



JRC TECHNICAL REPORTS

Preparatory study of Ecodesign and Energy Labelling implementing measures for High Pressure Cleaners

*Task 1 - Scope
First draft*

Rodríguez-Quintero, R. (JRC)
Bennett, M.J. (JRC)
Paraskevas, D. (JRC)
Rizzo, M. (VM)
Viegand, J. (VM)
Sweeney, K. (Intertek)
Rhodes, P. (Intertek)

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Table of Acronyms

MEErP	Methodology for Ecodesign of Energy-related Products
NACE	Nomenclature used in the European Union
HPC	High pressure cleaner
IECEE CB	International Electrotechnical Commission Electrical Engineering Certification Body
EN	European Norm
ISO	International Standardization for Organisation
IEC	International Electrotechnical Commission
EMC	Electromagnetic compatibility standards
ANSI	American National Standards Institute
CPC	Cleaning Performance Program
LCA	Life Cycle Assessment
LCC	Life Cycle Cost

Introduction

Background

The European Commission has launched a preparatory study of Ecodesign and Energy Labelling implementing measures for High Pressure Cleaners (HPC).

The current report covers Task 1 of the Methodology for Ecodesign of Energy-related Products (MEErP)¹ used for this preparatory study. The methodology consists of seven well-defined tasks, where Tasks 1 to 4 have a clear focus on data retrieval and initial analysis, and Tasks 5 to 7 have a clear focus on modelling and modelling analyses aiming at providing sufficient background for deciding whether and which potential Ecodesign and Energy Labelling requirements should be set for the product group. Figure 1 presents an overview of all MEErP tasks which will be followed in the HPC preparatory study.

- **Task 1** – *Scope definition, standard methods and legislation*
- **Task 2** – *Market analysis*
- **Task 3** – *Analysis of user behaviour and system aspects*
- **Task 4** – *Analysis of technologies*
- **Task 5** – *Environmental and economic assessment of base cases*
- **Task 6** – *Assessment of design options*
- **Task 7** – *Assessment of policy options*

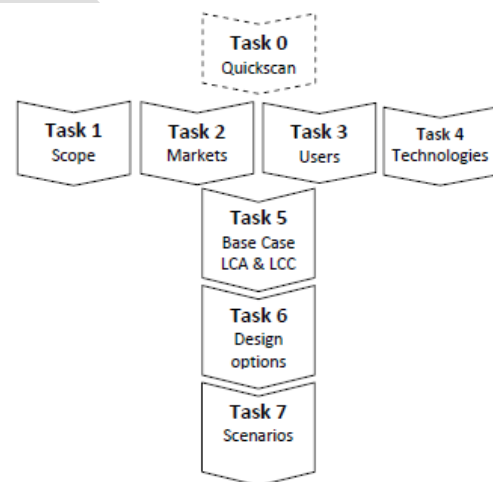


Figure 1: MEErP¹ structure

The research is based on available scientific information and data provided by stakeholders and experts, following a life-cycle thinking approach and engaging stakeholder experts in order to discuss key issues and to develop wide consensus.

Stakeholder consultation throughout the study

During the preparatory study, continuous stakeholder consultation will take place. An online communication system - BATIS - has been set-up for easy exchange of documents between registered stakeholders forming the Technical Working Group (TWG).

Questionnaires for gathering information on scope, definitions, and issues of relevance, as well as templates for the collection of relevant data, e.g., regarding energy and water consumption values, the definition of base cases and design options, and the discussion on policy options will be distributed to the TWG during the study process. Further, the project team will visit different manufacturers, test laboratories, recyclers and relevant

¹ "Methodology for Ecodesign of Energy-related Products. MEErP 2011. Methodology Report. Part 1: Methods". Prepared for the European Commission, DG Enterprise and Industry by COWI and VHK (2011) and Material-efficiency Ecodesign Report and Module to the Methodology for the Ecodesign of Energy-related Products (MEErP) (2013)

trade fairs to investigate the overall product group, and product sub-groups in detail, and to be completely up-to-date with the latest technical and market developments.

The present report will be discussed at the stakeholder kick-off meeting planned to be held in Brussels on 3rd May 2018.

1. Task 1: Scope, legislation and standardisation

Task 1 comprises the identification of the scope (categories, subcategories etc.), definitions, system boundaries, test standards and existing regulation, both within the EU and internationally. Its results consist of a preliminary scope definition, with a special focus on the products' performance, in combination with energy and resource efficiency of HPC during their use phase. Other Life Cycle and product aspects such as production, maintenance, durability, reparability, recyclability and product End of Life (EoL) treatment are also considered.

1.1 Product scope

The following sections first provide an analysis of existing definitions of High Pressure Cleaners, as used for example in European statistics, EU legislation, and standards. The product scope is based also on the preliminary stakeholder feedback regarding the initially proposed scope and definitions. Based on this information and further research and evidence, a preliminary product scope is presented as a basis for discussion at the 1st stakeholder meeting that will be held 3rd of May, Brussels, Belgium.

