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Standard Practice for Pressure Water Cleaning and Cutting[1]

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1. Scope

1.1 This practice covers the personnel requirements, operator training, operating procedures, and recommended equipment performance/design for the proper operation of all types of pressure water-jet cleaning and cutting equipment as normally used by industries concerned with construction, maintenance, repair, cleaning, cutting, and demolition work.

1.2 The term high-pressure water jetting covers all water jetting, including the use of additives or abrasives at pressures above 100.5 psig (0.69 MPa).

1.3 Any person required to operate or maintain pressure water-jetting equipment shall have been trained and have demonstrated the ability and knowledge to do so in accordance with the original equipment manufacturer's instructions, specifications, and training programs.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values in parentheses are for information only.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* See Notes 1-8 and Sections 8 and 11 for specific hazards statements.

2. Referenced Documents

2.1 *ANSI/IEEE Standard:*[2]

957-1987 IEEE Guide for Cleaning Insulators

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *dump system*, *n*—the discharge orifice operator-controlled, manually operated device or system that reduces the pressure to a level that yields a pressure flow at the nozzle that is considerably below the risk threshold.

3.1.2 *guard*, *n*—should be so designed, constructed and used that it will:

(*a*) provide positive protection;
(*b*) prevent all access to the danger zone during operations;
(*c*) cause the operator no discomfort or inconvenience;
(*d*) not interfere unnecessarily with production;
(*e*) operate automatically or with minimum effort;
(*f*) be suitable for the job and the machine;
(*g*) preferably constitute a design, integral built-in feature;
(*h*) provide for machine oiling, inspection, adjustment and repair;
(*i*) withstand long use with minimum maintenance;
(*j*) be durable, fire- and corrosion-resistant;
(*k*) not constitute a hazard by themselves (without splinters, sharp corners, rough edges, or other sources of accidents); and
(*l*) protect against foreseeable use and foreseeable misuse of operational contingencies, not merely against normally expected hazards as determined from a job safety analysis

3.1.3 *high-pressure water cleaning*, *v*—the use of high-pressure water, with or without the addition of other liquids or solid particles, to remove unwanted matter from various surfaces, where the pressure of the liquid jet exceeds 100.5 psig (0.69 MPa) at the orifice.

NOTE 1—**Warning:** The limit of 100.5 psig (0.69 MPa) does not mean that pressures below 100.5 psig (0.69 MPa) cannot cause injury or require any less attention to the principles of this practice. Adequate precautions, similar to those of this practice, are required at all pressures.

3.1.4 *high-pressure water cutting*, *v*—the use of high-pressure water, with or without the addition of other liquids or solid particles, to penetrate into the surface of a material for the purpose of cutting that material, where the pressure of the liquid jet exceeds 100.5 psig (0.69 MPa) at the orifice.

3.1.5 *hose assembly*, *n*—a hose with safety coupling attached in accordance with manufacturer's specifications.

3.1.6 *lance*, *n*—a rigid metal tube used to extend the nozzle from the end of the hose.

3.1.7 *lancing*, *v*—an application whereby a lance and nozzle combination is inserted into, and retracted from, the interior of a pipe or tubular product.

3.1.8 *moleing*, *v*—an application whereby a hose fitted either with a nozzle or with a nozzle attached to a lance is inserted into, and retracted from, the interior of a tubular product. It is a system commonly intended for cleaning the

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[2] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

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internal surfaces of tubes, pipes, or drains. It can be self-propelled by its backward directed jets and is manufactured in various shapes, sizes, and combinations of forward- and backward-directed jets.

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

3.1.10 *operator*, *n*—a person who has been trained in accordance with the original manufacturer's instructional training program and has demonstrated the knowledge, experience, and ability to perform the assigned task.

3.1.11 *operator trainee*, *n*—a person not fully qualified due to the lack of sufficient knowledge or experience, or both, to perform the assigned task without supervision.

3.1.12 *pressure water jet system*, *n*—water delivery systems that have nozzles or other openings whose function is to increase the speed of liquids that may cause injury. Solid particles or additional chemicals may also be introduced, but the exit in all cases will be in a free stream. The system shall include the pumps (pressure-producing devices), hoses, lances, nozzles, valves, safety devices, and personal protective equipment, as well as any heating elements or injection systems, attached thereto.

3.1.13 *shotgunning*, *n*—an application whereby a lance or nozzle combination can be manipulated in virtually all planes of operation.

