100 Bar	Weight	140 kgs
Max Pressure	138 Bar	Noise measured	100 dB L _{WA}
Hydraulic Tank Capacity	22 Litres		



Starting the Powerpack

Pre-Checks

- Check engine oil and hydraulic oil levels
- Check the condition of hoses and connectors
- Check the cooler matrix is clear
- Check the tightness of fasteners
- Check powerpack for signs of damage, including signs of oil or fuel leaks.



Ensure that the powerpack is in level ground as operating the machine at an angle greater than 20 ° may cause the engine lubrication system to fail and in turn damage the engine.

Ensure that the powerpack is far enough away from combustible materials and there is adequate ventilation for the removal of exhaust gases

Make sure that the flat face coupling (if disconnected) are clean. Ensure that the ON/Off lever is in the flow off position. Ensure that the hoses are connected from the pack to the pile driver.

The powerpack has a key ignition in addition to the traditional starter cord. Move the key to the on position and pull the cord to start the engine. When using the starter cord, care must be taken as the starter cord kickback will pull your hand and arm towards the engine faster than you can let go. Therefore when starting the engine (other than through key), pull the starter cord back slowly until resistance is felt and the pull rapid to avoid kickback. To start the engine of the powerpack:

1. Turn the fuel shut off line to on (A), this has the black handle and is twisted 90 degrees downward, this valve using an extension cable which easily comes off, so please be very careful of this. If it does come off it is relatively easy to reconnect.
2. To start a cold engine, move the choke lever to the closed position. To restart a warm engine leave the choke lever in the open position.
3. Move the throttle control to the fast position, and operate engine in that fast position.
4. Turn the key ignition and then pull the starter cord.



5. To power the piling vibrator open the flow valve on the front of the power pack to the Flow on position. The operate the manual direction valve as previously stated.

To stop the engine in an emergency, simply turn the Ignition key to the OFF position. Under normal conditions follow the following procedure:

- Move the throttle lever to the slow position
- Turn the engine switch to off
- Turn the fuel valve lever to the OFF position.
- Turn the flow valve to the off position.



Fitting the Piling Vibrator to an excavator

As previously stated the EMS series vibrators can be physically mounted or suspended, and likewise they can be powered by a separate powerpack or directly off the excavator. When fitting to an excavator EMS's should only be fitted by those trained and competent to do so; often a hirer will supply a trained service technician to make the necessary connections.

Electrical connection

The EMS range are fully hydraulic and so require no electrical connections.

Hydraulic connection

All EMS's have three hoses that need fitting to the excavator, Pressure (P), Return (T) and a Drain (D). The P and T Lines need to be reversible (bidirectional) to enable proper clamp function of the EMS. These hoses preferably fastened using threaded or flange fittings rather than quick release fittings. It is appreciated that quick release fittings are a major time saving device on site, reducing leakage of oil from hoses when the attachment is removed or reconnected. However, when used in conjunction with piling vibrators, they can prematurely fail and cause pressure issues.

When quick release fittings are supplied at the request of the hirer to facilitate repeated connection and disconnection, they must be limited to use on the P & T hoses. Any use of quick release fittings on a drain line, can create back pressures damaging motor seals and void warranties.

Historically, to ensure a reversible P & T lines hoses were connected to the bucket ram hoses, however with the increased mechanical connection to quick hitch devices, it is more standard to fit to an auxiliary circuit. Likewise the drain line, can be fitted to an auxiliary return line, so long as it has an unrestricted route back to tank (no back pressure); and clearly if not already used for the P or T lines. In the event that no addition auxiliary line is available there are a number of locations that the drain can be connected to including: Redundant or surplus valve ports, teeing into existing drains, such as a slew drain, via main valve manifold using a tee or simply using a modified tank plate.

Mechanical connection

These vibratory attachments are designed to be mounted directly to the dipper or if fitted with a shackle suspended from the excavator. The former permits addition crowding force that increases the reaction force and makes piling more effective. Albeit it does apply addition side loads to the driving process, also due to the presence of two separate single pin linkages on the vibrator, this creates pivot points. This design does reduce positioning control, when compared to such attachments as compactor piles; but this is deliberate and inhibits the application of levering forces, that would result in equipment damage. It is important that the shear pin is properly bushed to prevent wear on the bracket.



Quick Hitches

A quick hitch is a device design to facilitate the fast interchange of attachments on an excavator. The connection of a quick hitch, a device designed to remotely release, to a piling vibrator, a device designed to produce high levels of vibration, will never be as safe as a direct connection of the piling vibrator to the excavator. The key issue here is the unexpected release of the attachment.

