Jetstream®

Subsidiary of Federal Signal Corporation

GENERAL WATERBLAST SAFETY MANUAL

Jetstream®
Subsidiary of Federal Signal Corporation

Jetstream manufactures industrial high-pressure waterblasting equipment operated at pressures up to 40,000 psi for a wide range of applications, including hydro-demolition, industrial cleaning and surface preparation. Backed by strong after-sales service and support, Jetstream product offerings include a complete line of skid and trailer-mounted pump units, control guns, valves, hoses, replacement parts, nozzles, and safety gear.

Jetstream® RightStart

In order to ensure customer satisfaction, Jetstream has developed the Right Start program, a four-step plan designed to provide the owners and operators of new Jetstream waterblast units with the knowledge and support needed to feel familiar, confident and satisfied with Jetstream equipment and personnel.

1. Transportation

Once a new waterblaster is built and thoroughly tested, the Shipping Manager contacts the new owner to arrange for the unit's arrival to the right place at the right time.

2. Training

All new waterblasters include personal training by the Right Start Technician. Training involves both classroom and "hands-on" instruction to make sure that each operator is thoroughly familiar with the design and function of the unit and accessories, enabling him to safely put the new equipment to optimal use.

3. Follow-up

Within thirty days of delivery, and again within sixty days, the Solutions Provider will call to answer any questions and ensure complete satisfaction.

4. Trust

If any questions or problems ever arise, the Jetstream team is available and committed to providing prompt answers and solutions.

TABLE OF CONTENTS

FOREWORD

Welcome to the our growing family of Jetstream customers. The current series of units reflect the latest developments from the continuous research program of our engineering staff. Our research brings you the latest and most efficient waterblasting equipment available in the world today.

This Safety Manual contains information on all aspects of the safe operation of a Jetstream unit.

Proper operation and maintenance of your unit is critical to protect the safety of operators and others and to maximize performance and product life. Operators and maintenance personnel must familiarize themselves with this manual as well as proper operating procedures before operating or maintaining a unit.

The information in this publication is based on the information in effect at the time of approval for publication. We are constantly improving our products and, therefore, reserve the right to make changes at any time without notice.

If a question arises concerning your Jetstream product or this publication, please contact your Jetstream representative.

FSESG Environmental **Solutions** Group

Jetstream® Subsidiary of Federal Signal Corporation

Jetstream of Houston, LLP
5905 Thomas Rd.
Houston, TX 77041
United States

Subsidiary of Federal Signal Corporation

Inform Jetstream of any change of unit ownership or address.

This operator's manual must be considered a permanent part of the your unit and must be with the unit at all times for ready reference.

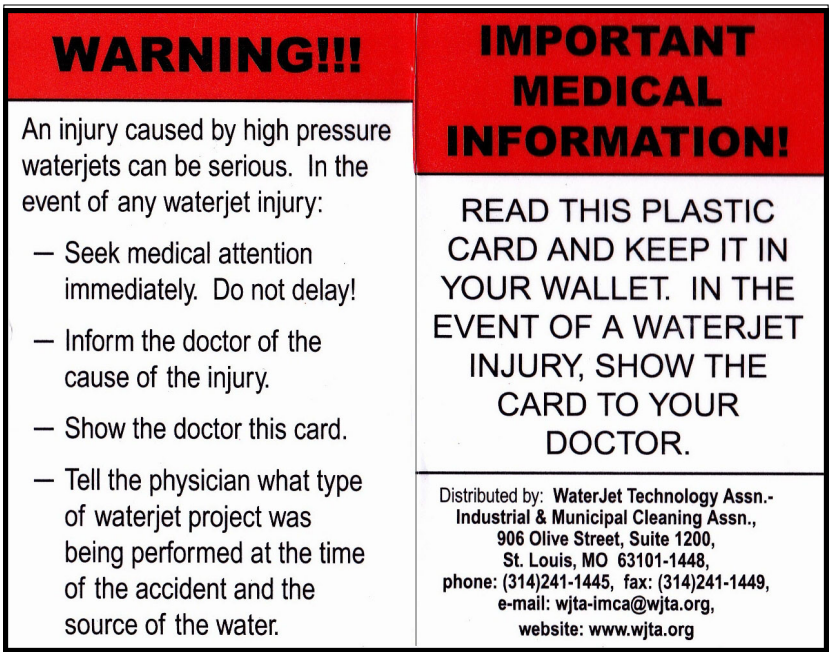
⚠ WARNING

IMPORTANT MEDICAL INFORMATION

An injury caused by high pressure waterjets can be serious. In the event of any waterjet injury:

- Seek medical attention immediately. Do not delay!
- Inform the doctor of the cause of the injury.
- Tell the physician what type of waterjet work was being performed at the time of the accident and the source of the water.

Medical Alert



Laminated Wallet Medical Alert Card (Front and Back)

Note: Available from the WJTA.

WaterJet Technology Association
917 Locust Street, Suite 1100
St Louis MO 63101-1419
(314) 241-1445
fax (314) 241-1449
e-mail: wjta@wjta.org
website: www.wjta.org

Also available from the WJTA:

Recommended Practices for the Use of High Pressure Waterjetting Equipment

Recommended Practices for the Use of Industrial Vacuum Equipment

GENERAL WARNING

WARNING

Jetstream could not possibly know, evaluate, and advise the service trade of all conceivable ways in which operation or service might be done or the possible hazardous consequences of each way. Anyone who uses operational procedures, service procedures, or tools, whether recommended by Jetstream or not, must first satisfy himself thoroughly that neither his safety nor the product safety will be jeopardized by the methods he shall select.

Jetstream units are designed to user specifications. The owner/operator/user is responsible for the safe use and application of this equipment and proper waste disposal. Transportation and disposal of waste may be subject to local, state or federal laws.

Read and follow the safety practices described in this manual and in the common industry references that are also provided to help in the decision making process.

General Safety Procedures

1. Perform all operations with at least two operators.
2. Only trained personnel may operate, perform maintenance, or repair the unit.
3. The work area must be clear and clean for good visibility and footing.
4. Work areas must be properly secured, barricaded and warning signs erected.
5. All operators must wear proper safety apparel: hard hat with plastic face shield, rain suit, non-skid knee boots with metatarsal protection, shin and foot shields, gloves, ear protection, safety glasses and appropriate armor are all recommended.
6. Never alter system components or reprogram. System components must be used only as intended.
7. If a malfunction occurs, immediately stop and follow repair instructions.
8. In case of freezing conditions, drain water from all components. Refer to the winterizing instructions in the unit manual for specific instructions or contact Jetstream.
9. Operating the unit inside a building or a confined area can create additional risks to the unit, operators and building occupants. Engine exhaust gas can reach deadly levels. Heat build up from the engine and exhaust discharge can overheat people and equipment.
10. Never operate engines where there are or can be combustible vapors. Vapors pulled in to an engine air intake can cause engine acceleration and over-speeding. This can result in death, injury and property damage.
11. The use of this equipment in the removal or handling of any regulated substance or material must be performed in strict accordance with all applicable federal, state and local laws and regulations, and approved safety and personal protection equipment and clothing must be used and worn at all times.
12. Reference to OSHA regulations are for informational purposes only and not intended as legal advice.
13. Inspect all components of the waterblast system before use. Do not use any damaged, unrated or underrated components.
14. If flammable or combustible materials or gasses will be encountered, ensure all components are bonded and the unit is properly grounded using the grounding cable.

