



◀ BEST PRACTICE GUIDE PRESSURE SYSTEMS

A response to risks identified on construction sites working with pressure systems



MOVING LONDON FORWARD



INVESTORS
IN PEOPLE | Silver



A best practice guide produced in collaboration between



Acknowledgements

The Pressure Systems Booklet has been developed in collaboration with the above key industry stakeholders.

This booklet will be reviewed at intervals, and any amendments arising

from the review will be published in an amended version. This document does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Index

Introduction

Preface and Purpose	3
Best Practice Guide - Pressure Systems	3

Part A – Planning

Concrete Pumping and Spray Concrete Lining (SCL)	6
Jet Wash Operations	7
Single Sourcing Components	8

Part B – Competency / Training

Selection	12
Training	12
Best Practice - Sprayed Concrete Lining	16

Part C – Execution and Control

Concrete Pumping and Spray Concrete Lining	18
Pump Set-up	18
Concrete Delivery area	18
Receiving hopper and hopper guarding	19
Operational safety zone	19
Delivery Pipeline Set-up	19
Pipe Clamps	20
Pipeline Movement	21
End-hose	21
End-hose and reducer combination	21
During Pumping Operations	22
Hose-whip	22
Controls which reduces likelihood of hose-whip	23
Cleaning / Blowing Out	24
Pipeline	24
Best Practice Concrete - 'Blow-out' Chambers with Exclusion Zones	25
Best Practice - Protection of concrete flexi-hoses	27
Pressure Wash Operations	28
Jet Washing / Pressure washers	37

Part D - Inspection and Maintenance

Concrete Pumping	32
Concrete Pump Examination and testing	32
Concrete Pump Maintenance	33
Pipeline Components	33
Best Practice - High Pressure Hose Compensation Grouting	35
Best Practice - Safetrak Electronic Inspection	36

Appendices

A. Concrete Pumping Operation Check Sheet	40
B. Concrete pipe Blow Out Check Sheet	42
C. Cleaning Concrete Lines with Compressed Air	44
D. Jet Washing Operation Check Sheet	47
E. Examination Checklist for Concrete Pumps	49
F. Crossrail Vehicle Safety Kit	50
G. References	53

Introduction ►

Preface

The Crossrail project consists of multiple work sites and contractors where exposure to pressurised systems and stored energy release is significant.

This guide brings together information collected in response to risks identified on Crossrail construction sites, to ensure pressurised systems are operated safely across the Crossrail project.

This document has been produced by consolidating the specialist knowledge from the Crossrail Contractors, JVs, supply chain and industry partners identified on Page 2 of this document.

Purpose

Pressure Systems are defined as:

1. A system comprising of one or more pressure vessels of rigid construction, any associated pipework and protective devices
2. The pipework with its protective devices to which a transportable pressure receptacle is, or is intended to be, connected
3. A pipeline and its protective devices which contain or is liable to contain a "relevant fluid".

The principal causes of pressure-related incidents are:

- Poor design, installation and/or maintenance of equipment
- Inadequate repairs or modifications to the equipment
- An unsafe system of work

- Operator error
- Poor training/supervision.

The main hazards from pressure are:

- Impact from the blast of an explosion or release of compressed liquid or gas under pressure
- Impact from parts of equipment that fail or any flying debris
- Contact with the released liquid or gas, such as steam
- Fire resulting from the escape of flammable liquids or gases.

This Best Practice Guide suggests minimum requirements for the safe use of pressure systems, provides best practice, competency and training guidance.

Best Practice Guide— Pressure Systems

This Best Practice Guide applies to all personnel with an involvement with the procurement, operation and supervision of pressurised working systems and stored energy release; the guide specifically covers the following types of Pressurised Systems: Concrete Pumping, Spray Concrete Lining (SCL), Grouting, Compressed Air and Jet/Pressure Washing.

The aim of this document is to raise awareness of the consequences of working with pressurised and storage energy release systems and promote a safer working environment for all operatives working on Crossrail.

This Best Practice Guide should be used alongside:

- Pressure Equipment Regulations 1999 (PER)
- Pressure Systems Safety Regulations 2000 (PSSR)
- Provision and use of Work Equipment Regulations 1998 (PUWER)
- BS EN 12001:2012, Conveying, spraying and placing machines for concrete and mortar–Safety requirements
- BS 8476:2007, Code of Practice for Safe Use of Concrete Pumps 2012.



Section A – Planning

FARRINGDON
SCL WORK AREAS
UPDATED 2010/14

COALS PASSAGE WORKS
In Progress In PTE

PROCEED WITH
CAUTION.

PTE

MSD

MSD

SECONDARY LINING PREPERATION

Substation (under way)



←PTW

--- Plant Movement Area

GREEN LINE WORK'S COMPLETED.

- Blue hatched box: Pedestrian Walking
- Red hatched box: Work to be Completed
- Black hatched box: Exclusion Zone 'Do Not Enter'

PTE →

E.T.H.

Concrete Pumping and Spray Concrete Lining (SCL)

Planning and preparation are essential in order to ensure that concrete pumping and sprayed concrete lining is done safely. In order to maintain awareness and ensure sufficient resources are made available, it is recommended that regular planning meetings are held. At these meetings, consideration should be given to ensure that:

People

- The pump operator is competent, qualified and experienced
- There is a sufficient number of competent, qualified and experienced operatives, including a competent person, present at all times
- Appropriate personal protective equipment is worn and other relevant safety equipment is available as necessary.

Plant

- The concrete pump is suitable to complete the pour safely and within the required time frame
- The location of the pump is suitable taking account of the footprint of the pump, the ground conditions and the access / egress requirements for delivery trucks
- A relevant, up to date operating instruction manual is with both the pump and the boom
- Relevant, up to date maintenance/ repair manuals are with the pump

- Up to date, maintenance log books and parts catalogue are with the pump and boom
- Maintenance and repairs to the equipment are only carried out by competent, qualified and experienced personnel who have been authorized to carry out the work
- The couplings are suitable and of a consistent type across the system, of higher pressure rating than the pump, are complete with a seal and safety pin and are clean and undamaged
- The pipeline is fixed on both the horizontal and vertical runs and that the brackets used are adequate for the task, clean and undamaged

Process

- There is an understanding of events or circumstances that would require the operation to be stopped
- There is an agreed sequence of steps to be carried out to ensure complete and safe stoppage
- There is an understanding of the impact of stoppages on other operations
- There is an understanding of the impact of other operations on the pressure system
- There has been an assessment of manual tasks that may cause muscle/ ligament strains or other injuries
- There is safe access eliminating trip, slip and fall hazards

- All systems of work comply with electrical safety legislation
- Whether enough operatives are available, including a competent person being present at all times
- Events or circumstances that would require the operation to be stopped
- The pipeline is suitable to complete the pour safely and within the required time frame, the wall thickness is sufficient to withstand the maximum pressure that the pump can exert and the pipeline must be clean and undamaged
- The end placing hoses are suitable to complete the pour safely and within the required time frame—they are of higher pressure rating than the pump, clean and undamaged.



Jet Wash Operations

Jet Wash operations have the potential to affect a large number of surrounding operations if not properly controlled. The following considerations during planning will result in a safer working environment for the operator and others in the area:

- Implement an exclusion zone around the operation with sufficient safety signage to warn other operators
- The work area around the equipment should be clean and free of debris. Oil spillages result in slippery floors and must be cleaned up immediately
- Shield and bundle equipment hoses and cables so they do not obstruct the operator's freedom of movement. Refer to Section D for further suggested control measures.

Personal Protective Equipment (PPE) Requirements:

PPE should always be regarded as the 'last resort', as it protects the operator without changing the level of hazard. Always consider that other control measures may be needed in addition to PPE which could reduce the level of protection needed from PPE. Standard PPE for operators should include:

Eye/Face Protection:

- Safety Glasses/Goggles/Face shield (EN 166 Class A or B). Goggles and face shields should be suitable to use with other PPE (helmets, hearing protection etc.).



What do operators do when visibility is reduced by splashes, mist or fog?

Systems of work should consider how this will be addressed.

Anti fogging goggles/glasses are available, but try different models first to find which performs best for your condition.

Waterproof Clothing

- **Waterproof safety boots** (EN 345 or EN ISO 20345)
- **Waterproof gloves:** Operators need to ensure gloves are maintained and in good condition to ensure proper grip and personal hygiene



Waterproof garments only protect the operator from spray and flying debris. They do NOT deflect direct jet impact.

