



HIGH PRESSURE WATER BLASTING STANDARD WORK PRACTICE

DOCUMENT INFORMATION

Description	Provides guidance for the safe operation and maintenance of water blasting equipment and describes methods for eliminating or reducing hazards and risks associated with water blasting.
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1. INTRODUCTION

1.1 Context

This standard provides users of water blasting systems guidance concerning safe operating practices used to protect and safeguard persons who may be in the vicinity of water blasting operations and equipment users.

1.2 Scope

This document applies to all operating pressures at 5000psi or greater:

- High pressure water blasting:
 - Operations 5000psi or less where there is a foreseeable risk of injury to operators or other persons
 - Operations carried out at pressures above 5000psi and include jetting operations involving the potential use of additives and abrasives.
 - Systems pressurized by positive displacement pumps with an output capability greater than 5000psi
- Only qualified personnel may be assigned to Water Blast operations
- New hired employees must be teamed with an experienced employee until such time as they're evaluated to be competent by a qualified Water Blast Operations Supervisor

2. ACCOUNTABILITIES

- **Executive Management**
 - Provides properly maintained equipment and capable, trained personnel for the safe execution of Water Blast operations
 - Assures that the provisions of the program are implemented for all operations under their control.
- **Facility and Field Management**
 - Provides properly maintained equipment and capable, trained personnel for the safe execution of Water Blast operations.
 - Considers all aspects of safety Water Blast operations as they pertain to specific projects.
 - Communicates to Health and Safety any unsafe acts or conditions corrected during the project following near miss reporting procedures.
 - Apprises the client of all issues and concerns involved with water blast operations as it relates to their facility and project.
 - Assure that all provisions of this program are being met and take appropriate action to achieve that goal.
 - Assure that Supervisors or Job Leads on Water Blast operations:
 - Is competent in the assessment, set up, and safe operations of the water blast equipment.
 - Is capable of identifying hazards associated with the water blast operations and is capable of taking necessary actions to eliminate or correct those hazards.
 - Is familiar with the concerns or issues of the project as it relates to the water blast operations to be completed.



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- Communicates with Health and Safety prior to project start up and whenever there are changes, new hazards, or unsafe actions taken on site.
- **Operator**
 - Use equipment in accordance with manufacturer's recommendations
 - Ensure equipment has been inspected/serviced before use
 - Tag "Do Not Use" or "Out of Service" any equipment that has been found to be inoperable/damaged
 - Participate in the development of the job specific JSA and/or risk assessment
 - Wear appropriate PPE as required
 - Hard Hat
 - Safety Glasses with affixed Side Shields
 - Face Shield
 - Metatarsal Foot Protection (Blast Boots)
 - Ear Plugs
 - Gloves- Made of Neoprene, rubber and PVC for protection against chemicals
 - Rain Suits/Chemical Suits
 - Cut Suit when conducting manual lancing or moleing operations
 - Understand hand signals associated with water blasting between operator and crew
 - Carry an immediately accessible, waterproof Water Blast Medical Alert card
 - Only conduct operations for which they've been trained and within the breadth of the training received.
- **Pump Operator**
 - Observe the water jetting operations
 - Shut down the system in the event of emergency or malfunction
 - Control (or communicate with the controlling operator) the system pressure requested by the jet operator
 - Control the access of personnel into the barricaded area
- **Supervisor**
 - Ensure basic equipment checks take place through a visual inspection using the Water Blast Pre-Operations Checklist
 - Hoses cannot have broken or rusted steel braids
 - O-rings and gaskets must be properly installed and in good condition
 - Rupture discs are installed (Rated for no greater than 1.2 times Maximum allowable working pressure (MAWP) of lowest rated component in the system
 - Check water filters
 - Dead-man style relief valve (foot pedal or trigger) must be installed and operating correctly
 - Check for worn or plugged nozzles (tips)
 - Hoses have been inspected for wear and damage
 - Fittings, barrels, lances, and stingers must be made from stainless steel. All components must be rated for a working pressure at least equal to or greater than the maximum working pressure of