SAFETY STANDARDS

These standards apply to the operation and maintenance of all Jetstream equipment.

The following definitions apply to all terms used throughout this manual unless otherwise stated.

DISTRIBUTOR: A person that distributes Jetstream equipment to a person or employer.

EMPLOYER: A person that hires one or more persons to work in the business of maintaining or operating equipment.

HAZARD: Description of a physical or environmental condition that creates the potential for injury.

MAINTENANCE PERSON: A person who cares for, inspects, cleans, maintains and repairs Jetstream equipment.

OPERATOR: A person who controls the use and operation of Jetstream equipment other than in the course of servicing or repair.

PERSON: An individual, corporation, partnership, legal entity or business.

WORK AREA: Pump, hoses, and all pressurized components including lance exit areas.

OPERATION

It shall be the responsibility of the Employer to:

- Provide properly maintained equipment that meets all applicable codes, local, state and federal ordinances and safety standards
- Instruct and train operators in safe and correct methods of operation before assigning any person to operate a unit. Such instructions and training shall include all operational and safety data furnished by the manufacturer.
- Prohibit operators from operating a unit unless trained and qualified.
- Ensure all personnel operating or in the vicinity of the equipment are trained on the hazards and precautions of high pressure water and compressed air.
- Ensure all decals are in place and legible.

It shall be the responsibility of the Employee to:

- Use all safety features provided on the unit and abide by all safety instructions.
- Operate the unit only after being instructed and trained in accordance with instructions given in (Employer Responsibility).
- Ensure the work area is secure.
- Report any damage or malfunction of the unit or components to your employer, either at occurrence or at end of working day, depending on the extent of damage or malfunction.
- Never ride, or let any other person ride on any part of the trailer when in motion.
- Stop operation at any time that a hazardous condition is identified.

MAINTENANCE

It shall be the responsibility of the Employer to:

- Ensure adequate care for cleaning, inspecting and maintaining the entire unit.
- Establish and follow a program of regular maintenance to ensure that the complete unit is in a safe operating condition and in accordance with the manufacturer's recommended specifications. A record of these inspections and of any maintenance work shall be kept.
- Ensure maintenance personnel are competent and properly trained for maintaining Jetstream equipment.
- Provide an adequate and safe work area for maintenance personnel to maintain the unit.
- Establish procedures for mandatory use of safety equipment when working.
- Establish a procedure wherein the engine will be shut off, the ignition key removed, and a sign stating "UNIT UNDER REPAIR - DO NOT OPERATE" be displayed on the control panel during repairs to unit.

It shall be the responsibility of the Maintenance Personnel to:

- Follow all of the employer's programs and use all the safety procedures established by the employer and manufacturer.
- Perform all repairs in accordance with all applicable codes, local, state and federal ordinances and according to the design specifications as recommended by the manufacturer.

PART FAILURE HAZARD

Use only Jetstream supplied replacement parts to ensure proper installation, quality and longevity.

RECONSTRUCTIONS OR MODIFICATIONS

Any reconstruction or modification to Jetstream equipment shall be the responsibility of the person making these reconstructions or modifications.

Any person reconstructing or modifying Jetstream equipment must furnish instructions with the reconstruction or modification. These instructions shall include operating, maintenance and safety precautions associated with the reconstruction or modification.

GENERAL SAFETY

RECOGNIZE SAFETY INFORMATION

⚠ This is the safety-alert symbol. When you see this symbol on your unit or in this manual, be alert to the potential for personal injury.

Follow recommended precautions and safe operating practices.

UNDERSTAND SIGNAL WORDS

A signal word – DANGER, WARNING, or CAUTION – is used with the safety-alert symbol. DANGER identifies the most serious hazards.

This symbol and these signal words appear on the unit and in this manual. Read and understand the following definitions of the signal words before operating or working on the unit.

⚠ DANGER DANGER is used to indicate the presence of a hazard which will cause severe personal injury or death if the warning is ignored.

⚠ WARNING WARNING is used to indicate the presence of a hazard which can cause severe personal injury or death if the warning is ignored.

⚠ CAUTION CAUTION is used to indicate the presence of a hazard which will or can cause minor personal injury, if the warning is ignored.

NOTICE NOTICE indicates installation, operation, or maintenance information which is important but not hazard-related.

CALIFORNIA PROPOSITION 65 WARNING

Please note this warning and remember:

- Always start and operate the engine in a well-ventilated area
- If in an enclosed area, vent the exhaust to the outside
- Do not modify or tamper with the exhaust system

CALIFORNIA

PROPOSITION 65 WARNING

Diesel engine exhaust and some of its constituents are known to the State of California to cause

cancer, birth defects and other reproductive harm.

FOLLOW SAFETY INSTRUCTIONS

Carefully read all safety messages in this manual and on the unit's safety decals.

Keep decals in good condition. Replace missing or damaged safety decals. Replacement safety decals are available from Jetstream.

Learn how to operate the unit and how to use the controls properly. Do not allow anyone to operate the unit without instruction.

Keep the unit in proper working condition. Unauthorized modifications to the unit may impair function and/or safety and affect unit life.

If you do not understand any part of this manual and need assistance, contact your Jetstream representative.

HANDLE FUEL SAFELY — AVOID FIRES

Handle fuel with care. It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks.

Always stop the engines before refueling the machine. Fill the fuel tank outdoors.

Prevent fires by keeping the machine clean of trash, grease, and debris. Always clean up spilled fuel.

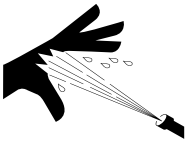
AVOID CONTACT WITH MOVING PARTS

Know where operators are before starting the engine.

Moving part hazards exist on the engine and pump. Stay clear of these moving elements during operation.

Keep hands, feet, and clothing away from power driven parts.

AVOID HIGH PRESSURE FLUIDS



Pressurized fluids can penetrate the skin, causing serious injury. Avoid the hazard by relieving pressure before disconnecting hydraulic or other high pressure lines. Tighten all connections before applying pressure. Protect hands and body from high pressure fluids. If accident occurs, seek immediate medical attention.

Keep hands and body away from pinholes and nozzles which eject fluids under high pressure.

PRACTICE SAFE MAINTENANCE/REPAIRS

Keep the area clean and dry. Remove any build-up of grease, oil, or debris.

Keep all parts in good condition and properly installed. Fix damage immediately. Replace worn or broken parts.

Maintenance and repairs must be completed by qualified and authorized personnel. All applicable industry standards and practices and regulations must be followed during maintenance and repairs.

PART REPLACEMENT

During replacement of any part, inspect the mating component for wear and replace if necessary.

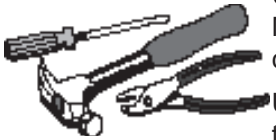
Do not attempt to install or use a part whose dimensions or clearances are suspect. Worn parts are subject to fail in high pressure systems.