- **Warm Clothing:** The risk of finger blanching (due to reduced circulation of blood) increases at low temperatures. Operators working outdoors in cold weather should have adequate protection
- **Safety helmet:** (EN 397) or of higher standard if specified through risk assessment
- **Hearing protection:** (as identified by the Risk Assessment) to be worn at all times. Ear defenders should not be worn over clothing or PPE likely to interfere with the effectiveness of the defenders
- **Respiratory Protection:** if identified in the Risk Assessment for the activity, which must consider the possibility that the activity may generate a water mist / aerosol that contains harmful material.

Single Sourcing Components

Single sourcing of components offers multiple benefits for an organisation, these benefits include:

- Reductions in product variation,
- Streamlined training is possible due to consistent product,
- Reduced downtime and inefficiencies caused by interoperability issues.

With regards to safety of pressurised systems components, the procurement of complete product/component ranges from a single, reputable manufacturer/supplier is highly recommended.

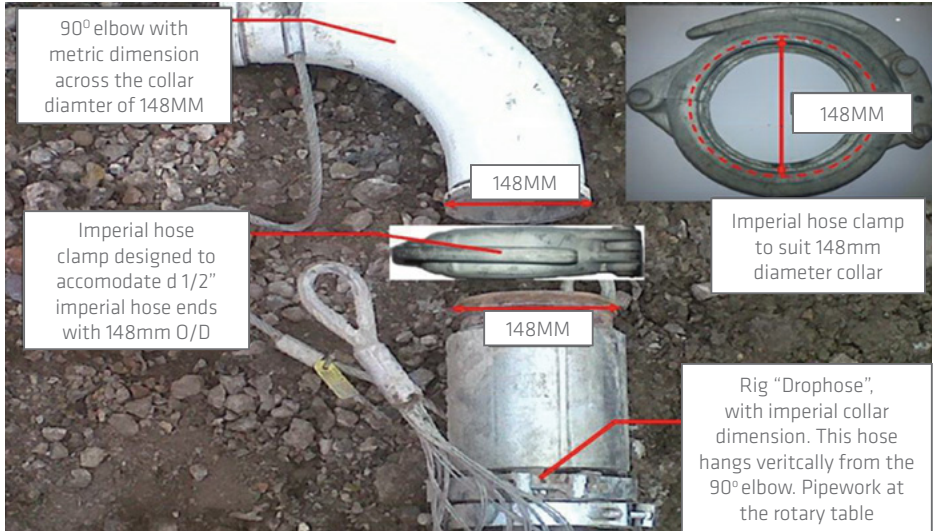
The hazards inherent in pressurised systems necessitates that all components of the system are compatible and securely fitted.

To ensure that single sourcing of components provide adequate risk control, the following additional checks are recommended:

- Ensure that detailed and complete product requirements are defined and included in any purchase agreement
- The requirements must address form, fit, and function
- It should also define delivery time and packaging, including clear and consistent labelling

- Periodically inspect and test the product to ensure continuous compliance with the requirements.

Always confirm specifications of supplied components. Be aware that equipment could be supplied with metric connections when it is expected to have imperial connections.





Section B - Competency / Training



The safe operation of pressurised systems is heavily reliant on the selection and training of operators to ensure they are competent to not only carry out their respective operations, but also to identify and react safely to any abnormalities in the standard operation of equipment.

Selection

When selecting operators to work with pressurised systems, ensure they are:

- Competent and over 18 years of age. In some cases a higher standard is required eg. for lorry-mounted concrete pumps the recommended age is over 21 years if driving on the highway
- Physically and mentally fit, with particular regard to eyesight, hearing and reflexes. Medical reviews to be held at regular intervals and not exceeding 5 years between intervals
- Able to judge distances, heights and clearances
- Adequately trained and certified for the class of equipment being operated with sufficient knowledge of any relevant machinery and safety devices
- Fully conversant with the duties of the signaller and should understand the signals code.

Training

The Construction Plant Competence Scheme (CPCS) provides a registration card scheme acknowledged by industry for those involved in plant operations by recognizing skills. Knowledge and understanding, competence and qualifications. The scheme offers awards in the following categories:

- A06 Concrete Pump = Truck Mounted Boom—Note: LGV license must be held
- A44 Concrete Pump Trailer Mounted
- A72 Static Concrete Placing Boom
- A06 additional category award—A44.



Training needs to be specific to the equipment and task being undertaken.

Everyone must be familiar with who is authorised to operate various equipment.



This Section lists training resources available through Crossrail as well as training available from outside sources. Most equipment hire companies provide specialist training for their equipment and can be contacted directly for arrangements, examples provided



Title:	Sprayed Concrete Lining (SCL) Training and Assessment
Location:	TUCA Ilford, London E12 5LN.
Content:	Training with regards to Health and Safety, Equipment and Spraying, assessments will be done through practical assessments, observation, discussion and questions.
Who is this training for:	Training is intended for experienced and semi-experienced nozzle men, who require up-skilling on the use and application of spray concrete equipment.
Entry Requirements:	SCL experience is mandatory for this programme. Delegates need to hold a current CSCS card.
Duration:	5 days.
Contact:	0300 456 7424.



Title:	Trailer Mounted Concrete Pump/Pressurised Systems
Location:	TUCA Ilford, London E12 5LN.
Content:	Concrete pumping accidents, concrete pump operational safety checks, communication, pumping concrete-priming the line, key issues pumping concrete, problem solving, blockage essential actions, pump maintenance, safety reminders, Control of Substances Hazardous to Health.
Who is this training for:	Training for those who hold a CPCS Blue Card but have not used pressurised systems in the last six months, or other operatives deemed to need refresher training by their employer.
Entry Requirements:	Must be able to demonstrate a background knowledge of pressurised concrete pump systems.
Duration:	2 days refresher + 1 day test.
Contact:	Steve Howard 07825 377 036 steven.howard@citb.co.uk or National Construction College 0344 994 4455.



Title:	Safe Use of Low Pressure Washers
Location:	Arranged on site.
Content:	Pressure Washer Description, Legal requirements and responsibilities, nature of hazards and identification of causes, identifying the risks, safe and correct use, Selection of correct machinery and PPE, Wash down bays, essential maintenance, Practical assessment.
Who is this training for:	This programme is designed for any person who may be required to use any low pressure jet washer with a pressure rating below 5000 psi in the workplace or requires familiarisation with the associated regulations.
Entry Requirements:	Delegates attending this course should be 18+ years and be physically and mentally fit to withstand the rigours of training.
Duration:	2 days refresher + 1 day test.
Contact:	0845 604 6682 / speedy.training@speedyservices.com / www.speedyservices.com/training.



Title:	Water Jetting Safety Awareness (WJ Association Approved Course)
Location:	Arranged on site or various training centres (eg. Dartford).
Content:	<p>To provide practical training in the safe, effective use of jetting equipment and the supervision of jetting equipment and operations.</p> <ul style="list-style-type: none"> • Identification of potential hazards • Setting up equipment with regard to the safety of operators, other staff and the public • Hands on experience using equipment effectively and safely • Immediate procedures to adopt in the event of injury by the impact of a water jet • Nozzle selection with regard to the correct application • Precautions to be taken when using a mains water supply • How to identify and set up a safe system of work when jetting as required by the Health and Safety at Work Act 1974 • Selection of the appropriate Personal Protective Equipment with regard to the P.P.E. Regulations 1992 • Knowledge of the Sewer Jetting Code of Practice as published by the WRc, June 1997 • Knowledge of the Code of Practice as published by the Water Jetting Association • The content of this course is approved by the Water Jetting Association.
Who is this training for:	Those involved in, or about to become involved in, the use and supervision of high pressure water jetting equipment for cleaning drains, sewers, pipes, culverts, tanks and manholes.
Entry Requirements:	Participants should bring with them a safety helmet, face visor to BS2092 Grade 1, ear defenders, a waterproof suit, safety wellingtons and waterproof gloves.
Duration:	1 day.
Contact:	Total Protection (UK) Limited / Tel: 0844 567 7423 / info@totalprotectionuk.com / www.totalprotectionuk.com.

Best Practice

Sprayed Concrete Lining

A logbook has been designed to record and monitor the progress of trainees during their formative / initial tenure on the project. The logbook will provide documented evidence of progress and achievement and includes:

- Personal Details
- Training & Qualifications
- Medicals and Occupational Health Monitoring

- SCL Operations
- Major Projects information.