It is also known that quick hitches can be used to apply additional push (levering) forces on to the attachment. Damage may not be instantaneous, but such use has shown to damage the swivel neck, elastomers and clamp. Each resulting in breakage or unexpected release of the attachment, or components of that attachment.

One problem with excavator mounted piling vibrators is the maximum height of the pile that can be driven, due to limitation in reach of the excavator. Stretching to drive long piles, can damage the piling vibrator, pile and potentially the excavator. Quick hitch use reduces the available height for sheet piling further, increasing the chance of inappropriate loading of the attachment.

However, with the high prevalence of quick hitch use, it would be unrealistic to expect the site not to use quick hitches with piling vibrators; indeed, quick hitch removal is not without risk. It must be said this is one application where market forces have determined the need for a solution. The vast majority of site problems occur as a result on some action attempting to save time. Quick hitches are one such area, where the time saving is clear, but the safety in use is compromised.

The CPA Safe Use of Quick Hitches on Excavators, Strategic Forum for Construction Best Practice Guide Reference No. CPA 1001. Is the first publication to actually state:

**It is essential that attachments are always fitted to both jaws of a quick hitch.
Attachments must never be attached to the quick hitch by a single pin.**

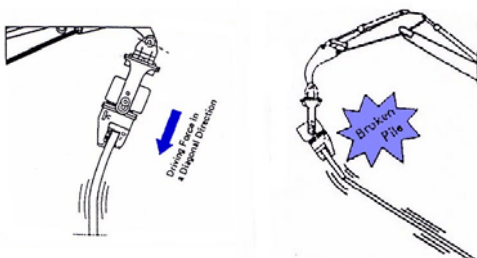
In the CPA guide, the suggested means of attachment to a quick hitch is via a bespoke adaptor bracket, such as the one shown in the photos below. Please also note that, it is now becoming more common for certified lifting points to be added to this location. This eliminate the need to use the clamp to lift piles. This lifting point is now governed by LOLER rather than the pile driver itself.

When excavator mounted or during extraction using a crane, pay attention to the rubber elastomers. Ensure that these do not become over stretched as they will tear.

During pile extraction always ensure that the vibrator is operating prior to applying line pull, else damage to the elastomers will result.

Care must be taken when pushing down on the excavator to avoid damaging the pile through the application of side loads. Excavator do not push down straight, but also forward and so effort and some skill is required to adjust the position of the excavator to ensure that the vibrator remains straight at all times.

If site find this too difficult suspend the



Limit Conditions

As with all machinery there is a limit as to the operational conditions under which the machinery is expected to operate. In the most basic sense the installation is taking far too long or simply not at all. Within piling, when the sheet effectively stops moving a conditional of refusal has been reached. Using equipment beyond refusal is damaging to the equipment and can lead to breakages and the hazards. The most common symptom with vibratory equipment is that they get very hot. The effect of heat is to reduce the life of seals, hoses and bearings. Leakage is a common symptom.

When refusal is reach you must use a more powerful vibrator, change to an impact hammer or pre-auger to loosen the ground. For vibratory driving STIG defines these limit conditions for REFUSAL and REBOUND as follows:-

Refusal - under normal predictable and reproducible conditions, refusal is defined when the penetration rate (time count) exceeds 5 minutes per 0.25m. The penetration distance of 0.25m is absolute, i.e. No conversion is allowed to, for instance, 60 minutes per 1 metre penetration.

Rebound - This occurs when a large portion of the hammer's energy is "bounced" back up into the pile as a result of force reflection at the pile tip due to the pile hitting a nearly impenetrable layer or obstruction. The rebound forces will be transferred back into the hammer and the suppresser head, as a result the head will start "jumping" relative to the vibratory case. In this situation driving should be stopped immediately or the hammer be retracted.

Suitability of work equipment with regards to location of use

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 the owner will often be remotely situated from site and unless notified of site conditions and the nature of neighbouring buildings cannot provide advice on this matter.

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.

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.

Transporting the vibrator

When transporting the vibrator, ensure it is placed correctly in the stand. Once in place on the stand the jaws must be closed. Release hydraulic hoses from the excavator (the jaws will remain closed) and cap the hose ends to prevent contamination. Disconnect the vibrator from the excavator.