Do not attempt to install or use a part whose function or operation is questionable.

TEST ALL REPAIRS

Test repaired equipment carefully and thoroughly before putting a component or assembly back into service. Do not put any piece of repaired equipment into service if its performance is questionable. If repaired equipment performance is questionable, call the manufacturer for assistance.

USE PROPER TOOLS



Use tools appropriate to the work. Make-shift tools and procedures can create safety hazards.

Use power tools only to loosen threaded parts and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners, or vice versa. Avoid bodily injury caused by slipping wrenches.

Use only service parts meeting Jetstream specifications.

PREVENT BATTERY EXPLOSIONS

Battery gas can explode. Keep sparks and flames away from batteries. If battery electrolyte level must be checked, use an electric light.

Never check battery charge by placing a metal object across the posts. Use a voltmeter or hydrometer.

Always remove the grounded (–) battery cable first and connect it last.

Do not charge a frozen battery; it may explode. Warm the battery to 60° F (16 °C).

OBSERVE ENVIRONMENTAL PROTECTION REGULATIONS

Be mindful of the environment and ecology.

Before draining any fluids, find out the correct way to dispose of them.

Observe the relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, and batteries.

EMPLOYEE SAFETY MEETINGS

It is a good idea to hold safety meetings with the crew to discuss safety items prior to waterblast operations. Doing this keeps safety fresh on the minds of the people operating and maintaining the equipment.

Advance safety meetings are a good opportunity for personnel to brainstorm and share stories that may be helpful to others.

PLAN THE JOB

Before waterblasting, make a plan to outline the safest method of how to accomplish the job. Check the area for hazards beforehand. Discuss how to make the area safe. Plan for any special equipment such as backstops to be brought in and positioned. Ensure the operators are fully aware of the logistics of the job plan.

EMERGENCY PROCEDURES

It is important to know what to do in an emergency. Having a plan in place for different scenarios will help alleviate the confusion that may occur during a crisis and help speed the response. Review different scenarios with your crew and train them on the proper response.

FIRST AID KITS

Keep first aid kits on the nearby at all times. Accidents can occur at any time. It is important to be prepared and properly trained should an accident occur.

FIRE EXTINGUISHERS

Keep the fire extinguisher on the unit at all times. It is important to be prepared and properly trained on how to use the fire extinguisher should a fire occur. Ensure the fire extinguisher is properly serviced at regular intervals.

WATERBLAST SAFETY

SAFETY TRAINING

Only trained personnel may setup, operate, or maintain this equipment.

Waterblast operators must be aware of the dangers that exist while using water blasting equipment. The cleaning nozzle's discharge jet(s) can inflict serious bodily injury. Jetstream® recommends demonstrating to new operators the potential damage of the discharge jet(s). This can be done by showing the effect of a waterjet from a straight tip nozzle cutting a scrap piece of 2 in. x 4 in. (50 mm x 100 mm) wood.

A safety training DVD is available from Jetstream® at their website (www.waterblast.com).

Training materials are also available from the Water Jet Technology Association (WJTA) (www.wjta.org).

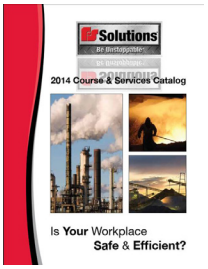
NEW UNIT START UP TRAINING

Jetstream Right Start

At Jetstream, we think you need to know exactly what you're getting. Right Start is free unit start up training for U.S. customers and is designed to get you familiar with your new Jetstream waterblaster!

For more information on Right Start Training, contact Jetstream at 1-800-231-8192

FS SOLUTIONS TRAINING



FS Solutions training begins where Right Start training stops. Our certified training covers all skill levels and incorporates: safety, application, troubleshooting, and field maintenance training.

For more information contact Jetstream.

READ INSTRUCTIONS

Read and follow all the manufacturer's instructions prior to using any waterblast product. Contact the manufacturer if unsure of any details.

Further instructions for safe operation are located in the Jetstream Operation Manual. Read this manual before operating the equipment.

JETSTREAM TRAINING

Jetstream Training Classes

Jetstream offers multiple certified training classes to promote safe, efficient, and profitable operation.

For more information on Jetstream Training, contact Jetstream at 1-800-231-8192.

CHECK WATER SUPPLY

Use only clean water. Check water filters daily and replace filter bags and cartridges as needed. If your water source is questionable, check the filters more often. Dirty filters will eventually allow particles to pass through them and damage equipment. Refer to the unit's operation manual for details on filtration and water quality.

BARRICADE THE WORKING AREA

Place barricades or shields with warning signs or use barricade tape around the complete work area. The barricade must be far enough from the blasting to keep observers safe.

USE ONLY PRODUCTS INTENDED FOR HIGH PRESSURE WATER BLAST

Know the pressure ratings of all equipment and components being used and never exceed their operating pressure. The lowest pressure rated component in the system establishes the system operating pressure. Jetstream® stamps all products with the maximum recommended operating pressure. Find the lowest rated component in the system and do not exceed that pressure.

NEVER ALTER WATERBLAST PRODUCTS

Do not alter any product without written consent from the manufacturer. Specifically, never alter or modify hand held control guns.

INSPECT EQUIPMENT

Inspect the condition of all components prior to use. Do not use any item that is in suspect condition. If unsure about the condition of a component, ask a supervisor or maintenance personnel for instructions. Use only components that are marked with a recommended operating pressure. Never exceed the operating pressure of the weakest component in the system.

SAFETY DECALS

Each unit is equipped with various safety decals located in areas where the operator must stay informed and be aware. Ensure that all safety decals are in place and can be read. Replace illegible decals with new ones. Refer to the Operation manual for the location of each decal.

RUPTURE DISCS

Installation of two rupture discs are necessary to protect the pump and operators.

- Rupture disc ratings: one at 120% of operating pressure, one at 140% of operating pressure

CHECK CONNECTIONS

Check the condition of the connection threads prior to making any high pressure connection. For 15,000 psi (1000 bar) and lower pressures use at least four wraps of Teflon tape on male pipe (NPT) threads for sealing purposes. Do not allow any tape to overlap the end of the fitting. Tape fragments may enter the system's water stream and clog the nozzle's orifices. Apply a coat of anti-seize compound over the Teflon sealant to prevent "galling" or seizing of threads. For "Jetstream® 20K"; "type M"; "MP (20K)" & HP (40K)" connections use anti-seize compound on the threads and the male cones.

TIGHTEN CONNECTIONS

Properly tighten all high pressure connections. Hand-tighten pipe (NPT) fittings and then tighten with a wrench another 1 1/2 - 2 full revolutions. Do not exceed two revolutions on NPT threaded connections. All NPT connections must have a minimum engagement of four threads.

Use caution when using a pipe wrench. Pipe wrenches can cause deep scoring leading to weakened components.

Refer to the Technical sections at the following web page for more information and torque specifications for the various fittings used on these units.

http://www.waterblast.com/Service_and_Support/Resources/Download_Literature.aspx

Protect Workers and Equipment with the Jetstream®

Visual Safety System*

Yellow	Green	Blue	Orange
10,000 PSI	15,000 PSI	20,000 PSI	40,000 PSI
690 Bar	1,034 Bar	1,379 Bar	2,758 Bar

Be sure operators are using the right equipment.

