Safety Saves
Quality Pays

Remember:

Everyone at Bridges is empowered to STOP work if they feel the task they are being asked to perform is unsafe.

If you are unhappy with the way you are being asked to work or feel unduly pressured, **STOP** and speak with your Supervisor, Manager or a member of the SHEQ Team.

MECHANICAL SAFETY RULES

SAFE WORKING PROCEDURES

The Bridges Mechanical Safety Rules are in place to ensure that the actions of our employees, staff or any person working directly for or on behalf of the company do not create a hazard or dangerous occurrence that may put themselves or any other person in a situation that could cause injury.

These rules are mandatory and it is the responsibility of all to ensure that they are complied with and to give a route to allow persons to advise of any occurrence or situation that they consider being dangerous or having the risk of causing a situation that could cause injury.

Supporting mandatory documents: -

Health and Safety at Works act 1974
Electricity at Works act 1989
IEE Wiring Regulations BS7671

Written: S Spencer – HSEQ Compliance Director

Reviewed & Checked: P Singer - SAP, J Chadburn – Mechanical Engineering Manager, J Clarke – Delivery Director, M Bridges - Managing Director.

Approved: M Bridges – Managing Director

Revision status

Revision	Description	Approval Date	Status
Revision 01	First Issue	01/08/17	First Issue

Index

Mechanical Safety Rules

2. General

2.1 Introduction

The purpose of the Mechanical Safety Rules is to ensure that all persons working on or near plant and apparatus, to which these Rules apply, are safeguarded from the hazards that may arise from mechanical systems.

The Mechanical Safety Rules and associated documents and procedures are based on the principal that they state what shall be done to ensure that the specified work or activity is carried out without danger so far as is reasonably practicable. The dangers that can arise are two-fold:

- inherent dangers from systems, plant, and apparatus that are covered by the Safety Rules;
- general dangers associated with the work as it proceeds, including dangers from access and egress, the place of work and the working environment.

Even the best rules and procedures are of no value unless all persons working on, with, or near electrical and mechanical systems are thoroughly conversant with them, and comply strictly with the Rules. The safety of employees and contractors working on behalf of Bridges electrical and mechanical installations is paramount.

2.2 Issue of Safety Rules

A copy of these procedures shall be issued to all employees & sub-contractors who may be concerned with Mechanical work at the company and/or customer sites. The employee shall sign that they have read and understood this document and their responsibilities to those working for / with them. A copy of this document will be kept in the vehicle / site Health and Safety file and also in the technical library at the place of employment.

Accompanying these procedures will be a Health & Safety Handbook.

The Mechanical Safety Rules set the **minimum** safety requirements that shall be applied by all personnel working on sites where the company has responsibility for the mechanical system, installation and equipment. The implementation of these Safe Working Procedures is **Mandatory** and will be followed by all employees & sub-contractors at all times.

Personnel may carry out work on premises where a third party has the legal responsibility for the mechanical system, installation and equipment under the third party's own safety rules. Providing these safety rules and associated procedures meet or exceed the minimum standards laid down in these procedures this is acceptable. All affected personnel shall be fully trained and assessed on the third party's rules.

3. Scope

These safety rules apply to all sites, work areas and all work activities dealing with mechanical systems and equipment and all Bridges employees and to sub-contractors carrying out work for the Company.

Work involving electrical systems are managed by Bridges Electrical Safety Rules (BHS HSI 41) and these should be read & implemented where applicable.

4. Duties.

It is the duty of all concerned to:

- Act in a responsible manner and take reasonable care of themselves, their colleagues and anyone else who may be affected by the activities of the Company
- Avoid careless behaviour, horseplay that may affect themselves or others.
- Carry out their work in accordance with the Company policy, safe working practices and other instructions at all times
- To be conversant with all regulations governing the work they may be requested to undertake. These procedures do not overrule any statutory regulations that may be in force at that time, they are to be read in conjunction with these.
- Undertake only such duties as have been specified to them in the instruction to work or as detailed in the Method Statements issued to them, as and when required they shall modify this Method Statement to suit the work as found at the job. Any person carrying out such work must be Competent to carry out that work and where necessary, suitably authorised as detailed below. No persons shall undertake work unless they have the appropriate training and experience defined in the requirements for authorisation and competency.
- Use tools, materials and equipment safely, inspecting it before use to ensure it is safe to use.
- Immediately report any risk, hazard or shortcoming that may affect health and safety and not to undertake any work until matters have been resolved to their satisfaction.

There is a legal obligation on all persons to take reasonable care of his / her health and safety and the health and safety of other persons who may be affected by his / her acts or omissions.

5 Associated Documents

This document should be read in conjunction with the following documents:

Health and Safety at Works act 1974
Electricity at Work Regulations 1989
Electrical safety, quality and continuity regulations 2002
Management of Health and Safety at work regulations 1999
Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013
Construction Design and Management regulations 2015 (CDM)
The Provision and Use of Work Equipment Regulations 1998.

The Health and Safety document register details all documents issued by the company relating to Health and Safety, listed below are those that apply in particular to this document.

Bridges Health and Safety Policy	BHS POL 02
Risk Assessments	BHS HSI-01
Permit to work issue and control	BHS HSI-12
Lone working	BHS HSI-36
Electrical Safety Rules	BHS HSI-41

6 Definitions

6.1 Authorised Persons

Definition of Persons

Definition of Persons		Bridges Mechanical Safety Rules - Authorised Persons
`Skilled Person`	=	**AP MECH** – Authorised Person
`Instructed Person`	=	**CP** - Competent Person
`Ordinary Person`	=	**Apprentice or Trainee** or any other person (Trainee can progress to CP when in third year of training)

For clarity Bridges definitions of authorised persons will be used in this document.

Authorised Person Mechanical (AP MECH)

A person who fulfils the requirements of a Competent Person and has relevant experience and/or qualifications in a mechanical discipline and who has had adequate training to work without danger and accepts responsibility for the safety of others working under his direction.

Unless otherwise specified on the Certificate of Appointment they can: -

- Carry out Lock Off procedures for low voltage electrical supply and distribution systems
- Issue & cancel Permits to Work
- Carryout or supervise restricted operations such as Pressure Testing & Lifting
- Oversee training of Apprentices/Trainee's
- Supervise the work of Competent Persons, Trainees & other persons

Competent Person (CP)

A person with sufficient technical knowledge and experience to prevent danger or, where appropriate, injury, during his or her work. This person will have successfully completed the relevant sections of the Bridges competency questionnaire. He or she must be adequately advised or supervised by a skilled person (AP MECH) to enable that person to perceive risks and to avoid hazards.

