

Australian/New Zealand Standard™

High pressure water jetting systems

Part 1: Safe operation and maintenance



AS/NZS 4233.1:2013

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee SF-043, High Pressure Water Safety. It was approved on behalf of the Council of Standards Australia on 11 October 2013 and on behalf of the Council of Standards New Zealand on 17 October 2013.

This Standard was published on 12 December 2013.

The following are represented on Committee SF-043:

Australasian High Pressure Water Jetting Association, Australia
Australasian High Pressure Water Jetting Association, New Zealand
Australian Chamber of Commerce and Industry
Australian Industry Group
Bureau of Steel Manufacturers of Australia
New Zealand Council of Trade Unions
Royal Australian Chemical Institute
Safe Work Australia
WorkCover New South Wales

Keeping Standards up-to-date

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at www.saiglobal.com.au or Standards New Zealand web site at www.standards.co.nz and looking up the relevant Standard in the on-line catalogue.

For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update options. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of either Standards Australia or Standards New Zealand at the address shown on the back cover.

This Standard was issued in draft form for comment as DR AS/NZS 4233.1.

Australian/New Zealand Standard™

High pressure water jetting systems

Part 1: Safe operation and maintenance

Originated as AS/NZS 4233(Int):1994.
Previous edition AS/NZS 4233.1:1999.
Second edition 2013.

COPYRIGHT

© Standards Australia Limited/Standards New Zealand

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Australia) or the Copyright Act 1994 (New Zealand).

Jointly published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001 and by Standards New Zealand, Private Bag 2439, Wellington 6140.

ISBN 978 1 74342 635 7

PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-043, High Pressure Water Safety, to supersede AS/NZS 4233.1:1999, *High pressure water (hydro) jetting systems, Part 1: Guidelines for safe operation and maintenance*.

The objective of the revision is to reflect current industry best practice and the technological advances since the publication of the previous edition. The revision broadly aligns with, but is not equivalent to EN 1829-1:2010, *High pressure water jet machines—Safety requirements, Part 1: Machines* and EN 1829-2:2008, *High-pressure water jet machines—Safety requirements, Part 2: Hoses, hose lines and connectors*.

The principal differences between this and the previous edition are as follows:

- (a) Changes in technology including personal protective equipment, electronic control systems and hold-to-active devices.
- (b) Machinery including remote and automated.
- (c) Training including new units of competencies for high pressure water jetting.
- (d) Systems of work including maximum reaction force and mechanically held devices.

Additionally, much of the informative text has been made normative.

This Standard is the first of a series of Standards applicable to high pressure water jetting.

This series comprises the following:

AS/NZS

- 4233 High pressure jetting systems
- 4233.1 Part 1: Safe operation and maintenance (this Standard)
- 4233.2 Part 2: Construction and performance

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

CONTENTS

	<i>Page</i>
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	5
1.2 OBJECTIVE	5
1.3 APPLICATION	5
1.4 GENERAL REQUIREMENTS.....	5
1.5 NORMATIVE REFERENCES	6
1.6 TERMS AND DEFINITIONS	7
SECTION 2 GENERAL REQUIREMENTS	
2.1 GENERAL.....	11
2.2 LIMITATION AND USE	11
2.3 SAFEGUARDS	11
SECTION 3 INSPECTION AND MAINTENANCE	
3.1 GENERAL.....	13
3.2 MAINTENANCE AND INSPECTION	13
3.3 SERVICING	15
3.4 REPAIRS.....	15
3.5 TOOLS	15
3.6 COMPATIBILITY.....	15
3.7 ELECTRICAL EQUIPMENT.....	15
3.8 MAINTENANCE RECORD.....	16
3.9 FROST PROTECTION.....	16
SECTION 4 PERSONAL PROTECTIVE EQUIPMENT	
4.1 GENERAL.....	17
4.2 HEAD PROTECTION	17
4.3 EYE AND FACE PROTECTION.....	17
4.4 BODY PROTECTION.....	17
4.5 HAND PROTECTION	17
4.6 FOOT AND LOWER LEG PROTECTION	18
4.7 HEARING PROTECTION	18
4.8 RESPIRATORY PROTECTION	18
SECTION 5 PRE-OPERATIONAL PROCEDURES	
5.1 PLANNING.....	19
5.2 CHECKLIST	19
5.3 SYSTEM CONTROL	19
5.4 WORK AREAS	19
5.5 SET-UP.....	20