New color coded parts and accessories clearly show water-blast components in use are correctly and safely suited to current pump pressures with the Visual Safety System.

- Easy to use and implement
- Easy to see at a distance
- Helps keep workers safe
- Helps prevent equipment damage

WJTA
WaterJet Technology Association

*Complies with WJTA visual safety system color guidelines

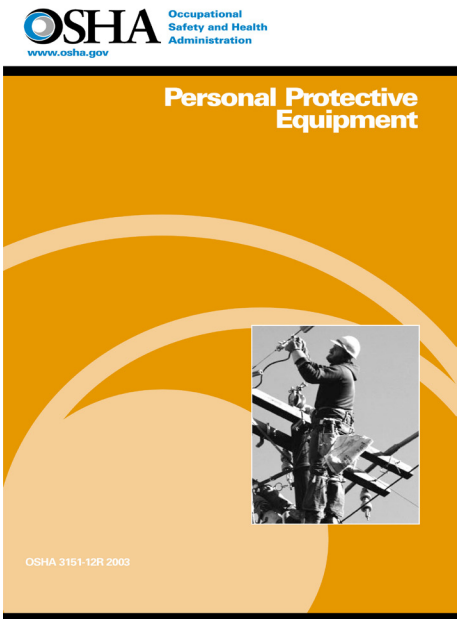
PERSONAL PROTECTIVE EQUIPMENT

All operators must be provided with proper protective equipment (PPE) including: hard hat with plastic face shield, rain suit, non-skid knee boots with metatarsal protection, shin and foot shields, gloves, ear protection, safety glasses and appropriate armor. (Fig. 1)

Most high pressure waterblasting operations produce noise levels in excess of OSHA standards, 90 dB(A). Control gun operators and unit operators must wear ear protection in accordance with OSHA regulation.

Perform regular inspections and maintenance of hearing protection equipment. All personnel exposed to 90 dB(A) or greater noise levels must receive instruction for the proper use of ear protection so that their noise exposure lies within the limits specified by OSHA.

OSHA guidelines for Personal Protective Equipment are available in document number 3151-12R 2003. The full document can be obtained from www.osha.gov.



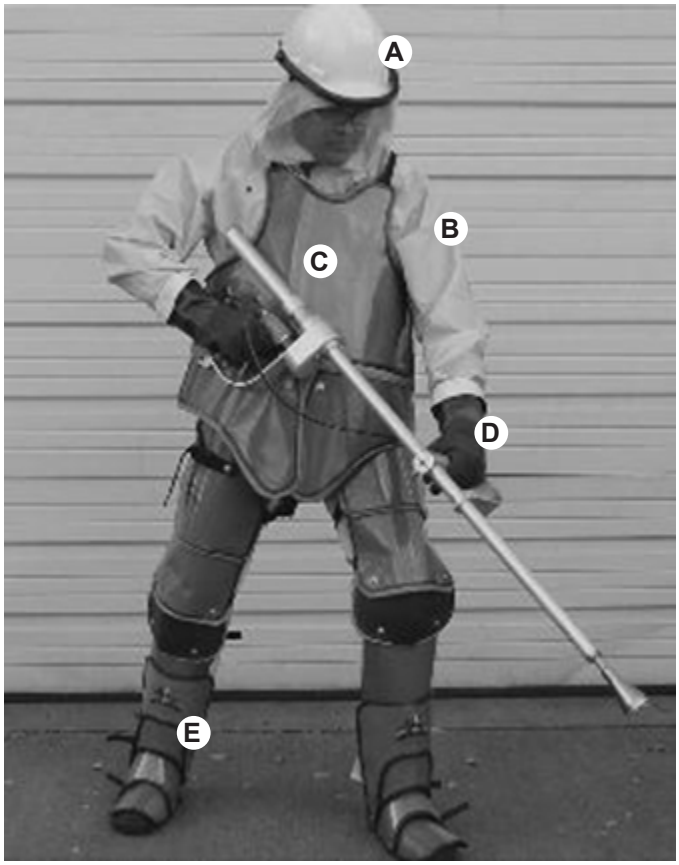


Fig. 1: Proper PPE

Recommended Safety Apparel	
A	Hard Hat with Face Shield, Safety Glasses, Ear Protection
B	Rain Suit
C	Protective Armor
D	Waterblasting Gloves
E	Non-skid Knee Boots with Metatarsal Protection, Shin and Foot Shields

USE TWO OPERATORS

Use at least two operators when waterblasting. The primary operator handling the cleaning device must maintain control of the water discharge at all times. The secondary operator controlling the waterblast unit must be positioned from a safe distance of at least 12 ft. (3.7 m).

Fig. 2: Using Two Operators

PURGE THE SYSTEM

Before attaching a nozzle to the control gun or lance, operate the pump at low speed to purge dirt and debris from the system. Dirt and debris can clog nozzle orifices and cause excessive system pressures.

Fig. 3: Flushing the Discharge Hose

TEST THE SYSTEM

With the nozzle installed, operate the pump at low speed (low pressure) to test the system. Should system repairs or adjustments be necessary, stop the pump and relieve all pressure before performing any required repairs or adjustments.

SLOWLY INCREASE PRESSURE

Visually inspect all fittings for leaks at 1000 psi (69 bar), and then again once the system reaches full pressure. Do not use your hand to find leaks. If leaks are evident, turn the system off and relieve the pressure. Remove the leaking fitting, clean and inspect. If the fitting looks undamaged, re-install the fitting. If the leak persists, the fitting must be replaced. Leaking fittings can cause fitting damage and very dangerous injection wounds.

With the system operating properly, slowly increase pump speed until operating pressure is reached.

USE THE MINIMUM PRESSURE REQUIRED

Do not exceed the operating pressure of the system's lowest pressure-rated component. Do not use components that are rated at a lower pressure than the intended operating pressure. Components with a lower pressure rating can be overlooked and explode if vigilance is not maintained. Keep equipment pressure rating and warning tags intact.

BE PREPARED

If the equipment malfunctions or a malfunction is suspected, immediately stop the cleaning activity and relieve the pressure in the system before attempting any repair. Always follow manufacturer's repair instructions.

FREEZING CONDITIONS

After shutting down in freezing conditions, even for brief periods, drain the water from all components and add anti-freeze. Prior to starting the equipment after a freeze, the operation of all equipment components must be checked carefully to ensure they are not frozen, or cracked, and are still in safe operating condition.

STORE COMPONENTS PROPERLY

Properly store components to protect from damage when not in use. Ensure all warning tags and markers remain intact for the next usage.

PERFORMING MAINTENANCE OR REPAIRS

Because of the hazards involved with water blasting, maintenance or repairs may only be performed by service personnel that are properly trained to maintain this equipment. Training is available through Jetstream® and can be requested from the Jetstream website (www.waterblast.com) or FS Solutions rental centers.

Following repairs or maintenance, operate the system at low pressure to test the system. Adjust the pressure slowly during operation.

