BS EN 1829-1:2021

BSI Standards Publication

High-pressure water jet machines — Safety requirements

Part 1: Machines

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National foreword

This British Standard is the UK implementation of EN 1829-1:2021. It supersedes BS EN 1829-1:2010, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/6, Pumps and pump testing.

A list of organizations represented on this committee can be obtained on request to its committee manager.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

This publication has been prepared under a mandate given to the European Standards Organizations by the European Commission and the European Free Trade Association and is intended to support essential requirements of the EU legislation detailed in the European foreword. Annex ZA/ZZ describes how the publication relates to the legislation.

For the Great Britain market (England, Scotland and Wales), if the UK Government has designated this publication for conformity with UKCA marking legislation and has not amended the essential requirements of that legislation, Annex ZA/ZZ and any references to EU law in the publication should be read in accordance with the designation as applying to UK legislation in the same way as to EU law. Further information on designated standards can be found at www.bsigroup.com/standardsandregulation.

For the Northern Ireland market, UK law will continue to implement relevant EU law subject to periodic confirmation. References to EU legislation are therefore still valid.

More information on legislation can be found at www.gov.uk.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 539 00478 6

ICS 43.180; 97.080

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2021.

Amendments/corrigenda issued since publication

Date	Text affected

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1829-1

January 2021

ICS 43.180; 97.080

Supersedes EN 1829-1:2010

English Version

High-pressure water jet machines - Safety requirements - Part 1: Machines

Machines à jet d'eau à haute pression - Exigences de sécurité - Partie 1 : Machines

Hochdruck-Wasserstrahlmaschinen - Sicherheitsanforderungen - Teil 1: Maschinen

This European Standard was approved by CEN on 9 November 2020.

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Ref. No. EN 1829-1:2021 E

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Contents

Page

European foreword ... 4
Introduction ... 5
1 Scope ... 6
2 Normative references ... 7
3 Terms and definitions ... 8
4 Safety requirements and/or measures ... 11
4.1 General ... 11
4.2 Requirements for high pressure water jet machine with intended exit of water under high pressure ... 12
4.2.1 Replacement inserts ... 12
4.2.2 Safety devices to prevent excessive pressure ... 12
4.2.3 Pressure indicator ... 13
4.3 Mechanical requirements ... 13
4.3.1 Common requirements ... 13
4.3.2 Spraying devices ... 13
4.3.3 High pressure lines ... 15
4.3.4 Requirements for mobile machines ... 15
4.4 Requirements for transport ... 15
4.5 Electrical requirements ... 15
4.6 Requirements for emergency stopping ... 15
4.7 Thermal requirements ... 16
4.8 Noise reduction ... 16
4.8.1 Noise reduction at source by design ... 16
4.8.2 Noise reduction by protective measures ... 17
4.9 Requirements for vibration with hand-held spraying devices ... 17
4.10 Requirements for program controlled water jet machines ... 17
4.11 Marking the control devices ... 17
5 Verification of the safety requirements and/or measures ... 17
5.1 General ... 17
5.2 Hydrostatic pressure test ... 18
5.2.1 General ... 18
5.2.2 Testing of safety devices for preventing excessive pressure ... 18
5.2.3 Pressure indicator ... 18
5.2.4 Hydrostatic pressure test of spraying devices ... 18
5.3 Mechanical tests and/or visual inspection ... 18
5.3.1 General ... 18
5.3.2 Testing the stability of the high pressure water jet machine ... 19
5.4 Transport devices ... 19
5.5 Electrical tests ... 19
5.6 Testing of emergency stopping ... 19
5.7 Thermal tests ... 19
5.8 Vibration measurement ... 19
5.9 Testing of program controlled high pressure water jet machines ... 19
5.10 Verification of markings ... 19

Documents
Document Sharing Hub
Full document details: BS EN 1829-1:2021

6 Information for use 20
6.1 General 20
6.2 Marking and Warnings 22
6.2.1 General 22
6.2.2 Marking of the machine unit 22
6.2.3 Marking the safety devices 23
6.2.4 Marking the spraying devices 23
6.2.5 Marking of pipelines 24
6.3 Additional warnings 24
Annex A (normative) Emission of vibration 26
Annex B (informative) Vibration report 39
Annex C (informative) Routine tests 41
Annex D (informative) List of significant hazards 42
Annex ZA (informative) Relationship between this European Standard and the essential requirements of Directive 2006/42/EC aimed to be covered 44
Bibliography 46

Documents
Document Sharing Hub

Full document details: BS EN 1829-1:2021

European foreword

This document (EN 1829-1:2021) has been prepared by Technical Committee CEN/TC 197 “Pumps”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2021, and conflicting national standards shall be withdrawn at the latest by July 2021.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1829-1:2010.

