

HSEQ Work Procedure

High Pressure Water Blasting (HPWB)

10-HSEQ-I-G	
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Introduction

To provide guidance on implementing safe work practices for Boron Operations employees and contractors conducting High Pressure Water Blasting (HPWB) activities in order to minimize the potential for injury and/or damage equipment or impact to environment by having in place procedures to identify, assess, control and reduce known hazards and associated risks.

Scope

This procedure applies to all Boron Operations employees and contractors involved with the application of HPWB operations and/or maintenance of HPWB equipment.

Definitions

Anti-withdrawal device – A device designed to stop a flexible lance from ejecting or being pulled from a tube or pipe during the lancing operation.

Automatic unloader valve – A device that automatically removes operating pressure on the pump by opening a free flow path for the pump outlet when it senses the line to the nozzle/s is closed. It automatically adjusts the amount of water sent to the nozzle/s line, dependant on the pressure set by the Operator and the capacity of the pump.

Bursting disc – A safety device designed to rupture and discharge the fluid so as to prevent a safe pre-determined pressure being exceeded. *(Requires replacing before operations can continue).*

Changeover valve – An operator-controlled valve designed to properly direct high pressure water flow from the pump to another item or items of equipment at the operator's choice.

Class A systems – HPWB systems are identified as Class A systems when the maximum energy produced by the system falls in the range 3000 and 21500 output capacity (GPM x PSI).

Class B systems - HPWB systems are identified as Class B systems when the maximum energy produced by the system exceeds 21500 output capacity (GPM x PSI).

Competent Person – A person who has acquired through training, qualification or experience, or a combination of these, the knowledge and skills enabling that person to adequately and safely perform the task required.

Dead Man device (Failsafe) - A switch or valve that requires the operator to retain the mechanism in the ON position and that when released will automatically return the device to the OFF position.

Dry shut-off valve (See Appendix A Foot Pedal) – An operator's control valve that has the capability to completely shut off flow to the nozzle, typically seen as a handgun or foot valve and should only be used in conjunction with a regulator or automatic unloader valve.

Dual Trigger Systems – Two separate hand activated dead man devices that must be operated simultaneously to control the flow of pressurized water from the handgun.

Dump valve system – An operator controlled system, normally of the dead man type that opens a free flow path for the water, thereby reducing the system pressure to a safe level. This type of system does not shut off the flow to the nozzle but does reduce it to a safe level.

Electrical Control System – A control system that uses various servomechanisms to control the engine speed and pressure loading of the pump system, typically uses a 'hold to activate' switch (e.g., foot pedal) to bring the system up to pre-set operating conditions. Enables operation without a shut-off or dump valve in the nozzle line.

Exclusion zone – An area within a barricaded area that has been identified as having a high risk of human exposure to High Pressure Water, these zones shall be clearly identified by tape, rope or flagging, with adequate signage stating 'Exclusion Zone'. No persons shall enter the Exclusion Zone until the flow of high pressure water to the nozzle or blasting/jetting tool has ceased and the system isolated.

Fan jet – Spreads the stream of water in one plane, giving wide band coverage of the workplace. A typical application is for cleaning larger areas so allowing less energy to remove unwanted matter.

Flexible lance – A flexible tube/hose to feed a nozzle through an enclosed space such as heat exchanger tubes

Flexi-lancing - An application whereby a flexible lance and nozzle combination is inserted into, and retracted from, the interior of a pipe, usually heat exchanger tubes, it may be self-propelled by backward-directed jets. Nozzles may be manufactured with various shapes and combinations of rotating, radial, forward and/or backward-directed jets.

Foot control valve - The operator's control valve may be arranged for actuation by the Operator's foot if desired, either in place of, or in addition to, hand-control.

Handgun - A portable combination of operator's control valve, lance and nozzle, normally resembling a gun in arrangement.

High Pressure Water cleaning - The use of High Pressure Water, with or without the addition of other chemicals or abrasives to remove matter from various surfaces.

High Pressure Water Blasting - HPWB (jetting) Covers all water blasting/jetting systems including use of additives or abrasives with an output capability greater than 3000 (See Class A and Class B Systems. Note blasting and jetting can be used interchangeably

High Pressure Water jetting system - A water delivery system consisting of an energy source (e.g. electric motor or IC engine), pump, control mechanism, hoses and pipes, nozzles and various other attachments and components necessary for the equipment to function as a system. The function of the system is to increase the velocity of the liquids at the point of application. Solid particles or additional chemicals may also be introduced, but the exit in all cases will be in a free stream.

Hose assembly – A hose with couplings or end fittings attached in accordance with the hose manufacturer's recommendation

Hose shroud (See Appendix B) - A protective sheath that fits over the high pressure water hose and connection ensuring greater protection for the operator. Usually made of a lightweight aramid – 'Kevlar' - material and is primarily used to cover where the High Pressure Water hose joins the handgun.

Medic Alert Card (See Appendix C) - Wallet size cards with Medical and Emergency contact details attached. These cards are to be carried by persons involved in high pressure water blasting operations.

Moling (Pipe cleaning) – An application whereby a hose fitted either with a nozzle or a nozzle attached to a lance is inserted into, and retracted from the interior of a tubular product. It is a system commonly intended for cleaning the internal surfaces of pipes or drains.

Jetting gun – A portable combination of the operator's control valve, lance and nozzle, normally resembling a gun in arrangement.

Mechanical device – A device engineered and manufactured to restrain a nozzle carrier, or lance where reaction forces exceed 55 pounds. These devices can either be manual or automated.

Nozzle – A device with one or more openings (orifices) where the fluid discharges from the system. The nozzle restricts the area of flow of the fluid, accelerating the water to the required velocity and shaping it to the required flow pattern and distribution for a particular application. Combinations of forward and backward nozzles are often used to balance the thrust. Such nozzles are commonly referred to as tips, jets or orifices.