Trainee / Apprentice (Trainee)

A person employed or sub-contracted by the company to undertake training as part of recognised technical progression. Trainees shall always work under the guidance and instruction of an AP MECH They will always work on equipment that is not energised and that has been isolated by an AP MECH.

Certificate of Appointment

A certificate appointing an AP MECH, CP or Trainee stating details to which it applies and operations/work the person is authorised to carry out.

A certificate of appointment will be countersigned by the holder confirming their acceptance and understanding of the extent of his authority. The competency will be displayed upon their work safety helmet wherever possible.

6.2 Definition of Mechanical Apparatus

Pressure / Hydraulic system - Any system, whether fixed or mobile, which has a system incorporating a rigid pressure vessel containing steam, a liquid, gas or vapor (including gas dissolved in a solvent) at a pressure greater than 0.5 bar above atmospheric should be considered as a pressure system . All Pressure systems must be designed, installed, operated & maintained in line with the the Pressure Systems Safety Regulations 2000 (Approved Code of Practice L122)

Permit to Work - A permit-to-work system is a formal written system used to control certain types of work that are potentially hazardous. These are also referred to as `Restricted Operations`. A permit-to-work is a document which specifies the work to be done and the precautions to be taken. Permits-to-work form an essential part of safe systems of work for many activities.

Non-Destructive Testing - (NDT) may be defined as the application of an inspection method to a component or structure in which the component (s) are not adversely affected by the testing method

Commissioning - commissioning is a critical part of the overall process of taking a plant and equipment from construction and installation through to full operation and includes various tests and confirmations of safe and effective operation.

Machine/ Rotating Machinery - An assembly of linked parts or components at least one of which moves joined together for a specific application, in particular for the processing, treatment, moving or packaging of a material. It also includes interchangeable equipment modifying the function of a machine

The machine to be worked on should be assessed as to its criticality to the site process. The product information and procedures sourced from the manufacturers along with operator's procedures should be included as a part of the assessment of the planned activity of work.

Temporary Works - Any structure used during the construction of the permanent works that does not form part of the finished permanent works, or elements of the permanent works themselves in a temporary condition prior to structural completion (i.e. cast in soffit forms, steel building frames etc.), permanent works subject to construction loads in excess of the permanent works design load.
This includes: falsework, formwork, shoring, gantries, structures undergoing demolition, crane supports, excavation supports, temporary bridging, protection screens, weather enclosures (sheeted scaffolds), sign-boards, fencing, pressure testing of pipework, temporary and construction loads on the permanent structure (Boom lift etc.).

The need for Temporary Works shall be considered in relation to the planned activity (e.g. for services support / bracing, pressure testing and any necessary structures needed, etc.). Should the need for temporary works be identified, the design, associated calculations and checking MUST be carried-out. No works must be allowed to take place where the need for temporary works has been identified and the necessary action has not been taken.

Risk Assessments - A risk assessment is nothing more than a careful examination of what, in your work, could cause harm to people. Specific risk assessment must be produced to identify and address the hazards related to the system, its isolation, the resulting impact on other systems and the hazards involved with actually carrying out the task itself. Hazards may include potential risk to others not related to the work but affected by it, i.e. the public, concurrent work activities and other personnel. Work is not permitted without a Risk Assessment being in place and all staff undertaking the work being briefed on its contents.

Method Statement
A method statement, sometimes called a "safe system of work", is a document that details the way a work task or process is to be completed. The Method Statement should incorporate the necessary safety sequences required.

RAMS - The term RAMS refer to the combined documents Risk Assessment & Method Statement. The RAMS together must adequately identify the specific steps that will be taken to ensure the safety of the system being worked upon at all times during the work activity. The relevant detail in terms of residual risk, control measures and sequence of works MUST be fully briefed to the team completing the activities.

Machinery Guarding - The moving parts of machinery must be designed and constructed in such a way as to prevent risks of contact which could lead to accidents or must, where risks persist, be fitted with guards or protective devices. An assessment of the existing and required standard of guarding for the work must be made before commencing any work and, where necessary, replacement or repair organized as part of that work. A complete system of guarding including safety-locking devices must be in place before the machine is put back into operation.

Guards shall not be removed or loosened until the isolating/locking off procedures are completed.

PM / PE - Project Manager or Project Engineer, the person managing the overall scheme of work.

PRA – Process Risk Assessment, normally completed with the client to manage the impact of works on the plant process.

7.0 Permit to Work

A permit-to-work system is a formal written system used to control certain types of work that are potentially hazardous (restricted operations)

Permitting should be carried out by the Principle Contractor (PC) and their procedures should be followed providing it meets or exceed Bridges requirements. Where they don't provide sufficient control or Bridges are undertaking the role of PC, then Bridges procedures should be followed.

Bridges have a mandatory requirement for permitting of the following activities and these activities must not be undertaken without a permit system in place:

- Hot Works (welding, cutting, grinding, etc.)
- Electrical or Mechanical Isolation
- Confined Space Entry
- Breaking Ground (excavation, earth rod installation, fencing)
- Working at Height
- Pressure Testing
  (See Appendix A – C)