SECTION 6 OPERATIONAL PROCEDURES

6.1	GENERAL.....	21
6.2	WORK AREAS	21
6.3	PERSONAL PROTECTIVE EQUIPMENT (PPE)	21
6.4	OPERATIONS.....	21
6.5	PRESSURIZING SYSTEMS	23
6.6	OPERATING PERSONNEL	23
6.7	HAND-HELD JETTING GUN OPERATIONS.....	25
6.8	LANCING, PIPE AND DRAIN CLEANING	25

SECTION 7 OPERATIONAL TRAINING

7.1	QUALIFIED OPERATORS	27
7.2	TRAINING CLASS A	27
7.3	TRAINING CLASS B	27
7.4	REFRESHER TRAINING	28

SECTION 8 PERMANENT CLEANING AREAS

8.1	GENERAL.....	29
8.2	ENCLOSURE.....	29
8.3	ACCESS	29
8.4	HAZARDS	29
8.5	ELECTRICAL HAZARDS.....	29
8.6	WASTE COLLECTION.....	29
8.7	DISPOSAL OF HAZARDOUS MATERIAL WASTE	29

SECTION 9 INCIDENT AND ACCIDENT REPORTING FOR COMMERCIAL AND INDUSTRIAL APPLICATIONS

9.1	REPORTING	30
9.2	PERSONAL INJURIES	30
9.3	MEDICAL REQUIREMENT	30
9.4	IMMEDIATE FIRST AID	30
9.5	MEDICAL ALERT CARD.....	30

APPENDICES

A	PRESSURE FLOW DIAGRAM	31
B	INSPECTION, CARE AND MAINTENANCE OF HOSE ASSEMBLIES	33
C	PRE-SERVICE AND OPERATIONAL CHECKLIST FOR HIGH PRESSURE WATER JETTING	35
D	HAND SIGNALS	37
E	INSPECTION AND TESTING OF HIGH PRESSURE WATER JETTING SYSTEM HOSE ASSEMBLIES	39

BIBLIOGRAPHY.....	42
-------------------	----

STANDARDS AUSTRALIA/STANDARDS NEW ZEALAND

Australian/New Zealand Standard High pressure water jetting systems

Part 1: Safe operation and maintenance

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard provides requirements and guidance for the operation and maintenance of water jetting equipment. It describes methods for eliminating hazards or minimizing risks associated with high pressure water jetting.

This Standard applies to high pressure water jetting systems with an output capability greater than 800 bar litres per minute and less than 5600 bar litres per minute (identified as Class A) and systems with an output capability in excess 5600 bar litres per minute (identified as Class B).

This Standard applies to:

- (a) High pressure water jetting systems pressurized by positive displacement pumps with an output capability greater than 800 bar litres per minute.
- (b) High pressure water jetting operations carried out at pressures above 800 bar litres per minute and includes jetting operations involving the use of additives and abrasives.
- (c) Water jetting operations below 800 bar litres per minute where there is a foreseeable risk of injury to operators.

NOTE: The guidance provided in this Standard may also be used for any water jetting operation.

1.2 OBJECTIVE

The objective of this Standard is to provide users of water jetting systems with requirements and guidance concerning safe operating practices to protect and safeguard equipment users and other persons who may be in the vicinity of high pressure water jetting operations.

1.3 APPLICATION

This Standard shall be read in conjunction with AS/NZS 4233.2.

1.4 GENERAL REQUIREMENTS

The following requirements shall be observed to protect persons against the harmful effects of hazards associated with water jetting:

- (a) Before commencing any water jetting operations, steps shall be taken to ensure that all hazards likely to affect the safety of persons operating equipment or working in the vicinity of water jetting operations are eliminated or minimized to as low as reasonably practicable.