The main changes compared with the previous edition are as follows:

— general revision according to the state of the art;

— revision of the vibration test code requirements;

— deletion of previous normative Annex A on noise test code, which has been replaced by normative annex on emission of vibration;

— addition of informative Annex B on vibration report and informative Annex C on routine testing;

— clarification of hydrostatic pressure testing;

— transfer of Clause 4 on the list of significant hazards to informative Annex D;

— update of Annex ZA in relation to Directive 2006/42/EC.

EN 1829, *High-pressure water jet machines — Safety requirements*, consists of the following parts:

— Part 1*: Machines*

— Part 2*: Hoses, hose lines and connectors*

This document has been prepared under a standardization request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of Directive 2006/42/EC.

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this document.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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Introduction

This document is a type-C standard as stated in EN ISO 12100:2010. This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document. The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the scope of this document. When requirements of this type-C standard are different from those which are stated in type-A or type-B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

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1 Scope

This document contains safety-related requirements for high pressure water jet machines with drives of all kinds (e.g. electric motor, internal combustion engine, air and hydraulic) in which pumps are used to generate pressure. This document deals with all significant hazards, hazardous situations and events arising during assembly, erection, operation and servicing relevant to high pressure water jet machines, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Annex ZA). All references to high pressure water jet machines within this document includes machines for one or more of the following industrial applications:

— cleaning;

— surface preparation;

— material removal;

— readjustment of concrete;

— cutting.

NOTE 1 List of significant hazards is given in informative Annex D.

This document applies to mobile and fixed high pressure water jet machines, in which the water pressure is generated by a pressure generator/pump and in which the maximum allowable working pressure is more than the upper limit fixed in the scope of EN 60335-2-79:2012.

NOTE 2 35 MPa is currently the upper limit for machines covered by EN 60335-2–79:2012.

This document does not cover:

— requirements of the Pressure Equipment Directive 2014/68/EU;

NOTE 3 In some cases, specific parts can be in the scope of that directive, but their application is not dealt with in this document.

— high pressure cleaners which are dealt with in EN 60335-2-54:2008, EN 60335-2-54:2008/A11:2012, EN 60335-2-54:2008/A11:2012/AC:2015, EN 60335-2-54:2008/A1:2015 and EN 60335-2-79:2012;

NOTE 4 EN 60335-2–54:2008, EN 60335-2–54:2008/A11:2012, EN 60335-2–54:2008/A11:2012/AC:2015 and EN 60335-2–54:2008A1:2015 applies to steam cleaners for household use. EN 60335-2–79:2012 applies to high pressure cleaners having a rated pressure not less than 2,5 MPa and not exceeding 35 MPa, as well as steam cleaners and those parts of hot water high pressure cleaners incorporating a steam stage which have a capacity not exceeding 100 l, a rated pressure not exceeding 2,5 MPa and a product of capacity and rated pressure not exceeding 5 MPa.

— additional hazards due to the incorporation of high pressure water jet machines into other process-technology machines;

— specific hazards associated with explosive atmospheres, use on ships or ambient temperatures outside the range 5 °C to 40 °C;

— hazard due to the nature of liquids used for jetting, other than that due to pressure;

— hazards associated with the drives or specific hazards due to any heat generation function. However, the hazards due to high temperatures of touchable surfaces are dealt with;

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— high pressure water jet machines which are manufactured before the date of its publication as EN;

— hazards due to noise for what concerns the declaration of noise emission values in the instructions.

NOTE 5 Noise emission measurement and noise declaration will be dealt with in an upcoming amendment to this document.

Tests according to this document are type tests unless they relate to routine (informative) tests to be carried out during series manufacture.

NOTE 6 Routine tests are described in informative Annex C.