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- the pump
- Ensure the working area is properly prepared and secured from unauthorized entrants that is demarcated by barricade tape, cones, etc. (preferred Red Danger Tape)
- Discuss the scope of the job with the customer contact who issues work permits (including confined space permits)
- Develop a JSA or risk assessment with the work crew identifying and controlling any associated hazards
- Determine the need for a Safety Observer (Pump Operator)
- Ensure whip checks have been installed on all connections
- Ensure appropriately rated safety shrouds are in place at connections in proximity to operators, pump operators, and potential traffic areas
- Ensure work crew is briefed on the job and the role they will be performing
- Ensure all other equipment or controls to eliminate or manage identified hazards are in place

3. DEFINITIONS

Competent Person	A person who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them.
Operator	A person who has been trained and has demonstrated the competency necessary to perform an assigned water blasting related task without supervision.
Pump Operator	A member of the work crew assigned to observing the jetting operation, shutting down the system in an emergency, controlling system pressure and controlling access to the area.
Dump System	An operator-controlled system that opens a free flow path for water, thereby reducing the system pressure to a safe level without shutting off the flow to the nozzle.
Dry Shut-Off Valve	An operator's control valve which has the capacity to completely shut off flow to the nozzle. Typically seen as a hand gun or foot valve.
Automatic Unloader Valve	A device that automatically removes operating pressure on the pump by opening a free flow path and adjusts the amount of water sent to the nozzle when it senses the line to the nozzle is closed.
Electronic Control Systems	A control that uses various servo-mechanisms to control the engine speed and pressure loading the pump system.
Regulator Valve	Automatically adjust the amount of water sent to the nozzle line dependent on the pressure set by the operator. Unlike the automatic unloader valve, it does not reduce the pump operating pressure.
Relief Valve	A valve which automatically opens to discharge fluid to relieve pressure. It is activated by the static pressure at the inlet of the valve.



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Foot Control Valve	A control valve arranged for the actuation by an operator's foot either in place of, or in addition to, a hand-control.
Class A Systems	High Pressure water blasting systems where the maximum energy produced in bar litres/minute falls in the range of 800-5600
Class B Systems	High Pressure water blasting systems where the maximum energy produced in bar litres/minute exceeds 5600
High Pressure Water Cleaning	The use of high pressure water, with or without the addition of chemicals or abrasives, to remove matter from various surfaces.
High Pressure Water Cutting	The use of pressurized water, with or without the addition of additives to penetrate into the surface of a material for the purpose of cutting that material.
High Pressure Water Blasting System	A water delivery system consisting of an energy source (i.e. electric motor or DC engine), pump, control mechanism, hoses and pipes, nozzles and various other attachments and components necessary for the equipment to function as a system, designed to increase the velocity of the liquids at the point of application.
Hydraulic	Hydraulic occurs when there is not enough room between the nozzle and the wall of the tube or pipe to allow water or debris to pass. Pressure builds up, and the flex-lance or rigid lance is forced backward, toward the operator
Retro Gun	A gun fitted with forward and backward facing jets which reduce the thrust experienced by the operator.
Jetting Gun	A portable combination of operator's control valve, lance and nozzle.
Stinger	A rigid piece of pipe affixed to a tube nozzle that prevents reversing of the nozzle in the line. Used when lancing or pipe cleaning.
Anti-Withdrawal Device	An Anti-Withdrawal device (AWD) also referred to as a Back Out Preventer (BOP) is an effective mechanical means of restraint used during a flex-lance or line moleing operation where the unplanned movement of the hose or nozzle could endanger a worker. The device must be able to withstand the forces that it will be subjected to, and capable of safely performing the functions for which it is used

4. PROCESS

4.1 Planning

Employees must complete a job specific daily task assessment (JSA) which includes a risk assessment of the operations and surrounding work area. When completing the JSA/risk Assessment the work crew must ensure that all hazards likely to affect the safety of persons operating the equipment or working in the vicinity of water blasting operations are minimized by considering:

- Whether it is reasonably practical to remove equipment to a less hazardous area
- The need to isolate, flush and ventilate tanks, shafts, equipment, etc.
- The presence of corrosive or toxic materials, gases, vapors, dusts, fibers, or substances that may pose a hazard to the operator or damage the equipment



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- The safe work limit, risk appropriate barricading and warning sign placement
- Communication, notification of those in the vicinity and methods within the crew
- Hose protection, layout and support required to avoid damage to equipment by vehicles or equipment
- The location of emergency first aid supplies
- Whether a safety observer needs to be identified
- If pump needs to be moved, equipment must be shut down prior in order to eliminate inadvertent/accidental pressurization of equipment while moving to the new location.