4. Significance and Use

4.1 This practice is intended to provide guidance on the proper operation of pressure water-jet cleaning and cutting equipment.

4.2 This practice is also applicable at lower pressures where there is foreseeable risk of injury.

4.3 This practice is provided to assist persons unfamiliar with the operation of water-jet cleaning and cutting equipment in learning to correctly use the equipment.

4.4 Correct operation and use of the pressure water-jet cleaning and cutting equipment is the responsibility of the operator and employer. After the operator has familiarized himself with the identification of pressure metal fittings, hoses, guns, and accessories in accordance with the original equipment manufacturer's specifications, instructions, and programmed instructional material, hydrojetting may begin. Modification of water-jetting equipment shall not be done without prior written approval by the manufacturer of the equipment. Employees shall be instructed in the recognition and avoidance of unsafe conditions.

NOTE 2—**Warning:** Serious harm or injury may result from the misuse of water-jetting equipment and the use of improper fittings, hoses, or attachments.

4.5 The use of pressure water-jet equipment for cutting and cleaning is a rapidly evolving technology. This practice will be periodically reviewed for any required changes at least every five years.

5. Apparatus

5.1 *Pressurizing Pump*—A unit designed to deliver pressure water or other fluid with or without chemicals or particle material. This is usually based on positive displacement pistons or rubber diaphragm/hydraulic systems and discharges water into a common manifold in which either flexible hoses or rigid tubing connect to lances and nozzles. These pumps can be either mobile or permanently mounted.

5.1.1 The pump shall have permanently mounted identification plates or tags which provide the following information:

5.1.1.1 Product and supplier,

5.1.1.2 Production model and serial number, or year of production,

5.1.1.3 Maximum performance, in terms of gallons per minute and pressure in pound-force per square inch, and

5.1.1.4 An outline of recommended safety procedures and warnings.

5.2 *Relief System*—The system shall be equipped with an automatic relief device on the discharge side of the pump and an auxiliary relief dump device as part of the pump.

5.3 *Relief System-Types*—These may take the form of the following:

5.3.1 *Pressure Relief Valve or Bursting Disk in Holder*—Usually mounted on the pump discharge chamber to prevent the pressure exceeding the rated maximum pressure of the whole system.

5.3.2 *Automatic Pressure Regulating Valve (Unloading Valve)*—Limits the pressure at which the pump operates by releasing a preset proportion of the generated flow back to the pump suction chamber or to waste. It may be used to regulate the water pressure from the pump and is individually set for each operation. This device may be integral with the pump hydraulic assembly. Where there is no demand for pumpage, the pressure is brought down to zero.

5.3.3 *Bypass Valve*—Limits the pressure at which the pump operates by releasing a preset proportion of the generated flow back to the pump suction chamber or to waste. It may be used to regulate the water pressure from the pump and is individually set for each operation. This device may be integral with the pump hydraulic assembly.

5.4 *Pressure Gage*—The system shall be equipped with a gage indicating the pressure being developed. Gages shall have a scale range of at least 50 % above the maximum working pressure of the system.

5.5 *Filter or Strainer*—The water system shall be equipped with a filter or strainer to prevent particles from restricting the orifices in the nozzle. The strainer or filter shall be capable of removing particles smaller in size than the smallest orifice in the nozzle and usually smaller to protect pumps and other components.

5.6 *Dry Shut-Off Control Valve*—This operator-controlled valve, normally hand-controlled, automatically shuts off flow to the lance or nozzle assembly, or both, when released by the operator but retains the operating pressure within the supply

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line when so shut off. This valve shall be used in systems with an automatic pressure regulating valve.

5.6.1 Release the pressure in the dry shut-off valve and line when the pump is shut down; otherwise, the valve operating lever may remain alive. This valve may alternatively be actuated by solenoid or pilot pressure mechanism.

5.7 *Dump System*—The system should be equipped with a device that will either shut down the unit, idle it to low revolutions per minute, bypass the flow, or reduce the discharge pressure to a low level. The dump system shall be manually controlled only by the nozzle orifice operator. The dump system actuator device should be shielded to preclude inadvertent operation. This device shall immediately shut off the pressure water stream if the operator loses control.