Supervisor/Leading Hand – A person that has been trained and has demonstrated the competency necessary to plan and oversee water-jetting operations

Operator/Crew Leader – A person who has been trained and has demonstrated the competence necessary to perform an assigned task without continued supervision.

Operator Trainee – A person not qualified due to the lack of necessary knowledge or experience to perform the assigned task without supervision.

Reaction force – The force created by the movement of the water as it leaves the nozzle. The force acts in the opposite direction to the movement of the water.

Regulator valve – Automatically adjusts the amount of water sent to the nozzle line dependent on the pressure set by the operator and the capacity of the pump. Unlike the automatic unloader valve, the regulator does not affect the pump operating pressure at any time.

Refresher training – Training that reviews the required operations or principles. The person receiving refresher training either would not have performed the particular operations regularly or have reached the recommended time limits since training was last provided.

Relief valve – A valve, which automatically opens to discharge fluid to relieve pressure.

Retro gun – A gun fitted with forward and backward facing jets, which reduce the thrust experienced by the operator.

Rigid lance - A rigid tube used to extend the nozzle distance from the end of the hose or flexible lance.

Safety Observer – A member of the work crew responsible the following tasks:

- observing the jetting operations and barricaded area;
- shutting down the system in the event of an emergency or malfunction;
- controlling (or communicating to the controlling operator) the system pressure as requested by the jet operator; and
- controlling the access of personnel into the barricaded area.

Safety valve – A valve that automatically, without the assistance of any energy other than the fluid consumed discharges a certified quantity of the fluid so as to prevent a predetermined safe pressure from being exceeded. It is designed to re-close and prevent the further flow of fluid after normal pressure conditions of service have been restored.

Shotgunning – An activity where a jetting gun is used to blast deposits out of the end of a pipe or tube. The gun is commonly fitted with a shrouded nozzle, which is pushed firmly against the open end of the pipe or tube while the jet is operated in short bursts.

Starter bar – A rigid piece of pipe fixed to a nozzle that prevents reversing of the nozzle in the line.

Straight jet – Concentrates the stream of water over a small area of work-piece by minimizing the spread. A typical application includes cutting, or for general cleaning of matter with higher shear and/or bond strength

Water jet – A jet stream of water produced from the individual outlet orifice of a nozzle. The shape of the jet is determined by the form of the orifice while the speed at which it travels is determined by the orifice design, orifice area and pressure.

Procedure

General Safety and Environmental Risk Assessment

In keeping with *Element 3 Hazard Identification and Risk Management* the following steps are required to be undertaken before any HPWB operations are to commence to ensure that all hazards that could affect the safety of employees operating the equipment or working near the equipment, or could affect the environment have been documented and minimised where practicable.

- Pre-start meeting/s have been conducted which will take into account the work schedule for the day.
- Project/contract specific site inductions have been conducted, which include site specific safety and environmental considerations.
- A hazard identification (including environmental, mechanical and process hazards) has been undertaken.
- A CCVS or CCFV for *Release of Energy (High Pressure Equipment Management)* has been completed.
- All the risk controls measures that have been implemented have been clearly documented. (See CCVS example at the end of the procedure)
- All efforts shall be taken to eliminate, reduce or control the risks and hazards identified with HPWB however, should this not be practicable then appropriate personal protective equipment (PPE) shall be worn by all Boron Operation employees, contractors, and any other persons in the immediate vicinity of the work area.

High Pressure Water Blasting Operations

Before HPWB activities commence operators should agree on a code of signals or the means of communication used during the operation of the equipment (see Appendix D). Operators shall cease HPWB operations immediately when;

- unauthorized or inadequately protected employees/visitors enter the barricaded area;
- the introduction of any hazards not previously identified;
- any recommended practices are violated; and
- any malfunction or equipment failure occurs.

There are to be no adjustments to HPWB equipment, including hose connections fittings nozzles or attachments etc. while the system is pressurized. Adjustments can only be made if the system is de-pressurized and the flow from the high-pressure water pump is isolated.

Note: Care should be taken to release any residual pressure in dry shut off guns, hoses and foot pedals prior to any adjustments being made.

Hand Gun Operation

When utilizing a hand held gun for HPWB activities operators must be mindful of the following:

- The operator controlling the handgun shall be in direct control of the water flow.

- A pressurized system shall never be left unattended.
- If more than one HPWB activity is being undertaken in the same area, a physical barrier is to be installed to provide adequate spacing between the operators. This will prevent the possibility of injury from the other HPWB activity.
- Items being water blasted should be firmly secured and at no time to be held by employees.
- Unless otherwise determined, the hose shall be restrained at the point where the hose connects to the gun. This restraint shall be in the form of a stocking and is employed to protect the operator should the hose, pipe or fitting rupture.
- Approved hose shrouds shall be fitted over the restraining device and secured to the handgun. This is employed to protect the operator from any release of pressurized water should the hose, pipe or fitting fail.
- The length of the barrel (lance) shall be such that the nozzle strikes the ground before the operator can inadvertently direct it onto his/her feet or legs. Should this not be practicable then a full Level 2 Risk Assessment must be carried out and submitted to the Boron Operations Site/Department Manager or Designee for approval. The Risk Assessment should quantify the barrel length required (minimum barrel length is 4 feet) and assist in the selection of additional PPE if required (i.e., foot and leg protection).
- All Ultra High Pressure Water Handguns shall be fitted with a dual trigger safety release system. (unless through a Risk Assessment all potential hazards have been eliminated or controlled and the risk assessment has been signed off by the Health and Safety Manager or his nominated representative) This system should ensure that no flow of water exits the lance until both trigger levers are depressed. When designating or allocating employees to any HPWB activity, which includes the use of handguns, the reaction forces shall be taken into account to ensure the forces exerted by the gun and the hose on the gun operator are not excessive.
- Consideration should be given to mechanical control where a higher reaction force is required to achieve acceptable results.
- When mechanical control is not possible, consideration should be given to the size and strength of the individuals assigned to the task and the time to be spent “on the gun”. Higher reaction forces than those recommended may be controlled for short periods.