1.1.1 Existing definitions and categories

This section describes existing definitions, categories and sub-categories based, inter alia, on Eurostat PRODCOM categories, standards and labelling categories.

1.1.1.1 PRODCOM categories

The PRODCOM database is the official source of production and sales of products in the EU according to the MEErP methodology.

Since 2008 the PRODCOM database nomenclature has been NACE Rev. 2.0², which means that the data registered for high pressure cleaners is part of the category "28.29.22.30 – Steam or sand blasting machines and similar jet-projecting machines (excluding fire extinguishers, spray guns and similar appliances)". However, this category also includes products other than HPCs for various purposes, including specialised industrial applications. As such, the category is considered as not totally representative for the HPC market.

Table 1 lists the nomenclature headings corresponding to the products relevant for this study. However, the PRODCOM database does not have quantified data per subcategory, which means that the data cannot be disaggregated. Thus, additional market data and estimations are needed.

² <http://ec.europa.eu/eurostat/web/prodcom/data/database>

Table 1: Product subcategories used in the PRODCOM database

PRODCOM nomenclature	Description
84.24.30.01	Water cleaning appliances with built-in motor, with heating device
84.24.30.05	Water cleaning appliances with built-in motor, without heating device, of an engine power $\leq 7,5$ kW
84.24.30.09	Water cleaning appliances with built-in motor, without heating device, of an engine power $\geq 7,5$ kW
84.24.30.10	Steam or sand blasting machines and similar jet projecting machines, compressed air operated
84.24.30.90	Steam or sand blasting machines and similar jet projecting machines (excl. compressed air operated and water cleaning appliances with built-in motor and appliances for cleaning special containers)

1.1.1.2 Existing categories from standards, Ecodesign or Energy labelling

For scoping, there are two relevant European standards which cover HPCs. These standards primarily focus on safety, and performance considerations are largely limited to noise evaluation. However, the terminology and parameters defined within the standards are still relevant for the work and have been used throughout this report.

The first standard covers high pressure cleaners with a rated pressure not less than 2.5 MPa and not exceeding 35 MPa: EN 60335-2-79 "Household and similar electrical appliances - Safety - Part 2-79: Particular requirements for high pressure cleaners and steam cleaners" (2016). It does not define specific categories for HPCs. However, it covers HPCs without a traction drive, intended for household and commercial indoor or outdoor use, having a rated pressure not less than 2.5 MPa and not exceeding 35 MPa. Hot water high pressure cleaners may incorporate a steam stage.

EN 60335-2-79 covers the following power systems of the drive for the pump in the high pressure cleaners:

- mains powered motors up to a rated voltage of 250 V for single-phase machines and 480 V for other machines;
- battery powered motors;
- internal combustion engines;
- hydraulic motors;
- pneumatic motors;

The above standard does not apply to:

- high pressure water jet machines having a rated pressure exceeding 35 MPa;
- steam cleaners intended for domestic use;
- hand-held and transportable motor-operated electric tools;
- appliances for medical purposes;
- agricultural sprayers;

- non-liquid, solid abrasive cleaners;
- machines designed to be part of a production process;
- machines designed for use in corrosive or explosive environments (dust, vapour or gas) or
- machines designed for use in vehicles or on board of ships or aircraft.

The second relevant European standard covers all high pressure cleaners with a water pressure above 35 MPa: EN 1829-1 High pressure water jet machines - Safety requirements - Part 1 (2010)

The Standard 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. Standard EN 1829-1 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. The standard includes machines for one or more of the following industrial applications:

- Cleaning
- Surface preparation
- Material removal
- Readjustment of concrete
- Cutting

In standard EN 1829-1 there is no formal definition of a minimum cutting pressure (and therefore a maximum cleaning pressure), since this depends upon the material to be cut.

The high pressure cleaner product category is not covered by current EU Ecodesign criteria, nor is it covered by current EU Energy Labelling criteria. However, it should be noted that water pumps and electric motors used as components in high pressure cleaners are already subject to Ecodesign implementing measures (please see further detail in Section 1.3 dealing with legislation).

1.1.2 Feedback from stakeholders with regard to the initial scope and definitions

The project team distributed a questionnaire in January 2018. To date 8 stakeholders have submitted their feedback on "Task 1: Scope" via this questionnaire. These stakeholders comprise: 2 trade organisations for the sector, 2 consumer/environmental organisations and 4 manufacturers of HPC products.

From the responses received so far, most stakeholders agree that the scope of the Ecodesign / Energy Labelling preparatory study should be limited to the same scope and exclusions as defined in standard EN 60335-2-79 "Household and similar electrical appliances - Safety - Part 2-79: Particular requirements for high pressure cleaners and steam cleaners", i.e., HPCs with a maximum pressure of 35 MPa.

