



Federation of Piling Specialists

NOTES FOR GUIDANCE ON PUWER

(REGULATIONS 11 & 12)

IN RELATION TO

GUARDING AND CLEANING OF AUGERS ON PILING OPERATIONS

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1.0 INTRODUCTION

1.1 The Federation of Piling Specialists (FPS) Auger Safety Working Group was formed following a meeting with the Health & Safety Executive (HSE), in April 1999. The working group included representatives from the FPS, HSE and rig manufacturers.

1.2 These guidance notes seek to identify a practical approach to The Provision and Use of Work Equipment Regulations (PUWER) 1998, as they apply to rigs used in the bored piling industry. After much discussion regarding the practicability of such requirements it was decided to form a working group to consider how to best implement PUWER. Subsequently it was decided to form two working groups: -

A Federation of Piling Specialists (FPS) chaired working group to consider continuous flight auger piling, rotary bored piling, displacement auger piling and limited access augered piling.

A British Drilling Association (BDA) chaired working group to consider small diameter drilling and mini-piling.

1.3 These guidance notes cover continuous flight auger, rotary bored piling, displacement auger piling, and limited access augered piling, as outlined below.

2.0 PILING SYSTEMS

2.1 Continuous Flight Auger Piling (CFA Piling)

With this type of pile the auger or digging tool extends over the full depth of the pile bore. Generally the auger is screwed into the ground in one pass although there are some variations involving telescoping masts or locking drive bars. On completion of the boring process concrete or grout is pumped through the stem of the auger as the tool, which is loaded with spoil, is extracted.

Spoil emanates at the surface as a result of displacement during the boring process as well as during the concreting or extraction process. The spoil is removed from the proximity of the pile by some form of excavator.

2.2 Rotary Bored Piling

The primary means of excavation for this type of pile is by auger, digging bucket or barrel. The tool is rotated by a Kelly bar powered by either a mechanical or hydraulic rotary table.

The excavation cycle consists of the tool being lowered into the pile bore, rotated to load the tool and then withdrawn fully loaded. Once the tool is above the ground the rig is commonly slewed off the bore and the spoil is discharged. Each digging cycle typically advances the bore up to 500mm, thus each pile consists of a large number of repetitive cycles.

2.3 Displacement Auger Piling

A variety of displacement auger piles are now being utilised in the UK. Here the tool is designed to displace the pile spoil laterally into the ground thus either eliminating or significantly reducing the volume of spoil emanating at the surface. The tooling is similar to rotary bored piling in the context of this report in that a drilling head is generally driven by a smooth shaft at a low rotational speed.

2.4 **Limited Access Augered Piling**

The FPS differentiates between mini-piling and other bored piles on the basis of diameter in that less than 300mm is classed as mini-piling and 300mm to 600mm is classed as small bored piling. When access is limited (e.g. headroom, width or weight restrictions, etc) smaller 'limited access' piling rigs may be employed to do small (i.e. greater than 300mm diameter) bored piles with the depth of pile being achieved by adding lengths of auger/casing. The bore is advanced to the required depth using an auger (either CFA or kelly). Casings may also be used to provide support. To permit concrete or grout to be introduced the tool is either withdrawn or the materials can be pumped through the stem of the tools in a similar fashion to CFA piling.

(Augered mini-piles of less than 300mm have traditionally been undertaken by small rotary drilling rigs and for guidance with regard to drilling rigs installing piles of less than 300mm diameter, reference should be made to the BDA Guidance Notes. Similarly any system using rods would be dealt with under the Guidance from the BDA)

GENERAL REVIEW

3.1 The PUWER

These guidance notes are concerned with Regulations 11 and 12 of PUWER. An extract is appended to this document and it is recommended that this be read in full. (There is also a listing of relevant documents in appendix B). In summary Regulation 11 requires an employer to take measures to prevent access to any dangerous part of machinery or measures to stop the movement of any dangerous part before a person enters the danger zone. With regard to the measures to be taken there is a strict hierarchy of options which need to be examined in terms of their practicability. They are ranked in order of importance as follows:-

Fixed guards

Other guards or protection devices

Protection appliances

Training, supervision, instruction and information

The employer must fit the guarding to comply with the highest practicable level in the hierarchy. He may only fit a lower level of guarding if it is evident that the higher level is not practicable. It means that, for example, only if it can be demonstrated that a fixed guard is not practicable can other guarding be considered. Similarly training and supervision can only be adopted as the sole control solution if the measures of the three higher categories are demonstrably not practicable.