FOLLOW LOCKOUT TAGOUT PROCEDURES

Follow all requirements for lockout/tagout when servicing the unit. The Occupational Safety and Health Administration (OSHA) requirements apply to most workers. The following information is from OSHA 3120 2002 (revised). The full document can be obtained from www.osha.gov.

"Lockout/tagout" refers to specific practices and procedures to safeguard employees from the unexpected startup of machinery and equipment, or the release of hazardous energy during service or maintenance activities. This requires, in part, that a designated individual turns off and disconnects the machinery or equipment from its energy source(s) before performing service or maintenance and that the authorized employee(s) either lock or tag the energy-isolating device(s) prevent the release of hazardous energy and take steps to verify that the energy has been isolated effectively. If the potential exists for the release of hazardous stored energy or for the reaccumulation of stored energy to a hazardous level, the employer must ensure that the employee(s) take steps to prevent injury that may result from the release of the stored energy.

Lockout devices hold energy-isolation devices in a safe or off" position. They provide protection by preventing machines or equipment from becoming energized because they are positive restraints that no one can remove without a key or other unlocking mechanism, or through extraordinary means, such as bolt cutters. Tagout devices, by contrast, are prominent warning devices that an authorized employee fastens to energy-isolating devices to warn employees not to reenergize the machine while he or she services or maintains it. Tagout devices are easier to remove and, by themselves, provide employees with less protection than do lockout devices.

Why do I need to be concerned about lockout/ tagout?

Employees can be seriously or fatally injured if machinery they service or maintain unexpectedly energizes, starts up, or releases stored energy. OSHA's standard on the Control of Hazardous Energy (Lockout/Tagout), found in Title 29 of the Code of Federal Regulations (CFR) Part 1910.147, spells out the steps employers must take to prevent accidents associated with hazardous energy. The standard addresses practices and procedures necessary to disable machinery and prevent the release of potentially hazardous energy while maintenance or servicing activities are performed.

NOTICE

Reference to OSHA regulations are for informational purposes only and not intended as legal advice.

CONTROL GUN SAFETY

USE SAFETY DEVICES

Use safety devices such as the following to protect the operator from harm.

- Trigger Lock (Fig. 4) - Prevents accidental discharge from the control gun.
- Adjustable Shoulder Stock (Fig. 4) - Provides support and control during operation.
- Handle (Fig. 4) - Provides control during operation and offers reduced trigger force to prevent fatigue.
- Safety Shroud (Fig. 5) - Provides added protection in the event of a hose failure.
- Whip Check (Fig. 6) - Restrains hose in the event of the end fitting or hose coupling failure.

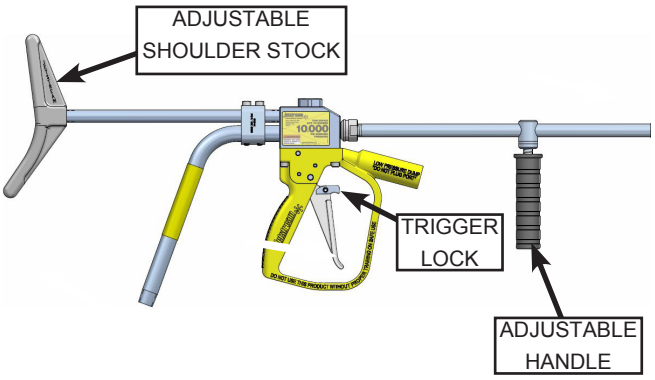


Fig. 4: Control Gun Safety Features

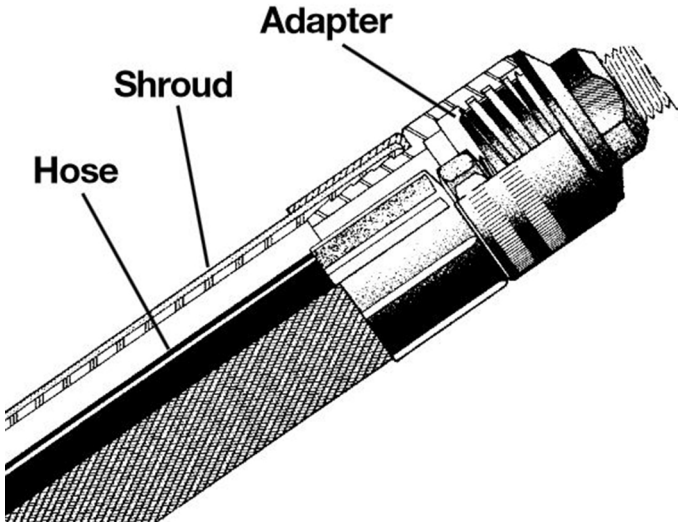


Fig. 5: Safety Shroud Installation

Fig. 6: Whip Check

KEEP GUN BARREL AT SAFE DISTANCE

It is recommended to use a 48 in. (1.2 m) long barrel to promote safe gun operation.

Shorter barrels are available, but only for use in confined spaces. Never make any modifications to the gun barrel or gun!

CHECK YOUR CONTROL DEVICE

Check the control gun or control device for smooth and proper operation before each operator's shift. Do not use any control gun or control device that has not been checked.

CHECK GUN DUMPING PRESSURE

When using dump style control guns, ensure the system pressure drops to near zero immediately when its trigger/pedal is released. If the control gun does not relieve system pressure immediately or the system pressure does not fall below 200 psi (138 bar) when the trigger/pedal is released, do not use the control gun.

BRACE YOURSELF

The thrust or rearward force from the control gun is substantial and is usually nozzle-limited to around 50 lb. (23 kg) or one third the operator's weight. A control gun operator using a hand held gun must position himself, with firm footing, and brace their body for gun thrust before depressing the gun trigger. The operator must maintain a firm, solid footing at all times to counter this thrust force (Fig. 7). The thrust can be controlled by proper sizing of the nozzle. However, in some cases the flow and pressure required to do the cleaning produces a thrust greater than 50 lb. (23 kg). In these instances, a mechanized cleaning tool may be required.

Pull the trigger slowly to prevent becoming thrown off balance.

Fig. 7: Counteracting Thrust

START AT LOW PRESSURE

When beginning a blasting job, start with the system at a low pressure, then slowly increase to operating pressure. Depress and release the control gun trigger/pedal several times at operating pressure to check operation of the control gun before commencing cleaning.

NEVER USE A MALFUNCTIONING GUN

Never use a control gun or control device that has malfunctioned or is suspected of malfunctioning. Suspect and malfunctioning equipment must be inspected and/or repaired by a qualified high pressure maintenance mechanic.

DO NOT LOCK THE TRIGGER IN THE BLASTING POSITION

Never tie or wedge the control gun trigger in the blasting position. Doing this can cause accidental discharge and cause great bodily harm or death.

CHECK ELECTRICAL CORDS

Use only electric throttle control cords that have been rated for wet conditions. Keep cord connectors and switches out of water.

CHECK DUMP WATER HOSE

Any hose used for transporting dump water back to the pump or to the ground must be properly sized. Dump water hoses must have a large enough diameter and short enough length so potentially dangerous back pressure is kept low.