Transporting piles on site

When first introduced nearly 20 years ago, it was clear that the methodology conceived for this equipment, included an element of lifting. However, this was clearly a lift from a localised stack to the position of piling works, so within the 15m exclusion zone stated. Unfortunately, it has become apparent that many sites take this too far, it become fairly common practice to use the piling vibrator to not only lift a pile, but also to carry across site. The equipment is not designed for this, and this is one instance where capability exceeds intent. Following several instances, where piling vibrators have dropped piles, resulting in safety reviews, there has been a high level of demand to get such equipment covered by LOLER rather than PUWER. To prevent this unnecessary burden, it must be stated that on no account should a piling vibrator be used to lift or carry piles or other objects in a movement that requires the excavator to transverse. Controlled pitching of piles, from a nearby stack is permissible through slow controlled slew movement. Exclusion zones can be created to minimise the risk of falling piles, however, if this is still an issue on site, please use alternate lifting equipment or lifting points incorporated on quick hitches or EMV brackets.

Noise levels

The majority of information on noise from vibratory pile drivers is generic, as the noise is of a constant pitch when compared to impact hammers, and sometime can be hard to differentiate between other equipment operating at site. Max noise levels will clearly occur when the hammer is vibrating. Other factors can influence noise such as working is enclosed spaces, driving steel or plastic piling etc.

<i>Ambient air temperature</i>	21°C
<i>Air pressure</i>	1020 hPa
<i>Wind velocity</i>	<1m/s
<i>Reference Parallelepiped d dimension</i>	10.0m x 3.4m x 3.0m tall 1.0m

Sound Power Level



Hazard narrative for Piling Operations

Notes: The following hazard list applies specifically to the following types of hammer: excavator mounted (EMV) type, suspended (remote power-pack) type.

The following standards apply specifically to piling operations:

BS EN 996:1996 - Piling equipment. Safety requirements

BS 5228:Part 1:1997 - Code of practice for basic information and procedures for noise and vibration control

BS 5228:Part 4:1992 - Code of practice for noise and vibration control applicable to piling operations

Many hazards associated with piling equipment can be avoided if a personnel exclusion zone of 15 m is maintained around the pile during piling operations. Operators must be trained and competent in the operation of piling equipment. Both the operator and his supervisor should be made familiar with the operational controls and the supplier's instructions of the specific piling equipment in use.

Personal protective equipment e.g. gloves, hardhat, goggles, ear defenders, high visibility jacket etc should be used when necessary during piling operations.

Pile driving hammers are designed to transfer extremely high loads from the hammer into the pile and the surrounding soil. The forces are so high

Vibratory Hammers		
Hazard Associated with Activity	Precautions to be taken to reduce the risk	Comments
4.1 Crushing Hazard	Keep hands clear of the clamping mechanism	
4.2 Pile falling from clamp	<p>Ensure operator is trained and competent and familiar with the operational controls of the specific equipment in use.</p> <p>Ensure that the hydraulic hoses are in good condition.</p> <p>Ensure that the correct safety chain is fitted and is within certification and of sufficient capacity for the pile being lifted.</p> <p>Ensure that the retainer works correctly and is used at all times.</p> <p>Operatives should as far as is reasonably practicable stand clear from the slung pile whilst it is being traversed into position.</p>	<p>Ensure that the supplier's instructions have been supplied with the equipment.</p> <p>The safety chain is prone to accidental crushing by the clamping device; care should be taken to avoid this.</p>
4.3 Noise	<p>Follow guidance in BS 5228 (see Note 2 above)</p> <p>Maintain 15m-exclusion zone (see Note 3 above)</p> <p>Operatives must wear ear defenders at all times.</p> <p>If power-packs are insulated for sound, keep access doors shut.</p>	
4.4 Vibration	<p>Follow guidance in BS 5228 (see Note 2 above)</p> <p>Maintain a 15m-exclusion zone as noted above.</p> <p>Use high frequency or resonant free type vibrators.</p>	Resonant free vibrators can significantly reduce effects of vibrations to personnel and structures during the critical start up period of the vibrator.
4.5 Settlement	Seek professional advice in sensitive locations.	
4.6 High pressure fluid injection	<p>Ensure all hydraulic hoses and fittings are in good condition.</p> <p>Fit burst protection guards to hoses.</p> <p>PPE should be worn at all times.</p>	Equipment should be inspected at the start of each shift or if the operator suspects that the hoses have become snagged during piling operations.
4.7 Failure of swivel components	Regular inspections of the swivel connection including all pins and retaining clips should be carried out.	Equipment should be inspected at the start of each shift.



The Hammerman Equipment

Unit 19 Cinder Road
 Zone 3 Burntwood Business Park
 Burntwood
 Staffs
 WS7 3FS

www.plasticpiling.co.uk



The worlds smallest piling vibrators