Notwithstanding the recommendations below, the working party believe that training, supervision etc must be maintained at a high level on piling sites. In addition the Management of Health and Safety Regulations require that all operations be the subject of a risk assessment.

The word practicable has been defined by legal case law and is an extremely stringent test. It is important to note that the law does not consider cost to be a relevant factor in the determination of what is practicable. Regulation 12 is concerned with protection against specific hazards. In this note the hazard being considered is the ejection of spoil from piling equipment. This is considered to present a particular hazard when ejection could occur at some height above the ground.

3.2 **Historical Context**

The FPS has for many years sought to minimise accidents and incidents. It has a very active safety and training committee which enables members to share experiences and difficulties in order to achieve improvement. All members inform the FPS of notifiable accidents on a quarterly basis and the causes and remedial measures are discussed at length. Since 1994 such reports have been related to various factors (e.g. age, time of day, etc., and, in particular, the piling system has been recorded).

The subject of auger guarding and cleaning has been reviewed with the benefit of this information and in the context of the PUWER. The following observations are made for each of the piling systems being considered.

3.3 **Continuous Flight Auger Piling**

3.3.1 The guarding on CFA rigs has been the subject of much discussion. It is apparent that a certain amount of guarding can be provided over the lower area of the auger string. Adequate protection can be achieved by extending the gate (guide) which is used to maintain the position of the augers. This is present on the majority of rigs used for CFA piling. The gate needs to be opened to allow the piling rig to achieve its full depth and to facilitate the rigging of the augers. Larger guards which could accommodate the rotary table can be considered but these will still need to be opened, or entered within, for rigging purposes.

Additionally they do not allow work immediately adjacent to structures, especially in corners. To be acceptable, when anyone has to enter the danger zone, the auger must NOT be rotating.

- 3.3.2 During the drilling process spoil rises to the surface as a result of displacement of the auger volume and bulking of the strata. The amount of spoil that arises can be quite large. Normally excavators are used to remove this spoil. The bottom of the guard has to be above ground level to allow spoil to be removed. The height of the top of the guard has to be such as to prevent personnel coming into contact with the auger but there also needs to be due regard to the means of auger cleaning. A survey of a number of piling projects has been carried out and the current proposed means of auger cleaning reviewed. The recommendations for dimensions given in section 4 arise from these.
- 3.3.3 Of much greater seriousness is the incidence of spoil either being ejected or becoming detached from augers at various heights above ground and falling. This has caused injuries to personnel adjacent to the auger. This situation is of concern to the members of the FPS. Several methods and procedures have been tried with differing degrees of success. All members believe that action is needed in this area and that the development of suitable cleaners would mean significant progress.
- 3.3.4 A variety of means of cleaning have been examined. There are obvious problems with manually cleaning the auger using conventional hand held tools. This method is not viable for the larger diameter of pile and for ground conditions which make the removal of spoil from the auger very difficult. This method would only be legal when the auger is not rotating.

- 3.3.5 An attendant excavator can be used to remove spoil but this generally requires the bucket to be adapted and the 'local' driver to be trained to undertake this task.
- 3.3.6 Dedicated mechanical cleaners can be classified into two groups. The first clean from the side and use the rotation of the auger to facilitate the removal of spoil (e.g. the star wheel, the FPS/Kvaerner cleaner). The second rotate around the auger and are made by several manufacturers (e.g. Soilmec, Casagrande, Dawson)
- 3.3.7 The Federation of Piling Specialists have developed, in conjunction with Members, a rotating wire brush cleaner which removes the spoil in most soil conditions although it is not entirely successful in stiff clays. Details of this and other cleaners can be obtained from the Secretary of the FPS.
- 3.3.8 It is believed that both groups of mechanical cleaner can be used to effectively and safely clean augers. The ones that clean from the side are probably at their most effective on the smaller diameter of pile and the rotary cleaners will have their greatest use on the larger diameters.
- 3.3.9 If the cleaners themselves rotate then appropriate measures (eg guarding) will be required and the discharge of spoil must be such as to not cause a hazard.