Pipe Cleaning/Lancing

There must be sufficient clearance between the outside diameter of the hose, lance and nozzle assembly and the inside wall of the pipe/tube being cleaned to allow adequate washout of water and debris. If the diameter of the nozzle and hose assembly is greater than two thirds of the inner diameter of the pipe/tube being cleaned, additional care should be taken to minimise the risk of the nozzle and debris forming a hydraulic piston, which may be forced out backwards toward the operator.

- Hose and nozzle assemblies should only be placed in or removed from pipes/tubes when the flow of pressurized water has ceased and the HPWB pump has been turned off or the isolation

ball valve has been closed and locked out. The first 4 feet if possible shall be cleaned with the gun before using the lance.

- Anti-ejection devices shall be used in all manual pipe/tube cleaning operations, (see Appendix E). These devices will retain the HPWB hose and nozzle assembly disallowing it to fully exit the anti-ejection device.
- Where practicable, a rigid lance should be placed between the HPWB hose and the nozzle. The length of the lance including the bend radius of the hose being used shall be greater than the diameter of the pipe being cleaned. This should ensure, the hose will not turn around in the pipe and divert itself towards the opening of the pipe to where the operator is situated.
- The hoses should be clearly marked at one meter from the nozzle. This will allow the operator to gauge how far the nozzle is from the working end of the pipe/tube being cleaned.

Maintenance and Servicing HPWB Equipment

Every component of a HPWB system shall be regularly inspected, serviced and maintained in accordance with the manufacturers or technical department's recommendations.

Only competent persons shall carry out maintenance and servicing of equipment. Records are to be kept of all maintenance and servicing performed on major pieces of equipment. Examples of components that should have maintenance records include, but not limited to the following list.

- High pressure pump unit.
- Safety valves.
- High pressure water guns.
- High pressure water valves (foot controls, isolation valves, fail-safe stations etc.).
- Pump control (umbilical) and emergency stop cables.

Tools such as wrenches with serrated gripping jaws should not be used when maintaining or assembling blasting/jetting systems and associated equipment. Ensure that the correct size tools are always used so as not to damage equipment fittings.

All equipment shall be maintained in accordance with appropriate equipment maintenance, testing and inspection standards.

Daily Pre-Operational Equipment Checks

The following equipment used HPWB blasting operations are to undergo a daily pre-operational check. (See Appendix F)

1. High Pressure Water Blasting Pumps

These pumps should be inspected prior to each use. Items to be checked should include as a minimum the following list:

- Lubricating oil in both pump gear end and drive unit.
- Coolant levels.
- Drive belts.
- Emergency shut off devices.
- Electrical (umbilical) leads.
- Water filters.
- Machine (belt) guards.
- Fuel level.
- Spark arrester fitted (if required).
- Fuel, Oil & Coolant Leaks

2. Shut Off/Emergency Devices

All Class B HPWB systems shall have a minimum of two shut off devices available to the operator/s. Where feasible one should be electrically operated and the other mechanically operated. Typical shut off/emergency devices include:

- dry shut off valves;
- dump valves;
- trigger guns; and
- electronic control systems.

Every Class B HPWB system shall have an emergency stop button which, when activated stops the motor that drives the high pressure pump. These safety devices shall be located on or near the high pressure water blasting pump and at the job face. Where feasible the Safety Observer shall be in possession of this emergency stop device at all times during HPWB activities.

3. Hose Assemblies

All hose assemblies should be visually inspected prior to use so as to ensure:

- the correct pressure rating and size is selected;
- there is no noticeable structural damage, e.g. corroded or broken wires, bulging, kinking or cuts; and
- that all fittings and couplings are in good condition, threads and sealing faces are free from corrosion and damage and that they are of the correct pressure rating for the pump being used.

It is recommended that all 'hose to hose' fittings have a cover over the joiner to prevent pressurised water exiting the joiner. All Class B hose assemblies utilised in pipeline cleaning or other similar working environments including those using a hose reel must comply with the following conditions.

- All hose assemblies are to have a minimum burst pressure of two and a half times the maximum rated operating pressure.

- All connections to equipment, e.g. pumps, handguns or associated specialist remote controlled high pressure water tools shall be restrained by braided coverings (stockings) to restrict their movement in the event of a hose end failure (*see Appendix G*).
- All hose to hose connections that are suspended shall also be restrained by stockings and fastened (tied off) to a supporting structure, eliminate excessive load on the connections and also to prevent hose assembly falling in the event of a hose end failure.
- All thermal plastic (ultra-high) hose to hose connections shall be restrained by use of braided stockings.
- All other hose to hose connections shall be restrained by using an approved restraining device.
Note: If using whip-checks they must be tight and cable tied at each end.
- Defective or incompatible hose assemblies shall not be used. Defective hose assemblies shall be removed from service and an 'Out of Service' tag attached clearly identifying the defect or non- conformance.

4. Hose Testing (Class B Systems)

Prior to sending for repair, a hose assembly should be visually inspected to determine its condition and suitability for repair.

All hose assemblies shall be hydrostatically tested by a Competent Person when the hose assembly is new, repaired or at intervals of no greater than six months. An in-test certificate will be kept at the appropriate site (*see Appendix H*).