However, one stakeholder has pointed out that there is a segment of HPCs with operating pressures higher than 35 MPa (products specially designed for heavy duty industrial and agriculture applications). Thus, it would be premature to consider excluding such

products from the HPCs product scope, especially without a preliminary analysis. More specifically on that topic, one stakeholder suggested that the scope should only include units with a maximum water pressure of 15 MPa, whilst another respondent suggested a maximum pressure of 70 MPa. Regarding additional exclusions, with reference to EN 60335-2-79, one stakeholder proposed that HPC machines mounted on trucks or trailers should be excluded from the scope without reasoning this exclusion. Another stakeholder proposed hand-held and transportable motor-operated electric tools (IEC 60745 series, IEC 61029 series, IEC 62841 series) to be excluded.

Regarding the question of whether high-pressure cleaners with internal combustion engines should be included or excluded from the scope, most respondents have mentioned that this product type is a niche product which is mostly used in the industrial or agricultural sectors. However, to have a complete picture, apart from the market share, other parameters should be taken into account, as for example the energy and resource consumption, the environmental impact and use pattern of these HPC equipment. Two stakeholders are in favour of including the machines in the scope. One respondent has estimated that the market share of HPCs with internal combustion engines is relatively small without giving estimates. In contrary, two stakeholders state that the internal combustion engines market share of the hot water commercial cleaners market is between 6% and 15%. Three stakeholders have no information of the market for HPCs with internal combustion engines.

Regarding the question of including battery-driven HPCs within the scope of the study, responses received until now in general indicate that currently there are few to none battery-driven domestic HPC on the EU market. The project team noticed that there are battery powered HPC already available on the market with low as well in medium range maximum water pressures. Three respondents are of the opinion that battery-powered HPCs, is not a significant product sub-group, and that they do not expect this will change in the foreseeable future as current battery capacities can only support high pressure cleaners with low maximum pressure or short performance time. Large batteries with sufficient capacity would make the high pressure cleaner so heavy that it would not be considered mobile due to its weight. On the other hand, three stakeholders respond that they do expect more battery driven high pressure cleaners in the future.

All but one submitter say that stationary high pressure units should not be included in the scope. Most submitters claim that the user group is in industrial sector (either are used in an industrial environment or in an environment with explosive atmosphere or in car wash facilities) and their use is very different from domestic and commercial applications. Furthermore, that it is a niche market with very low sales (first estimations from stakeholder place these units sales at the level of few thousands units per year, however more detailed information will be provided in Task 2). On contrary, one submitter states that the inclusion of the stationary units would give a complete overview of the HPC product group.

Seven out of eight stakeholders agree that steam cleaners are a different product and should not be included in the scope. One of these stakeholders mention that commercial 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 capacity and rated pressure not exceeding 5 MPa fall under EN 60335-2-79 and could be seen within scope. One stakeholder doesn't answer directly on this question but notes that the machine needs to be evaluated in all its functionalities following the current International Technical Standard.

1.1.3 Preliminary product scope

Based also on the initial round of feedback from stakeholders, summarised in the above section, together with initial findings from the HPC project team, a preliminary description of the product scope is given in this section. This will be the base of discussion for the 1st Technical Working Group planned for the 3rd of May in Brussels, Belgium. The proposed primary performance parameter or otherwise mentioned 'functional unit' (i.e. related to the cleaning function), the description of the main components, and the energy and resource consumption during the use phase of the product are presented in this chapter.

1.1.3.1 Description of products

The European market has many designs of high pressure cleaners that are available to both the European consumers and commercial operators. A high pressure cleaner (HPC) is a: *machine with nozzles or other speed-increasing openings which allow water, also with admixtures, to emerge as a free jet. In general, high pressure jet machines consist of a drive, a pressure generator, hose lines, spraying devices, safety mechanisms, controls and measurement devices*³.

A high pressure cleaner has a motor that drives a water pump, which is provided with water from either a water tap or a built-in container. The water pump accelerates the water to high pressure that is let out through a hose. The hose can have various attachments that can be used for different cleaning purposes and applications. Some HPCs have a container for detergent which can be mixed into the water for optimising the cleaning purpose.

The motor can be electric or fuel powered (diesel, petrol or gas) or hydraulic or pneumatic. There is also a very small volume of battery driven units available on the EU market. Fuel powered units are generally able to provide higher pressures. Units that deliver a water jet at pressures above 35 MPa, are also available for commercial and industrial cleaning applications.

High pressure cleaners may work with hot or cold water. Hot water high pressure cleaners have integrated a burner or boiler which enables them to convert cold into hot water. Warm or hot water can also be supplied to some HPCs directly from the water connection without the need of internal conversion.

High pressure water jet machines may be mobile or stationary. Definition from the Outdoor Noise Directive⁴:





- mobile high pressure water jet machines are mobile, readily transportable machines which are designed to be used at various sites, and for this purpose are generally fitted with their own undergear or are vehicle mounted. All necessary supply lines are flexible and readily disconnectable.
- stationary high pressure water jet machines are designed to be used at one site for a length of time but capable of being moved to another site with suitable equipment. Generally skid or frame-mounted with supply line capable of being disconnected.