These steps shall include—

- (i) identification;
 - (ii) risk assessment; and
 - (iii) risk control.
- (b) Processes shall be put into place to prevent or control the release of injurious or harmful substances or material into the working environment.
- NOTE: This may be achieved through the improved design of plant and equipment, buildings and work areas or by work procedures and controls which eliminate the need for persons to enter or remain within barricaded work areas when equipment is operating.
- (c) The requirements of this Clause (1.4) shall extend to persons and environments that are not directly concerned with the water jetting operations, e.g. persons who and the environment which may be exposed to toxic substances carried away from the work area in the form of airborne particulate, runoff and noise.
- (d) Where hazardous or toxic products are encountered appropriate measures shall be taken to ensure proper decontamination and disposal of these products.

1.5 NORMATIVE REFERENCES

The following are the normative documents referenced in this Standard:

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

AS

- 1319 Safety signs for the occupational environment
- 1742 Manual of uniform traffic control devices
- 1742.3 Part 3: Traffic control devices for works on roads
- 1885 Measurement of occupational health and safety performance
- 1885.1 Part 1: Describing and reporting occupational injuries and disease (known as the National Standard for workplace injury and disease recording)
- 1939 Degrees of protection provided by enclosures for electrical equipment (IP Code)
- 2865 Safe working in a confined space
- 60529 Degrees of protection provided by enclosures (IP Code)

AS/NZS

- 1270 Acoustics—Hearing protectors
- 1337 Eye protectors for industrial applications
- 1715 Selection, use and maintenance of respiratory protective devices
- 1801 Occupational protective helmets
- 1891 Industrial fall-arrest systems and devices
- 1891.1 Part 1: Safety belts and harnesses
- 1891.3 Part 3: Fall-arrest devices
- 2161 Occupational protective gloves
- 2161.2 Part 2: General requirements
- 2161.3 Part 3: Protection against mechanical risk
- 2161.5 Part 5: Protection against cold

AS/NZS

2210 Occupational protective footwear

2210.2 Part 2: Specification

4801 Occupational health and safety management systems—Specification with guidance for use

AS/NZS ISO

6529 Protective Clothing—Protection against chemicals

1.6 DEFINITIONS

For the purpose of this Standard, the terms and definitions below apply.

1.6.1 Anti-withdrawal device

A device that will stop a flexible lance from ejecting or being pulled from a tube or pipe during the lancing operation.

1.6.2 Automated or remote operations

Using equipment or tools that remove the operator from directly handling the device and away from the effective range of a jet of high pressure water.

1.6.3 Automatic unloading device/pressure-regulating device

A device or system that automatically controls operating flow and pressure. This may be achieved by opening a free flow path for the pump output when it senses the line to the nozzle is closed. It automatically adjusts the amount of water sent to the nozzle line, dependent on the pressure set by the operator and the capacity of the pump.

1.6.4 Bar litres per minute

A measure of the energy produced by a high pressure water jetting system expressed as a pressure, volume value per unit of time (see Appendix A).

1.6.5 Capable person (New Zealand)

A person assessed by the controller (e.g. owner or lessee) as being suitably qualified, adequately trained, and appropriately experienced in accordance with generally accepted industry practice for the class or kind of work in which the person is engaged. (For Australia, see definition of ‘competent person’.)

1.6.6 Class A systems

Pressure water jetting systems are identified as Class A systems when the maximum energy produced by the system, measured in pressure volume units per minute (i.e. bar litres per minute), falls in the range 800 bar litres per minute and 5600 bar litres per minute (see Appendix A).

1.6.7 Class B systems

High pressure water jetting systems are identified as Class B systems when the maximum energy produced by the system, measured in pressure volume units per minute (i.e. bar litres per minute), exceeds 5600 bar litres per minute (see Appendix A).

1.6.8 Competent person (Australia)

A person who has acquired through training, qualification or experience the knowledge and skills to carry out the task. (For New Zealand, see definition of ‘capable person’.)

1.6.9 Dry shut-off valve system

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

1.6.10 Dump valve system

An operator controlled system that opens a free flow path for the water (either to ground or recycled), thereby reducing the system pressure to a safe level without shutting off the flow to the nozzle.

1.6.11 Electrical or pneumatic control system

A control system that uses various servo-mechanisms to control the engine speed and pressure loading of the pump system. Typically uses a 'hold-to-activate' switch (e.g. a hand or foot control device) to bring the system up to present operating conditions. Enables operation without a shut-off or dump valve in the nozzle line.

1.6.12 Foot control device

A hold-to-activate device using a double action trigger that is controlled by the operators foot.