On completion of SCL works the logbooks will be issued to the operatives as evidence of competence and experience. The Logbook will undoubtedly provide future employers with credible details of competence and performance. The logbook can also be used in the pursuit of construction NVQ's.

CRL1-XRL-Z7-AAG-CR001-50001



Section C – Execution and Control



Concrete Pumping and Spray Concrete Lining

Concrete in pumps and/or pipelines is often under considerable pressure and failure of pipeline can result in significant damage or injury. A concrete pump may give up to 85 bar pressure into the pipeline whereas a compressor will give 7 or 8 bar. Also the pump has a pulsing effect whereas the compressor will apply the pressure more evenly.

Pump Set-up

The concrete pumping area should be level, solid and free of obstructions, with careful attention paid to the positioning of the pumping equipment and any stabilising devices. In particular, the area should be:

- Clear of excavations, trenches or holes in the ground
- Clear of inadequately compacted or soft ground
- Clear of cellars, basements, pits or back-filled ground, unless stability is approved in writing by a qualified engineer
- Clear of overhead power lines and fixed electrical equipment
- Of a size enough to allow for safe operation
- Of a size enough to allow for the safe discharge from the concrete delivery trucks.

Where the pumping or pipeline set-up is for a longer duration, the isolation methods should be made more permanent. No person, other than those workers directly involved in the concrete

pumping operation, should be in the operational safety zone during concrete pumping.

Concrete Delivery area

The concrete truck delivery area, including the area around the pump hopper, should be set up to ensure that:

- Workers are safe from other vehicles
- Adequate lighting is provided if pumping in non-daylight hours
- Appropriate signage is posted
- There is clear access for delivery trucks.



Keep clear when truck is reversing into position - don't stand between the truck and hopper.



Keep clear when truck is reversing into position - ensure that you remain in the driver's view.

If multiple concrete deliveries are expected and on-site traffic management is not provided, only one delivery truck should approach and discharge into the hopper at a time.

If a designated on-site traffic controller is provided, the following safety rules should be followed:

- All personnel connected with discharging from concrete trucks are to wear appropriate high-visibility safety vests
- All concrete delivery trucks must have operational reversing beepers.

All vehicles entering Crossrail are subject to requirements detailed in the Crossrail Vehicle Safety Kit (see Appendix F).

Receiving hopper and hopper guarding

The concrete pump should be positioned so the receiving hopper is at a height that allows a gravity flow of concrete from the pre-mix delivery trucks into the hopper.

The concrete pump should not be operated unless the hopper is equipped with a grille with a fitted and working safety interlock. The grille should:

- Be constructed of parallel or mesh bars
- Be designed to prevent access to the moving parts in the hopper
- Be designed so it requires a tool to be removed
- Not, under any circumstances, be used to stand on.

Operational safety zone

Access to areas around the concrete pump and delivery pipeline should be restricted - the most appropriate method of isolating the area should

be used. The use of one or more of the following controls is recommended:

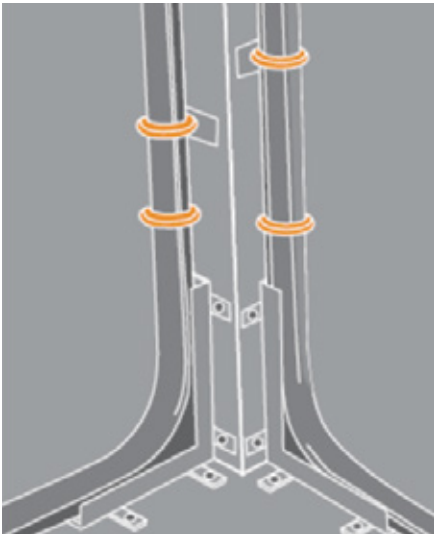
- Barricades
- Posts and safety mesh
- Posts and danger tape or flags
- Covered walkways
- The traffic controller and truck driver should be in positions which prevent them from being caught between the hopper and a reversing truck
- The traffic controller should be in a position visible to the reversing driver and where the hopper area can be observed
- Delivery drivers should ensure that their vehicles remain clear of the discharge area until signaled to reverse into position by the traffic controller.

Delivery Pipeline Set-up

When installing a pipeline, ensure that:

- All specifications contained in BS EN 12001:2012, Section 5.3, are adhered to, particularly with regards to factors of safety when considering maximum delivery pressure
- The safe working pressure of the pipeline is equal to or greater than the rated maximum concrete pressure of all pumps to be used
- All pipes and pipeline components are identified and inspected before installation
- The pipeline is set up along the shortest possible route

- The pipeline is set up using as few bends as is possible
- Hoses are only used to distribute the concrete at the end of a line, never used in the middle of a pipeline and/ or as an alternative to a bend
- A safety pin should be used to secure each and every coupling
- Each section of the pipeline is adequately supported and secured to the structure
- The pipeline should not be secured to a cranes or hoist towers, scaffolding or framework unless the bottom or footed bend (or bend cast into a ballast block) is used when the pipeline changes from horizontal to the vertical.



Securely fix the pipeline to avoid movement.

Pipe Clamps

Clamps connecting concrete piping need to be of the correct size, maintained

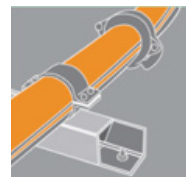
and rated at a working pressure greater than the maximum delivery pressure specified above. All pipe clamps used on any pipeline system must be:

- Able to sustain the maximum concrete pressure applied to the pipeline by the pump
- Regularly inspected by a competent person for signs of wear or fatigue
- Immediately replaced if deformed or damaged.

Clamps should also be permanently marked with the manufacturer's name (or trademark), and the maximum permissible operating pressure.

When using quick-release pipe clamps on fixed lines (horizontal or vertical), ensure that:

- The pipe clamps used are able to sustain the maximum concrete pressure
- Locking pins are used and are engaged
- Pipe clamps are regularly inspected for signs of wear by a competent person
- Clamps showing any deformation or damage are replaced before pumping begins
- Safety pins are fitted to all clamps. Clamps which do not allow for safety pins to be fitted should be removed prior to pumping operations



- Clamps are locked as per the manufacturer's instructions. Using a hammer or other means to force a clamp closed can cause unnecessary wear and result in failure of components.

All pipeline connections from the boom must be secured by safety chains or wire strops (whip-check devices) to prevent the pipeline falling to the ground if a clamp fails.



Pipeline Movement

The pipeline should be adequately secured to the building or structure, with attention given to the reaction forces generated where high pump pressures are involved. The mounting system should be designed to ensure the pipeline remains in place.

Support brackets in a vertical pipeline should be spaced no more than three meters apart. Expansion anchors of the high-load slip control type or other fixing methods of at least the same structural strength should be used if fixed to masonry.

The surging action of the pump should not cause excessive pipe movement. If required, additional anchor brackets or other suitable methods to restrict pipe movement should be used.

End-hose

The rubber delivery end-hose should:

- Where connected to a boom, be secured by a safety chain, sling or other restraining device and not be longer than specified by the pump manufacturer
- Be inspected for excessive wear or damage prior to being fitted and on a regular basis
- Be single ended, in the case of the final hose/ end placing hose.

If concrete pumping has stopped and the hose is maneuvered over a work or public area, the operator must use the hose shut off valve, if fitted, to prevent concrete falling from the hose outlet. If such a valve is not fitted, the boom should not be moved until all of the excess concrete has fallen from the boom and hose under gravity and the path the boom must travel is clear of people.

End-hose and reducer combination

If the delivery end-hose is replaced by a hose and reducer combination, only those combinations assembled to the manufacturer's instructions should be used, and:

- Locking pins are to be engaged on all quick-release pipe clamps in the assembly
- Each piece must be capable of withstanding the rated maximum pressure of the pump
- Each hanging piece is tethered by a safety cable, sling or chain



End-hose and reducer with safety slings.

- The combined weight of all pieces **MUST NOT EXCEED** manufacturer's recommendations.

During Pumping Operations

To safely operate any type of concrete pumping equipment, it is necessary to have enough workers to control the pumping operation. These workers need to be trained and experienced in conducting pumping operations.

The effective passing of directions from the hose-hand to the pump operator is essential for safe concrete pumping. The following examples may be used:

Effective communication between the hose-hand and the pump operator is essential for safe concrete pumping. The following examples may be used:

- Non-verbal: a set of standard hand signals which cover all of the pump's operational functions
- Verbal: standard operational phrases that may be delivered by a dedicated two-way radio system.

Regardless of the system used for communication, signals need to be agreed by the pump operator and hose-hand.