4.2 Water Blasting Controls

4.2.1 Work Permit Authorization

Before work can begin, some customers require a Work Permit to be obtained. The permit is completed after the customer has personally inspected the area of work and confirmed that a JSA/Risk Assessment has been completed.

Where there is a possibility of encountering corrosive or toxic material, the Customer issuing the permit must inform the Operations Manager and/or Supervisor of any precautions that may be necessary and ensure a copy of the relevant SDS has been provided, communicated to the crew and available.

4.2.2 Variances

Established policies, procedures and operating practices cannot be written or implemented to address all situations; therefore, it is necessary to originate a method of authorized deviation from policy, procedure, or practice to assure job execution in a fashion that achieves the high level of safety detail by all. Variances are not to be interpreted in a general sense; rather they shall apply to specific job in question.

All lancing operations are to be conducted with automated water blast equipment. Any manual lancing will be considered a variance to that requirement and must receive executive approval.

In all cases, the person requesting consideration of the variance shall bring it to the attention of their supervisor. The requestor is responsible for completing the variance form in sufficient detail to adequately describe the variance desired. All variances will be approved by The Regional Manager and Corporate Safety Director. Where necessary, Customer Management will be involved in the process if the customer's safety program is involved. Before variances will be approved, all attempts to identify automated methods must be exhausted. All safety precautions discussed with the regional manager and safety director. Any additional procedures, controls, or PPE will be communicated and required for the operation to be approved. The safety director will confer with the regional manager before providing an approval.

4.2.3 Confined Space



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The addition of water blasting hazards to the hazards associated with confined spaces, may increase the hazards. All aspects of the SES Confined Space program, which meets the OSHA standard for permit-required confined spaces (29CFR1910.146), will be followed. Additional customer requirements which meet or exceed the OSHA standard may be implemented per the customer's discretion.

4.2.4 Elevated Work

When work is completed from scaffolding platforms, elevated work platforms or other similar locations or where there is an assessed risk of falling, the operator shall follow SES Fall Protection requirements which requires fall protection four feet or greater above a lower landing. If working from a temporary platform, it must be secured to prevent movement caused by the reaction force of the water blasting system. The use of other methods of achieving elevated work, ladders or step stools will not be used while shotgun work is being done. Only safe work platforms are to be used.

4.2.5 Electricity

Any electrical equipment in the immediate area of the operation that presents a hazard to the operator shall be de-energized, shielded or otherwise made safe.

All high-pressure equipment shall be grounded before work starts and during operation, to prevent the development of electrostatic charges between the lance and the workplace and all connections, junction boxes, switches and supply cables should be checked daily for any visible damage. All bonding and grounding connections shall be tested for continuity prior to use.

4.2.6 Exclusion from Defined Work Area

Prior to commencing any water blasting operations, the work area limits applicable to the particular operation will be defined and suitably barricaded to restrict unauthorized access. The perimeter of this area will be outside the effective range of the water blasting equipment. At minimum 15' of space is necessary.

Entry into the cordoned or barricaded area by unauthorized persons will be prevented whenever blasting operations are in progress. As part of their duties, the safety observer will watch for intrusions into the cordoned or barricaded area. Observer will disengage the pump if unauthorized persons are found in the work area. Operations can resume once the area is safe to do so.

The barriers used will be highly visible and appropriate to the level of risk. Warning notices will be displayed so as to be clearly visible and legible to all persons who are in or near the restricted area where the equipment is being used (refer to Figure 1 as an example, other signage can be used warning others).



Figure 1: Example of acceptable signage



4.2.7 Work Surface

Operators should have good access to the workplace, a safe platform (see section 4.2.3) and secure footing. The area in which work is to proceed shall be kept clear of loose items and debris to prevent fall/trip/slip hazards. Ensure that water discharge from the system is being controlled so that it does not create a greater hazard due to accumulation, freezing, contact with electrical equipment, or spreading contamination from cleaning area.

4.2.8 Shielding

Where necessary all equipment in close proximity to the area where water blasting is being performed will be adequately shielded or protected from debris and ingress of water resulting from the operation of the water blasting equipment.

“Target” and “side” shields will be suitably placed to safeguard personnel as well as equipment against water or grit, and solids removed by the blasting operation. An appropriate safety shield shall be used to protect the operator where there is the possibility of being impacted by the returning or reversing nozzle while lancing or pipe cleaning.