Protect dump water hoses from traffic.

USE CONTROL GUN AS INTENDED

Do not operate hand operated guns by foot. Use the hand trigger only as intended.

NOZZLE SAFETY

CHECK NOZZLE FLOW RATING
The nozzle flow rating must be compatible with the pump discharge and pump pressure rating. The flow rating is stamped on the side of Jetstream® nozzles. Nozzle flow and pressure determine the thrust generated by the control gun or lance. Choosing the correct nozzle size for the pressure will limit the thrust creating a safer work environment.

CHECK PRESSURE RATING
Only use nozzles with a manufacturer's pressure rating that is correct for the proposed operating pressure.

CHECK ORIFICES
Prior to installation, check the nozzle for clogged orifices. Clean or replace as necessary.

CONNECTING A NOZZLE
Use Teflon tape on the male pipe (NPT) thread before connecting a pipe thread nozzle. Do not allow any tape to overlap the end of the fitting. Tape fragments may enter the system's water stream and clog the nozzle's orifices.

Hand-tighten nozzle pipe (NPT) fittings and then tighten with a wrench another 1 $^{1/2}$ - 2 full revolutions. Do not exceed two revolutions on NPT threaded connections. All NPT connections must have a minimum engagement of four threads.

Use wrench flats (when available) or a properly adjusted pipe wrench for tightening the nozzle. Use caution when using a pipe wrench. Pipe wrenches can cause deep scoring leading to weakened components.

CHECK THREAD LOCKING PIN
Special nozzles that require a thread locking pin must have the pin installed prior to use. Failure to use the pin may cause the nozzle to unscrew from the lance while in service and cause the lance to blow back toward operator.

STOP PUMP IF NOZZLE APPEARS CLOGGED
If the nozzle appears clogged, stop the pump, immediately. Depressurize the system and remove the nozzle from the control gun or lance. Clean the nozzle if its orifice(s) appears clogged or partially blocked with dirt or debris. A blocked orifice can cause excessive system pressure. Replace the nozzle if the orifice is damaged.

REMOVE DAMAGED NOZZLES FROM SERVICE
Remove the nozzle from service if it is split or damaged or if the nozzle's sidewall is worn by more than 25% at any point.

Remove the nozzle if its ability to hold pressure is suspect.

HOSE SAFETY

CHECK PRESSURE RATING
High pressure hoses must have a burst rating that is no less than 2.5 times the pressure at which it will operate. For example, when operating at 10,000 psi (690 bar), the high pressure hose must have a minimum burst rating of 25,000 psi (1725 bar).

CHECK BURST RATING
Do not use a high pressure hose that has an unknown burst rating or manufacturer's operating pressure rating.

USE WHIP CHECKS
Use whip checks to restrain a hose in the event of a fitting or coupling failure.

HOSE CONNECTIONS
Use only the wrench flats when making threaded connections. Do not use the end fitting ferrule (collar) to make a connection.

PROTECT HOSES
Protect hoses from contact with sharp objects, abrasive surfaces and foot or wheel traffic.

STORE SAFELY
Disconnect, drain, coil, and store hose properly after each use.

ROUTE HOSES AWAY FROM WALKWAYS
Position and route hoses out of the way of walkways and areas where the hose can be a trip hazard.

FLEXIBLE LANCE SAFETY

CHECK PRESSURE RATING
Flex lances must have a burst rating no less than 2.25 times the pressure at which it will operate. For example, when operating at 10,000 psi (690 bar) the flex lances being used must have a burst rating of 22,500 psi (1,552 bar). (Some stainless steel lance material is less.)

CHECK BURST RATING
Do not use a flex lance that has an unknown burst pressure or unknown manufacturer's operating pressure.

CHECK LANCE CONDITION
Never use a lance which is kinked, worn, frayed, or whose ability to hold pressure is suspect.

CHECK LANCE CLEARANCE IN THE TUBE
Lance clearance within a tube must be great enough to permit unrestricted backflow of water and debris.

Before connecting a lance, check the operating clearance inside of the tube to be cleaned. For tubes containing hard deposits, the clearance in between the lance and the tube must be at least 0.125 in. (3.20 mm) on the diameter (0.063 in. (1.60 mm) per side). Allow additional clearance for tubes containing soft, pliable deposits. Insufficient clearance may cause the lance to blow back toward the operator.

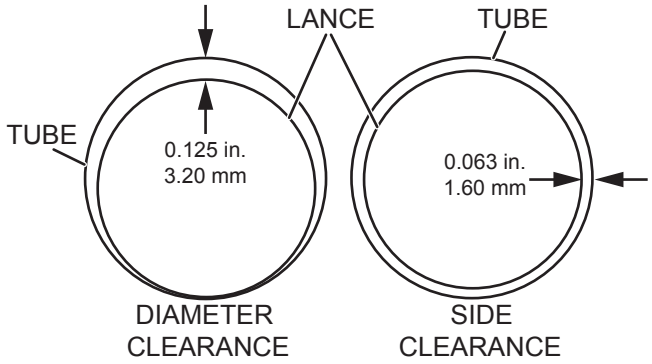


Fig. 8: Lance Clearance in Tube

⚠ WARNING

Insufficient tube clearance can cause a lance to be propelled out of the tube. Serious injury may occur if a lance with a pressurized nozzle exits a tube unexpectedly. Check for sufficient clearance before inserting a lance.

Use a lance safety grip and stinger for further protection from tube cleaning accidents.

USE SAFETY EQUIPMENT

Use the following Jetstream lance accessories for safer lance operation:

- Lance Strain Relief Hose (Fig. 9) – Helps prevent kinking of flex lances to extend service life and prevent failures.
- Lance Stinger (Fig. 10) - Gives the operator greater control of the nozzle. Stingers establish a “safety zone” so the operator knows when the nozzle is about to exit the tube. Stingers will also eliminate the possibility of nozzle and lance “double back” toward the operator when cleaning large diameter pipe if the stinger is at least 1.5 times the diameter of the pipe being cleaned.
- Safety Grip (Fig. 11) - Minimizes the risk of operator injury should a live nozzle exit a tube.
- Safety Shield (Fig. 12) - Attaches to the safety grip and deflects water spray from the operator.

Contact Jetstream for additional information regarding these products.