Pump operators must:

- Be competent, qualified and experienced
- Be familiar with the pump's instruction manuals

- Be able to carry out daily maintenance tasks (greasing, topping up fluids, inspections etc.)
- Carry out a visual inspection of the pump and pipeline prior to each and every pour
- Be located at the pump controls or, if using a remote control, have a clear view of either the hose-hand or the hopper
- Follow the directions of the hose-hand
- If using hand signals and out of view of the hose-hand, be assisted by another worker to relay directions
- Report problems with the pump/ pipeline to the pumping supervisor without delay
- Stop pumping, in the event of a serious problem and do not re-commence pumping till the problems have been remedied
- Record daily inspections, defects and repairs in the logbook.

Pump operators must not:

- Leave the pump/ remote control box unattended whilst the pump is turned on
- Adjust the hydraulic pressure of the pump
- Pump concrete unless the hopper guard is in the closed position
- Stand or allow any other person to stand on the hopper grille or beneath the raised boom.

Hose-whip

Hose-whip occurs when pressure in the pipeline is released rapidly causing the end placing hoses to whip unmanageably. When a hose-whip occurs, the hose can strike those in the danger zone violently and can cause severe injury.

Controls which reduces likelihood of hose-whip

- Ensure that the concrete pump operator is competent, qualified and experienced
- Ensure that the concreting operatives are competent, qualified, experienced and aware of the risks and dangers associated with pressurized hoses
- Ensure good communication between the pump operator and the hose-man
- Use the correct quality and quality of grout when grouting up
- Reject any concrete that is out of specification/un-pumpable especially that which is too lean, too stiff, or has been in the mixer for too long
- The hose should not be stretched if it cannot reach the pouring location
- Do not allow concrete to stand in the delivery pipeline for too long. If necessary, clean out the line, re-grout re-commence the pumping operation
- Do not allow the concrete level in the hopper to drop below the level

of the pumping cylinders–this can introduce air into the line

- Do not allow the hoses to kink
- Ensure that the delivery hoses are clean and undamaged before each and every pour.

Controls that can reduce the danger of injury due to hose-whip

- Use single ended hoses for the final hose/ ending placing hose
- Ensure that all operatives are clear of the danger zone when the pipeline is being grouted up and at the beginning of a fresh load of concrete is being pumped through.

Other controls that can reduce the danger of injury while working with concrete delivery pipelines

- The length of the end hose of a placing boom must not exceed the manufacturers recommendation
- The hose-hand should stand on a flat surface and not walls or underground structures edges
- The end hose of the boom pump should hang vertically, be guided and not forced
- Where possible, avoid working directly beneath the placing boom by guiding the hose from the side
- When the pump is stopped, close the hose shut off-valve and allow any extra concrete in the hose to fall before moving the boom
- Keep personnel/ members of the public clear of the concrete pump pour area

- Maintain good housekeeping around the pour site to minimize tripping hazards.

Cleaning / Blowing Out

Cleaning out residual concrete from pumping equipment should only be carried out by competent, qualified, experienced workers in accordance with the manufacturer's procedures or the detailed written instructions developed by a competent person. When concrete pumping equipment is being cleaned out, ensure that another person is in the immediate vicinity to provide help in an emergency.

Pipeline

Concrete delivery lines can be cleaned out after a pour by pumping water through the line. Short lines and pipelines in sensitive areas (adjacent to areas of public access, alongside live railway lines, roads etc.) are cleaned out manually. Longer lines and fixed lines are usually cleaned out using compressed air.

On some contracts, longer lines are cleaned out by pumping water through the pipeline but this requires specialist equipment and is therefore not so common.

When cleaning out pipelines using compressed air, the following safety precautions should be observed:

- All hoses should be removed from the pipeline

- The blow-out adapter used should be fitted with an air entry port, a large air discharge port, a pressure gauge and a non return device to prevent the sponge balls returning under pressure and blocking the discharge port
- A ball catcher should be attached to the discharge end of the pipeline
- All workers must stand clear of the discharge end while the line is being cleaned
- No attempt should be made to split or dismantle the pipeline while it is still under pressure.

If compressed air is used to clean the pipeline, the air entry point to the pipeline is to be fitted with:

- A large diameter discharge air ball valve, to allow de-pressurization (venting) of the line before removal
- A smaller air entry ball valve
- A pressure gauge, to show the air pressure in the pipeline.

Refer to:

[Appendix A: Concrete Pumping Operation Check Sheet.](#)

[Appendix B: Concrete Pipe Blow Out Check Sheet](#)

[Appendix C: Cleaning Concrete Lines with Compressed Air](#)

Best Practice

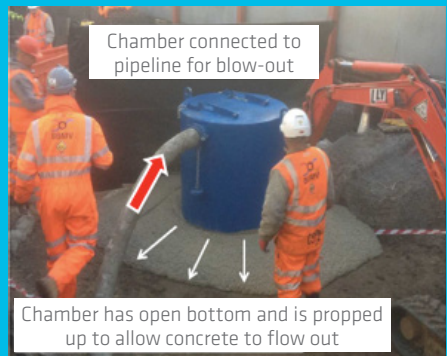
Concrete 'Blow-out' Chambers with Exclusion Zones

Concrete pipeline clean-out operations commonly involve the insertion of ball(s) that are driven through the line using compressed air. A ball catcher that allows the waste concrete to pass through it catches the sponge ball when the line is clean. Control of the volume of air in the line is required to prevent the potentially dangerous explosive releases of concrete and the cleaning balls into the ball catchers.

C512 has developed a bespoke chamber to control concrete blow-out during pipeline cleaning at Whitechapel. This chamber controls concrete blow-out and allows waste to flow out from its open base, in this way, the risk of injury from the release of concrete and/or sponge balls is minimised.

After the operation, the chamber can be disconnected and lifted away. Then the waste concrete is then allowed to set, prior to broken up and removed from site.

Other designs in use on Crossrail are shown below:



**** The top photo shows the pipeline connected to the discharge chamber by placing a hose. All hoses should be removed from the line prior to blowing it out. setting up a cleaning line follows:

- Set up the main pumping line with a 1m pipe in the line close to the pump
- Remove the 1m pipe and replace it with a bend pointing towards the discharge chamber
- Set up the cleaning out line from the bend to the discharge chamber using all steel pipes and bend—as few bends as possible
- Connect the cleaning out line to the discharge chamber
- Secure the cleaning out line especially close to the discharge chamber
- When all of this is in place, remove the bend that diverts the pipeline to the cleaning out line and replace the 1m pipe
- It is ready to pump
- After the pumping operation has been completed, remove the 1m pipe and replace the bend to divert to the cleaning line
- Clean the line using compressed air back to the discharge chamber (This assumes cleaning back towards the pump).

Best Practice

Protection of concrete flexi-hoses

The mechanical pressing-in of the hose by external forces is the most frequent cause for premature wearing of concrete pump hoses. This is what happens to the concrete pump hose if a heavy machine drives over it. Another frequent cause of damage is the hose rubbing against a sharp steel edge when flexing during pumping concrete.

The concrete delivery hose contains a reinforcing layer of steel fibres, similar to a car tyre. Once the external rubber skin of the hose has been damaged, moisture and oxygen come into contact with the reinforcing steel fabric which reduces the lifespan of the hose. To protect the delivery hose, the following is recommended:

- An additional layer protection. Whilst double-bagging is effective, it prevents easy inspection of the hose. An alternative is shown on the right which allows for visual inspection of the hose



- Protection of hoses from site traffic. Some examples of how this might be done are shown below. The aim should be to prevent contact between vehicle traffic and the delivery hoses thus minimising risk of damage.



Pressure Wash Operations

Pressure washers are used to clean equipment, materials and work areas on the job. Using such equipment often presents the perception that the associated work is low risk when in fact can cause serious injuries. Because the water used in jet washing operations is under high pressure, it moves with enough force to cause damage to the eyes or skin and contribute to other types of injuries.

Jet Wash Operations should only be undertaken following a Risk Assessment of all the tasks where it can be clearly demonstrated that there is no increase of risk to the operator and/or third parties.

i

Ensure welfare facilities are provided to be used to wash / clean up after work activities

Hazards

- The fast, strong spray can throw objects, striking and injuring others who are close by
- The strong spray from a pressure washer can cause serious wounds that might first appear minor. Wounds that appear minor can cause a person to delay treatment, increasing risk of infection, disability or amputation
- Electric shock can occur if the pressure washer is not used properly and if safety instructions are not followed

- Jet washing can generate a large amount of noise. A Noise Risk Assessment is required to identify the actions required to comply with the Control of Noise at Work Regulations 2005.