4.2.9 Equipment Safeguards

4.2.9.1 Dead Man switches/Fail Safe

Nozzles must be fitted with fast acting self-actuated cut-off devices. Operators will ensure there is no interruption or interference to the release mechanism of hand or foot controls which will prevent the equipment operating in a manner consistent with the manufacturer’s specifications. If, for any reason the water flow does not shut off when the trigger or foot pedal is released, cease work until the malfunctioning item of equipment has been serviced, repaired or changed by authorized and competent personnel. These devices are never to be defeated by using tape, blocks, zip ties, ropes, tools, or any other device.

4.2.9.2 Bypass and Pressure Safety Relief Valves

All systems must incorporate at least two control mechanisms to ensure immediate cut-off of water and/or depressurization of the system. Examples of the control mechanisms include:

Dump valves: Operator controlled; opens a free flow path for water, reducing pressure without effecting flow.

Dry shut-off valves: Operator controlled; completely shuts off flow to the nozzle, should only be used in combination with a regulator or automatic unloader valve.

Regulator valves: Automatically adjust the amount of water sent to the nozzle line in line with set pressures and pump capacity.

Automatic unloader valve: Automatically removes operating pressure by opening a free flow path for the pump output when it senses the nozzle line is closed.

Electronic Control Systems (hold to activate): Controls pump engine speed and pressure loading and enables operation without a shut-off or



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dump valve in the nozzle line.

Relief valves: Automatically opens to discharge water to relieve pressure. Operators should be aware of the reactive effect of pressure in the line which can transmit a sever jolt or “line pulse” to the operator when the dump valve or dry-shut valve is operated. To minimize this effect, total hose lengths should be kept as short as possible.

A ‘Hold-to activate’ device is not required when the operator is remote from the work or the system is operated automatically.

4.2.10 Equipment Checks

Operators of water blasting systems will not carry out repairs or maintenance other than simple adjustments of the replacement parts which are specifically listed in the manufacturer’s instructions.

4.2.10.1 Daily Pre-operational checks:

Pump System:

- Pump unit
- Drive unit
- Hydraulic hose reel
- Condition of guards, shields, rupture discs, and safety interlocks
- Electrical leads and connectors

Filters & Strainers:

- All water filters should be checked at regular intervals, dependent upon water supply conditions, and in accordance with pump manufacturer’s recommendations.

Hose Assembly:

- All hoses shall be inspected prior to each use to ensure:
 - No structural damage
 - End fittings and couplings are in good order and are the correct pressure rating
 - All hose connections to equipment or other hoses are restrained with Whip Checks.
 - All shotguns are equipped with tested and rated safety shrouds.

Only hose assemblies specifically designed for water blasting systems, and of the correct pressure rating, will be used for this purpose.

Fittings:

- All fittings should be cleaned before installing in a system
- Seals should be replaced and lubricated as necessary.
- Use of Teflon tape on 10K systems or anti-seize for metal connections, Reapply as appropriate.

4.2.10.2 Major Servicing

Servicing and repair of the following equipment requires specialized knowledge and should only be completed by a competent person with thorough knowledge of the equipment, including:

- Pressure relief valves
- Bursting discs (if used)



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- Pressure control devices
- Pump control valves or dry shut-off valves
- Electrical controls and equipment

Work shall not proceed unless the operator is satisfied that all equipment has been inspected or serviced in accordance with the manufacturer's recommendations; and is free from any fault that may adversely affect the performance and safe operation of the equipment.

Operators shall report any defect in the water blasting system to their supervisor immediately so that the defect may be investigated and rectified. Repairs or maintenance will be carried out by the manufacturer, or a competent mechanic specifically trained in repairs to the piece of equipment. Suitable maintenance records shall be kept for each major piece of equipment.

4.2.11 Communication

Before starting a blasting operation, the work crew will agree on code signals or means of communication to be used during the operation of the equipment.

It is important to ensure all personnel working in the vicinity of water blasting operations are notified.

If direct line of sight is not possible the use of a link man will be used.

4.2.12 Personal Protective Equipment

In addition to SES's minimum PPE requirements, the need for supplemental PPE is assessed based upon the demands of the equipment being used, the nature of the job and the associated risks. Additional PPE must be worn where the risk of injury cannot be eliminated or suitably controlled by higher end controls. Where PPE is issued it shall be used, and instruction and training regarding its correct use and maintenance must be followed.

