


**FEDERATION
OF PILING
SPECIALISTS**

Federation of Piling Specialists

**Best Practice Guidance
Pumping Concrete to Form Piles**

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Of necessity this document addresses the broad principles that should be adopted. Advice in respect of specific equipment or operations should be obtained from the appropriate body or technical reference source.

The recognition of the various and individual responsibilities of "DUTY OF CARE" are fundamental to the application of these Best Practice Guidance Notes and the principle of "Identify the Hazard, Assess the Risk and Take the Appropriate Corrective Action" should always be applied.

Best Practice Guidance Pumping Concrete to Form Piles

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1. Introduction and Scope

This Federation of Piling Specialist best practice guidance has been prepared to supplement the Construction Plant-hire Association (CPA) Good Practice Guide 'Safe Use of Concrete Pumps' (September 2013) and provides sector specific guidance.

This document should be used in conjunction with the relevant legislation and guidance listed at Appendix A to ensure the safe pumping of concrete to form piles. This document provides guidance associated with pumping concrete from the concrete pump to the point of discharge into the pile. This document also provides guidance on the maintenance of; plant and equipment, the concrete pipeline, cleaning the pipeline, dealing with blockages within the pipeline and arrangements for wash out water.

2. Selection of Personnel

The safe operation of plant and equipment used in a concrete pumping system relies heavily on suitably competent personnel to carry out the required duties. Other site personnel involved in associated activities must also be suitably competent to carry out their duties.

The Pump Operator will hold the CPCS category for a relevant type of pump being used. This category will be supplemented by type specific training for the concrete pump and concrete agitator.

The Rig Operator will hold the CPCS category for a relevant type of rig being used. Periodic assessments of all those involved with the process should be carried out by a competent person to verify the continuation of safe standards and to assess any further training needs.

Where required, additional familiarisation training should be carried out whenever an operator is transferred to a different make or model of plant or equipment.

3. Components of a Concrete Pumping System



It is important to evaluate the components of the concrete pumping system to ensure the maximum pressure developed by the pump does not exceed the working pressure of the concrete hose, its couplings and connections.

Figure 1 shows the typical components of a concrete pumping system which consists of:

Concrete Pump

Has a typical maximum Pressure of 70 to 100 bar.

Concrete Agitator

Generally used to ensure continuity of concrete supply.

Pipelines:

Typically used on both the ground and at fixed locations on the rig. Pipelines can be constructed of:

- Steel, which is available in a variety of lengths that usually has a wall thickness of 4mm or 6mm.
- Reinforced rubber hose, which is available in a variety of lengths and usually 100mm or 125mm in diameter.

The bend radius limit on reinforced rubber hose typically is:

- For 100mm hose the radius must not be less than 550mm.
- For 125mm hose the radius must not be less than 700mm.

Note: This should be clarified with the supplier of each contractor's hose

Consideration must be given to the transporting and handling of hoses (both on site and in equipment storage yards) to ensure that minimum bend radii are not compromised.

Consideration should be made to shroud the loop hoses on the rig and the hoses that connect directly to both the concrete pump and to the rear of the rig.

Note: *Failure of reinforced rubber hose is often as a result of the hose being forced into too tight a radius.*

Pipeline Couplings

There are various types of couplings available but more common couplings are either bolted or snap - quick release couplings, which must be fitted with a securing spilt pin. Each coupling should be fitted with a rubber seal.

The following couplings must have a safety sling (Whip-check) incorporated to independently connect the pipeline to either the rig or the pump:

- All couplings on the loop hoses on the rig.
- The hose connection from the rig to the ground pipeline.
- The connection from the ground pipeline to the concrete pump.
- All other connections where the pipeline is not laying on the ground, for example; pipeline between the concrete pump and the concrete agitator.

Consideration may also be given to fitting a safety sling (Whip-check) to all ground pipeline couplings.

The safety sling (Whip-check) will act to restrain and secure the connection should the coupling fail.

Concrete Delivery System on the Rig

To allow the auger to move up and down the mast during pile formation, the rig is fitted with a number of components that form the concrete delivery system, these include:

- Steel/Reinforced rubber pipeline that runs along the side of the rig and up the mast.