³ Definition from the outdoor noise directive, see description of the directive in section 1.3

⁴ Description of the Outdoor Noise Directive in section 1.3

In general, products meant for domestic and light use are not fitted with any form of traction drive. Higher powered industrial units may include traction. In all cases, the discharge line is considered to be hand held. Table 2 presents six typical product types of high pressure cleaners.

Table 2: Typical high pressure cleaners

<p>Low performance HPC</p>	<p>Compact units, suitable for general cleaning duties including garden tasks and furniture. Typically electric powered. Very few units on the market are battery driven today.</p> <p>Typical power range 1200W to 1600W. Typical pressure up to 11 MPa</p> <p>Example product: Karcher K2</p>	
<p>Medium performance HPC</p>	<p>Compact units, often upright units, suitable for general cleaning duties including garden tasks, furniture, patio and paths and car washing duties. Typically electric powered.</p> <p>Typical power range 1600W to 3000W. Typical maximum pressure up to 16 MPa and/or with maximum flow rate below 900 l/h</p> <p>Example product: Bosch AQT 37-13 Plus</p>	
<p>High performance HPC</p>	<p>More powerful units, often upright units and suitable for a broad range of demanding cleaning duties. Typically electric powered.</p> <p>Typical power range: 1 800W to 3 000W. Typical maximum water pressure above 16 MPa and/or with maximum flow rate above 900 l/t.</p> <p>Example product: Karcher HD 20/15-4 Cage-plus</p>	
<p>HPC with combustion engine</p>	<p>Typically, petrol combustion engine-based units although there are also electric units. Units are typically mounted on larger wheels (but are still intended to be transported manually) with a frame similar to a manual lawnmower or in a trailer. Useful in remote applications where an electrical power source is not available.</p> <p>Used for cleaning purposes including large areas such as car parks or warehouse yards or large vehicle washing duties.</p> <p>Alternate sources of power may include diesel, biodiesel, gas, hydraulic or pneumatic or</p>	

electricity.

Power range: 5-15 hp; 3000W to 15000W.
Pressure is typically 16MPa and higher

Example product: SIP Tempest PPG680/210
207 Bar Petrol Pressure Washer

This type of HPC typically requires an electrical supply for the fuel pump and ancillaries and incorporates a fuel tank, burner and heat exchanger for heating water. Power sources can be electrical, diesel or petrol and sometimes a combination of fuels for the motor and burner.

Hot water
HPC

Units are typically 10-15 Mpa, deliver hot water up to 90°C and rated at the level of 3 hp.

Example product: V-Tuf – Rapid VSC Hot Water
230V



Typically, this type of unit is installed in a cabinet or bench or rack mounted. Units may be hot or cold. Applications may include vehicle cleaning. Water pressure may be 10 to 20 MPa or higher. Motor ratings are typically 3 to 10hp and the units incorporate a fuel tank with low level warning.

Stationary
cold or hot
water HPC

The mains supply may be 230V single phase for lower pressure units but above 15 MPa or 5 hp, units will typically require a 415V 3-phase supply. Temperatures 0-100°C

Example product: Mac International –
Plantmaster



1.1.3.2 Proposed product scope

The preliminary scope of this study covers:

1. Cold water medium/low performance high pressure cleaners
2. Hot water medium/low performance high pressure cleaners
3. Cold water high performance high pressure cleaners
4. Hot water high performance pressure cleaners
5. Cold water stationary high pressure cleaners
6. Hot water stationary high pressure cleaners

The above first, the third and the fourth sub-groups represent the three main categories which were preliminarily investigated in the Preparatory study to establish the Ecodesign

Working Plan 2015-2017⁵. In addition, cold and hot water stationary hot pressure cleaners are added as separate categories (excluding stationary HPC equipment installed as part of industrial/production processes). Figure 2 illustrates the proposed product scope which is further explained in the following sections.