Key Control Measures

- Pressure washers must only be used by suitably trained, competent and authorised persons
- Manufacturer's safety information must be available and briefed to operatives
- Pressure washers should only be used for the purpose intended, not for cleaning PPE

- Residual pressure must always be released from all washer units after use



- Confirm that lance safety catch is in position before starting and when putting down lance

- Start engine and, if adjustable, set desired pressure.



- Do not point lance at anyone, or yourself

- Hold lance with two hands to ensure control and maintain balance

- To avoid back blast of debris, pull triggering some distance back from

point required and move it in slowly

- Set up exclusion zones or segregation of work area with suitable warning signs prominently displayed. Ensure other operatives are properly briefed on jet wash operations
- Avoid/eliminate potential distractions for jet wash operators in vicinity of works



- Take care with hoses to avoid trip hazards
- Refer to Page 30 for Jet Wash Risk Categories and recommended controls.

Refer to:

[Appendix D: Jet Washing Operation Check Sheet example](#)



Jet Wash Risk Categories and Recommended Controls

Risk Category	Operating Pressure	Controls
Low	Up to 1500psi (100bar)	Standard PPE, Segregation of area, Awareness training, risk assessment briefing, Pre-use checks.
Medium	1501psi - 3000psi	Same as above, with additional: Exclusion zone (“Authorised personnel only”), Safety Footwear (EN 345 or EN ISO 20345) Accredited one-day safety awareness course.
High	3001 - 20000	As above, with additional: Permit to work required, Exclusion zone (“No entry, permit to work area”), Specialist footwear, gloves and clothing.
Very high	20001psi +	As above, with additional: Re-assessment of task and controls, Supervision (“top-man” concept), Re-assessment of PPE, Specialist training/competence.



Potential damage caused by jet washers decreases significantly the further way items are from nozzle. Newer jet washers have a safety feature: a safety cone around the nozzle which ensures a minimum distance is kept from the object being sprayed.

Section D – Inspection and Maintenance



Concrete Pumping

Provision and Use of Work Equipment Regulations 1998 (PUWER) require that work equipment is maintained in an efficient state, in efficient working order in good repair and any machinery has a maintenance log, the log is kept up to date.

Concrete Pump Examination and testing

Careful consideration should be given to the condition of the site where the test is to be conducted. It should be remembered that the recommendations provided in the operating instructions for the machine relate to operations within the safe working load and that more stringent requirements apply when loads are being applied for the purpose of testing.

A concrete-placer boom is not an item of lifting equipment as defined in the Lifting Operations and Lifting Equipment Regulations 1998. The examination of concrete-placing booms is specified in BS EN 12001.

Inspections should be completed by the concrete pump operator, or another competent person, on a weekly basis at least and by mechanical staff carrying out routine services. A written record of the inspections must be retained and be available at all times for examination.

A concrete-placing boom should be thoroughly examined:

- Every 500 operating hours or 20,000m³, whichever occurs first, but
- At least once a year and

- Following substantial alteration or repair.

The manufacturer of the machine or the competent person appointed to examine it may specify a more frequent examination period because of the machine's age, its condition or its operating conditions, etc.

The thorough examination should be completed by a competent person who has the necessary knowledge and experience to carry out that duty.

In certain conditions, for example after substantial repairs to the boom, the competent person who examines the machine may specify the requirement for a load test to demonstrate that it is stable and / or structurally sound. Load testing of a concrete-placer boom should only be carried out under the direction and close supervision of a competent person.

A certificate of test and thorough examination should be issued following each thorough examination; a copy must be made available for viewing on the machine. The test certificate should state the maximum safe working load of the boom.

The test certificate should be endorsed with the information necessary to ensure that there is no ambiguity as to the configuration of the machine during the test. Certificates of test and thorough examination may be stored in any way appropriate to the owner of the machine, i.e. in paper format, electronically.

The safe working load of the machine, i.e. the maximum length of delivery hose full of concrete to be suspended

from the boom, should be clearly marked on the machine and shown on the certificates of test and thorough examination.

Any other conditions, e.g. the deployment of stabilisers, must be noted on the certificate.

Following the thorough examination, a record of the examination should be retained for a period of at least three years to prove a regular inspection regime.

Refer to:

[Appendix E: Examination Checklist for Concrete Pumps.](#)

Concrete Pump Maintenance

As with all machinery, good maintenance of a concrete pump is paramount to safety. Road safety and on-site safety must both be considered when planning a maintenance system. A good defect reporting and repair system is also vital.

The concrete pump operator should carry out regular inspections of the machine to ensure that it is fit for use.

For Road vehicles, maintenance and inspection schedules should correspond to those required by the Vehicle and Operator Services Agency (VOSA).

Any defect affecting vehicle safety in respect of Road Traffic Act requirements must be reported immediately to the maintenance department.

Any defect that, in the opinion of the concrete pump operator would affect the safe operation of the concrete-placer boom and its supporting

structure should be recorded on maintenance checklists and handed to a manager immediately.

Defects of a minor, non-safety related, nature should be recorded on maintenance checklists. They should be recorded weekly until the defects have been repaired.

A programme of servicing the chassis, the boom and its supporting structure and the concrete pump should be devised as a part of a preventative maintenance system. The period between services may be determined by the manufacturer or the owner of the machine and may be based on mileage, the number of hours worked or a period of time.

Pipeline Components

In addition to daily/weekly checks of the pipeline components, additional measures can be taken to ensure potential failure is minimised.

It is important to measure the wall thickness of concrete delivery pipeline on a regular basis. Over time and with use, the wall thickness of a concrete delivery pipe will reduce, being worn away by the scouring effect of the pumped concrete. As the thickness of the pipe reduces, so does its capacity to contain pressure. If the pipes are allowed to wear excessively they can burst causing the pressurized concrete to explode out and potentially injure site personnel and members of the public. With testing and recording the thickness of pipeline walls at frequent intervals, excessive wear and potential failure of the pipeline can be avoided.

Wall Thickness Testing

Wall thickness testing can be conducted by ultrasonic test instruments or other suitable method. All testing must be carried out by competent persons and test equipment calibrated according to the manufacturer's requirements.

Any used components in storage should be tested before being returned to service.

Pipes must not be used if the wall thickness is less than that recommended by the pipe manufacturer for the maximum concrete pressure of the pump. The suppliers of pipes for concrete pumps should provide data on the minimum wall thickness for differing pump pressures. The safe minimum wall thickness of single wall pipe is dependent on the grade of steel, the pipe diameter and the maximum working concrete pressure that can be exerted by the pump.

Ultrasonic Testing

When using ultrasonic testers, it is essential to have the test instrument calibrated for the material to be tested before carrying out any tests. This can be achieved by using a piece of pipe material of a known thickness to calibrate the instrument and by following the manufacturer's instructions. The test equipment should be maintained according to the manufacturer's requirements, which may include regular factory calibration and replacement of worn transducers.

Pipeline Test Recording

To assist operators to detect erroneous measurements, cross referencing to previous wall thickness measurements during the testing process is essential. A suggested method of recording this information is to maintain a test sheet over the life of each component

This record of pipe component testing may include:

- Component identification number or mark
- Minimum allowable wall thickness
- Dates of tests
- Monthly measurement for each of the test points.

Non-Destructive Testing (NDT)

The presence of flaws in critical components (e.g. welding/joints in pipelines) may result in the integrity of such systems being compromised and increase the likelihood of failure.

Non-Destructive Testing (NDT) is the application of measurement techniques in order to identify damage and irregularities in materials.

If done well, NDT can provide useful information to assist in the management of plant safety. However, if inappropriate NDT is applied or NDT is not applied correctly, then the results are likely to give a false impression of the integrity and safety of the plant.

Hence, always seek professional advice with regards to the need and implementation of NDT.

Best Practice

High Pressure Hose Compensation Grouting

Following a small number of cases where 'ballooning' of compensation grouting hoses occurred (Fig. 2), it was found that de-bonding of the inner skin and subsequent 'kinking' (that is not visible from the outside) has led to these failures. This is most likely



Fig.2 Internal 'ballooning' failure

to occur at either end of the hose, but progressive de-bonding can allow the failure to progress along the length of the hose.

Following collaboration between Crossrail, the hose supplier and the manufacturer, a solution was implemented which resulted in a hose with a thicker and more integrated

reinforcing bond between the inner and outer skin (Fig. 3).