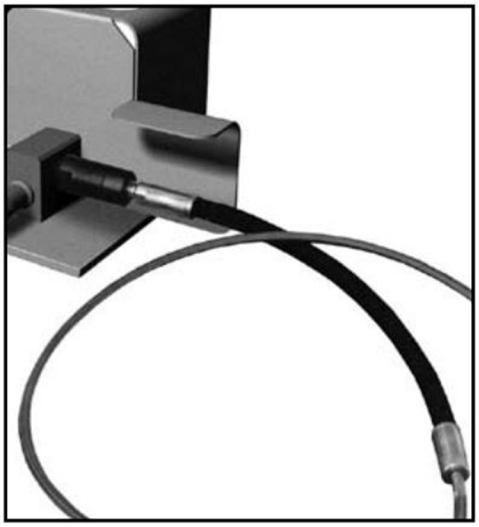


Fig. 9: Strain Relief Hose

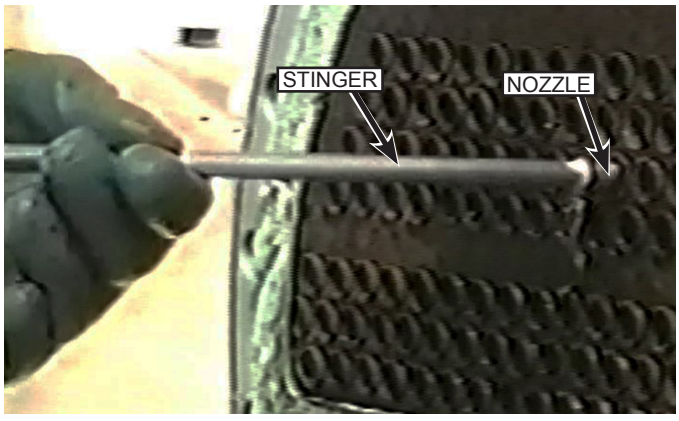


Fig. 10: Lance Stinger

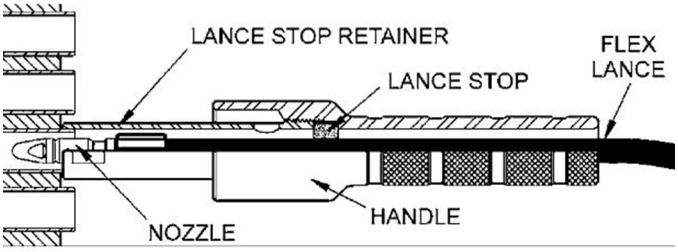


Fig. 11: Lance Safety Grip

Fig. 12: Lance Shield

CHECK NOZZLE

Use only nozzles designed for use with flex lances. Only nozzles drilled with sufficient rear facing orifices are suitable. These nozzles will pull the lance through the tube and wash debris out of the tube.

CONNECT NOZZLE

If a lance end fitting does not have wrench flats, use properly adjusted pipe wrenches to connect the lance to the pressure source and nozzle. Do not clamp the flexible hose surface in a vise when installing the nozzle.

HANDLING LANCES

Avoid rough handling, stretching, straining, or kinking of the lance. Improper handling can lead to lance failure.

PROPER LANCE USAGE

During operation, never force a lance through blockages.

LANCE REPAIR

Do not attempt to repair or install new fittings to a lance. Only Jetstream® is authorized to make repairs or install new fittings.

RIGID LANCE SAFETY

CHECK PRESSURE RATING

Rigid lances must have a burst rating no less than 3 times the pressure at which it will operate. For example, when operating at 10,000 psi (690 bar), rigid lances must have a burst rating of 30,000 psi (2,070 bar).

CHECK BURST RATING

Do not use a rigid lance that has an unknown burst pressure or unknown manufacturer's operating pressure.

CHECK LANCE CLEARANCE IN THE TUBE

Lance clearance within a tube must be great enough to permit unrestricted backflow of water and debris.

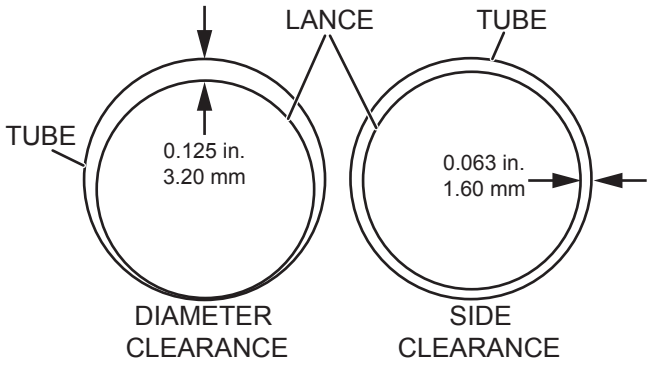


Fig. 13: Lance Clearance in Tube

Before connecting a lance, check the operating clearance inside of the tube to be cleaned. For tubes containing hard deposits, the clearance in between the lance and the tube must be at least 0.125 in. (3.20 mm) (0.063 in. (1.60 mm) per side). Allow additional clearance for tubes containing soft, pliable deposits. Insufficient clearance may cause the lance to blow back toward the operator. Measure at the largest diameter spot on the lance.

⚠ WARNING

Insufficient tube clearance can cause a lance to be propelled out of the tube. Serious injury may occur if a lance with a pressurized nozzle exits a tube unexpectedly. Check for sufficient clearance before inserting a lance.

Use a lance safety grip and stinger for further protection from tube cleaning accidents.

Using a limited number of rear facing orifices will help backwash debris out of the tube. This is helpful when lancing by hand.

CHECK THREAD SIZES

Ensure the nozzle, lance and adapter thread sizes are compatible before installing a nozzle and adapter on the lance.

CONNECTING A LANCE

Use caution when using a pipe wrench to connect lances. Pipe wrenches can cause deep scoring leading to weakened components.

SUPPORT THE LANCE

When using and moving the lance, support it in a manner to avoid stress and possible breakage at the inlet end connection.

USE TWO OPERATORS

A rigid lance over 4 ft. (1.2 m) long requires two operators for support and safe operation. The operator at the tube entrance must use a foot control gun in order to instantly relieve the system pressure in case of emergency.

The operator in control of the nozzle must also control the foot pedal.

PROPER LANCE USAGE

Do not force a lance through blockages. Forcing a lance can result in damage to the lance and danger to the operator.

PROTECT LANCES

Transport and store lances in tubes or racks to avoid bending or other damage. Remove lances that have bends, kinks, or excessive wrench scoring from service.

Protect alloy steel lances from corrosion by properly storing them.

HIGH PRESSURE FITTING SAFETY

USE PRESSURE SAFE FITTINGS

Use only fittings which are manufactured for high pressure waterblast use. Never use brass or cast iron fittings on high pressure systems.

CHECK BURST RATING

High pressure fittings must have a burst rating of no less than 3 times system operating pressure. For example, when operating at 10,000 psi (690 bar), fittings must have a burst rating of 30,000 psi (2,070 bar).

Do not use a high pressure fitting unless its burst rating or manufacturer's operating pressure rating is known.

DAMAGED AND CORRODED FITTINGS

Discard damaged or corroded fittings. Using damaged or corroded fittings may result in a burst fitting.

CONNECTING FITTINGS

Use wrench flats (when available) or a properly adjusted pipe wrench to tighten fittings. Use caution when using a pipe wrench. Pipe wrenches can cause deep scoring leading to weakened components.

FALL PROTECTION

Use fall protection devices such as harnesses and fall nets when blasting on scaffolding or sloped surfaces. Do not operate a hand held control gun while standing on slippery surfaces.

Follow all requirements for fall protection when working around mobile equipment. The Occupational Safety and Health Administration (OSHA) requirements apply to most workers. The following information is from OSHA 3146 1998 (revised). The full document can be obtained from www.osha.gov.