3.4 **Rotary Bored Piling**

- 3.4.1 It is not practicable to introduce guards into this process which would themselves cause a greater hazard. However temporary casings can be used to provide ground support at the surface. They also prevent personnel accidentally slipping into the bore and ensure that loose material cannot fall into the bore during the reinforcing or concreting cycles. Extending this casing to project above site level provides some protection during most of the boring process.

3.4.2 In the recommendations in Section 5.0 consideration will need to be given to the hierarchy of measures detailed within PUWER, Regulation 11.

3.4.3 The digging tools used in rotary piling vary according to the strata being excavated and include augers, digging and cleaning buckets and coring barrels. Since the buckets generally discharge directly onto the ground or spoil heap with no rotation, this guidance note only considers the cleaning of augers.

3.5 **Displacement Auger Piling**

3.5.1 Whilst this system is currently only a minor part of the existing UK bored piling market its use is likely to increase.

3.5.2 Being displacement piles, spoil is not an issue. The general nature of these systems is described above.

3.5.3 The rigs used to install displacement auger piles are the same as those used to install CFA piles. It is envisaged that the measures taken to meet the PUWER, regulation 11 for CFA piling will be equally applicable to displacement auger piling.

3.6 **Limited Access Piling**

3.6.1. Limited access piling generally comprises smaller rigs installing piles of 300 to 450mm diameter. However this guidance is also applicable to greater size of pile installed by means of extending the auger string to reach the required depth. Though generally limited in height these rigs may be of large dimensions in plan and be used for forming piles up to 600mm or more in diameter.

3.6.2 Short lengths of auger (or unflighted stem) , typically 1m to 3m long, are added to the auger string until the required depth is reached. It is necessary for the

rotary table to travel close to the ground given the restricted height of this type of rig. New lengths of auger are added either by manual means alone or with the assistance of the auxiliary winch. Similarly short lengths of casing may be added. Neither augers or casings should be fitted whilst the auger is rotating with the guard open.

- 3.6.3 On extraction, short lengths of auger/casing are removed requiring repeated access by the crew to the head of the auger string with the rotary table needing to pass up and down the full length of the mast. It is essential for the spoil arising to be handled as it is extracted so that there can be safe access for handling of the auger string, etc.

4.0 CFA PILING : RECOMMENDATIONS ON GUARDING AND CLEANING

4.1 CFA Piling : Guarding

- 4.1.1 The guard on the rig should be kept closed whenever the auger is turning, except as noted below. Should manual intervention be required then the auger must be stopped.
- 4.1.2 To enable spoil emanating from the pile during drilling to be removed whilst constructing the pile, the bottom of the guard should be no more than 500mm above ground level; or 750mm above ground level if the spoil is removed by an excavator, with no one else in the vicinity of the machine, other than the driver in the cab of the rig.
- 4.1.3 The top of the guard should be at such a height above ground level as to preclude personnel coming into contact with the auger in normal usage. This height will be dependent on the shape of the guard but typically the level of the top should be 2.0 metres above ground level.

- 4.1.4 On some rigs a mechanical cleaner may also be used as a guide. If it is to provide guarding then it would either need to be fixed or have limited movement such as to maintain the required dimensions of guarding (see above).
- 4.1.5 It may be necessary to open the guard towards the end of the boring cycle to facilitate the lowering of the drill head to ground level. If such an event is necessary then the gate must be opened remotely and no personnel should be in the area of the open gate whilst the auger is turning. Alternative guarding arrangements will also need to be made if any personnel are, or can be, within such proximity of the auger as to make contact. The guard should be closed as soon as the rotary table is above the level of the gate during the extraction or concreting cycle.
- 4.1.6 Many rigs have fixed access on the mast, which could enable personnel to come into close proximity of an unguarded auger. The auger must not be rotated when personnel are using such access. It is recommended that the bottom of such ladders are removed whilst augering is in progress.
- 4.1.7 It is deemed good policy that no one should be working in the specific vicinity of the rig without the knowledge and permission of the piling crew and it is recommended that suitable visible signage be placed on the outside of the rig to indicate this. A full risk assessment should be made for each site prior to commencement of work.