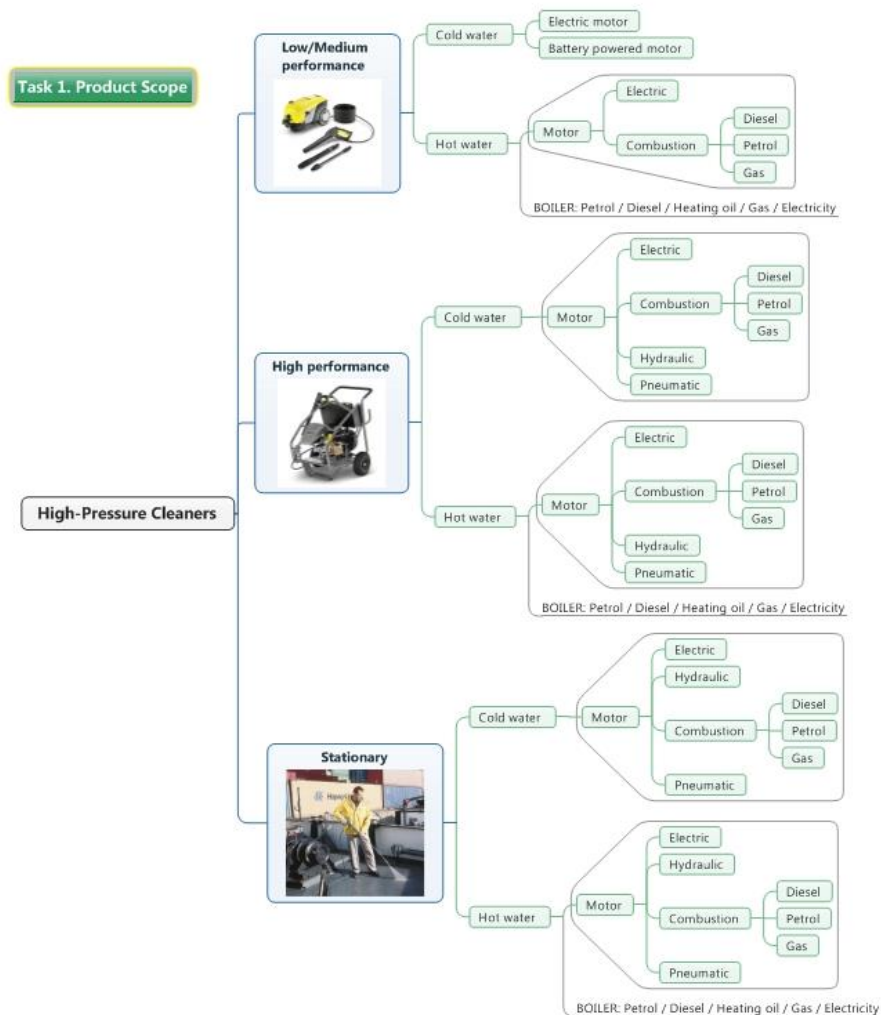


Figure 2: HPC product scope

Preliminary scope proposed:

High pressure cleaners without traction drive, intended for indoor or outdoor use, having a rated maximum water pressure not less than 2.5 MPa and not exceeding 60 MPa. The high pressure cleaner may be fitted with a water heater (boiler or burner) for hot water production and can be mobile or stationary. Hot water high pressure cleaners may incorporate a steam stage.

The following power systems of the drive for the high pressure pump are covered:

- mains powered motors up to a rated voltage of 250 V for single-phase machines and 480 V for other machines;
- battery powered motors;
- battery and electric powered (hybrid)
- internal combustion engines;
- hydraulic or pneumatic motors.

⁵ <http://ec.europa.eu/DocsRoom/documents/20374>

Exclusions proposed:

- High pressure water jet machines having a rated pressure exceeding 60 MPa;
- Steam cleaners *per se* (i.e., steam cleaning technology only);
- Appliances for medical purposes;
- Agricultural sprayers;
- Non-liquid, solid abrasive cleaners;
- Machines designed to be part of a production process;
- Machines designed for use in corrosive or explosive environments (dust, vapour or gas);
- Machines designed for use in vehicles or on board of ships or aircraft.

Definitions proposed:

- **"High pressure cleaner"** means a device that ejects water at high speed with the aim to remove dirt, dust, mould, paint etc. from a soiled surface or structure.
- **"Hot water high pressure cleaner"** means a high pressure cleaner that incorporates a water heater to raise the temperature of the input water.
- **"Low/medium performance high pressure cleaner unit"** means: the maximum water pressure does exceed 2.5 MPa but does not exceed 16 MPa, and the maximum water flow rate does not exceed 900 liter per hour (l/h).
- **"High performance high pressure cleaner unit"** means a unit where: the maximum water pressure does exceed 16 MPa but does not exceed 60 MPa, or the maximum water flow rate does exceed 900 liter per hour (l/h).
- **"Stationary high pressure cleaner unit"** means: A unit that is designed to be used at one site for a length of time but capable of being moved to another site with suitable equipment. Generally they are skid or frame-mounted with the supply line capable of being disconnected.
- **"Steam cleaner"** means: A unit that are designed for steam cleaning only.
- **"Agricultural sprayer"** means: A unit that is used to apply liquid fertilizers, pesticides, or other liquids to crops during their growth cycle.

Further proposed definitions of key parameters related to high pressure cleaners are available in the Annex.

Rationale for the proposed scope

Regarding the inclusion of stationary HPC: The project team would like to note that although the sales of stationary units can be much lower compared with the rest of the HPC sub-categories; their environmental impact is likely to be disproportionately higher compared to the rest of the HPC categories, as their use can be more intense (e.g. for the case of stationary units for car washers one unit can serve multiple service points), and their energy and resource consumption can be much higher.

Regarding the maximum water pressure limits (2.5 MPa to 60 MPa): Below the 2.5 MPa pressure the product cannot be considered as HPC. This minimum pressure limit was selected to be in line with the EN 60335-2-79 safety standard. The maximum water pressure upper limit was selected at 60 MPa, to cover all available HPC in the market and be well below the water jet cutting applications limit.