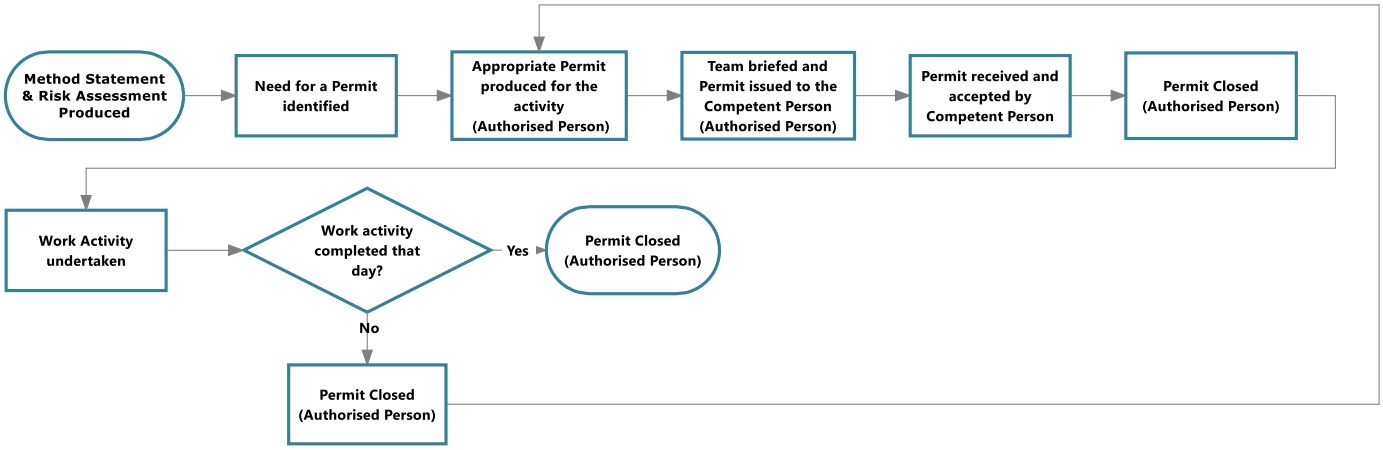
The Risk Assessment will document which permits are required for which project activity and who will issue the permits (Client/Bridges etc.)

Permits to Work shall be issued daily and are valid only between the times specified therein or for a maximum period of 24 hours or one working shift. After this time a new Permit must be issued on each occasion.

Persons authorised to issue permits:

Permit	**Person Authorised to produce Permit**	**Notes**
Hot Works	Client or Bridges APLV, AP/T, SAP or AP Mech	
Electrical Work – Non-Intrusive, Lock-off Only	Client or Bridges APLV, AP/T, SAP or AP Mech	
Electrical Work – Intrusive, Proving Dead	Client or Bridges APLV, AP/T, SAP	
Mechanical Isolation/Lock-out	Client or Bridges APLV, AP/T, SAP or AP Mech	
Confined Space Entry	Client or Bridges APLV, AP/T, SAP or AP Mech	*Provided they are Confined Space qualified*
Breaking Ground	Client or Bridges APLV, AP/T, SAP or AP Mech	
Working at Height	Client or Bridges APLV, AP/T, SAP or AP Mech	
Pressure Testing	Client or Bridges AP Mech	*Provided they are Pressure Test Authorised*
Lifting	Client or Bridges APLV, AP/T, SAP or AP Mech	*Provided they are Lift Supervisor or Appointed Person (Lifting Operations) qualified*

7.1 Permit Procedure



8.0 Isolation & Lock-Off

Where maintenance or installation requires that normal guarding is removed, or access is required to operational machinery (such as pumps, pressure systems, screens etc.), then measures are needed to prevent danger from the mechanical, electrical and other hazards that may be exposed. Many items of plant are controlled automatically and can operate without notice.

Where both an electrical isolation & mechanical isolation are required, the electrical isolation must be put in place first. Likewise the mechanical isolation should be removed prior to the electrical isolation before putting back into service. This is to prevent any equipment inadvertently starting against a closed valves.

It is extremely important to positively identify the plant or system to be worked on and to ensure it is prevented from being started. This can be achieved by running the plant in `Hand` (Manual), isolating it and attempting to run it in `Hand` (Manual) again. If the correct item of plant has been isolated, it should not start. Site identification numbers must not be relied upon as being correct. For example `Pump No1` & `Pump No2` may have been interchanged during maintenance activities and the labelling may no longer be correct.

The basic rules are that there should be isolation from the power source (usually, but not exclusively, electrical energy), the isolator should be locked in the `Off` position (by using a padlock), and a sign should be used to indicate that work is in progress. Isolation requires the use of devices that are specifically designed for this purpose; not devices such as emergency stops or other types of switches that may be fitted to the machine. Any stored energy (hydraulic or pneumatic power) should also be safely dissipated before the work starts.

If more than one worker is involved in the task, each of them should lock off the power with their own padlock wherever possible (Multi-padlock hasps can be used in such circumstances) Such isolation procedures can also be applied to locking off valves for services (such as rising mains, wash water systems & chemical pipelines etc.) Where the system is isolated & locked off by a third party, a `Permit to Work` must be received and your own padlock should be applied. Before entering or working on the equipment, it is essential that the effectiveness of the isolation is verified by a suitably competent person (AP MECH)

Not all sources of energy are evident, care must be taken to ensure items of equipment cannot rotate due to the effects of gravity (for example a loaded conveyor may rotate when the gearbox is removed). Also the effects of inbalance of other energy sources such as wind driving a fan or turbine. Effective means of preventing rotation from all energy sources must be found prior to dismantling any equipment.

8.1 Electricity

No person shall work on electrical equipment unless they have been authorised under the Bridges Electrical Safety Rules.

8.2 Pressure / Hydraulic Systems Isolation & Locking Off

The system to be worked on should be visually inspected and checked off against the associated schematic and valve schedule. Special consideration must be made of the likely impact on process if the equipment is stopped, a process risk assessment and authorisation from the client may be necessary.

- The compressor / pump / engine (which provides the pressurisation) must be electrically isolated, along with any secondary system of pressurisation i.e second pump
- The system must be assumed to be under pressure until proved otherwise and extreme caution must be exercised on dismantling the system.
- The means of venting the pipe work system and/or pressure vessel(s) should be agreed.
- The potential hazards of loss of pressure and spillage of fluid should be addressed.
- The system section to be isolated should be marked and the sequence of isolation be written down within the method statement.
- All points of Isolation required to enable the work to be undertaken must be identified, locked off and "*DO NOT OPERATE"* tags affixed at each point.

Mechanical isolation should be achieved by either shutting off valves and padlocking them, spading the line or removing a spool section of that line. "DO NOT OPERATE" tags should be affixed at each point. Secondary circuitry (air start systems, hydraulic drives, etc.) need to be located and isolated in the same manner. Wherever possible a double isolation should be put in place to provide additional protection.

Note: Not all valves open & close in the same direction. The normal rotation for closing valves is clockwise (CW) however valves on potable water installations are anti-clockwise (CCW) closing. In some cases the wrong valves can have been fitted on previous installations, therefore care must be taken to ensure the valve is in fact closed.