The following identification of hose assembly shall be reported in accordance with AS/NZS 4233.2:1999 *High Pressure Water (hydro) jetting systems. Part 2: Construction and performance*.

- Hose manufacturer.
- Hose assembler.
- Date of assembly.
- Length of hose.
- Description of end fittings.
- Recommended (rated) working pressure.
- Date on which the test was carried out.
- Name of the test laboratory or authority responsible for performing the test.
- Name of the person responsible for the hose assembly inspection and repair.
- Details of the equipment used.
- Ambient temperature.
- Hydrostatic test pressure and length of time of the test.
- Identity of any reference material used to assist in the validation of the test result.
- Whether the hose assembly passed or failed the pressure test.

- Condition of outer surface of the hose after testing.
- Reference to test method, i.e. Appendix A, AS/NZS 4233.2:1999.

5. Handguns and Lances

Handguns and lances shall be checked prior to each use with particular attention being given to the trigger mechanisms and guards to ensure correct operation. All jetting guns shall have an automatic safety lock (see Appendix I). Each length or lengths of tube (lance) and end connections carrying high pressure water to the nozzle shall be manufactured from material suitable for the application.

6. UHP Handguns

All Ultra HPWB handguns shall be fitted with dual trigger control mechanisms and a flexible hose shroud (fitted at the HPW hose connection to the gun).

Permits and Tags

Permits

All relevant Site Permits must be authorised and signed by the Area Supervisor or Designated Manager, before any HPWB activities can commence. These may include but are not limited to the following areas.

- Equipment Isolation.
- Electrical Isolation.
- Confined Space Entry.
- Start Work Permit.

If the scope of work changes, Operators are to stop work and discuss these changes with the Area Supervisor or Designated Manger, as a new permit may have to be raised.

Do Not Operate Tags (Red Tag)

These are used to identify tools and/or equipment that are faulty, out of date or in need of service or repair. Employees who identify faulty tools and/or equipment shall place a 'Do Not Operate Tag' on those items and inform their immediate Supervisor. Information placed on the 'Do Not Operate Tag' must be clear and legible and must as a minimum contain;

- an item description and equipment number;
- the employee's full name and department;
- the date item was tagged;
- a detailed description of fault or reason item was tagged; and

Do Not Operate Tags can be placed by any employee who believes it is required. Equipment that has a 'Do Not Operate' tag attached must not be used until the fault or non-conformance is rectified. (See Appendix J)

Personal Protective Equipment

HPWB activities can present very specific and potentially harmful hazards therefore the selection of appropriate PPE should be determined by the utilization of administrative tools such as, pre-task risk assessment (Take 5), Level 2 risk assessment, and HPWB standard work instructions.

Appropriate PPE shall be worn where:

- hazards cannot be otherwise prevented or suitably controlled, e.g. by elimination, engineering or administration controls, total enclosure or substitution;
- complete protection is essential, e.g. in some occupational environments with uncertain levels of hazards;
- legislation requires it; and
- it is a specific client or site regulation or requirement.

High Pressure Water Blasting PPE

Consideration shall be given to the use of the following PPE before any HPWB activities commence:

Eye Protection

- The minimum standard of eye protection used by employees at the site shall be approved firm fitting safety glasses or mono-goggles and face shield. The use of safety glasses or Mono-Goggles under the face shield shall be determined by a risk assessment based on the type of work being performed and the substance being blasted. All forms of eye protection used must conform to CalOSHA General Industry Safety Order §3382.Eye and Face Protection.

Protective Clothing

- Suitable waterproof clothing consisting of full-length pants and jacket or one-piece suit shall be worn by employees working at the job face. Chemical resistant clothing, in addition to a Kevlar suit may be required where there is an assessed risk of injury or illness.

Head Protection

- Wear appropriate suitable head protection complying CalOSHA General Industry Safety Order §3381.Head Protection.

Hand Protection

- Approved and adequately fitting hand protection shall be worn where there may be a risk of injury and where that injury can be prevented by wearing/using such hand protection. All forms of hand protection used must conform to CalOSHA General Industry Safety Order §3384.Hand Protection.

Foot Protection

- All forms of foot protection used must conform to CalOSHA General Industry Safety Order §3385.Foot Protection.

Note: Additional foot protection (spats or gators) shall be worn when there is an assessed risk of injury e.g.: hand lancing below the knee or using a short barrel lance.

Hearing Protection

- Suitable hearing protection shall be worn at all times when the noise levels exceed limits set by regulatory authorities. All employees and operators must receive instruction in the correct use and maintenance of hearing protectors. Double hearing protection is required when working within a 10 metre radius of all high pressure water blasting activities using 'Class B' equipment.

Respiratory Protection

- Respiratory protection shall be worn where there is an assessed risk of injury or illness. Only persons who have been adequately trained in the use of such respiratory protection shall be assigned to such tasks

Reference [Appendix K](#) for the Personal Protective Equipment (PPE) requirements for all HPWB tasks.

Training

All HPWB operators shall be appropriately trained and should be conversant with this procedure and other appropriate safety procedures. The training shall be documented on a MSHA 5000-23

Training should also be provided in the following areas:

- equipment specific training;
- training in the use, care and maintenance of personal protective equipment (PPE), this shall be provided as and when required;
- selection and types of nozzles;
- different types of pump's including flow rates etc.;
- shutdown devices (foot pedals and emergency stop/shutdown) devices;
- basic fault finding (HPWB pumps and associated equipment);
- equipment maintenance (pump pre-start checks oil and water etc.);
- any respective client HPWB procedures that cover safety, quality and the environment;
- high pressure hose selection and associated fittings and joiners etc.;
- correct stance whilst operating water jetting equipment;
- risk assessment and hazard control,
- fatigue management;
- the function and importance of 'Medic Alert Cards'; and
- refresher training for when equipment is upgraded or replaced or to continually ensure a higher standard of understanding amongst employees.