The categorisation of the HPC: to medium/low performance (2.5 to 16 MPa and up to 900 l/h maximum flow rate), and high performance (above 16 MPa or above 900 l/h maximum flow rate) was based on a preliminary analysis of 77 HPC models (hot and cold water, mobile and stationary) available in the market, presented in Figure 3. This database will be further extended. Apart from the maximum water pressure, the maximum flow rate of the HPC equipment is also an important performance parameter which also highly affects the environmental impact by increased water consumption.

For including battery driven HPC: generally, appliances with batteries are appreciated by the consumers. Battery driven HPC are already available in the market. Furthermore the battery technology is significantly improving over the last years (affected also by the fast development of electric cars) with new materials and technologies increasing their capacity and efficiency, lowering their weight; which results also in a price decreasing trend.

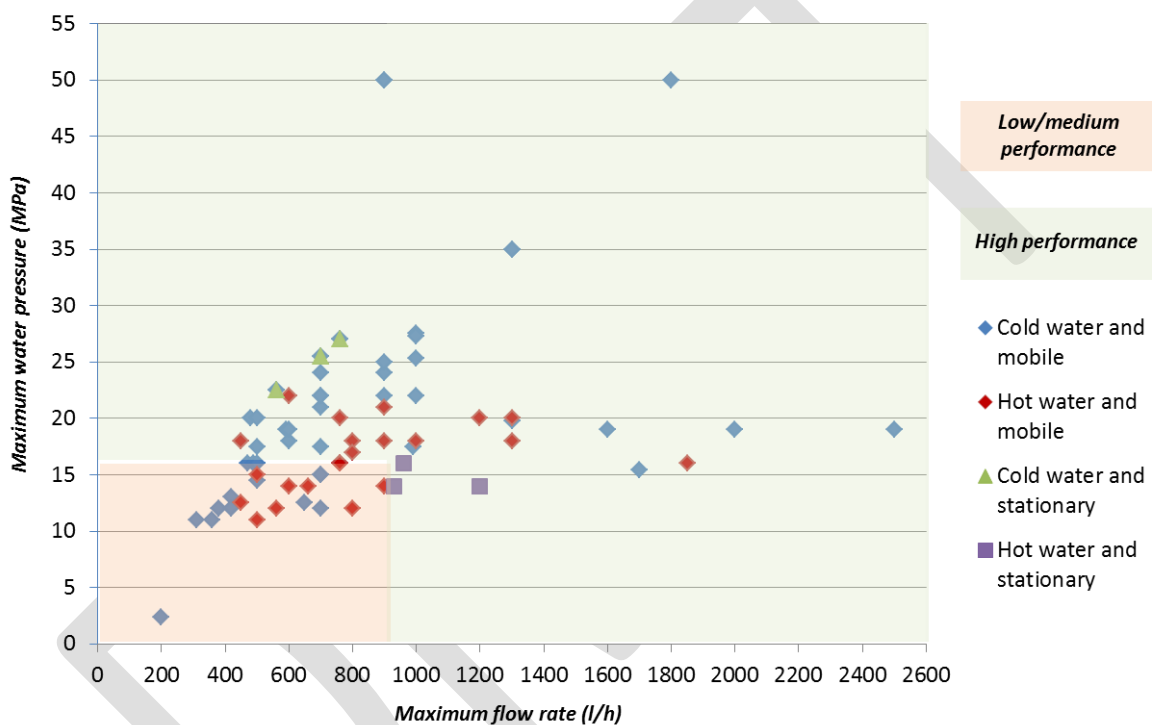


Figure 3: Maximum water pressure vs maximum flow rate of various HPC models (preliminary database, to be extended).

1.2 Test standards (EU, Member State and third country level)

The following tables collect and give details of the most relevant existing standards where parts of the standard can be relevant for Ecodesign or Energy labelling.

1.2.1 EN or ISO/IEC test standards

Table 3 presents the relevant test standards. They are divided into EN standard series on safety, EN standard series on electromagnetic compatibility and EN ISO standard series on acoustics. The table specifies the directive or regulation the standards relate to and a brief description of the content and scope.

Table 3: Overview of relevant EN and ISO standards

Standard	Title	Directive /Regulation	Content and scope
EN STANDARD SERIES ON SAFETY			
EN 60335-1:2012+A13:2017	Household and similar appliances – Safety: Part 1: General requirements	Harmonised under: Low Voltage Directive (2014/35/EU) Machinery Directive (2006/42/EC)	<p>This European Standard deals with the safety of electrical appliances for household environment and commercial purposes, their rated voltage being not more than 250 V for single-phase and 480 V for others.</p> <p>This standard covers the reasonably foreseeable hazards presented by appliances and machines that are encountered by all persons.</p> <p>The EN version is similar to the IEC version with Group Differences but excludes A1+A2 and adds amendment A13)</p> <p>Parameters and attributes covered: General, Classification, Marking and Instructions, Protection against access to live parts, power, heating, leakage current and electric strength, overvoltage, moisture resistance, endurance, abnormal operation, stability and mechanical hazards, mechanical strength, construction, external supply cords, earthing, insulation, resistance to heat and fire, resistance to rusting, radiation, toxicity and similar hazards.</p> <p>Use Performance parameters (other than power input and output) are NOT covered.</p>
EN 60335-2-79:2016	Household and similar appliances – Safety: Part 2-79: Particular requirements for high pressure cleaners and steam	Harmonised under: Machinery Directive (2006/42/EC) Note 1	<p>Part 2 standards supplement or modify the corresponding clauses in EN 60335-1, so as to convert that publication into the European Standard: Safety requirements for high pressure cleaners and steam cleaners.</p> <p>When a particular subclause of Part 1 is not mentioned in this part 2, that subclause applies as far as is reasonable.</p> <p>When this standard states “addition”, “modification” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.</p> <p>The scope covers the safety of high pressure cleaners without traction</p>