It is also important to release (vent) any residual pressure in the system before starting to dismantle. This can be achieved by slowly opening any valve to atmosphere (water or non-hazardous liquids/gases) or by slowly loosening flange bolts to allow pressure to be dissipated. The method of releasing pressure from systems containing hazardous substances must be carefully risk assessed to prevent danger to people or the environment from expelled liquids/gases.

Caution must be taken before removing any parts of the system which may be providing thrust restraint. These may include `tied joints` or concrete pads/blocks etc. If there is any doubt as to why a pipework system is designed or installed, it should be discussed with the design department BEFORE making any changes.

Where long-term isolations have been put in place, care must be taken regarding any `dead leg` sections of pipework which may hold stagnant water. The risk of Legionella or other bacteria being present must be assessed & mitigation measures put in place.

8.3 Compressed Gas Systems

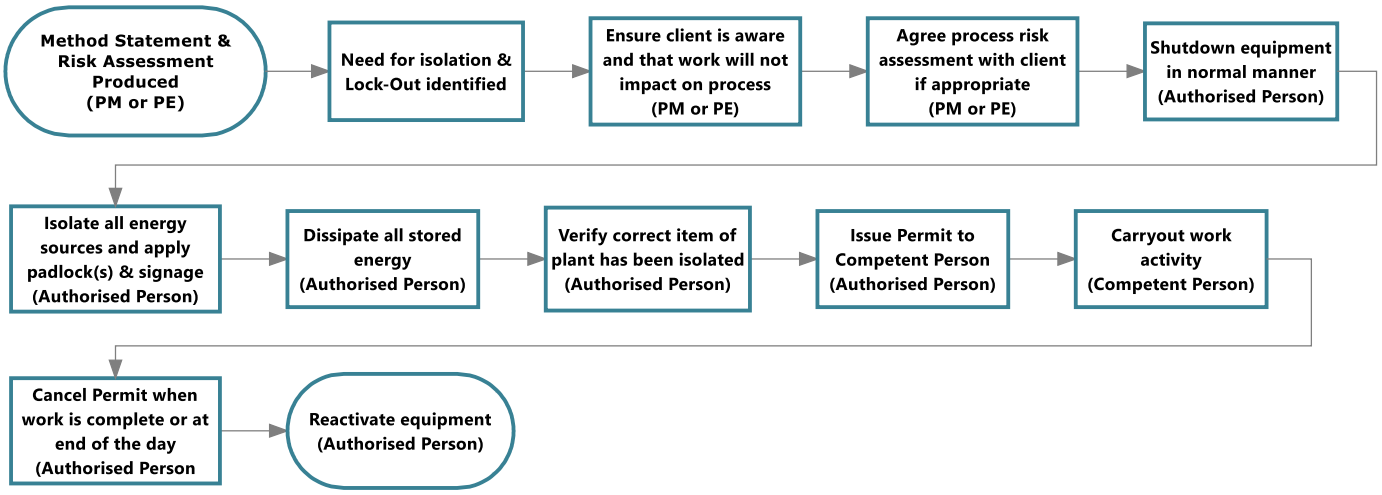
Many treatment installations contain gas bottle storage systems used for either purging gas lines or as fire suppression to switch rooms. Existence and status can be checked utilising the Health and Safety Notice board and direct liaison with the operator of the site. These systems should be isolated as per the procedure stated above, however there may be further inherent hazards.

- The control devices triggering the discharge should be isolated / disconnected.
- It is recommended that the specialist supplier be engaged to isolate and reinstate their system.
- There should be a working procedure to follow in the equipment O&M manual.

8.4 BIOGAS & Natural gas systems

Sewage treatment plants produce 'Biogas' from the sludge digestion process which is in turn used as a fuel to aid the same digestion process via a Biogas (natural gas) boiler / heating circuit which promotes digestion by heating the sludge. Biogas is also used as the primary source of Gas Engine Driven Electricity Generators. These generators, although not on every Sewage treatment site, provide site electrical standby or generate electricity into the national grid. Only Authorised contractors can work on these systems. A specific isolation, purging & permitting, Safe System of Work is required for work on these systems.

8.5 Isolation & Lock-Off Procedure



9.0 Hot Works

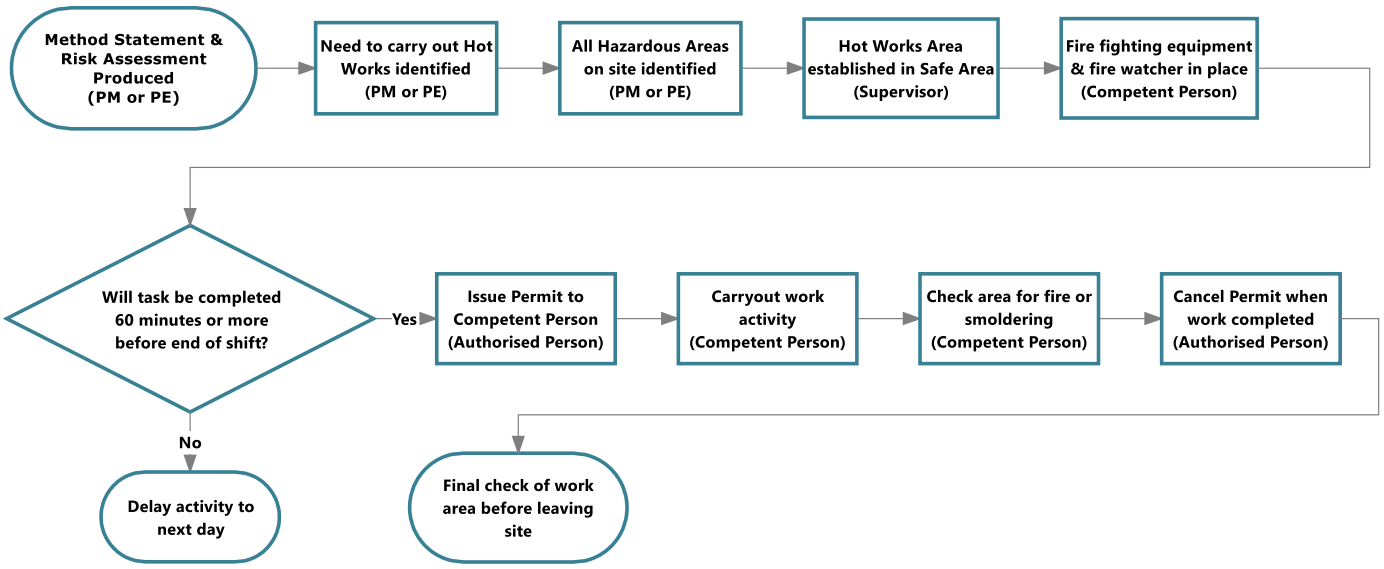
Welding, burning, & cutting operations must be carried out using the appropriate eye & face protection/shields and protective clothing/boots. As many operations give rise to dangerous fumes, local exhaust ventilation is the primary means of control and where this is not achievable respiratory protective equipment should be used. Welding, burning, grinding
and disc cutting operations, elsewhere than in a recognised and appropriate workshop, will require a Hot Work Permit issued by an Authorised Person (APLV or AP Mech) Only trained & competent staff should undertake cutting or welding activities.