4.2 **CFA Piling : Cleaning**

- 4.2.1 All CFA augers must be cleaned to prevent spoil being raised to such a height above ground level as to cause injury in the event of the spoil becoming dislodged. Given the guarding it is envisaged that cleaning will take place between 2 and 4m above ground level.

- 4.2.2 What is deemed to be a satisfactory level of cleaning must involve some judgement since it is not practicable to remove all material. The primary reason to remove spoil is to prevent injury and it must therefore be the responsibility of the practitioner to decide what this amount is.
- 4.2.3 A mechanical means of cleaning the auger is preferred.
- 4.2.4 Should any manual cleaning be required then the auger must not be rotated whilst this operation is being performed.

5.0 ROTARY BORED PILING : GUIDANCE ON GUARDING AND CLEANING

5.1 Rotary Bored Piling : Guarding

- 5.1.1. Temporary casings must be used on all piles and left typically 1m. above the ground level to provide protection to the bore and at the area where the auger repeatedly passes below ground level.
- 5.1.2. On rotary bored piling rigs where the kelly bar is mounted some considerable distance from the base machine (typically 4-5m), any fixed guard is not practicable.
- 5.1.3. Similarly any other guard or protection device is not practicable given the fact that the auger and kelly bar repeatedly enter the bore, are withdrawn and the whole assembly slewed off location to discharge spoil (typically some 45° to 90° slew).
- 5.1.4. The final measure in the hierarchy is the provision of information, instruction, training and supervision. It is recommended that the following procedures be adhered to on rotary piling (as defined in this guidance note) operations.

5.1.5. A controlled zone must be nominated at each pile location. This zone will be defined as the area bounded by a line drawn at a distance of 2m. beyond the arc of the circle described by the centre of the kelly bar being rotated around the centre of rotation of the base unit between the pile position and the area where spoil is being discharged. Only the authorised persons will be permitted within the controlled zone. A rotary piling rig banksman will be at all times in attendance on the piling rig and will be given responsibility and authority to ensure only authorised persons are permitted within the zone.

5.1.6. All persons entering the controlled zone must be properly informed and instructed on the risks associated with the rotary piling operation. The banksman must be trained on slinger signalling matters, have had a minimum of one day's safety training in the previous 12 months and must be identified.

5.1.7. A full risk assessment should be made for each site prior to commencement of work.

5.2. **Rotary Bored Piling : Cleaning**

5.2.1 The discharge of spoil could be hazardous and a thorough risk assessment should be made and appropriate measures taken. The recommendations made below will minimise risk.

5.2.2. The loaded auger should be carefully slewed off the pile position to the discharge point in a controlled manner.

5.2.3 When the auger is being spun off it should be as close to the ground (or spoil heap) as possible to minimise spread of spoil.

5.2.4 The auger spin speed should be only sufficient to empty the tool so as to minimise the spread of spoil.

5.2.5 In the event that it is necessary for the works to be carried out in close proximity to untrained or unaware personnel (e.g., adjacent site boundary or other operations) then suitable barriers will need to be erected or precautions taken to contain the spoil and protect any personnel from debris.

6.0 DISPLACEMENT AUGER PILING : GUIDANCE ON GUARDING

6.1 Displacement Auger Piling : Guarding

6.1.1 It is proposed that the recommendations on guarding for CFA piling in section 4 above be used for displacement auger piling.

7.0 LIMITED ACCESS PILING: GUIDANCE ON GUARDING AND CLEANING

7.1 Limited Access Piling : Guarding

7.1.1 Due to the significant variation in the nature of the rigs undertaking this work the recommendations below are firstly those that are suggested for all rigs and then options are suggested for the appropriate means of guarding.

General recommendations

7.1.2 The controls should be positioned so that the operator has a clear view of the working process. Appropriate means of covering any blind spots should be provided eg use of trained banksman, CCTV, mirrors.

7.1.3 All controls should be biased to the neutral position. All controls to be physically remote from the rotary table and augers.

Options on guarding

7.1.4 Where practicable the larger rigs should adopt the recommendations made in Sections 4, 5 and 6 above.

7.1.5 On smaller piling rigs, especially those having limited mast height, opening guards are not practicable. In this case some form of trip device will need to be fitted close to the rotating auger i.e. as close as practicable to the auger to prevent injury from entrapment within the danger zone. Trip devices must stop the rotation quickly enough to prevent injury. This is within half a turn. At least two are required if the rotary head can rotate in both directions. The fitting of a trip device is in addition to the requirements of items 7.1.2 to 7.1.4. above.