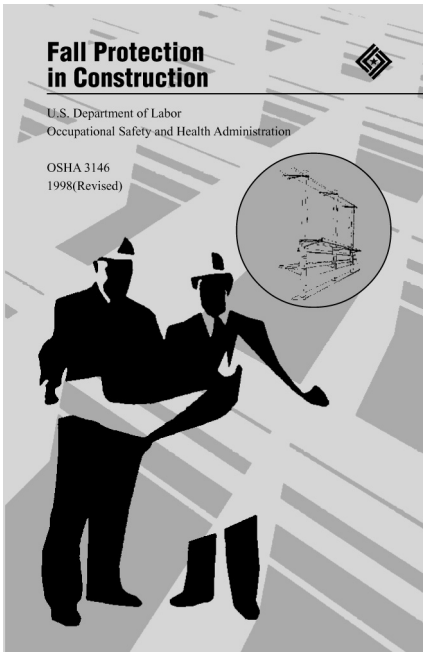
In the construction industry in the U.S., falls are the leading cause of worker fatalities. Each year, on average, between 150 and 200 workers are killed and more than 100,000 are injured as a result of falls at construction sites. OSHA recognizes that accidents involving falls are generally complex events frequently involving a variety of factors.

Consequently, the standard for fall protection deals with both the human and equipment-related issues in protecting workers from fall hazards. For example, employers and employees need to do the following:

- Where protection is required, select fall protection systems appropriate for given situations.
- Use proper construction and installation of safety systems.
- Supervise employees properly.
- Use safe work procedures.

NOTICE

Reference to OSHA regulations are for informational purposes only and not intended as legal advice.



CONFINED SPACES

Follow all requirements for working in confined spaces. All tanks and vessels that can be entered are to be considered permit-required confined space as defined by the Occupational Safety and Health Administration (OSHA). The following information is from OSHA 3138-01R 2004. The full document can be obtained from www.osha.gov.

Many workplaces contain spaces that are considered to be "confined" because their configurations hinder the activities of employees who must enter into, work in or exit from them. In many instances, employees who work in confined spaces also face increased risk of exposure to serious physical injury from hazards such as entrapment, engulfment and hazardous atmospheric conditions. Confinement itself may pose entrapment hazards and work in confined spaces may keep employees closer to hazards such as machinery components than they would be otherwise. For example, confinement, limited access and restricted airflow can result in hazardous conditions that would not normally arise in an open workplace.

The terms "permit-required confined space" and "permit space" refer to spaces that meet OSHA's definition of a "confined space" and contain health or safety hazards. For this reason, OSHA requires workers to have a permit to enter these spaces. Throughout this publication, the term "permit space" will be used to describe a "permit-required confined space."

By definition, a confined space:

- *Is large enough for an employee to enter fully and perform assigned work*
- *Is not designed for continuous occupancy by the employee*
- *Has a limited or restricted means of entry or exit*

These spaces may include underground vaults, bodies, storage bins, pits and diked areas, vessels, silos and other similar areas.

NOTICE

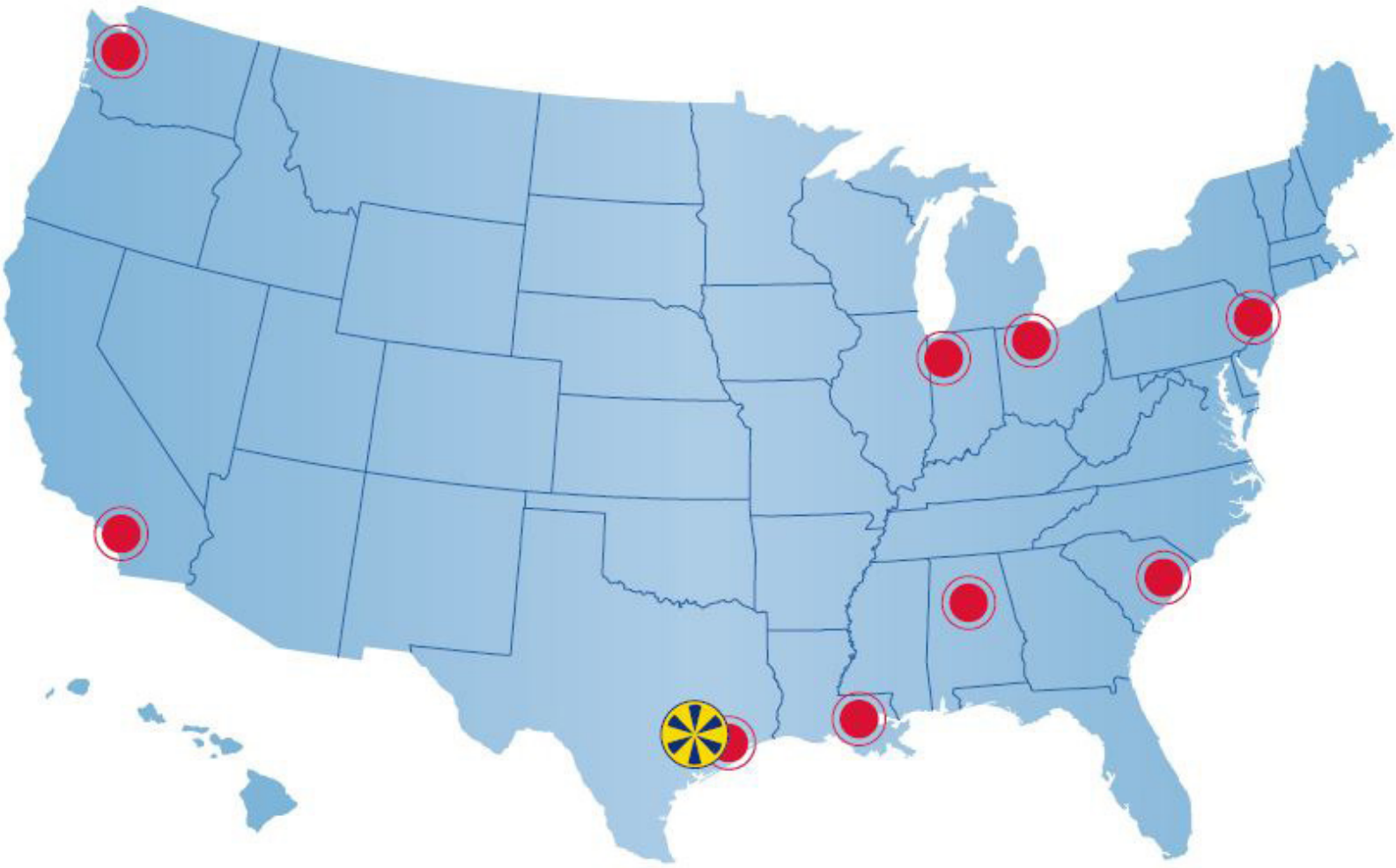
Reference to OSHA regulations are for informational purposes only and not intended as legal advice.

By definition, a permit-required confined space has one or more of these characteristics:

- *Contains or has the potential to contain a hazardous atmosphere;*
- *Contains a material with the potential to engulf someone who enters the space;*
- *Has an internal configuration that might cause an entrant to be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross section; and/or*
- *Contains any other recognized serious safety or health hazards.*

Note: High pressure waterblasting is a serious safety or health hazard.

NOTES



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