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- Reinforced rubber loop hose connecting the steel pipeline, elbow, swan neck and concrete swivel.
 - 180° elbow which conveys the concrete from the steel pipeline running up the mast to the loop hose that connects to the swan neck and concrete swivel.
 - Swan neck and concrete swivel allows movement of the auger during the pumping process.



Figure 1

4. Planning and Management of the Concrete Pumping Process

Planning Arrangements

A competent person representing the piling contractor shall plan the piling works in liaison with the Principal Contractor. A working platform certificate, safe system of work and project specific risk assessment must be in place prior to work commencing.

Selection of plant, equipment, pipeline and pumping equipment for the work must be carried out by a competent person.

Arrangements for the safe delivery of plant and equipment must be agreed with the Principal Contractor prior to work commencing.

Designated areas and routes for the rig, pipeline, pumping equipment, materials and concrete deliveries must be agreed with the Principal Contractors and communicated to all contractors during their site induction.

Concrete hose crossing points should be clearly identifiable and evident to all site traffic (Typical examples are shown in Figures 2 and 3).



Figure 2



Figure 3

Consideration must be given to the location of the pumping equipment in relation to the works and the route of the ground pipeline in relation to the Plant and Vehicle Management Plan.

Note: *The location of the pumping equipment will require regular, possibly daily review, during the course of the works.*

Pipeline Management.

All reinforced rubber hose must be uniquely identified. A record of its inspection and test must be readily available at site.

Where necessary and site conditions permitting, the use of steel concrete pipelines may be an option if an undisturbed run of pipeline can be established and used for extended periods.

Designated crossing points must be agreed with the Principal Contractor so that site plant and vehicles can cross the pipelines without damaging them.

The crossing points must be suitable and of sufficient strength to provide adequate protection to the pipeline.

Movement of pipeline (Both ground reinforced rubber hose and reinforced rubber loop hose on the rig) must take into account the bend radius to avoid kinks or sharp bends, which will cause internal damage.

Note: *Reinforced rubber hose that has been subject to crushing by plant and vehicles will sustain internal damage, which may lead to premature failure of the hose.*

Where stillage's are used to transport pipeline, these must be subject to an appropriate inspection in accordance with current legislation.

Equipment Deliveries to and from Site

Procedures must be in place to ensure the safe loading and unloading of; plant, equipment, pipeline and pumping equipment. Consideration should be made for the safe working practice when working at height on the back of vehicles. Appropriate control measures will need to be in place.

Communication during the Pile Formation Process

It is essential that effective communication (Visual, radio or other means) is maintained between the concrete pump operator, the rig attendant and the rig operator at all times.

Forming the Pile

All works forming the pile shall be carried out in accordance with procedures, a safe system(s) of work and risk assessment(s), which must have been communicated to all those involved in the process prior to the work commencing.

Dealing with Blockages within the Concrete Pumping System



Under no circumstance must compressed air be used in an attempt to clear a blockage

Procedures must detail safe methods of clearing blockages, which must be communicated to the piling operatives prior to the commencement of work. Procedures must include the following:

- General safety precautions
 - Work at height.
 - Manual handling.
 - Working with pressurised systems.
 - Exclusion zones and restricted working areas.
 - Working with concrete.
 - Personal Protective Equipment (PPE) requirements.

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- Assessment of the blockage and determining the action plan on how to deal with the blockage:
 - Consideration of how long clearance work can progress before the pipeline needs to be washed out.
 - Locating the blockage within the pipeline.
 - Dealing with blockages in the ground pipeline.
 - Dealing with blockages on concrete delivery system on the rig, including within the augers.

Cleaning the Concrete Pumping System

Procedures must detail safe methods of cleaning the concrete pumping system, which must be communicated to the piling operatives prior to the commencement of work. Procedures must include the following:

- General safety precautions
 - Work at Height
 - Use of compressed air
 - Working with pressurised system.
 - Exclusion zones and restricted working areas.
 - Manual handling
 - Working with concrete
 - Personal Protective Equipment (PPE) requirements
- Cleaning out the concrete pump and agitator.
- Cleaning out the pipelines:
 - Use of the blow out adaptor.
 - Ball catching arrangements.
 - Means of containment of spent concrete (Typical examples are shown in Figures 4 and 5).
- Arrangement for dealing with wash out water.