Standard	Title	Directive /Regulation	Content and scope
			<p>drive, intended for household and commercial indoor or outdoor use, having a rated pressure not less than 2,5 MPa and not exceeding 35 Mpa.</p> <p>Parameters and attributes covered:</p> <ul style="list-style-type: none"> • Rated Pressure (MPa) • Flow rate (l/m) • Maximum Flow rate (l/m) • Rated temperature • Sound Pressure Level (dBA) • Protection Class (Electric Shock) • IP Rating • Maximum power (Water heater/if fitted) – (kW) • Cleaning agent, volume • Commercial use • Operator <p>The standards also include:</p> <ul style="list-style-type: none"> • Acoustic emissions • Vibration <p>The standard IEC/EN 60335-2-79 requires that the product's vibration characteristic is documented and verified using the method defined in Annex DD of the standard.</p>
EN 1829-1:2010	High pressure water jet machines – Safety requirements – Part 1: Machines	Harmonised under: Machinery Directive (2006/42/EC)	<p>This standard is complimentary to EN 60335-2-79 and addresses HPCs above 35Mpa</p> <p>It 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. The standard deals with all significant hazards</p>
EN 1829-2:2008	High pressure water jet machines – Safety requirements – Part 2: Hoses, hose lines and connectors	Harmonised under: Machinery Directive (2006/42/EC)	As above but relates to significant hazards associated with the hoses and lines of machines covered by EN 1829-1.
EN STANDARD SERIES ON ELECTROMAGNETIC COMPATIBILITY			
EN 55014-1:2017	Electromagnetic compatibility. Requirements	Harmonised under:	This is a product family specific standard that covers all aspects of EM emission from products such as HPCs.

Standard	Title	Directive /Regulation	Content and scope
	for household appliances, electric tools and similar apparatus. Emission	EMC Directive: (2014/30/EU)	
EN 55014-2:2015	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Immunity.	Harmonised under: EMC Directive: (2014/30/EU)	This is a product family specific standard that covers all aspects of EM immunity of products such as HPCs.
EN 61000-3-2:2014	Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current \leq 16 A per phase)	Harmonised under: EMC Directive: (2014/30/EU)	This standard is listed separately in the Official Journal of the European Union (OJEU) and is mandatory for any product that is connected to the Public Low Voltage Supply.
EN 61000-3-3:2013	Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current \leq 16 A per phase and not subject to conditional connection	Harmonised under: EMC Directive: (2014/30/EU)	This standard is listed separately in the Official Journal of the European Union (OJEU) and is mandatory for any product that is connected to the Public Low Voltage Supply.
EN ISO STANDARD SERIES ON ACOUSTICS			
EN ISO 4871:2009	Acoustics – Declaration and verification of noise emission values of machinery and	-	This standard is called up by EN 60335-2-79:2012 2017 as the means of declaring the noise emission Sound Pressure Level (SPL). Gives information on the declaration of noise emission values, describes

Standard	Title	Directive /Regulation	Content and scope
	equipment		acoustical information to be presented in technical documents and specifies a method for verifying the noise emission declaration.
EN ISO 11203:2009	Acoustics. Noise emitted by machinery and equipment. Determination of emission sound pressure levels at a work station and at other specified positions from the sound power level	-	This standard is called up by EN 60335-2-79:2012 as the method for determining airborne noise.
EN ISO 3744:2010	Acoustics. Determination of sound power levels and sound energy levels of noise sources using sound pressure. Engineering methods for an essentially free field over a reflecting plane	Annex III of Outdoor Noise Directive	<p>This standard is called up by EN 60335-2-79:2012 as one of 2 methods for the method for determining Sound Pressure Level (SPL).</p> <p>ISO 3744:2010 specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured on a surface enveloping the noise source (machinery or equipment) in an environment that approximates to an acoustic free field near one or more reflecting planes. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source, in frequency bands or with frequency A-weighting applied, is calculated using those measurements.</p> <p>The methods specified in ISO 3744:2010 are suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001.</p> <p>ISO 3744:2010 is applicable to all types and sizes of noise source (e.g. stationary or slowly moving plant, installation, machine, component or sub-assembly), provided the conditions for the measurements can be met.</p> <p>The test environments that are applicable for measurements made in</p>