First Aid and Treatment for HPWB Exposure

All injuries due to High Pressure Water Blasting need to be treated very seriously. Anyone that sustains such an injury **MUST** be taken to a hospital as damage to deeper tissues (that cannot be diagnosed immediately) may be identified.

Immediate First Aid Treatment

- Surface wound should be dressed with a sterile dressing to control bleeding and prevent further contamination. If possible position injury so any water or contaminate can drain out of the wound.
- If limbs have been injured, support and immobilize those as you would do for fractures. If any part of the body has been amputated, wrap it in a sterile manner and keep it cool.
- If the trunk (body) of the person has been injured, the patient should be placed in the recovery position and the airway kept open.
- If necessary, simple resuscitative measures and treatment of shock may be administered.
- Transport to the site Occupational Health Clinic via ambulance for further assessment and arrange for off-site transport (ambulance) to nearest hospital.

Hospital Treatment

Local medical personnel may not be aware of the recommended treatment. Although the Physician will be in charge of the treatment of the injury, the following recommended hospital treatment should be provided to the Physician **immediately**.

- Treatment should follow the accepted principles for deep penetrating muscle wounds.
- Determine possible contaminants in the wound and check for swelling.
- X-rays of injured area to determine if there is any subcutaneous air present.
- Refer to Senior Emergency Department Physician or Orthopedic Team for assessment.
- Immediate wide surgical decompression should be carried out, especially for hand and foot injuries.
- All surface wounds should be excised and the jet track into the tissue carefully explored.
- This should be followed by careful debridement along the length of the track.
- Copious gentle irrigation and removal of debris by suction may be required for contamination.
- For abdominal wounds, all viscera must be carefully examined. What appear to be small incisions may involve multiple lacerations and penetrations of abdominal viscera.
- Wounds should be packed open or closed loosely over drainage.
- Unusual infections with micro-aerophilic organisms occurring at lower temperatures have been reported. These may be gram-negative pathogens such as are found in sewage. Bacterial swabs and blood cultures may therefore be helpful.

Medical Alert Card

A water proof medical alert card that shall be carried by all operators engaged in commercial and industrial water blasting. This card shall:

- Outline the possible nature of injuries and post-accident infections that can be caused by high pressure water blasting;
- Provide details of immediate first aid treatment until medical treatment is available; and
- Provide the names and contact details of medical staff who should be contacted for expert medical advice for the treatment of high pressure water blasting injuries.

Reference the Medical Alert Card in [Appendix C](#)

Responsibilities

Supervision

It is the responsibility of the Supervision to:

- provide training for employees that covers both task-specific processes and the correct use of PPE as well as to ensure operators undertake regular refresher training;
- ensure employees have access to and carry out this procedure;
- rotate operator duties to avoid fatigue;
- organize inspections to identify any safety deficiencies;
- ensure all work and equipment/tools/machinery used in the undertaking of HPWB operations meets the requirement of this procedure;
- ensure all required permits to work are obtained before any HPWB activities can commence; and
- evaluate the effectiveness of this procedure and developing and implementing risk management process for HPWB operations.

Employees

Employees involved in the setting up or undertaking of HPWB activities are responsible for:

- following this procedure to reduce the risk of accidents and injury to themselves and others;
- completing a thorough risk assessment that identifies the task steps, known and potential hazards and agreed controls to be implemented prior to starting the job;
- conducting a thorough pre-work inspection of all equipment/tools and work area prior to use;
- not using equipment that has been identified as being faulty and reporting any safety issues immediately. (Faulty equipment shall be removed from service immediately and have an 'Do Not Operate' tag attached. [See Appendix J](#))
- ensuring no modification to any piece of HPWB equipment occurs unless written permission is obtained from the manufacturer;
- when part of operating crews, taking steps to adequately shield or protect (from flying debris and the ingress of water) items in close proximity to the HPWB operations; and

- before any HPWB activities are undertaken, ensuring the release mechanisms on all shut off devices (hand and/or foot) have been tested and are operational and work in accordance with the manufacturers specifications.

Appendices

Appendix A

Typical Dry Shut off Valve (Foot Pedal)

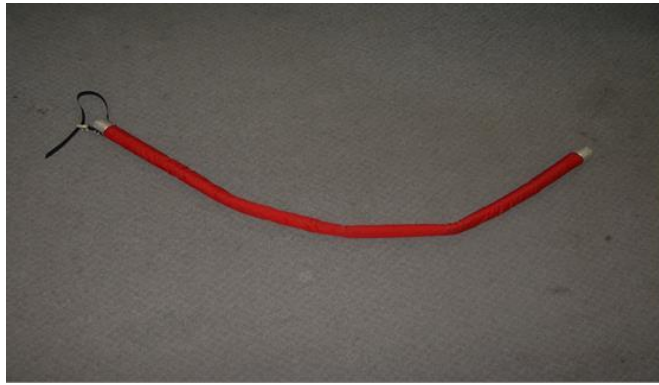
An operator control valve that has the capability to completely shut off the flow to the nozzle.



Appendix B

Hose Shroud

Hose Shrouds (protectors) shall be used on all Thermal Plastic to Handgun connections



Appendix C

Medic Alert Card

Front of Card

MEDICAL ALERT

FOLLOW DIRECTIONS ON THE OTHER SIDE OF THIS CARD

This person has been working with high pressure water blasting equipment. This should be taken into account during diagnosis. Unusual infections with microaerophilic organism occurring at lower temperatures have been reported. These may be gram-negative pathogens such as are found in sewage. Bacterial swabs and blood cultures may therefore be helpful.