1.6.13 Hand-held jetting/surface preparation devices

A hand-held, hold-to-activate device that is manually controlled. These may be fixed or rotational, single or multi jet devices.

1.6.14 High pressure water jetting

A process that uses a stream of pressurized water to remove material, coatings or contamination and debris from the surface of a work piece or material substrate.

1.6.15 High pressure water jetting system

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

1.6.16 Hose assembly

A hose with couplings and connectors or end fittings attached in accordance with the hose and fitting manufacturer's recommendation.

1.6.17 Hose restraint

A device that is attached to the hose and is able to restrain, withstand and contain the energy created at the time of a hose or hose coupling failure.

1.6.18 Jetting gun

A hold-to-activate portable device using a double action trigger, activated by the operators hands with a handle lance and nozzle.

1.6.19 Lances

1.6.19.1 Flexible lance

A flexible hose used to feed a nozzle through pipes or tubes.

1.6.19.2 Rigid lance

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

1.6.20 Lancing (rigid or flexible)

A process whereby a lance and nozzle combination is inserted into, and retracted from, the interior of a pipe or tubular structure.

It may be self-propelled by its backward-directed jets, and may be manufactured in various shapes, sizes and combinations of rotating forward and backward-directed jets.

1.6.21 Manipulator

A mechanical device designed to remove the reaction force from the operator.

1.6.22 Nozzle

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

1.6.23 Operator

A person who has been trained and has demonstrated competence to perform a water jetting task without supervision.

1.6.24 Operator trainee

A person deemed not yet competent/capable to perform a water jetting task without supervision.

1.6.25 Pipe or tube cleaning

A process whereby a hose fitted either with a nozzle or a nozzle attached to a lance is inserted into, and retracted from, the interior of a tubular structure. It is a system commonly intended for cleaning the internal surfaces of pipes or drains.

1.6.26 Reaction force

The force created by the volume and pressure of the water as it leaves the nozzle. The force acts laterally in the opposite direction to the flow of the water. (Refer to manufacturer's specifications for further information on reaction force.)

1.6.27 Refresher training

Training conducted to maintain competency.

1.6.28 Retro gun

A gun fitted with forward and backward facing jets which reduce the thrust experienced by the operator in accordance with the manufacturer's specifications.

1.6.29 Safety observer

A member of the work crew assigned the following tasks:

- (a) Observing the jetting operations and barricaded area.
- (b) Shutting down the system in the event of an emergency or malfunction.
- (c) Controlling (or communicating to the controlling operator) the system pressure as requested by the jet operator.
- (d) Controlling the access of personnel into the barricaded area.

1.6.30 Shall

Indicates that a statement is mandatory.

1.6.31 Shotgunning

A process where a jetting gun is used to remove deposits out of the end of a pipe or tube. The gun is commonly fitted with a shrouded nozzle which is pushed firmly against the open end of the pipe or tube while the jet is operated in short bursts.

1.6.32 Should

Indicates a recommendation.

1.6.33 Shroud

An impervious cover able to withstand and sustain the maximum output pressure of the unit that is attached from pressure hose to the attachment or pump outlet to protect the operator from a jet of high pressure water if a failure occurs.

1.6.34 Starter bar

A rigid piece of pipe affixed to a nozzle that prevents reversing of the nozzle in the line.

1.6.35 System control

1.6.35.1 *Emergency stop (E stop)*

A latching emergency stopping device(s) fitted or remote to a water jetting unit or system that will stop the motive power and flow of high pressure water when activated.

1.6.35.2 *Flow control*

A system that shuts down the unit, idles it to a low revolutions per minute, bypasses the flow or reduces the discharge pressure to a low level.

1.6.35.3 *Stop control*

A manual system that will shut down the motive power of the high pressure water jetting systems. It is in the form of a stop button or switch that is in a readily accessible location/s at the pump unit.