The benefits of this solution are:

- More rigid hose—less susceptible to damage by kinking and separation of inner hose.
- Larger bond surface between inner and outer hose reducing likelihood of separation.
- Stronger hose with a working pressure of 214bar.



Fig.4 Old hose (left), and new hose (right) showing 'castellated' bonding with the outer skin

Best Practice

Safetrak Electronic Inspection

Site teams working at Whitechapel and Finsbury Circus identified a need to improve the management of inspection regimes for pipework used to pump concrete.

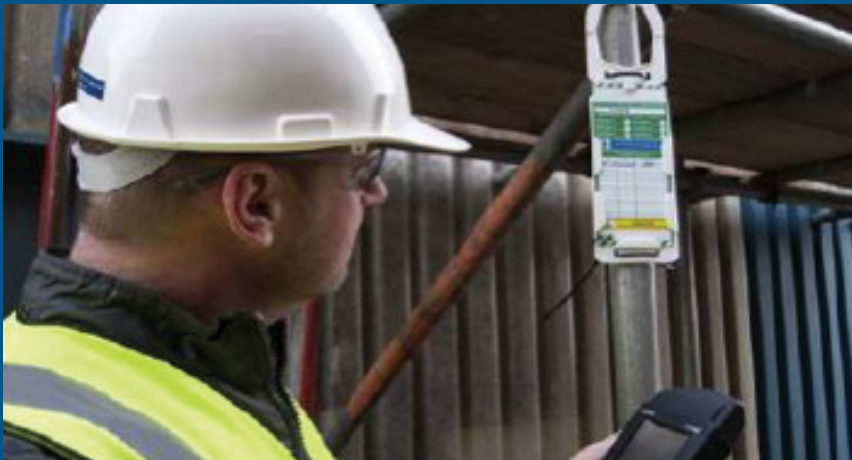
The Safetrak Electronic Inspection system was implemented to manage and simplify equipment inspections and reporting. The system uses mobile computers, in conjunction with visual tags, to report on the location, usage and inspection status of pipework. This data is then uploaded to a central database.

The system has additional benefits in being able to provide asset registers, schedule reminders for inspections

and produce high-level summaries of inspection outcomes.

Assets can be tagged using a number of methods, including bar codes, serial numbering or Radio-frequency Identification (RFID) tags, with tags being chosen in response to specific site conditions (ie. resilient to wear, water, dirt, chemicals etc.)

For further details email customer.services@safetrak.com or www.safetrak.com.



Jet Washing / Pressure washers

Regular maintenance is essential to ensure the safe operation of jet washers. This must be carried out in

accordance with the manufacturer's instructions. Records must be kept of all maintenance and repair work carried out. Please refer to sample inspection and maintenance check list below.

Inspection and maintenance checklist						
HD / HDS						
Date		Order No.				
Customer No.		Machine type				
Type No.		Serial no.				
Year of manufacture		Purchase date				
Name of tester		Signature				
Name of customer		Signature				
Operating hours total		Operating hours since the last maintenance				
Control "On"	_____ Hours	Number of gun switchings	_____			
Number of detergent bottles	_____	Burner	_____ Hours			
Number of gun switchings	_____	Pump	_____ Hours			
Burner	_____ Hours					
Pump	_____ Hours					
*Key test interval as per operating hours or at least:						
<input type="radio"/> Yearly <input checked="" type="radio"/> Every 3 months <input type="radio"/> Every six months <input type="radio"/> Quarterly * Always before the winter season		Inspection interval after operating hours or display or see key*	Not required / available	OK	Not OK	Repair
Safety check according to national specifications						
Safety check according to national specifications		500	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electrical installation and control panel						
General:						
Electrical safety Danger for person, object and environment Shut machine down.		500	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Electronics/control cabinets:						
Function and state: Electrical connections, lines, plugs, screwed contacts, fuses, casing, protective earth conductor, etc. Check for oxidation, damage, tight seating, conductivity		500	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Control and display elements						
Check programme selector switch, temperature setting, detergent dosing, pressure gauge, indicator lamps, display, service switch,... for function / locking function / ease. Check/reset error list and maintenance intervals		500	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Basic appliance						
General:						
Function and state: Check appliance casing, cover, castor, parking brake, tyre pressure, type plate, general condition of the drive motor, rubber buffer		500	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Key test interval as per operating hours or at least:	Inspection interval after operating hours or display or see key	Not required / available	OK	Not OK	Repair
<ul style="list-style-type: none"> ● Yearly ● Every 3 months ● Every six months ● Quarterly <p>* Always before the winter season</p>					
Hot-water system					
Oil burner:					
Function and state: Ignition cable, electrode plug, ignition electrodes, sight glass, photo cell, burner nozzle, heating coil, fuel level, fuel filter, fuel hoses, fuel solenoid valve, fan, emission valves, temperature increase, liquid softener, flow meter	500	●	○	○	□
			○	○	□
HD pump unit:					
Pump					
Function and state: HD pump, high-pressure and low-pressure valves, overflow valves, pressure gauge, pressure switch, pressure accumulator/SDS hose, pressure retaining valve, seals, operating pressure, circuit pressure, chemical function/quantity, check valve (chemical), detergent container, oil level, oil change, soiling, water shortage safety device, safety valve/safety block	500	●	○	○	□
			○	○	□
Water inlet					
Function and state: Hose lines, connecting pieces, float valve, float container, filter insert, valves	500	●	○	○	□
Checking for leaks, contamination, ...			○	○	□
Accessories					
Work tools					
Function and state: Check HD hose, gun, steel tube	● 500		○	○	□
			○	○	□
Internal combustion engine*					
Initial inspection / maintenance on the combustion engine petrol / diesel*					
Scope of maintenance: Oil, oil filter, operating speed	10-50		○	○	□
			○	○	□
Regular inspection / maintenance on the combustion engine petrol / diesel*					
Function and state: Combustion engine, radiator fins, cooling air induction	50-100	●	○	○	□
Function and state: Combustion engine, radiator fins, seals, oil, oil filter, air filter, spark plugs, preheating device (diesel), spark plug cable, fuel filter cup, fuel filter, starter, starter pinion, starter relay, fuel system, fuel hoses, accelerator cable, choke, starter rope, exhaust system, V-belt, toothed belt, electric connections, electric sensors...	50-100	●	○	○	□
Check for cleaning, replacement, oil level, damage, mounting, leaks, wear, settings, operating speed, valve clearance ...			○	○	□
			○	○	□
			○	○	□
			○	○	□
			○	○	□
*Note: The check and replacement intervals stated here can be used as target times for most of the combustion engines in the Kärcher range. However, different intervals can be stipulated by the manufacturer for some combustion engines. Please observe the machine-specific service documents.					

Section E - Appendices



Appendix A: Concrete Pumping Operation Check Sheet

Concrete Pumping Operation Check Sheet				
Inspection Date:				
Location of pour:				
Inspector Name & Job Role:				
Date of pour:				
		Tick confirmation		
Concrete Pump setup	Pump operator trained and in possession of proof of competence	Yes	No	N/A
	Concrete pump on level ground	Yes	No	N/A
	Load bearing capacity of ground sufficient for pump	Yes	No	N/A
	Outriggers, where fitted, are fully extended. The outriggers must be fully extended unless short rigging systems with boom restrictor is fitted by the pump manufacturer and used	Yes	No	N/A
	Delivery hopper is guarded by an interlock grille	Yes	No	N/A
	Safe access exists for delivery vehicles	Yes	No	N/A
	Pedestrians safe access is available			
	Concrete pump is clear of overhead obstruction			
	Wind Speed will not affect safe operation of the placing boom Has a system of signalling been agreed, i.e. hand signals or radio			
Pipeline Checks	All metal pipes and pipeline components are identified. Checked and visually inspected for damage prior to each and every pour.			
	Horizontal pipelines are adequately supported	Yes	No	N/A
	A bottom bend/ footed bend is used at the bottom of a vertical pipeline	Yes	No	N/A
	Unnecessary bends are avoided	Yes	No	N/A
	Vertical lines are positively secured to the building	Yes	No	N/A
	Flexible hoses are not at risk of being run over by other plant or equipment	Yes	No	N/A