Compliance with EN 1829-1 and EN 1829-2 provides the full requirements for high pressure water jet machines.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 614-1:2006+A1:2009, *Safety of machinery — Ergonomic design principles — Part 1: Terminology and general principles*

EN 809:1998+A1:2009, *Pumps and pump units for liquids — Common safety requirements*

EN 809:1998+A1:2009/AC:2010, *Pumps and pump units for liquids — Common safety requirements*

EN 981:1996+A1:2008, *Safety of machinery — System of auditory and visual danger and information signals*

EN 1829-2:2008, *High-pressure water jet machines — Safety requirements — Part 2: Hoses, hose lines and connectors*

EN 12096:1997, *Mechanical vibration — Declaration and verification of vibration emission values*

EN 12162:2001+A1:2009, *Liquid pumps — Safety requirements — Procedure for hydrostatic testing*

EN 60204-1:2018, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

EN 60335-2-79:2012, *Household and similar electrical appliances — Safety — Part 2-79: Particular requirements for high pressure cleaners and steam cleaners IEC 60335-2-79:2012)*

EN 60529:1991, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)*

EN 60529:1991/AC:2016-12, *Degrees of protection provided by enclosures (IP code) (IEC 529:1989)*

EN 60529:1991/A1:2000, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989/A1:1999)*

EN 60529:1991/A2:2013, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989/A2:2013)*

EN 60529:1991/A2:2013/AC:2019-02, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989/A2:2013/Cor1:2019)*

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EN ISO 5349-1:2001, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 1: General requirements (ISO 5349-1:2001)*

EN ISO 7010:2020, *Graphical symbols — Safety colours and safety signs — Registered safety signs (ISO 7010:2019)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13732-1:2008, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2015)*

EN ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2019)*

EN ISO 17769-1:2012, *Liquid pumps and installation — General terms, definitions, quantities, letter symbols and units — Part 1: Liquid pumps (ISO 17769-1:2012)*

EN ISO 20643:2008, *Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission (ISO 20643:2005)*

EN ISO 20643:2008/A1:2012, *Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission Amendment 1: Accelerometer positions (ISO 20643:2005/Amd 1:2012)*

IEC 62745:2017, *Safety of machinery — Requirements for cableless control systems of machinery*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010, EN ISO 17769-1:2012 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
high pressure water jet machine
machine with nozzle or other variable opening which allows water at high pressure together with any additive (chemical and/or abrasive) to emerge as a free jet

Note 1 to entry: In general, high pressure water jet machines consist of a drive, a pressure generator, pipelines, hose lines, spraying devices, safety devices, control and measurement devices.

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3.2
program controlled high pressure water jet machine
machine characterised by spatial separation of the installation site of the pressure generator and the workplace, by permanently installed high pressure lines between the installation site and one or more workplaces having spraying devices incorporating start-up/shut-down of the system by means of external switching mechanisms not activated by the operator of a spraying device

Note 1 to entry: In this context, the activation device of the spraying device is not considered to be a switching mechanism.

3.3
drive
power unit consisting of electric motors, combustion engines, hydraulic motors, or air motors depending on the application

3.4
pressure generator
unit to generate operating pressure and supply cleaning agent to the spraying device (e.g. pump, intensifier)

3.5
high pressure line
pipeline or hose line in which the high pressure water is fed to the point of use

3.6
pipeline
pipe which is permanently fixed and operationally connected to pipe fittings or valves

3.7
hose
flexible, tubular semi-finished product consisting of several layers and inserts

Note 1 to entry: Hoses and hose lines are covered within EN 1829-2:2008.

3.8
hose line
hose mounted with appropriate fittings

Note 1 to entry: Hoses and hose lines are covered within EN 1829-2:2008.

3.9
spraying device

3.9.1
general
spraying device consisting of the activation devices, the spraying pipe, extension pipe or nozzle pipe as well as the nozzle

Note 1 to entry: This also includes foot switches, foot valves with hose lines and spraying lances, spraying heads and nozzle mounts.

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3.9.2
hand-held spraying device
spraying device of which the recoil force is to be absorbed by the person activating the spraying device

Note 1 to entry: The activation mechanism can be separated from the spraying device for operating reasons in the form of a foot switch (e.g. for spraying lances).

3.9.3
mechanically operated spraying device
spraying device of which the recoil force is absorbed by a mechanical restraint

3.10
activation device

3.10.1
dry shut-off device
device for hand-held spraying devices by which the feed of liquid to the high pressure nozzle is actuated by opening or shutting a valve

Note 1 to entry: When shut no liquid exits the nozzle.