Figure 4



Figure 5

5. Maintenance

Procedures must be in place to rectify any faulty or defective equipment as soon as practicable in a safe and controlled manner. If defective equipment is unsafe to use or if there is any doubt on its safety then it must be immediately removed from service until it is made safe to use.

A robust maintenance scheme must be in place and carried out by competent personnel. Records of maintenance activities must be maintained and made readily available at site. The scheme should include the following for each component of the concrete pumping process:

Concrete Pump and Agitator

Maintenance shall be carried out in accordance with the manufacturers' instructions.

Drilling and Piling Rig

Maintenance shall be carried out in accordance with the manufacturers' instructions.

Cleaning Out Accessories

- Periodic inspection & maintenance of Blow Out Adaptor.
- Inspection of Blow Out Containment Chamber.
- Inspection of containment vessel/chamber for spent concrete.

Ground Pipeline

Maintenance of the pipeline shall consist of:

- Reinforced Rubber Hose
 - Pre-use visual checks for damage, coupling security (Where necessary placement of securing split pins), crossing points and where required fitting of safety slings (Whip-check).
 - Pressure testing to the working pressure as stated on the reinforced rubber hose which is held for a minimum of 2 minutes every six months (minimum).
- Steel Pipeline
 - Pre-use visual checks for damage, coupling security and crossing points.
 - Ultrasonic testing every six months to measure pipeline wall thickness. The steel pipeline is to be rejected if the thickness falls below 2 mm.

Concrete Delivery System on the Rig

Maintenance of the concrete delivery system shall be carried out in accordance with the manufacturers' instructions, however, in the absence of any instructions maintenance shall consist of:

- Reinforced Rubber Loop Hoses
 - Regular visual checks for damage, coupling security (Where necessary placement of securing split pins) and where required fitting of safety slings.
 - Pressure tested to the working pressure as stated on the reinforced rubber hose which is held for a minimum of 2 minutes every twelve months.
- Steel Pipeline, Elbow and Swan Neck
 - Pre-use visual check for damage, coupling security (Where necessary placement of securing pins) and where required fitting of safety slings (Whip-check).

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- Ultrasonic testing every six months to measure pipeline wall thickness. The steel pipeline, elbow and swan neck is to be rejected if the thickness falls below 3mm.
 - Concrete Swivel
 - Daily visual check for damage or leaks.
 - Daily greasing (To extend the life of the swivel and to prevent seizing best practice is that this is carried out twice daily; mid shift and during the installation of last pile of the shift).

Appendix A

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

Machinery Directive 2006/42/EC
Health and Safety at Work Act 1974
Management of Health and Safety at Work Regulations 1999
Provision and Use of Work Equipment Regulations 1998
Supply of Machinery (Safety) Regulations 2008
Construction (Design and Management) Regulations 2015
Manual Handling Operations Regulations 1992 as amended in 2002
Personal Protective Equipment at Work Regulations 1992
Work at Height Regulations 2005/SI735
The Control of Substances Hazardous to Health Regulations 2002
The Control of Noise at Work Regulations 2005

Standards

EN 16228 Parts 1 to 7; Drilling and foundation equipment, Safety Requirements
BS EN ISO 14121-1; Safety of Machinery, Risk Assessment Principles
BS EN ISO 12100, General Principles for Design, Risk Assessment and Risk Reduction
BS 8476, Code of Practice for the Safe Use of Concrete Pumps
BS EN 12001, Conveying, Spraying and Placing Machines for Concrete and Mortar – Safety requirements.
PD 5304:2005, Guidance on safe use of machinery.

Other Publications

Construction Plant-hire Association (CPA) Good Practice Guide 'Safe Use of Concrete Pumps'
HSE Leaflet INDG218 – Guide to Risk Assessment.
HSE Leaflet INDG163 – Five Steps to Risk Assessment.