Pipe Clamps & Brackets	The pipe clamps used are able to withstand the maximum concrete pressure applied to the pipeline by the pump.	Yes	No	N/A	
	Clamps are locked as per the manufacturer's instructions	Yes	No	N/A	
	The locking pins are used and are engaged	Yes	No	N/A	
	All pipe clamps are regularly inspected by a competent person for signs of wear and fatigue	Yes	No	N/A	
	Pipe clamps which show any deformation or damage are immediately replaced	Yes	No	N/A	
	Anchor brackets and tie-downs are used to adequately secure pipelines (2 brackets on the top face of slab and 1 bracket on vertical face. A competent person to assess whether additional brackets are required prior to pumping.	Yes	No	N/A	
During the pour	<p>Hopper grill with interlocked guard in place at all times</p> <p>Ensure the pump is turned off when not in use</p> <p>Ensure PPE is worn at all times. Long sleeves worn at all times.</p> <p>Splashes of concrete onto skin should be washed off as soon as possible with soap and water.</p> <p>Radio contact maintained between pump operator and other operatives at all times</p>				
Blowing Out / Cleaning	No pipeline connection or fitting should be disconnected unless it has been established that the pipeline is free of internal pressure.				
	No pipeline is to be left unattended unless it has been confirmed that the pipeline is free of internal pressure.				
	Only competent, qualified and experienced operatives are to clean out the pipeline	Yes	No	N/A	
	A ball catcher must be used to catch the sponge balls when the line is being cleaned out	Yes	No	N/A	
	All operatives must be briefed to keep clear from the discharge end while cleaning is in progress	Yes	No	N/A	
	Refer to the Concrete Pipe Blow Out Check Sheet in Appendix B for more detailed checks which need to be performed prior to every blowout operation				

Appendix B: Concrete Pipe Blow Out Check Sheet

	Site:								Date:							
	Time:															
Initials of Competent Person:																
Drive:																
	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
Are all personnel aware that blow out is about to commence? Are there sufficient competent, qualified and experienced operatives to clean out the pipeline																
Has the latest pipe line additions been checked? Has the blow out adapter been checked prior to the pour?																
With blowing end - is the cannon in good working order? Have the latest pipeline additions been checked prior to the pour?																
Are ball catching arrangements in place?																
Is there good communication between the blowing end and the receiving end? Is the pipeline adequately fixed and secure?																

<p>Is everyone in a safe location 30m from the catcher? Is there good communication between the blowing end, and ball follower and the receiving end?</p>																		
<p>Are all personnel aware that blow out is about to commence?</p>																		
<p>Is everyone in a safe location 30m from the catcher?</p>																		

Appendix C: Briefing-Cleaning out Concrete Lines with Compressed Air

Briefing: Cleaning out Concrete Lines with Compressed Air

Aim: To provide instruction, training and awareness to allow you to clean out a concrete pipeline safely using compressed air following concrete pumping operations.

Briefing:

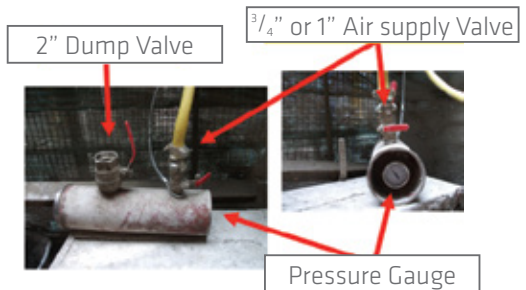
- On completion of a pour/advance, stop pumping, reverse the pump a minimum of three strokes to relieve the pressure in the line and then turn the pump off
- **Check the pressure gauge on the pump is reading Zero**
- Only when this is complete should you start dismantling the concrete line connected to the pump, ready for cleaning out.

The cleaning out activity on the surface must be controlled by the 'senior' pump operator on the shift.

- Disconnect the concrete pump from the pipeline
- Insert a wet hart sponge ball into the open end of the pipeline
- Re-check the blow out adapter to ensure that the valves can open and close properly and that the pressure gauge is undamaged
- The blow out adapter to the open end of the line with a good clean coupling seal and insert the safety pin
- Connect the airline, ensuring that the whip checks are in place

- Confirm that a ball catcher has been installed to the discharge end of the pipeline and the pipeline is secured adequately
- Inform the person controlling the operation (this is the person with the radio at the pump outlet) that you are ready to blowout the lines
- Await instruction to proceed
- Ensure that the Blow Out Check Sheet has been completed
- Do not start until instructed to do so by the person controlling the operation underground.

Blow out pot adapter configuration. This configuration MUST be used



- Concrete Pipe Blow Out Check Sheet

		Site:					
Time:							
Initials of Competent Person:							
Date:							
		YES	NO	YES	NO	YES	NO
Are all personnel aware that blow out is about to commence?		✓					
Has the blow pipe line adapter been checked?		✓					
Check with blowing end - is the cannon in its good working order?		✓					
Are ball catching arrangements in place?		✓					
Are the cannon and rubber seal checked (whip check)?			✗				
Is there good communication between the blowing end and the receiving end?		✓					

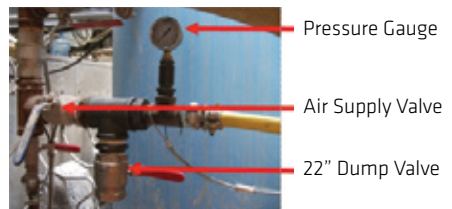
Ensure any problems are corrected BEFORE the blowout operation

- The person who is operating the blow out adapter should not leave the area for any reason whilst the adapter is connected to the line
- Ensure that there are visual communications at all times to back-up the radio system
- Before opening the air valve, ensure that the person controlling the blow-out underground has completed their checks and has moved everybody to a safe distance away from the blowout area
- Once confirmation is received, open the air valve to introduce the air while monitoring the pressure increasing on the gauge. Maintain communication with the person controlling the blow-out underground and inform them of progress
- Do not leave the air supply valve on all the time—introduce air progressively for 15 to 20 sec intervals. The pressure as shown on the gauge will fall when air is turned off and the concrete moves ahead of the ball
- Repeat the above process until all residual concrete/ grout is cleaned from the line
- Pressure can be released at any time during the process by switching off the air supply valve and opening the dump valve
- Be aware that if the line blocks and the air pressure is vented via the dump valve, some concrete may also be expelled and so it is

important to ensure that the dump valve vents in a safe direction

- A second flush can be made when the line has been blown out by blowing two sponge balls with a slug of water between them
- Remember that concrete/ grout build up in the lines can cause problems and potential dangers on subsequent pours.

Fail-safe pressure release arrangement (example at the rear of the compressor)



Procedure for ensuring that air pressure on completion:

- Close the air supply valve on the blow out adapter when instructed to do so and/or when the red light is displayed
- Open the dump valve on the blow-out adapter to vent any pressure in the pipeline
- Check that the gauge is reading zero.

If there is any doubt as to whether or not the pressure in the line has been fully released, take the following steps:

- Close the air supply valve at the compressor/receiver
- Open the dump valve at the compressor/receiver

- Open the air supply valve on the blow out adaptor
- Check that both gauges are reading zero.

This now ensures that the air pressure is relieved in the concrete line and air supply pipe.

- If there is still any doubt, turn off the compressor and dump the air from the receiver
- Report any mechanical or equipment issues immediately to the Pit Boss or mechanical department
- When you are certain that there is no retained air pressure in the concrete line, the blow adapter can be uncoupled and removed from the end of the pipe
- The blow-out adapter must be cleaned thoroughly after each use to prevent any grout build up in valves and gauge and to ensure it is fit for use each time it is used.

Check

- Before removing the blow-out adapter at the end of blowing out, make sure the air supply valve is closed, the dump valve is open and the gauge is reading zero.
- If an unsafe condition arises during any stage of the operation you must stop immediately!

Release the pressure and do not restart until the unsafe condition has been remedied.

Finally








- During the cleaning out operation the concrete lines will have a considerable amount of stored energy!

Any uncontrolled release of this energy/pressure is a serious safety hazard!