NOTE:
For further information contact: Antelope Valley Hospital
All hours: (661) 949-5000
Other: Loma Linda (909) 558-4000 UCLA (310) 825-2111

Back of Card

MEDICAL ALERT

(Approved by Occupational Health Physician Dr. Greaney)

First Aid:

- Surface wound sterilely dressed to control bleeding/contamination.
- Support and Immobilize limbs as for fractures.
- Trunk injuries nursed in coma position and airways kept open.
- Administer resuscitative measure and treat for shock as required.

Hospital Treatment:

Provide this information to the Physician immediately:

- Treatment should follow the accepted principles for deep penetrating muscles wounds.
- Determine possible contaminants & check for swelling.
- X-rays for injured area to determine subcutaneous air.
- Refer to Emergency Room physician or Orthopedic team for assessment.
- Immediate wide surgical decompression especially if for hand & foot.
- Excised surface wounds & jet track into carefully explored.
- Careful debridement along the length of the track.
- Copious gentle irrigation & suction removal of debris may be required.
- Abdominal wounds, all viscera must be carefully examined. What appear to be small incisions may involve multiple lacerations and penetrations of abdominal viscera.
- Wounds should be packed open or closed loosely over drainage.

Appendix D

Hand Signals

The following diagrams show the typical hand signals used when communicating between operators during HPWB activities

Ready To Start, Pressurize the System

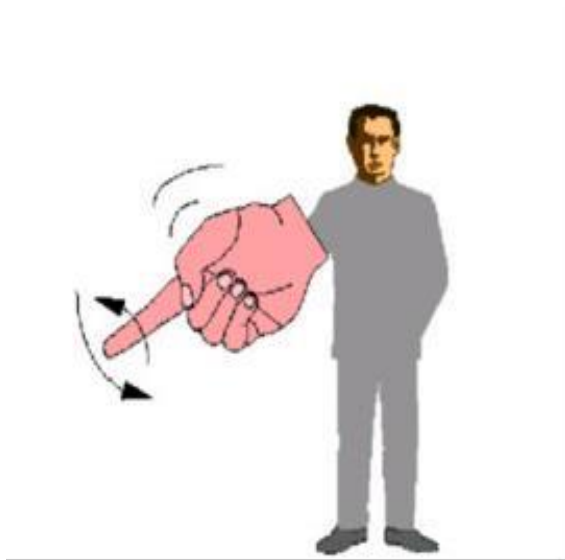
Increase/Raise the pressure



Decrease/Lower the pressure



Prepare to stop, De-pressurize the System



Appendix E
Anti-Ejection device

Device used to retain the high pressure water hose and nozzle assembly if for any reason they reverse towards the operator.



Appendix F



Hydro Blaster Pre-Start Checklist

This document must be filled out prior to moving the piece of equipment to the job site.

Operator:	Equipment Type:
<input type="text"/>	<input type="text"/>

Date:	Site:
<input type="text"/>	<input type="text"/>

Description

PUMP	Yes	No	Comments
Are the hoses, connections and fittings in good condition?			
Is the oil level adequate?			
Are there signs of water contamination in the oil?			
Are there signs of oil leaks?			
Are there signs of leaks in the system or water tank?			
Is the pressure gauge workign properly?			
Are the belts in good condition?			

Engine	Yes	NO	Comments
Does the engine start easily?			
Are all fluids in operating range? Water, Fuel , Oil			
Are all gauges working properly			
Are all switches working properly			
Is the Emergency Kill Switch working properly			

Safety	Yes	No	Comments
Is all PPE in place?			
Is special PPE needed? Boots, Faceshield or goggles, suit			
Is there a person dedicated to emergency shutdown in place?			
Is the fire extinguisher present and charged?			

Trailer	Yes	No	Comments
Are the tires in good condition?			
Is the hitch and safety chain in good condition?			
Is the trailer in road worthy condition?			

Appendix G

Hose Restraints

All hoses that connect directly to equipment shall be restrained by use of stockings (wire braid). All Thermal plastic hose connections and joins shall also be restrained by use of stockings.



Appendix H

Pressure Test Certificate

Indicates that the hose has been tested and is in current date for use

HOSEMASTERS HIGH PRESSURE AND TESTING DIVISION			
Pressure TEST -- FIELD REPORT IN ACCORDANCE TO AS/NZS 4233 .2			
TEST DETAILS			
Client: COLLEXPY LTD		Date: 30 September 2003	
Client Order No: 4500195705		HMI Job No: 2149	
Test Item Details: SPIR STAR TYPE 4/2 HOSE C/W M24 x 1.5 FEMALE SWIVEL & 1/8 BSPP MALE FITTING.			
Working Pressure: 17400 PSI (1200 BAR)			
Test Specification: Static			
Test Equipment: Haskel DSXHF-602		Pump: Haskel Liquid Pump	
Work Gauge No: W-75-1		Recorder No: Nil	
Other:		Test Gauge No: K-485-5	
TEST RESULTS			
Test Item	Temp (°C)	Time (Mins)	Pressure (PSI)
As Above Length 7.5 Meters	Amp	5	21750
Comments: Satisfactory. No leaks or Distortions. TEST ONLY.			
Marked as Follows: W797			
Tested By: T.MORGAN		Date: 30 September 2003	
Witnessed By: B.NASH		Date: 30 September 2003	
Certificate Issued	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Attachments	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
N.B. Hosemasters International Does Not Express Or Imply That These Hoses Are Suitable To Maintain A Working Pressure Other Than That As Recommended By Manufacturers.			
HOSEMASTERS HEAD OFFICE 17 Kewdale Road, KEWDALE WESTERN AUSTRALIA 6105 PO Box 309, WELLSPOOL WESTERN AUSTRALIA 6986 Telephone: (08) 9356 1533 Facsimile: (08) 9356 1988 Email: hose@hosemasters.com.au Web: www.hosemasters.com.au			
WESTERN AUSTRALIA ' NEW SOUTH WALES ' SOUTH AUSTRALIA ' VICTORIA ' QUEENSLAND			