Eye: Eye protection must be worn **at all times**. Where liquids liable to cause eye damage are encountered, a combination of face shield and goggles or a full hood with shield is required.

Body: Liquid or chemical resistant suits should be worn where there is an assessed risk to health or of injury as a result of chemical contact.

Hand: Suitable hand protection shall be worn to prevent slippage and mitigate injury.

Foot: Steel-toed, metatarsal boots shall be worn to prevent foot injuries. Rubber boot covers may be needed if working in puddled water.

Ears: Suitable hearing protection must be worn **at all times**.

Respiratory Protection: Respiratory protection must be worn where a risk of inhalation of toxic or harmful substances has been found to exist. (refer to section 4.2.1)

4.2.13 Incident/Injury Procedure

ANY PERSON STRUCK ON THE SKIN BY A HIGH PRESSURE WATER JET SHALL BE MEDICALLY ASSESSED IMMEDIATELY.

The injury may be more severe than apparent and could be internal. Large quantities of water may have punctured the skin, flesh and organs through a



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very small hole that may not even bleed.

All operators engaged in industrial water jetting operations should carry an immediately accessible, waterproof water-cut medical alert card explaining treatment specific to water-blasting injuries.

Recommended information includes:

- Typical post-accident infections
- First aid treatment
- Contact details for medical experts
- Worker identification and medical details

4.2.14 Hose Protection

All hoses will be protected at all times from being run over and crushed by vehicles, forklift trucks, or other equipment. Additionally, hoses must be protected from sharp edges.

Hose and lances will not be used improperly. Examples of improper use include using hoses to support operators when gaining access to work areas, i.e. confined spaces and moving jobsite equipment by pulling on hoses.

4.2.15 Number of Operators

4.2.15.1 Multi-person Operations

In most water blasting operations it is accepted practice to employ a minimum of two persons, but the number of operators used is generally based upon the demands of the equipment being used and the nature of the job.

The role of the second operator, also known as the “safety observer” or “pump operator” is to attend the pump unit, keep close watch on the first operator for signs of difficulty or fatigue (crew should rotate their duties, if properly trained and competent, during any job to minimize fatigue to the operator holding the lance or gun), and watch the surrounding area for intrusion by other persons or unsafe situations.

Additional operators may be required:

- To assist the first operator with the handling of the lance if it is too long or heavy for one person
- To provide communication if the lance operator is out of sight of the pump unit operator.

All multi-person water blasting operations will be controlled by a team leader who is trained and competent in all aspects of the blasting operation.

4.2.15.2 Single-person Operations

Are generally allowed where the method of operation does not place the operator at risk of jet impact i.e. drain or sewer cleaning.

The risks posed by the presence of other hazards must be considered and assessed when deciding on the advisability of single-person



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operation.

Single-person operations of “class A” systems is generally permitted except where the assessed level of risk to the operator or other persons in the vicinity cannot be reduced to an acceptable level. In these cases “class B” operating system recommendation(s) will be applied.

Single-person operation of “class B” systems is permitted under the following conditions:

- Where the operator is physically isolated from the pressurized water flow
- Where there is no risk of the operator being exposed to the jet impact
- Where the presence of other hazards does not expose the operator to other occupational, health and safety risks.

Single-person operation is also permitted when using mechanically operated or positioned pieces of equipment, where the operator is physically isolated from the pressurized water flow. Where such equipment is used, a set of written “safe operating instructions” will be prepared for each piece of equipment and the equipment will be operated strictly in accordance with these instructions by a competent operator specifically trained in its use.

4.2.16 System Pressurization

The pump shall not be started and brought up to pressure unless each crew member is in their designated position, the nozzle is not to be put on the system until water has been flushed through the system to remove any debris that could clog the nozzle orifices. The system will be monitored for any obvious leaks. The system will be shut off prior to attaching the nozzle to the system. Once the nozzle is attached the nozzle will be held in or directed at the work area, and the lance or gun will be securely held.

The pressure will be increased slowly, to half of the operating pressure, to allow the operator to experience the reaction force of the jet progressively. The system will be checked for any leaks or faulty components.

All leaks will be corrected; faulty components repaired or replaced before commencing operations (see 4.2.9). No attempt will be made to adjust any component, hose connection, fitting or similar, while the system is under pressure. The system will be depressurized or isolated before any repairs are carried out. If repairs are not possible, equipment will be disconnected and tagged “**out of service**”.