Care must be taken to ensure any resulting sparks are directed away from the body and that they do not cause damage to equipment or risk of fire. Protective curtains should be used where necessary.

Hot Works MUST NOT be carried out during the last full hour of the working day. This is an insurance requirement and is designed to ensure no smoldering materials are left when we leave site.

Hot works must not be carried out in Hazardous or Potentially Explosive Areas. Where there is an identified need for this, a specific risk assessment must be carried out, the area must be ventilated, gas checked and authorisation for the work must be given by the HSEQ Compliance Director on every occasion. Other methods of cutting (i.e. reciprocating saw) must be considered as part of the risk assessment process to limit the risk of sparking.

9.1 Hot Works Procedure



10 Pressure Testing

Pressure testing involves applying stored energy to an assembly of parts, in order to verify its strength, its integrity and/or its functionality.

Pressure Testing is a high risk activity and therefore a permit must be completed prior to carry out any Pressure Test activity.

When applying stored energy to an assembly, especially for the first time, there is potential for an unintended or premature pressure release while people are in the danger zone.

Release of stored energy under pressure can cause:

- test assembly rupture, creating flying fragments;
- component or connector failure, creating missiles projected under force;
- test hose failure including detachment, with consequential hose whip, striking people;
- sudden release of the test medium (liquid, gas, vapour, dust or other substance under pressure) causing injury, e.g. burns, eye damage or pressure injection into bodily tissue.

Water should be used as the primary liquid in all pressure tests as it is uncompressible and therefore dissipation of stored energy in the event of a failure is minimized. Air or pneumatic testing should not be carried out without a written justification and approval from the HSEQ Director.

10.1 Guidance

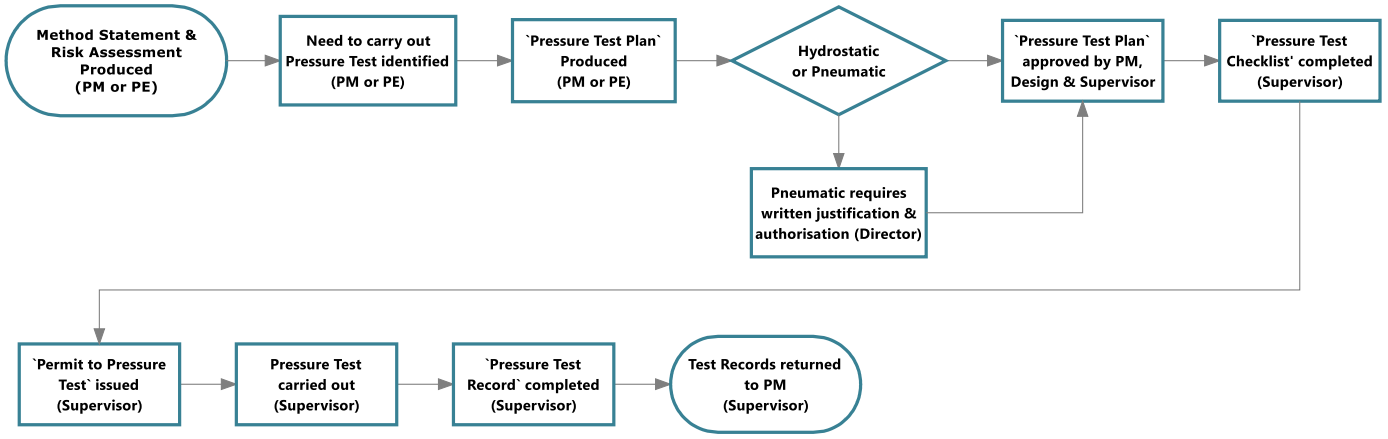
Gauges used for testing pressure pipelines shall either be of the conventional circular type, not less than 200 mm diameter, calibrated in metres head of water, or shall have a digital indicator capable of reading increments of 0.1 m head. Before any gauge is used, it shall be checked independently and a dated certificate of its accuracy shall be provided.

Before testing, valves shall be checked and sealed, the sections of pipework filled with water and the air released. After having been filled, pipelines shall be left under normal operating pressure for a suitable period, so as to achieve conditions as stable as possible for testing.

10.2 Method

- Erect adequate signage and ensure all site personnel are aware of pressure testing activities taking place.
- Exclusion zone to be imposed around test area, no persons to enter zone during test.
- Fit appropriate blanking spades to the pipework at the pre-identified and agreed flange connections.
- **HOLD POINT – The Pressure Testing Check List MUST be completed before proceeding.**
- Isolate all instrumentation prior to pressure testing.
- Attach one end of the high-pressure hose to the blank plate at one end of the pipe to be tested.
- Attach a bleed valve to the other end of the pipe to be tested.
- Attach the pressure testing rig and gauge to the other end of the high-pressure hose outside the exclusion zone.
- Fill the pipeline using the agreed water supply and ensure all air is allowed to escape during filling. It is essential that all trapped air is removed from the system.
- Pressurise the pipeline in 10% increments allowing 10 minutes settling time between increments until the test pressure is achieved. Record timings & pressure readings
- Observe designated test period, check for pressure drop and leaks.
- Client representative to witness test. Test results to be recorded on a pressure test record sheet, and be verified and signed by the clients representative.
- Upon successful test, remove test rig and release test pressure from pipe line in controlled manner.
- Dispose of test water to agreed location.
- Remove test blanks and re assemble joints as necessary.
- Remove isolations of instrumentation.
- Upon completion of the work, clear the test equipment from the work area.