7.2 Limited Access piling : Cleaning

7.2.1. Where the augers are removed in lengths of less than 3m, cleaning will not be necessary. If the height is greater than this then reference should be made to the appropriate section above with regard to the piling method employed.

8 REVIEW

8.1 It is recognised that technology may develop to the extent that both the systems operated in the UK and the guarding and cleaning methods referred to in this document may be superseded. It is the recommendation of the working party that this aspect be kept under review by the FPS Safety committee to ensure that these guidance notes are appropriate and remain valid in such circumstances. The Safety Committee is to ensure that any changes that need to be made in the light of any relevant developments are communicated to the FPS membership and other working group members as an addendum to these guidance notes.

APPENDIX A

The Regulations

The Provision and Use of Work Equipment Regulations 1998 (PUWER 98) are made under the Health and Safety at Work etc Act 1974 (HSW Act) and came into force on 5 December 1998. PUWER 98 is a revision of PUWER 92 effective from 1st January 1993. PUWER 98 brings into effect the non-lifting aspects of the Amending Directive to the Use of Work Equipment Directive (AUWED). The primary objective of PUWER 98 is to ensure that work equipment should not result in health and safety risks, regardless of its age, condition or origin.

To provide guidance on the Regulations the Health & Safety Executive (HSE) has prepared an Approved Code of Practice entitled Safe Use of Work Equipment published by Her Majesty's Stationery Office.

The particular regulations considered by this guidance note are Regulation 11 and Regulation 12 which are as follows:-

Regulation 11

- 1) *Every employer shall ensure that measures are taken in accordance with paragraph (2) which are effective –*
 - a) *to prevent access to any dangerous part of machinery or to any rotating stock-bar;*
or
 - b) *to stop the movement of any dangerous part of machine or rotating stock-bar before any part of a person enters a danger zone.*

- 2) *The measures required by paragraph (1) shall consist of –*
 - a) *the provision of fixed guards enclosing every dangerous part or rotating stock-bar where, and to the extent that it is practicable to do so, but where or to the extent that it is not, then*

- b) *the provision of other guards or protection devices where and to the extent that it is practicable to do so, but where or to the extent that it is not, then*
 - c) *the provision of jigs, holders, push-sticks or similar protection appliances used in conjunction with the machinery where and to the extent that it is practicable to do so, but where or to the extent that it is not, then*
 - d) *The provision of information, instruction, training and supervision*
- 3) *All guards and protection devices provided under sub-paragraphs (a) or (b) of paragraph (2) shall*
- a) *be suitable for the purpose for which they are provided;*
 - b) *be of good construction, sound material and adequate strength;*
 - c) *be maintained in an efficient state, in efficient working order and in good repair;*
 - d) *not give rise to any increased risk to health or safety;*
 - e) *not be easily bypassed or disabled;*
 - f) *be situated at sufficient distance from the danger zone;*
- not unduly restrict the view of operating cycle of the machinery, where such a view is necessary;*
- g) *be so constructed or adapted that they allow operations necessary to fit or replace parts and for maintenance work, restricting access so that it is allowed only to the*

area where the work is to be carried out and, if possible, without having to dismantle the guard or protection device.

4) *All protection appliances provided under sub-paragraph (c) of paragraph (2) shall comply with sub-paragraphs (a) to (d) and (g) of paragraph (3)*

5) *In this regulation –*

“danger zone” means any zone in or around machinery in which a person is exposed to a risk to health or safety from contact with a dangerous part of machinery or a rotating stock-bar;

“stock-bar” means any part of a stock-bar which projects beyond the head-stock of a lathe.