The lowest pressure capable of performing the work will be used. The pressure will not be adjusted without the operator’s awareness.

The system shall be de-pressurized when not in use, the defined work area is entered by an unauthorized person or any recommended practices are violated.



4.2.17 Reaction Force

Reaction forces will be taken into account when planning a particular job and allocating personnel to ensure the forces exerted by the gun and the hose on the water blasting operator are not excessive.

The reaction force along the axis of the gun barrel will be calculated in order for an “average operator” to retain control of the gun safely and comfortably. A maximum reaction force of 50 lbs is recommended for an eight-hour shift and this will not be exceeded for normal operations.

Where a high reaction force is required to achieve acceptable results, consideration will be given to mechanical control of the nozzle, and where such mechanical assistance is not possible, consideration will be given to the gun 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. The reaction force shall not exceed 1/3 of the operator’s weight.

4.2.18 Shotgun Operations

When using a wand or hand-held (shotgun) for water blasting operations, the operator will abide by the following principals:

- Back thrust is created by the high-pressure jet stream. Back thrust should be limited to each operator’s personal comfort zone but not exceed 1/3 of their body weight. The best way to limit back thrust is to lower the volume of water at the tip
- Person operating the shotgun will have direct control of the water flow
- The system will never be left unattended when pressurized
- When more than one operation is being performed within the same area, a physical barrier will be installed or adequate spacing between the operators will be maintained to prevent the possibility of injury from the water blasting operations
- Objects to be cleaned will never be held manually
- Length of shotgun from rear trigger to tip, must be at least 48". The overall gun length from stock butt to the tip must be at least 6" greater than the top of the operator’s shoulder. Shotguns less than 48" must be approved by a Variance prior to use.
- Steel-braided or crush-resistant hoses will be used on air-operated fail-safe systems to keep the system from being activated by someone stepping on, running over or otherwise crushing the hose.
- Avoid using pipe wrenches to tighten barrels
- On barrels fitted with wear nuts, place wrenches on the nut whenever possible to limit stress to the barrel
- Recommended to use thread tape on connections (For equipment rated for less than 20K psi.)
- Use support sling on long barrels
- Shotguns must be fitted with trigger guard which prevents accidental activation
- Trigger and relief valve must work properly
- If a drain hose is installed on a gun, ensure that no restrictions are introduced. Hoses and fitting too small can cause back-pressure



capable of activating the gun.

4.2.19 Lancing

Lancing operations are to be conducted with automated water blast equipment. When circumstances arise that will not allow automated operations, a variance must be obtained before operations. The following are minimum requirements for lancing operations and must be followed. Additional requirements may be directed during the variance process.

When operating lances, flexible or rigid, you must be alert to the operational behavior of these water blasting tools and the hazards they present.

- The operator inserting the nozzle will have direct control of the water flow to the nozzle. **A Variance must be obtained for operations where this is not possible.**
- When performing manual pipe cleaning or lancing operations, the entrance to a line or pipe **will not** be cleaned with a lance fitted with a retro(back) jets.
- The clearance between the outside diameter of the hose, lance and nozzle assembly and the inside wall of the item being cleaned will be sufficient to allow adequate washout of water and debris.
- Where the diameter of the nozzle and hose assembly exceed 2/3 of the inner diameter of the pipe or tube being cleaned, additional care will be exercised to minimize the risk of the nozzle and debris forming a hydraulic piston which may be forced out under pressure towards the operator (see 4.2.7).
- During manual operation, the nozzle will be inserted into the tube prior to commencement of the actual jetting water flow. Conversely, the water flow will be interrupted before removal of the nozzle from the tube.
- Plugged tubes can cause hydraulic back pressure that may cause lance to back out of tube.
- Anti-withdrawal devices must be used for all lancing activities.
 - Anti-withdrawal devices must be physically attached to the pipe or tube bundle which is being cleaned.
 - For operations where lancing is conducted while standing over the tubes, the AWD can be a foot-controlled device and not physically attached.
- Do not activate dead-man control unless the lance is inserted into the tube
- Do not withdrawal a lance from a tube when the lance is pressurized
- Where there is a possibility of the operator being impacted by a returning or reversing nozzle the operator will ensure that a length of rigid assembly ("Stinger") is sufficient length to prevent reversal of the nozzle assembly during water blasting operations. Alternatively, a suitable safety shield will be provided to protect the operator from the nozzle turning through 180 and doubling back towards the operator. Where the operator is not in a position to be impacted by a returning nozzle i.e. when the nozzle is in a drain reached by an access-way, the nozzle assembly length recommendations may not be necessary.
- Minimize lancing above "shoulder height". Lancing tubes at this height