5.7.1 *Dump Control Valve*—An operator-controlled valve, normally hand-operated, that automatically terminates significant flow to the lance or nozzle assembly, or both, when released by the nozzle operator, thus relieving the operating pressure within the whole system by diverting the flow produced by the pump to atmosphere. A valve size should be selected that will not cause generation of significant back pressure at the maximum possible pumping rate of the pump. This valve may alternatively be actuated by a solenoid or a pilot pressure mechanism.

5.7.2 *Solenoid and Electrically Operated Control Dump Systems*—All electrically controlled dump systems should be of fail-safe design.

NOTE 3—**Warning:** Voltage of an alternatingcurrent (ac) or directcurrent (dc) dump system handled by personnel shall not exceed 24 V.

5.8 *High-Pressure Hose*—A flexible hose that connects two components and delivers the high-pressure fluid to the gun or nozzle components. The hose shall have a burst rating of a minimum of 2.5 times the maximum working pressure. Operating levels below this ratio should require a protective shielding around that hose. The hose shall be marked with the manufacturer's symbol, serial number, the maximum permissible operating pressure, and the test pressure. High-pressure hose shall be tested at 2.5 times working pressure in accordance with the original equipment operators' specifications, test methods instructions, and training programs.

5.9 *End Fittings and Couplings*—Pressure hose end fittings and safety couplings shall be manufactured to be compatible with the hose and tested as a unit.

5.10 *Jetting Gun Extension*—A length or lengths of tube carrying pressure fluid to the nozzle. Each shall be manufactured from material suitable to the application. End connections shall be suitable for the application. The extension is used in conjunction with a control valve. The extension shall have a minimum burst strength of at least 2.5 times the highest actual operating pressure used.

5.11 *Nozzle*—The nozzle creates the water jet or jets at the required velocity, flow rate, pressure, shape, and distribution for a particular application. Combinations of forward and backward direct water jets are often used to balance the thrust. Such nozzles may be referred to as tips, jets, or orifices.

NOTE 4—**Precaution:** Personal protective equipment and nozzle guard shall be provided.

5.12 *Water Jet*—A jet stream of water produced from the individual outlet orifice of a nozzle. The shape of the jet is determined by the form of the orifice, while the speed at which it travels is determined by the orifice design, orifice area, and flow. The pressure drop at the orifice is a result of an increase in velocity. The two most commonly used jet shapes are the straight-jet and fan-shaped jet.

5.12.1 *Straight Jet*—Concentrates the stream of water over a small area of the workpiece by minimizing the spread. A typical application is for cutting, or for general cleaning of matter with higher shear or bond strength, or both.

5.12.2 *Fan Jet*—Spreads the stream of water in one plane, thus giving a wide band coverage of the workpiece. A typical application is for cleaning larger areas requiring less energy to remove unwanted matter.

5.13 *Jetting Hand Manifold and Spray Bars*—These are pieces of equipment which individual nozzles are fitted for protection of the workmen.

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

NOTE 5—**Caution:** An adequate guard shall be fitted to prevent accidental operation, and the base plate should be sufficient to ensure stability in use. If of the dump type, the layout should ensure that the dump line used is restrained from whipping when the valve is released.

5.15 *Jetting Gun*—A portable combination of operator's control valve, lance, and nozzle resembling a gun in layout and assembly. The control valve is hand-operated by a squeeze-action dead-man-type trigger for the hand of the operator who should always have control of this device and may be of the dry shut-off or dump type, the gun being named accordingly. The hand-control normally takes the form of a trigger or lever that is provided with a guard adequate to prevent accidental operation and that shall have the means of being immobilized in the "off" position by means of a safety catch. The gun shall be fitted with a shoulder pad or hand grips to facilitate back-thrust control.

5.16 *Retro Gun*—A retro safety gun is fitted with forward- and backward-facing jets. This reduces the thrust experienced by the operator. This type of gun is used mainly for underwater jetting operations. The retro balance jet protection tube shall be sufficiently long or constructed so as to prevent the operator from directing a retro balance jet at himself.

5.17 *Changeover Valve*—An operator-controlled valve designed to properly direct pressure water flow from the pump to one or other items of equipment at the operator's choice. It shall be designed to withstand 2.5 times the maximum system pressure, and may be power-operated.

5.18 *Original Equipment Manufacturer (OEM)*—The original equipment manufacturer shall design the equipment based upon the foreseeable uses and misuses and design recognized hazards out of the equipment. Hazards that cannot be designed out shall be guarded and warned to protect and alert the operator. Warnings and instructions shall never be used as a substitute for the elimination of hazards or guarding.

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