3.10.2
dump device
device for hand-held spraying devices where by opening or shutting of a valve the feed of liquid is directed to a bypass pipe by which the generated pressure is limited by the means of the larger bypass nozzle while the pipe to the high pressure nozzle is kept open

3.10.3
dump gun
hand-held spraying device in which the dump device is incorporated

3.11
safety device
device that automatically prevents any relevant critical parameter such as pressure or temperature being exceeded

3.12
maximum allowable working pressure
pressure without consideration of the pressure peaks in the system up to which the machine is functional and at which the machine may safely be run

3.13
operating temperature of the liquid
temperature of the liquid at any specified point

3.14
retooling
modification of the machines performance by using alternative components (e.g. replacement inserts and alternative nozzles)

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Full document details: BS EN 1829-1:2021

3.15
replacement inserts
changeable installation to a pressure generator, with pistons/plungers/seals/safety valves for different diameters resulting in different displacements and pressures

3.16
pulsation damper
device to diminish the amplitude of pressure pulsations

3.17
test pressure
gauge pressure to which a part, component or pump is subjected for the purpose of strength or leak testing

3.18
cleaning agent
water with or without the addition of gaseous, soluble or miscible detergent or solid abrasive

3.19
two hand device
device requiring at least simultaneous operation by both hands in order to activate and use the high-pressure operation of the machine

3.20
safety pressure
pressure at which the safety device of the system must activate

3.21
normal operation
conditions under which the machine is operated in normal use. It denotes the operation at which the drive is set at maximum power, the pressure is set at the maximum allowable working pressure, with the appropriate nozzle and hose line fitted

Note 1 to entry: All strainers and filters are in a clean operating condition, if applicable. The water heater, if fitted, is operated at maximum power.

4 Safety requirements and/or measures

4.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause.

Pumps and pump units shall conform to EN 809:1998+A1:2009, EN 809:1998+A1:2009/AC:2010.

If fixed guards are used, their fixing systems shall remain attached to the guards or to the machinery when the guards are removed.

In addition, the machine shall be designed according to the principles of EN ISO 12100 for relevant but not significant hazards which are not dealt with by this document.

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4.2 Requirements for high pressure water jet machine with intended exit of water under high pressure

4.2.1 Replacement inserts

For pressure generators/pumps with replacement inserts, provisions shall be made to indicate the mounted status in a clearly visible position.

4.2.2 Safety devices to prevent excessive pressure

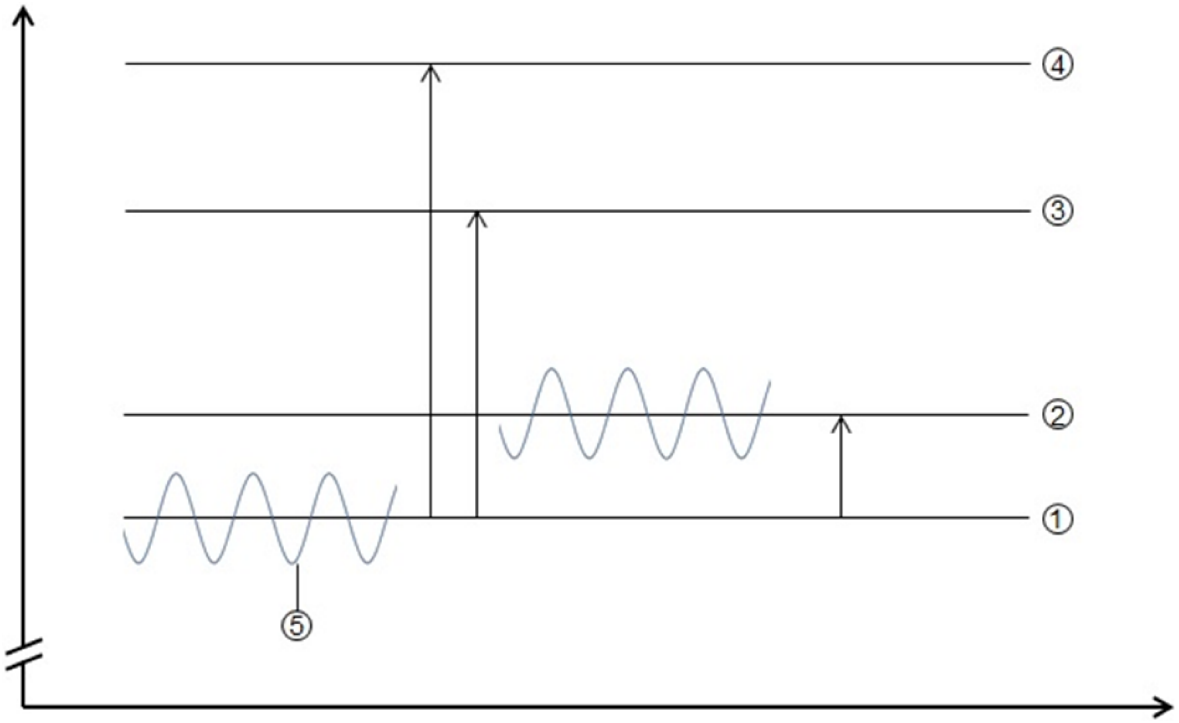
The machine shall have a safety device which prevents the maximum allowable working pressure from being exceeded by more than 15 % or in the case of machines with pulsation dampers by more than 10 %. It shall not be possible to switch off this safety device and it shall be designed and positioned in such a way that it cannot be made inoperative.