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allows fluids to enter through the collar of a rain suit and imparts ergonomic stresses (greater effort, awkward position) on the lance operator

- For lancing operations upward into tubes, Cut suits must be worn
- For vertical insertions, work platform (scaffolding) should be erected so the lance operator stands at least 12" above the tube sheet. The "Chicken Wing" type anti-withdrawal shall be used.
- In vertical insertions, cut suits must be worn or metallic shin guards are required (in addition to metatarsal protective boot)
- Vertical insertions, lance must be 6' or less in length
- Vertical insertions, manually rotating stiff lance is prohibited
- Rigid stiff lances, be mindful of footing problems when "walking" lances (Horizontal rotating lances longer than 6' may not be "walked")
- Rigid stiff lances, tips must have a "pull in" or neutral thrust
- Lance must be constructed of one continuous length of tubing.
- Avoid area where hose connects to lance, these are likely failure points. Hose shrouds rated for the operating pressure of the pump must be used at these connections.
- Flex Lance tips must propel the lance forward (away from the operator)
- Lance guards or stingers and/or nozzle assembly must be 1½ times longer than the diameter of the pipe to be cleaned or the cleanout port of the line. (T-shaped Ports)
- All lance parts shall have the manufactures markings to include, end markings, and MAWP permanently listed, directly on the part being used.

4.2.20 Line Moleing

Line moles are used for high pressure jetting of a line. Moles contain several jets. Part of the function of the jets is to propel the mole and hose through the line. Line Moleing operations must be conducted using automated water blast equipment. When circumstances arise that will not allow automated operations, a variance must be obtained before operations. The following are minimum requirements for line mole operations and must be followed. Additional requirements may be directed during the variance process

- Be aware that underground lines may contain toxic gases
- Ensure adequate access to above grade lines
- Prevent mole reversal. Lance guards or stingers and/or nozzle assembly must be 1½ times longer than the diameter of the pipe to be cleaned or the cleanout port of the line. (T-shaped Ports)
- Nozzles must propel the mole forward (away from the operator)
- Anti-withdrawal devices must be installed.
- Use powered hose reel whenever possible to avoid the need for man-handling the hose
- Do not allow the hose to go further than 10' without trying to retract it. This will prevent the line mole from becoming stuck. (Hacksaw method)
- Operate equipment within design limits
- All moleing parts shall have the manufactures markings to include, end markings, and MAWP permanently listed, directly on the part



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being used.

4.2.21 Work Stoppage

Work will cease:

- In the event that leaks become apparent on the high-pressure side of the pump or equipment damage becomes apparent
- If any person becomes aware of any change in conditions or any hazards being introduced or existing
- If the customer's work alarms are sounded
- If any unauthorized person enters the cordoned or barricaded areas
- If any of the recommended relevant practices in this standard are not being followed.
- Signs of operator fatigue

4.3.1 Automated Lancing Operations

Automated cleaning operations use specialty high pressure water jetting heads, 2d nozzles, 3d nozzles, gamma jets, rotary lances, etc, designed to be inserted into tanks, vessels, piping and other such equipment for cleaning purposes. Automated cleaning operations allow for long cleaning periods without exposing employees to the hazards of manual operated high pressure water jetting.

The advantage of using mechanized tools and nozzles is the increased level of safety and high cleaning efficiency that they generally provide. Where workers can be removed from the manual cleaning process, their exposure to water jets and hazardous material is significantly reduced and the safety and productivity are improved

Mechanized tooling options can be readily applied to cleaning projects that are repetitive, planned, or of short or long duration. The use of mechanized tools in confined spaces further reduces risk to workers and can often enable work to be completed sooner than if manual cleaning is planned.