10.3 Pressure Testing Procedure



11 Pipework Design / Installation

When installing any pipework systems (Ductile, uPVC, Steel) it is essential that the pipework is suitable for the fluid & pressure being applied & that flanges & joints are correctly assembled.

Careful consideration of pipework support is also necessary to ensure stability of the system. All pipework design is to be carried out by Bridges Design department and the design reviewed for suitability prior to installation. Supports are not to be fixed to hollow brick, breeze or hollow blocks.

11.1 Flange Jointing Method

Pipe material selection & layout design is to be carried out by Bridges Design Department. The overall design also needs to consider pipework support & expansion/contraction due to changes in temperature / pressure etc.

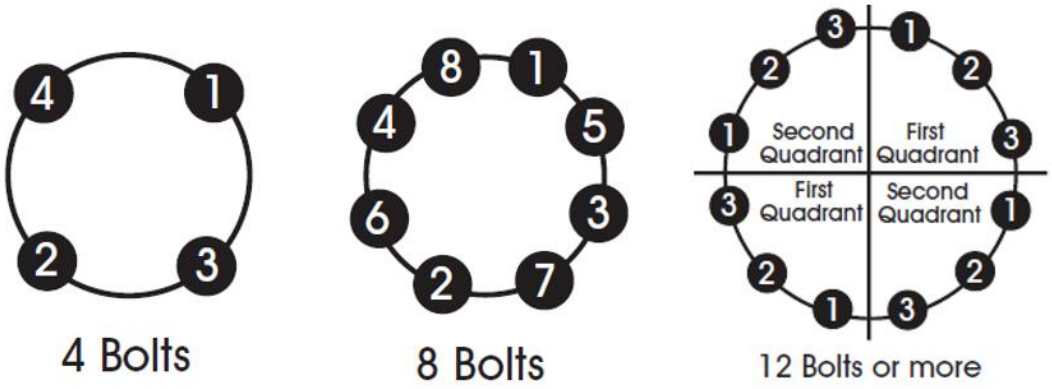
Flange Assembly

Ensure that the faces of the flanges are flat, clean and free from dirt or particles of foreign matter.

Use the bolts, nuts and washers provided; ensuring they are undamaged and rust free.

Lubricate the bolt threads and all mating surfaces of nuts, washers and flanges using a suitable lubricant.

Location bolts may be inserted in the first four positions as shown in the figure below.



- Use only appropriate gaskets to the liquid being transferred and the pressure of the system.
- Position the gasket on the location bolts.
- Offer the adjoining flange to bolts.
- Lightly tighten the four location bolts in the order as shown in the figure above to secure the adjoining flange.
-

- Insert the remaining bolts and, using a torque wrench, tighten in the correct sequence (as per the figure above). Where flanges have more bolts than shown follow the principle of tightening diametrically opposite bolts.
- Tighten gradually and ensure that a sufficient number of circuits are undertaken to achieve the specified bolt torque (see the table below).

Nominal Size DN	Approximate Bolting Torque in Nm for Fixed Flanges										
	PN 16 Flanged Joints				PN 10 Flange Joints			PN 25 Flanged Joints			
	To Seal at 10 bar	To Seal at 16 bar	To Seal at 20 bar	To Seal at 25 bar	To Seal at 5 bar	To Seal at 10 bar	To Seal at 16 bar	To Seal at 20 bar	To Seal at 25 bar	To Seal at 30 bar	To Seal at 35 bar
80	70	70	75	75	70	70	70	80	85	85	85
100	75	80	80	80	70	75	80	120	125	130	130
150	115	120	125	135	110	115	120	180	185	195	210
200	110	115	120	130	120	130	140	170	180	190	205
250	155	165	175	180	110	120	130	230	250	275	305
300	165	180	190	210	120	130	145	220	235	265	295
350	160	175	185	200	115	125	135	290	330	375	415
400	200	220	235	270	155	170	185	380	435	495	555
450	195	215	230	260	150	165	180	355	410	470	525
500	240	270	295	345	155	170	195	415	485	555	625
600	305	365	425	505	200	225	275	595	700	800	905
700	350	465	540	635	200	230	295	675	795	915	1040
800	470	630	735	870	250	300	405	965	1150	1330	1510
900	475	645	760	900	250	300	415	990	1185	1375	1565
1000	605	835	985	1175	300	390	535	1355	1620	1885	2155
1100	610	850	1005	1205	300	395	550	1380	1655	1930	2205
1200	810	1140	1360	1630	360	495	695	1610	1940	2265	2595
1400	915	1300	1555	1875	420	590	840	1980	2395	2805	3215
1600	1180	1690	2035	2460	530	765	1095	2265	2745	3225	3705

11.2 uPVC / ABS Solvent Jointed Pipework

uPVC or ABS pipework is solvent cleaned and welded using a number of proprietary solvent based products. It is extremely important to obtain and follow the manufactures safety data sheets specific to the solvents being used.

In general terms, all solvents are flammable and should be used in a well ventilated area. Never use them in a confined space without the assistance of forced air ventilation and then only following a specific risk assessment. Contact with skin & eyes must be prevented by the use of appropriate PPE. All solvents have a workplace exposure limit and this must be strictly observed, not only by the persons carrying out the operation but also by any other person in the affected area.

11.3 Basic Principles of Solvent Welding

To make consistently good joints, the following points should be clearly understood

I. The joining surfaces must be softened and made semifluid.

2. Sufficient cement must be applied to fill gap between pipe and fitting.

3. Assembly of pipe and fittings must be made while the surfaces are still wet and cement is still fluid.

4. Joint strength develops as the cement dries. In the tight part of the joint, the surfaces will tend to fuse together; in the loose part, the cement will bond to both surfaces. Penetration and softening can be achieved by the cement itself, by using a suitable primer or by the use of both primer and cement.

For certain materials and in certain situations, it is necessary to use a primer. A suitable primer will usually penetrate and soften the surfaces more quickly than cement alone.

11.4 Electrofusion

Electrofusion is a method of joining MDPE, HDPE and other plastic pipes using special fittings that have built-in electric heating elements which are used to weld the joint together

Basic Principles for Electrofusion Welding

1. With a permanent marker and proper measuring device, mark the pipe depth that will be inserted into the fitting

2. Scrape the pipe along the fusion zone where the fitting will be connected.

3. Clean pipe of any shavings and/or sharp edges. Chamfer the outside edge of the pipe with a hand scraper.

4. Remark insertion depth and clamp pipe with rounder clamps.

5. Prior to installation, ensure there is no damage on the fitting by inspecting the Electrofusion wires, pins and outer casing.