Appendix D: Jet Washing Operation Check Sheet

Date:				
Location/Machine Type:				
Inspector Name + Job Role:				
	Tick confirmation ✓			Comment
	Yes	No	N/A	
Is the work area clearly defined and are proper warning signs posted (exclusion zone if needed)?	Yes	No	N/A	
Have precautions been taken to protect all electrical equipment affected?	Yes	No	N/A	
Have all persons working in surrounding area been informed about the intention to carry out water jetting operations?	Yes	No	N/A	
Are hoses and lines protected from accidental damage (vehicles, other operations in the area)?	Yes	No	N/A	
Is there an adequate water supply?	Yes	No	N/A	
Have all personnel been provided with the appropriate PPE for this job?. Consider people in the immediate area too.	Yes	No	N/A	
Have all personnel received the proper training for this job?	Yes	No	N/A	
Have all personnel using the equipment been briefed and do they know how to use the equipment safely?	Yes	No	N/A	
Is the location of emergency medical aid known?	Yes	No	N/A	
Are all fittings of the correct pressure rating?	Yes	No	N/A	
Are all hoses of the correct pressure rating?	Yes	No	N/A	
Are all fittings in good operating condition?	Yes	No	N/A	
Are all hoses in good operating condition?	Yes	No	N/A	
Are HAVs trigger times known and a schedule of rotation in place if trigger times are exceeded?	Yes	No	N/A	
Are good washing facilities available to wash hands before eating or drinking	Yes	No	N/A	
Is the area clear of any obstacle which could cause slips, trips or falls?	Yes	No	N/A	

Important Notes:

-  Wear task specific PPE at all times
-  Wash hands before eating, drinking or smoking
-  Never use trigger-assist devices. Hand operation only.
-  Never try to clean PPE using pressure washers
-  Never point the jet at other people, regardless of distance
-  No line connection or fitting should be disconnected unless it has been established that the line is free of internal pressure.
-  No line is to be left unattended unless it has been confirmed that the line is free of internal pressure.



Appendix E: Examination Checklist for Concrete Pumps

A thorough examination should include as a minimum (where applicable):

- A visual inspection of all sections of the boom, its supporting structure, securing devices and stabilisers
- Non-destructive testing of the structure and welds when it is deemed necessary by the competent person
- The opening up of concealed or encased parts to the extent required by the competent person
- Measurement of backlash / play in the slewing system
- Measurement of wear in the slewing rack thrust pad
- Lift in the slewing ring
- The integrity of the slewing ring bolts
- Measurement of wear in pins and bushes at the boom joints
- A check on the security of boom pins
- The condition of boom pipe brackets
- The presence of security pins in pipe couplings on the boom pipeline
- The condition of the boom tip safety chain and its anchorage
- The correct operation of lock valves on the boom's hydraulic rams
- The stabiliser locking system for both travelling and working
- The mounting fixtures for the pump sub-frame and the boom pedestal to the chassis
- The workings of levers and switches on the remote control box(es)
- The condition of the remote control box lead
- The workings of manual control levers
- The operation of all emergency stop controls
- The clear marking of all controls
- The satisfactory operation of safety switches, e.g. slewing limits
- The operation of interlock systems, e.g. on the receiving hopper
- The integrity of the receiving hopper grille
- The guarding of the concrete pump cylinders' flushing box
- The guarding of the machine's prop-shaft
- The condition of the machine steps and walkway
- The condition of the washing-out adaptor and the sponge cleaning ball catching basket
- Working lights
- Appropriate warning signs
- The manufacturer's identification plates.

Appendix F: Crossrail Vehicle Safety Kit



DRIVER INDUCTION INFORMATION & CROSSRAIL VEHICLE SAFETY KIT ▶









MIRRORS AND VISUAL AIDS

Applies for:

- ✓ Small lorries 3.5 to 7.5 tonne
- ✓ Medium lorries >7.5 tonne
- ✓ Concrete mixer
- ✓ 2/3 Axle Rigid
- ✓ Grab or skip lorry
- ✓ 4 or multi axle tipper
- ✓ Articulated Low Loaders
- ✓ All other vehicles >7.5 tonne

12








Item	Location
 Class IV Mirror*	Front nearside
 Class V Mirror*	Front nearside
 Class VI Mirror*	Front of cab
 Rear view Mirror	In Cab (if applicable)
 Fresnel Lens or camera system (below)	Near side window
 Side Camera System* (optional)	Front mounted rear facing

STICKERS, SIGNS AND DECALS

Applies for:

- ✓ Small lorries 3.5 to 7.5 tonne
- ✓ Medium lorries >7.5 tonne
- ✓ Concrete mixer
- ✓ 2/3 Axle Rigid
- ✓ Grab or skip lorry
- ✓ 4 or multi axle tipper
- ✓ Articulated Low Loaders
- ✓ All other vehicles >7.5 tonne

19

Item	Location
 Cyclist warning sign	Rear nearside
 Pedestrian warning sign	Near side only
 Drugs & Alcohol warning	In the cab
 Seat belt reminder	In the cab
 DAILY INSPECTIONS MUST BE CARRIED OUT Daily inspection reminder	In the cab
 THE MAXIMUM LEGAL CAPACITY OF THIS VEHICLE IS: _____ Maximum Passengers*	In the cab
 High visibility markings	Rear/Sides









* Passenger carrying vehicles only e.g. minibus

LIGHTING AND CAB INTERIOR

Applies for:

- ✓ Small lorries 3.5 to 7.5 tonne
- ✓ Medium lorries >7.5 tonne
- ✓ Concrete mixer
- ✓ 2/3 Axle Rigid
- ✓ Grab or skip lorry
- ✓ 4 or multi axle tipper
- ✓ Articulated Low Loaders
- ✓ All other vehicles >7.5 tonne

20






Item	Location
 Rear fog lights	Rear of vehicle
 Amber flashing Beacon (All vehicles)	Top of cab
 Daytime running lights (or sidelights on)	Front of the vehicle
 Spare bulb kit	Stored on the vehicle
 Warning triangle	Stored on the vehicle
 Fire extinguisher	Stored on the vehicle
 Seat belts to be worn	Fitted to each seat
 No additional tinting	On any window

OUTSIDE THE VEHICLE

Applies for:

- ✓ Small lorries 3.5 to 7.5 tonne
- ✓ Medium lorries >7.5 tonne
- ✓ Concrete mixer
- ✓ 2/3 Axle Rigid
- ✓ Grab or skip lorry
- ✓ 4 or multi axle tipper
- ✓ Articulated Low Loaders
- ✓ All other vehicles >7.5 tonne

18

Item	Location
 Side scan detection kit	Nearside step or wheel arch area
 Side under run guards	Fitted both sides
 Reversing alarm <small>(can incorporate sensors and/or a camera)</small>	Rear of the vehicle
 External spoken warning alert*	Nearside of the vehicle
 Hi Vis Clothing <small>(See Principle Contractor site rules)</small>	Orange Driver PPE

For further information contact:

Crossrail Logistics
Traffic Coordination Centre

Tel: 020 3229 9885
pdptcc@crossrail.co.uk

November 2015

Driver name:

Company:

Contact:

www.crossrail.co.uk
MOVING LONDON FORWARD

EA487



Appendix G: References

Abbreviations	
PPE	Personal Protective Equipment
RFID	Radio-Frequency Identification
SCL	Sprayed Concrete Lining
TUCA	Tunnelling and Underground Construction Academy

References	
BS EN 12001 Conveying, spraying and placing machines for concrete and mortar safety requirements.	BS
Health and Safety at Work Act 1974	HASWA
Lifting operations and Lifting Equipment Regulations 1998	LOLER
Pressure Equipment Regulations 1999	PER
Pressure Systems Safety Regulations 2000	PSSR
Provision and use of Work Equipment Regulations 1998	PUWER
Road Traffic Act	
Vehicle and Operator Services Agency	VOSA

Further sources of information

All of the documents listed in the 'Reference documents' section can be found at the following sites which are also extremely useful for information on all other aspects of site safety.

Health and Safety Executive	www.hse.gov.uk
UK Government legislation	www.legislation.gov.uk
Construction Industry Publications	www.cip-books.com
Fire Protection Association	www.thefpa.co.uk
RISCAuthority	www.riscauthority.co.uk
Loss Prevention Certification Board (LPCB)	www.bre.co.uk
Institution of Engineering & Technology (IET)	www.theiet.org
British Standards Institution (BSI)	www.bsigroup.co.uk

Phonetic alphabet

A	Alpha	J	Juliet	S	Sierra
B	Bravo	K	Kilo	T	Tango
C	Charlie	L	Lima	U	Uniform
D	Delta	M	Mike	V	Victor
E	Echo	N	November	W	Whiskey
F	Foxtrot	O	Oscar	X	X-ray
G	Golf	P	Papa	Y	Yankee
H	Hotel	Q	Quebec	Z	Zulu
I	India	R	Romeo		

Numerals should be spelled out, not given as whole numbers:
121 is 'one-two-one'; NOT 'one hundred and twenty one'.



MOVING
HEALTH & SAFETY
FORWARD