Safety Controls

- Flow Control (Diverter) Valve: Remote cleaning systems shall be outfitted with a safety flow control valve (Diverter) at the pump. This control valve will be utilized to regulate the amount of pressure delivered to the cleaning unit. Excess water and pressure shall be diverted safely away from the pump operator through a secured blow off line larger than the hose diameter feeding the cleaning tool.
- Foot Pedal (Dump Valve): When feasible a safety foot pedal must be in place between the control valve and the automated tool itself. The operator of the foot valve shall be positioned to monitor the cleaning tool and shall be in sole control of the water pressure being delivered to the cleaning tool from this point forward. In the event of a hose rupture, cleaning head malfunction or other unexpected event the foot pedal operator shall shut down the cleaning operation immediately.

Equipment set up

- All automated system components will be set up per the manufacturer's recommendations.
- The proper tooling for the size of hoses to be used must be



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selected and properly installed.

- Appropriate safety devices (Anti-Withdrawal devices, “keys”, “saddles”) must be properly installed and checked by pulling on the flex lance hose to ensure the hose cannot pass the physical stop.
- Placement of the control box for the automated system must be set up at least 10 ft from and in plain sight of the point of operation.
- Consideration of additional hose management needed for the automated system must be made. The area where the hoses will be moving will need to be cordoned off to prevent potential trip hazards

5. TRAINING

Only competent personnel should supervise and operator water blasting systems. SES will ensure that all operators have been properly trained and completed a hands-on evaluation prior to operating the equipment. A visual evaluation will be given to the operator by a qualified employee. Once an employee receives the initial hands-on training, they will be permitted to operate only under the supervision of an experienced, competent operator for a period of time. Duration of the supervised operation will vary based on the time the employee has operating the equipment. In the event of an incident or near miss involving water blasting, the operator will be re-trained to ensure competency. Experienced personnel must receive annual refresher training.

Hands-on training includes:

- Demonstration of the cutting action of the waterjet stream and its hazards
- PPE-purpose, basic water blasting ensemble, donning and doffing
- Operation of a water blast system, including start-up, shut down, typical problems and their correction
- The importance of safety devices including their theory of operation, functionality, and maintenance
- The company's prohibitions on altering/tampering/disabling safety equipment
- The proper method of connecting hoses
- The proper handling of hose including set-up and storage practices which prevent or minimize damage
- Demonstration by the trainee that they can operate the equipment safely



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PRE-SERVICE CHECK LIST – HIGH PRESSURE WATER BLASTING

DATE: _____ LOCATION: _____

EQUIPMENT BEING USED: _____

		YES	NO	N/A
1	JSA completed and safety talk with crew conducted prior to work commencement?			
2	All personnel trained in accordance with manufactures operating procedures?			
3	Work area secured and being performed from a stable work surface?			
4	Proper PPE being utilized? As noted on JSA?			
5	Lockout/Tagout procedures implemented? Identified on JSA?			
6	All hoses in good condition?			
7	All fittings must be stainless steel and in good condition?			
8	Nozzles clear and operating properly?			
9	Dump valve operating properly?			
10	System tested to maximum operating pressure prior to use? Pressure psi			
11	Protective hose shroud in place and in good condition?			
12	Communication signals established and understood by crew?			
13	All control systems operating properly?			
14	Confined Space Entry Procedures implemented? CSE permit completed?			
15	Emergency medical available?			
16	Have precautions been taken to protect all electrical equipment?			
17	Have potential hazards to personnel from releases or contact with hazardous materials been identified and controlled?			
18	Are all fittings of correct pressure ratings?			
19	Are all hoses of correct pressure ratings?			
20	Is the filter on the pump suction clean and in good operating condition?			
21	Is there an adequate water supply?			
22	Have precautions been taken against freezing?			
23	Has the complete hook-up been flushed and air removed from the system prior to installing the nozzle?			
24	Has hook-up, including pipes, hoses and connections been pressure-tested with water at the maximum pump operating pressure?			
25	Flex Lancing: Is the length of the nozzle and coupling greater than the inside diameter of the pipe? Have precautions been taken to prevent "Flex Lance / Line-Mole" reversal?			
26	Flex Lancing: Is there the use of a nozzle support or stinger in place?			
27	Flex Lancing: Has the hose been identified at least 3 ft from the nozzle to warn the operator?			
28	Flex Lancing: Is there sufficient space to allow washout of debris and water?			
29	Have precautions been taken to prevent "Flex Lance / Line-Mole" Ant-withdrawal?			

I HAVE FILLED OUT THIS FORM WITH ALL INFORMATION GIVEN TO ME AND UNDERSTAND ALL ABOVE. Supervisor Signature _____