Regulation 12

1) *Every employer shall take measures to ensure that the exposure of a person using work equipment to any risk to his health or safety from any hazard specified in paragraph (3) is either prevented, or, where that is not reasonably practicable, adequately controlled.*

2) *The measures required by paragraph (1) shall –*

a) *be measures other than the provision of personal protective equipment or of information, instruction, training and supervision, so far as is reasonably practicable; and*

b) *include where appropriate, measures to minimise the effects of the hazard as well as to reduce the likelihood of the hazard occurring.*

3) *The hazards referred to in paragraph (1) are –*

a) *any article or substance falling or being ejected from work equipment;*

- b) *rupture or disintegration of parts of work equipment;*
 - c) *work equipment catching fire or overheating;*
 - d) *the unintended or premature discharge of any article or of any gas, dust, liquid, vapour or other substance which, in each case, is produced, used or stored in the work equipment;*
 - e) *the unintended or premature explosion of the work equipment or any article or substance produced, used or stored in it.*
- 4) *For the purposes of this regulation “adequately” means adequately having regard only to the nature of the hazard and the nature and degree of exposure to the risk.*
- 5) *This regulation shall not apply where any of the following Regulations apply in respect of any risk to a person’s health or safety for which such Regulations require measures to be taken to prevent or control such risk, namely –*
- a) *the ionising Radiations Regulations 1985;^(p)*
 - b) *the Control of Asbestos at Work Regulations 1987;^(q)*
 - c) *the Control of Substances Hazardous to Health Regulations 1994;^(r)*
 - d) *the Noise at Work regulations 1989;⁽²⁾*
 - e) *the Construction (Head Protect) Regulations 1989;^(t)*
 - f) *the Control of Lead at Work Regulations 1998.^(u)*

APPENDIX B Legislation and Standards

The following list, whilst not exhaustive, gives some of the more important legislation which may be applicable in Great Britain. In other countries, reference should be made to the appropriate national legislation.

Legislation

Health and Safety at Work Act 1974

Management of Health and Safety Regulations 1999

Machinery Directive 98/37/EC 22 June 1998

Provision and use of Work Equipment Regulations 1998

Supply of Machinery (Safety) Regulations 1992

Standards

BS EN 791: 1996	Drills Rigs – Safety
BS EN 996: 1996	Piling Equipment – Safety
BS EN 292 – 1: 1991	Safety of Machinery – basic concepts, general principles for design – Part 1: basic terminology, methodology
BS EN 292 – 2: 1991	Safety of Machinery – basic concepts, general principles for design – Part 2: technical principles and specifications
BS EN 953: 1997	Safety of Machinery – general requirements for the design and construction of guards
BS EN 293: 1992	Safety of Machinery – safety distances to prevent danger zones being reached by the upper limbs
BS EN 418: 1995	Safety of Machinery – emergency stop equipment, functional aspects – principles for design
BS EN 1088: 1995	Safety of Machinery – interlocking devices associated with guarding – principles for design and selection
BS EN 349: 1993	Safety of Machinery – minimum gaps to avoid crushing of parts of the human body

BS EN 811: 1997	Safety of Machinery – safety distances to prevent danger zones being reached by the lower limbs
BS EN 1050: 1997	Safety of Machinery – risk assessment
BS EN 1070: 1998	Safety of Machinery – terminology
BS EN 294	Safety of Machinery – Safety Distances to prevent danger zones being reached by upper limbs.

The following addendum has been agreed with the HSE (April 2002):

ADDENDUM to the Federation of Piling Specialists ‘Notes for Guidance on PUWER (Regulations 11 and 12) in relation to Guarding and Cleaning of Augers on Piling Operations Section 4.1 CFA Piling: Guarding, paragraphs 4.1.1 to 4.1.5 inclusive and section 6.1 Displacement auger piling: Guarding’

‘A controlled zone must be nominated at each pile position and can be defined as a zone at 2m radius from the centre of the auger. A banksman will be at all times in attendance whilst the piling rig is active and will be given authority and responsibility to ensure only authorised persons are permitted within the zone.

No person is permitted within the zone whilst the auger is rotating. (This precludes manual cleaning of the auger) Should any manual intervention be required the auger must be stopped. An excavator can be used within the zone for the purposes of clearing spoil but only under the banksman’s supervision

All persons entering the controlled zone must be properly informed and instructed on the risks associated with the CFA piling operation. The banksman must be trained on slinger signalling matters and have had minimum of the equivalent of one day’s safety training in the previous 12 months and must be identified.

Providing the above guidance is strictly adhered to then this may be adopted as an alternative approach to the guarding of CFA augers referred to under sections 4.1.1 to 4.1.5 when mechanical means of guarding are not reasonably practicable.’