The adjustment of the safety device shall be secured such that unauthorised changes are deterred by means such as a seal or tamperproof device.

Safety devices shall be designed and positioned in such a way that persons cannot be injured by escaping water or by broken pieces.

Water which passes through a safety device has to be discharged in a save way, for instance by the use of a by-pass-system, a catch basin or a discharging hose.

NOTE Figure 1 shows an overview of the different pressures and their relation to each other.



Key

(1) maximum allowable working pressure (see 3.12)
(2) shown safety pressure (see 3.20) at the high pressure water jet machine gauge (see 4.2.2)
(3) hydrostatic test pressure (see 4.3.1)
(4) hydrostatic test pressure of the spraying device (see 5.2.4)
(5) typical pressure pulsation inherent to high pressure water jet machines

Figure 1 — Pressure overview

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Full document details: BS EN 1829-1:2021

4.2.3 Pressure indicator

The machine shall have a pressure indicator which displays the actual operating pressure of the liquid at the outlet of the pressure generator in megapascals (MPa) [preferred] or bars (bar). The display shall be readily visible to an operator when setting up the machine and the maximum allowable working pressure shall be marked.

A pressure indicator may be an analogous pressure gauge or an electronic pressure sensor.

The pressure indicator shall be designed and positioned in such a way that, in case of leakage, persons cannot be injured by the escaping water or by broken pieces.

The pressure indicating device selected shall comply at least with an accuracy class of 2,5.

4.3 Mechanical requirements

4.3.1 Common requirements

All parts of the pressure system shall be designed to withstand the maximum allowable working pressure specified by the manufacturer. The test pressure shall be related by a factor to the maximum allowable working pressure which is given in the manufacturer's specification. In no case shall this factor be less than 1,3.

4.3.2 Spraying devices

4.3.2.1 Common requirements for spraying devices

Spraying devices shall be able to withstand the impact and shock stresses which can be expected during normal operation without displaying any leakage or limitation of the intended function.

The activation mechanism shall be protected against unintended activation (e.g. by a guard).

4.3.2.2 Hand-held spraying devices

When the activation mechanism is released, one of the following shall occur:

a) no more liquid shall emerge from the nozzle (dry shut-off);

b) any liquid emerging from the spraying device shall generate a reaction force no greater than the weight of the spraying device;

c) the pressure generator shall be switched off. The safety related parts of the control system shall present a performance level of at least "c", defined in accordance with EN ISO 13849-1:2015.

The release of the activation mechanism shall not be impaired or made impossible by recoil effects during shutting-off. The holding force that has to be exerted manually on the activation mechanism of the spraying device to maintain spraying shall not exceed 60 N for the whole hand.

The activation mechanism shall be lockable in the OFF-position. This can be achieved e.g. by a knob, hand lever or switch. There shall be no provision to lock the activation mechanism in the ON-position.

The recoil forces exerted on the spraying device shall not exceed 250 N in the longitudinal direction. The recoil forces shall not be released within a period shorter than 1 s to allow time for the operator to react.

When several spraying devices are connected to the same pressure generator, the recoil forces exerted on the other spraying devices shall not change abruptly by more than 15 % at any time that an operating element of another spraying device is activated.

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