6. Clean the fusion zone of the pipe ends and fittings with rubbing alcohol/acetone.

7. Insert the pipe into fitting up to the mark.

8. Ensure that there is NO TENSION between fitting and pipe during the welding and proper cool time period. Use clamps if necessary.

9. Connect fitting to Electrofusion Machine and follow machine prompts. 10. After the weld has been completed, make sure to mark fitting with date, welding time, weld number and operators initials in permanent marker.

11.5 Butt-fusion

Butt-fusion jointing is a thermofusion process which involves the simultaneous heating of the ends of two components which are to be joined until a melt state is attained on each contact surface. The two surfaces are then brought together under controlled pressure for a specific cooling time and homogeneous fusion is formed upon cooling. The resultant joint is resistant to end thrust and has comparable performance under pressure to the pipe.

1. Inspect pipe lengths and fittings for unacceptable cuts, gouges, deep scratches or other defects. Damaged products should not be used.

2. The fusion contact area must be free of any defects or surface disruption.

3. Be sure all required tools and equipment are on site and in proper working order.

4. Pipe and fitting surfaces where tools and equipment are fitted must be clean and dry. Use clean, dry, nonsynthetic (cotton) cloths or paper towels to remove dirt, snow, water and other contaminants.

5. Shield and/or cover fusion equipment and surfaces from inclement weather and winds. A temporary shelter over fusion equipment and the fusion operation may be required.

6. Relieve tension in the line before making connections. When joining coiled pipe, making an S-curve between pipe coils can relieve tension. In some cases, it may be necessary to allow pipe to equalize to the temperature of its surroundings. Allow pulled-in pipes to relax for several hours to recover from tensile stresses.

7. Pipes must be correctly aligned before making connections.

8. Trial fusions. A trial fusion, preferably at the beginning of the day, can verify the fusion procedure and equipment settings for the actual jobsite conditions.

Always follow the manufacturer instructions to ensure a good joint is made.

12 Commissioning

Commissioning covers the initial start-up of new equipment or the restarting of existing equipment following maintenance or repair. Commissioning should only be undertaken by competent persons.

12.1 Plant & Equipment

Commissioning of process plant is the practical test of the adequacy of prior preparations, including training of operating personnel and provision of adequate operating instructions. Since the possibility of unforeseen eventualities cannot be eliminated during this period when operating experience is being gained, the need for safety precautions should be reviewed. This should form part of the HAZOP / Risk Assessment processes applied to the installation. Full written operating instructions should be provided for all commissioning activities.

Commissioning Procedures document a logical progression of steps necessary to verify that installed plant is fully functional and fit for purpose. A general sequence of steps in commissioning may typically include:

- System Configuration Check;
  The purpose of this activity is to trace all pipework and connections to verify the system configuration, and to visually inspect items of equipment to ensure that they are clean, empty and fit for purpose as appropriate prior to undertaking water trials.
- Instrumentation System Check - Verification of Alarms and Trips;
  The purpose of this activity is to ensure that all instrumentation, alarm settings, microprocessor signals and hardwire trips pertaining to the installation are functional. This will also check that signals from the field instrumentation are displayed locally and are being correctly relayed to the computer interface rack, as well as to the computer system.
- Flushing and Cleaning of Lines and Vessels with Water;
  The purpose of this activity is to clean all items of pipework and the vessels that make up the installation. This task shall also ensure that there are no obstructions, blockages or any potential contaminants in any of the process lines or vessels that may have resulted from materials being left inside the system from the construction phase. If chemicals incompatible with water are to be used, it is important that the pipelines and equipment are thoroughly dried prior to introduction of the chemicals. This is normally done by passing dry air through the plant.
- Assessment of Ancillary Equipment;
  The main aim of this assessment is to verify the performance of all ancillary equipment. This may include pumps, fans, heat exchangers, condensers etc.
- Calibration of Vessels and Instrumentation;
  The purpose of this activity is to check the calibration and performance of all vessels and instrumentation pertaining to the installation. To a certain extent this will be carried out in conjunction with the system pre-checks to ensure that the correct set points and alarm points have been established for use in the water trials.
- Start Up Protocol;
  The purpose of this procedure is to provide guidance for bringing the installation online starting from an empty non-operational system.
- Shut Down Protocol;
  The purpose of this procedure is to provide guidance for taking the installation offline starting from a fully operational system.
- Chemical Trials;
  The aim of this activity is to verify the performance of the installation by simulating ‘live’ conditions by following standard procedures.
- Each section should be read in detail to gain understanding about the particular requirements of the activity prior to undertaking the activity itself and completing the associated check list. The checklist will serve as a permanent record of the activity, and can be reviewed if future modifications are undertaken.

Wherever possible the equipment manufacturer should be contracted to commission their equipment and in all cases equipment must be commissioned in line with their recommendations.

12.2 Pipe Systems

It is important that the integrity of pipe systems is checked during system filling & then via appropriate pressure testing (see Section 11)

13 Steelwork Erection

The erection of structural steelwork consists of the assembly of steel components into a frame/walkway or support structure on site. The processes involve lifting and placing components into position, then connecting them together.

Generally this is achieved through bolting but sometimes site welding is used. The assembled frame needs to be aligned before bolting up is completed, and the structure handed over.

Often the ability to complete these processes safely, quickly and economically is influenced significantly by early decisions made during design long before erection commences. It is important that designers clearly understand the impact that their decisions can have; "buildability" is a valid design objective.

Good site co-ordination will facilitate a smooth running project. Adequate access is required for steel transportation, unloading and erection, both on the site as well as on surrounding or adjacent access roads. The provision of well prepared level ground that is able to take the requisite wheel loads is essential.

The principal safety objectives when erecting steelwork are:

- Safe access and working positions
- Safe lifting and placing of steel components
- Stability and structural adequacy of the part-erected structure

The most serious hazards during steel erection are related to falls from height, either from working positions or while gaining access to them. Other serious hazards are related to structural instability or failure during erection and while handling, transporting, and lifting heavy components.