1.6.36 Water jet

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

SECTION 2 GENERAL REQUIREMENTS

2.1 GENERAL

Persons operating jetting systems shall comply with the following requirements:

- (a) The various pieces of equipment shall only be used for their intended purpose in accordance with the manufacturer's instructions.
- (b) Attachments such as lances and lance extensions shall be fitted and used in accordance with the manufacturer's instructions and in a manner that will not adversely affect the safety features or the safe operation of the system.
- (c) Jetting equipment and its attachments shall not be modified without written approval from the manufacturer or a competent/capable person.
- (d) Modification of Class B equipment and the development of new systems incorporating Class B equipment shall only be undertaken by competent/capable persons with appropriate engineering skills and such developments or modifications shall be consistent with appropriate safety recommendation/s.

2.2 LIMITATION AND USE

A water jetting system shall not be used unless—

- (a) it has been inspected, serviced and 'fit for use' tested in accordance with the manufacturer's specifications; and
- (b) it is free from any fault identified at the last inspection or service that may adversely affect the performance and safe operation of the equipment.

NOTE: Section 3 provides requirements for the inspection, care and maintenance of jetting systems.

2.3 SAFEGUARDS

Persons using water jetting equipment shall comply with the following safeguards:

- (a) Where necessary all equipment in close proximity to the area where jetting is being performed shall be adequately shielded or protected from debris and ingress of water resulting from the operation of the jetting equipment.

NOTE: Any essential electrical installation should meet the required protection levels against the ingress of water fumes or overspray.

- (b) All persons other than the authorized personnel shall be excluded from barricaded areas.
- (c) Operators using manually operated systems shall ensure they are in a safe and well-balanced position before they commence the jetting operations.
- (d) Operators shall 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.
- (e) Jetting operations shall cease when—
 - (i) a change of conditions or introduced hazards become known or apparent;
 - (ii) unauthorized persons enter the barricaded area;
 - (iii) any required practices are violated; or
 - (iv) immediately a malfunction occurs.

- (f) Systems shall be depressurized, shut-down and secured, ensuring isolation of high pressure water flow, when—
 - (i) not in use and left unattended; or
 - (ii) replacement of components or repairs are being made to the system.
- (g) Repairs or maintenance shall be carried out by the manufacturer, their agent or competent/capable persons.

SECTION 3 INSPECTION AND MAINTENANCE

3.1 GENERAL

All components of high pressure water jetting systems shall be inspected, serviced and generally maintained in accordance with the manufacturer's specifications. Records shall be kept of service, repairs and maintenance.

Defects identified in the high pressure water jetting systems shall be reported to the supervisor so that the defect may be investigated and rectified. All defective equipment shall be tagged out of service and quarantined to prevent use.

3.2 MAINTENANCE AND INSPECTION

3.2.1 Pump unit

The pump unit shall be maintained in accordance with the manufacturer's specifications. This shall include the following prior to each task:

- (a) Drive unit—lubricating oil, radiator level (water/coolant), hydraulic fluid, shut-down systems, emergency stops, gauges and fuel levels.
- (b) Pump unit—lubricating oil, water filters, drive belts, gauges, gearbox oil levels.
- (c) Hydraulic hose reel—lubricating oil, fluid levels.
- (d) Condition of guards, shields and safety interlocks.
- (e) Electrical leads and connectors, pneumatic lines and connectors and wireless interface technologies.

3.2.2 Filters and strainers

All water filters shall be checked at regular intervals, dependent upon the water supply conditions, and in accordance with pump manufacturer's recommendations. Where this is not possible, suitable filtration and/or water treatment shall be employed to achieve manufacturer's specifications.

CAUTION: EXTREME CARE SHOULD BE TAKEN TO ENSURE THAT THE WATER IS CLEANED THROUGH FILTERS WHICH MEET THE PUMP MANUFACTURER'S RECOMMENDATION/S. FAILURE TO DO SO MAY CAUSE DESTRUCTION OF THE EQUIPMENT AND MALFUNCTION OF THE CONTROL MECHANISMS, POSSIBLY CAUSING SERIOUS ACCIDENTS.

3.2.3 Hose assemblies

3.2.3.1 *Hose inspection*

All hose assemblies shall be visually inspected prior to each use to ensure the following:

- (a) The correct pressure rating and size is selected.
Operators shall ensure the pressure rating of the hose assembly is adequate for the intended application.
- (b) There is no apparent structural damage, e.g. corroded or broken wires, bulging, kinking or cuts.
Where the hose assembly shows evidence of damage, steps shall be taken to determine its serviceability before use.