Appendix I

Automatic Safety Lock (Handgun)



Appendix J

Do Not Operate Tag

A white rectangular tag with a hole at the top. At the top left, it says "NO. 101", "www.rtm.com", "800-442-2633", and "rtm@rtm.com". Below this, it says "TAG NO. 683650" and "DATE _____". In the center is a red oval with the word "WARNING" in white. Below the oval, it says "THIS WARNING TAG HAS BEEN ATTACHED BECAUSE WRITE REASON IN THE SPACE BELOW". A horizontal line separates this from the next section, which says "DO NOT USE, MOVE OR OPERATE WHILE THIS TAG IS ATTACHED" in red. Below this, it says "TAG ATTACHED BY" and "NAME _____ DEPT. _____". Another horizontal line follows, with the text "TEAR OFF THIS STUB, FILL IT IN AND HANG IT ON THE TAG BOX HOOK OR GIVE IT TO THE FOREMAN". Below this, it says "TAG NO. 683650" and "DATE _____". Another horizontal line follows, with the text "HAS BEEN ATTACHED TO _____". Below this, it says "BECAUSE _____". At the bottom, it says "Signed _____".

Appendix K

High Pressure Water Blasting Personal Protective Equipment (PPE)

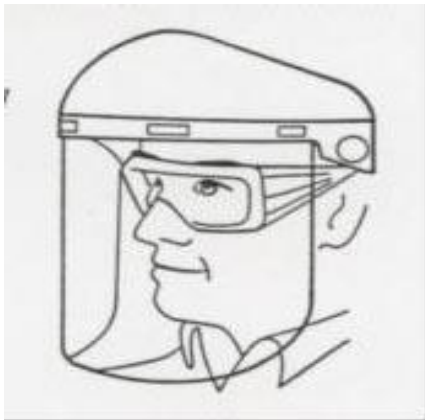
Ear Muffs



Full Rain Suit



Face Shield w/ Mono
Goggles or Safety Glasses

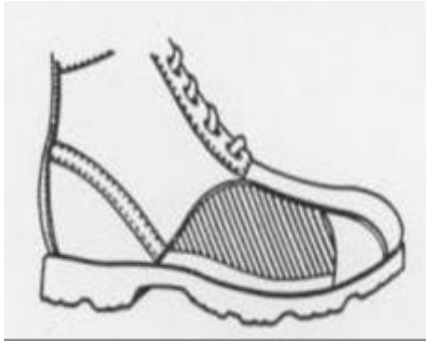


Full Length Rubber Gloves



Steel Capped Boots

Foot Spats or Gators



CCVS Example Release of Energy (High Pressure Equipment Management)

Control Element	What to Measure	How to Measure / Confirm	When to Measure	Who is Accountable? (for Control Element)
Design Are the design of controls adequate to manage the risk?	D 1.1 Does a register of high pressure (>3,000psi />200Bar) and ultra-high pressure (>30,000 Psi / >2,000 Bar) equipment exist?	D 2.1 Check the register and ask about maintenance regimes of equipment identified.	Semi-Annual	
	D 1.2 Does a site procedure or work instruction exist for all tasks identified as using high pressure equipment?	D 2.2 Check the JHA, SOP or other reference developed, and ensure that high pressure risks (>3,000psi />200Bar) and ultra-high pressure risks (>30,000 Psi / >2,000 Bar) have been identified.		
	D 1.3 Does a site procedure or work instruction require the regular inspection of equipment?	D 2.3 Verify there is a process to regularly inspect high pressure equipment (engine, pump unit, hoses, filter/strainers, hoses assembly and whip checks). Check if there is a regulatory requirement for testing and verification of hose assemblies. Does it include a requirement for record keeping?		
	D 1.4 Does the site procedure include minimum requirements for high pressure system design?	D 2.4 The procedure and practice should identify controls which prevent the unplanned release of the pressure, and may include: - Automatic pressure relief devices; - backout preventer; - use of flex-lance; - dump valves - dry shut-off valves - lancing; - moling; - regulator valves; - washing vs water blasting; - retro gun and shot gunning applications; - hydraulicling; - trigger guns; - whip checks. Verify the procedure includes the requirement for multiple "fail safe" systems to be installed. Where there is a requirement for multiple persons involved, the procedure must describe the method of communication between parties and must NOT rely on hand signals.		
	D 1.5 Does a response plan exist for treatment of injuries from Hydro-Blasting or other high pressure tool usage?	D 2.5 Check to see if the emergency response plan/medical response exists with Occupational Health and risk has been covered. Is there a requirement for workers engaged in high pressure washing to carry a medical information wallet card?		
Implementation Are the controls used and maintained according to design and plan?	I 1.1 Is the system being used with the design requirements for single - person operations?	I 2.1 High pressure (Class A systems (3,000 to 30,000PSI)) - generally can be operated by a single person. Ultra-high pressure (Class B systems (>30,000PSI)) - single operators can use where: 1) the operator is physically isolated from the pressurised water; 2) there is no risk of the operator being exposed to the jet impact; and 3) the presence of other hazards doesn't expose the operator to other health and safety risks.	Monthly	