It is important that our health and safety management system addresses the particular hazards and risks in steel construction as well as the normal range of issues in working on construction sites. Planning for health and safety is systemic to all the preparation for erection through risk assessment, devising safe systems of work and working up the erection method statement.

Specific Health & Safety advice for the erection of steelwork is available from the CITB

Issue No: _____

ELECTRICAL PERMIT TO WORK (LV)

(Complete precisely and legibly in ink and BLOCK CAPITALS)

Part 1. (Issue) – To be completed by the Company or Contractors Authorised Person

Issued to: .....

Employed by: .....

I hereby declare that it is safe to work on the LV electrical equipment listed below, which is **dead, isolated** from all **live** conductors and is connected to **earth if required.** I have shown the recipient the safety arrangements in place at the points of isolation, the notices I have posted and I have explained all relevant safety precautions and procedures.

Location .....

Equipment: .....

All other electrical equipment is dangerous to work on

The system is **isolated** with **safety locks, point of isolation notices,** posted at:	
The equipment is / is not* **earthed** at: (*delete as appropriate)	
Caution Notices posted at: (on isolated equipment)	
Danger Notices posted at: (on adjacent live equipment)	
The following work is to be carried out:	RAMS REFERENCE: _____

Company or Contractors Authorised Person

Signed: ..... Print Name: .....

Time: ..... Date: ..... Contact Tel No: .....

Part 2. (Receipt) - To be completed by the Recipient

I hereby declare that I accept responsibility for carrying out the work detailed in Part 1, I have been shown and understand the safety arrangements in place. And I am personally responsible for supervising the works or undertaking the works.

Signed: ..... Print Name: .....

Time: ..... Date: ..... Contact Tel No: .....

Part 3. (Clearance) - To be completed by the Recipient

I hereby declare that the works detailed in Part 1 are now suspended/completed* **(*delete as appropriate)** and that all persons, tools and instruments have been withdrawn from the place of work I have advised all persons associated with the works that it is no longer safe to work on equipment.

Signed: ..... Print Name: .....

Time: ..... Date: .....

Part 4. (Cancellation) - To be completed by the Company or Contractors Authorised Person

This permit is hereby cancelled. I hereby declare that I have checked that the equipment is in a safe condition.

Signed: ..... Print Name: .....

Time: ..... Date: .....

BHS F086 Rev C

Appendix B - Hot Works, Confined Space, Breaking Ground, Working at Height Permit

Permit No. 12401 Date .....

Bridges

Type of Permit (Tick Box)

Mechanical ☐ Hot Works ☐ Confined Space ☐ Work at Height ☐ Dig/Break Ground ☐

Site Name - Issued to - Company -

Scope of Works .....

.....

RAMS Reference .....

PPE & Equipment Required & Checked to be in Good Order (Only listed if not on RAMS)

List .....

.....

All Persons Trained and Competent to Carry Out Task YES/NO

Emergency Arrangements / Prccedures in Place YES/NO

List .....

.....

/Mechanical Permit

Points at Where System is Isolated - .....

.....

Any Special Precautions - .....

Segregation of Area YES/NO Signage YES/NO Locked off YES/NO

Hot Works Permit

Segregation of Area YES/NO Combustibles Removed YES/NO Extinguishers YES/NO

Atmosphere Checked YES/NO Flammables Purged YES/NO

The work and adjacent areas have been checked thoroughly on completion and 60mins later and no risk is present. **All HOT works to be stopped 1hr prior to end of shift** YES/NO To be completed before sign off

Confined Space Permit

Atmosphere Checked/Recorded YES/NO Safe to Enter YES/NO Isolations in Place YES/NO Vented Area YES/NO

Emergency / Rescue Plan in Place YES/NO ATEX Kit Required YES/NO Gas Monitoring YES/NO

Work at Height Permit

Safe Anchor Points YES/NO Harness/Lanyard Checked YES/NO Rescue Plan YES/NO

Control Measures Required to Prevent Falls .....

Break Ground / Dig Permit

Service Diagrams Checked YES/NO Surroundings checked for Services YES/NO CAT Scan YES/NO

Hand Dig Only YES/NO

Authorised - I have personally checked the above and consider it safe to proceed with work

Issued By ..... Position ..... Date/Time .....

Acknowledgement - I hereby declare it is my responsibility for carrying out the works above. No attempt will be made by me or others under my control to carry out any other work.

Received By ..... Position ..... Date/Time .....

Duration

Valid From - Date / Time ..... Valid Until - Date / Time .....

Clearance - I hereby declare that the work for which this permit was issued is now suspended / complete and that all persons under my charge have been withdrawn and it is no longer permitted to continue with the above works

Name ..... Signed ..... Date .....

Cancellation - This permit is hereby cancelled

Name ..... Signed ..... Date .....

Designed & Produced by FUTURGRAM CREATIVE SERVICES TEL: 01373 458501 RE-ORDER No: P9201

Appendix C - Permit To Pressure Test

Permit to Pressure Test

Project Number:		RAMS Reference:		Test Plan No:	
Site / Area:					
System Description:					

Type of Test	Hydraulic ☐	Normal Working Pressure	Test Pressure
	Pneumatic ☐ (Attach Justification & authorisation)	BARG/PSI	BARG/PSI
Description of test configuration:			

Pre Checks	Yes	No	N/A
Is the 'Pressure Test Plan' available & complete *(Attach)*?			
Have all the bolts been torqued to correct value?			
Are all pipe supports in place and tightened?			
Are the increase / decrease test rates and hold points available?			
Is the gauge & test equipment calibrated?			
Are temperature / pressure recorders required, if so are they calibrated?			
Are fill, pressurising, vent and drains in place?			
Has all air been vented from the system?			
Is all the test equipment certified for correct pressure?			

Test Area	Yes	No	N/A
Have personnel / contractors been notified of test?			
Has the test area been barriered off?			
Are warning signs in place?			
Has the area been checked and cleared?			
Exclusion zone required for the test = meters			

Test Personnel	Yes	No	N/A
Have test personnel been fully briefed?			
Is test control station set away from pipe to be tested?			

Issue of Permit			Receiving of Permit	
Person issuing permit	Signature	Date	Person receiving permit	Signature
Time of Issue	Time of Expiry	Date	Time work started	Time work stopped

Do not leave the work area unattended

TWS-F-003-0