<p>I 1.2 When the whipping of a high pressure line is possible, is a device in place to prevent the whip?</p>	<p>I 2.2 Ask the operator to show the device is in place, and ask how it is intended to work. Devices may include hose stockings or restraints, hose integrity tests, pressure release valves, etc.</p>		
<p>I 1.3 Does the equipment selected allow the person(s) to do the job safely?</p>	<p>I 2.3 Verify the hose and lance design does not allow for accidental withdrawal. Ensure handheld wand is of a length so the operator is unable to make contact between the high pressure and thier own body.</p> <p>Ask: Does the job really need to be done? Can this risk be eliminated? If not, is there a safer or more appropriate way of doing the job (robotics, in-cab remote operation cleaning devices, hydraulically driven hose turning device, etc).</p> <p>Verify all system components are compatible (all system parts capable of meeting or exceeding maximum operating pressure of the pump).</p> <p>Verify the safety relief device is set to cut out no more than 10% higher than the maximum operating pressure of the pump or of the manufacturer's recommendations.</p>		
<p>I 1.4 Has the high pressure equipment been inspected prior to use?</p>	<p>I 2.4 Check with the operator to see what the inspection process is, and if the inspection record (pre-op inspction) is available. Ask what the process is when a defect is noted. Check drive unit, pump unit, hoses and reels, guards, shields, safety interlocks, shut-off devices, electrical leads and connectors.</p>		
<p>I 1.5 Has a single person been designated as the safety observer while the task is being carried out?</p>	<p>I 2.5 Ensure that at least 2 people are there and one of them is dedicated as the safety observer.</p> <p>Note: Some operational set up may require more people.</p> <p>No matter how many people are working on the task, no person should be positioned where they would be exposed to high pressure if the system was to fail or the hose escape.</p> <p>Where foot pedals are used as an emergency safety stop, the operator should have no other task and should be in a position of good visibility of the work area but not in an area where he could be exposed to the high pressure.</p> <p>Ask what their task is and what signals are used in case an emergency shutdown is needed. Potential for confusion and/or misinterpretation should be minimised by the selection of communication (i.e. hand held radios preferred to hand signals).</p>		
<p>I 1.6 Is the area where the high pressure equipment is being operated controlled by proper barricading?</p>	<p>I 2.6 Check to ensure adequate barricading is in place. Barricading should be placed no less than 5m (15ft) from the task/activity being conducted or at a minimum, barriers should stop people from coming into contact with other hazards associated with the jetting operation like flying scale or debris falling from above.</p> <p>For high pressure work, the barricading is protecting people from a potential fatal injury. so ensure the type of barricading</p>		

		<p>selected reflects this level of risk.</p> <p>Barriers should be set up outside of where work is taking place inside vessels.</p> <p>Ask operator if consideration was given to shielding essential electrical equipment and protecting from flying debris.</p>		
	<p>I 1.7 Were other work options considered before needing to utilize a high pressure tool or method (e.g. Hydro-Blasting)?</p>	<p>I 2.7 Ask the operator/supervisor why high pressure tools were needed (e.g. Hydro-Blasting) as opposed to other options such as chemical cleaning.</p>		
	<p>I 1.8 Is adequate PPE in place and being used as designed?</p>	<p>I 2.8 Does the PPE in use meet the pressure rating of the equipment? (high pressure (Class "A") vs. ultra high pressure (Class "B") requirements). *Class A* = high pressure (>3,000psi />200Bar) *Class B* = ultra-high pressure (>30,000 Psi / >2,000 Bar)</p>		
	<p>I 1.9 When cleaning pipes are the appropriate nozzle, technique and engineering controls being used?</p>	<p>I 2.9 Verify retro (back) jets are not being used on the first section (4 feet/1.2 metres) of pipe unless suitable guards such as pipe entry covers or flanges are in place to protect the operator. Field Check: Are the operators cleaning vertical pipes - have they considered falling debris or loss of control of the hose? Are they using an anti-withdrawal device on the pipe?</p>		
	<p>I 1.10 When a Class "B" unit is being used, is the gun at least 4 feet (1.2 metres) from handle to tip?</p>	<p>I 2.10 Inspect the gun to ensure that no contact could be made with the operator (i.e. the operator is unable to cut their own feet).</p>		
<p>Training / Competency</p> <p>Are people involved, trained and competent in the controls?</p>	<p>T 1.1 Are personnel trained in the use of high pressure equipment/tools (e.g.Hydro-Blasting equipment)?</p>	<p>T 2.1 Check training records of personnel. Check that personnel are familiar with the risk assessment and/or procedure. The training should include topics such as: - cutting action, - control devices, - part compatibility, - hoses, - nozzles, - PPE, and - equipment maintenance.</p>	Semi-Annual	
	<p>T 1.2 Are personnel trained in the use of PPE specific to high pressure equipment/tools?</p>	<p>T 2.2 Check training records of personnel. Verify the training includes content on the selection of type and class of PPE.</p> <p>Ensure information on the PPE selection includes high-velocity impact and chemical exposure aspects.</p> <p>Verify the training includes information on protection of body, hand, arms, legs and feet.</p>		

References & supporting documents

Doc Ref.	Document Title
Australian/New Zealand Standard 4233.1:1999.	Pressure Water (hydro) jetting systems. Part 1: Guidelines for safe operation and maintenance
Australian/New Zealand Standard 4233.2:1999.	Pressure Water (hydro) jetting systems. Part 2: Construction and performance.
	Rio Tinto Alcan High Pressure Water Blasting Safety Standard
	Rio Tinto Alcan High Pressure Water Blasting Guidance Note
	Element 3 Hazard Identification and Risk Management
	HPWP Work Instruction
	HPWB Pre-Operational Checklist
	HPWB Inventory Register
	HPWB Permit
	Medical Alert Card
	Pressure Test – Field Results

Document Control

Version #	Description of Change	Prepared by	Date
1.0	Drafted Document	Ryan Ispisua	7/15/2015