Standard	Title	Directive /Regulation	Content and scope
			<p>accordance with ISO 3744:2010 can be located indoors or outdoors, with one or more sound-reflecting planes present on or near which the noise source under test is mounted.</p> <p>ISO 3743-1:2010 may be used as an alternative to this standard</p>
ISO 3746:2010	Acoustics - Determination of sound power levels of noise sources using sound pressure -- Survey method using an enveloping measurement surface over a reflecting plane	Annex III of Outdoor Noise Directive (refers to standard version from 1995)	<p>ISO 3746:2010 specifies methods for determining the sound power level or sound energy level of a noise source from sound pressure levels measured on a surface enveloping a noise source (machinery or equipment) in a test environment for which requirements are given. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source with frequency A-weighting applied is calculated using those measurements.</p> <p>The methods specified in ISO 3746:2010 are suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001.</p> <p>ISO 3746:2010 is applicable to all types and sizes of noise source (e.g. stationary or slowly moving plant, installation, machine, component or sub-assembly), provided the conditions for the measurements can be met.</p> <p>The test environments that are applicable for measurements made in accordance with ISO 3746:2010 can be located indoors or outdoors, with one or more sound-reflecting planes present on or near which the noise source under test is mounted.</p> <p>Information is given on the uncertainty of the sound power levels and sound energy levels determined in accordance with ISO 3746:2010, for measurements made with frequency A-weighting applied. The uncertainty conforms with that of ISO 12001:1996, accuracy grade 3 (survey grade).</p>
EN ISO 3743-	Acoustics - Determination	-	ISO 3743-1:2010 specifies methods for determining the sound power level

Standard	Title	Directive /Regulation	Content and scope
1:2010	of sound power levels and sound energy levels of noise sources using sound pressure -- Engineering methods for small movable sources in reverberant fields -- Part 1: Comparison method for a hard-walled test room		<p>or sound energy level of a noise source by comparing measured sound pressure levels emitted by this source (machinery or equipment) mounted in a hard-walled test room, the characteristics of which are specified, with those from a calibrated reference sound source. The sound power level (or, in the case of noise bursts or transient noise emission, the sound energy level) produced by the noise source, in frequency bands of width one octave, is calculated using those measurements. The sound power level or sound energy level with frequency A-weighting applied is calculated using the octave-band levels.</p> <p>The method specified in ISO 3743-1:2010 is suitable for all types of noise (steady, non-steady, fluctuating, isolated bursts of sound energy, etc.) defined in ISO 12001.</p> <p>The noise source under test may be a device, machine, component or sub-assembly. The maximum size of the source depends upon the size of the room used for the acoustical measurements</p>

Note 1: It should be noted that whereas the safety of HPCs is primarily addressed by the Household Appliance (and similar equipment) series of standards, a HPC is considered a tool or machine and therefore this standard is harmonised under the EU Machinery Directive.

The EN standards referenced in 1.2.1 are also available as IEC variants and are therefore recognised under the International Electrotechnical Commission Electrical Engineering Certification Body (IECEE CB) scheme. This is an international system for mutual acceptance of test reports and certificates dealing with the safety of electrical and electronic components, equipment and products based on IEC standards. IEC Standards form the basis for testing and evaluation under the IECEE CB Certification scheme. An IECEE CB Test Certificate and Report may be used as a 'passport' for gaining the certification marks of National Certification bodies and may aid market entry in certain countries. Retail and other sales channels may also accept an IEC Test Report (up to 3 years old) as evidence of compliance. The IEC variants are collected and explained in Table 4.

Table 4: Overview of relevant IEC standards

Standard	Title	Content and scope
IEC 60335-1:2010+A1:2013+A2:2016 (Ed. 5.2)	Household and similar appliances – Safety: Part 1: General requirements Note 2	The International IEC variant of the EN standard. It should be noted that there are some detailed differences between the IEC and EN variants (the EN version has not adopted A1+A2 but has amendment A14). The standard deals with the safety of electrical appliances for household environment and commercial purposes, their rated voltage being not more than 250 V for single-phase and 480 V for others. This standard covers the reasonably foreseeable hazards presented by appliances and machines that are encountered by all persons. The following countries list National Differences against this standard: Austria, Canada, New Zealand, Denmark, Sweden, UAE.
IEC 60335-2-79 Ed. 4.0:2016	Household and similar electrical appliances – Safety – Part 2-79: Particular requirements for high pressure cleaners and steam cleaners Note 2	The International IEC variant of the EN standard.

Note 2: IEC Standards form the basis for testing and evaluation under the IECEE CB Certification scheme. An IECEE CB Test Certificate and Report may be used as a ‘passport’ for gaining the certification marks of National Certification bodies and may aid market entry in certain countries. Retail and other sales channels may also accept an IEC Test Report (up to 3 years old) as evidence of compliance.

It should be noted that there is a standard in development under an IEC Technical Committee (TC59), which is very relevant. The standard’s title is IEC 62885-5 Ed. 1 Surface cleaning appliances - Part 5: High pressure cleaners and steam cleaners - Methods of measuring the performance. It is currently at the Committee Draft Vote stage (59F/340/CDV) up for vote in May 2018. As it is still in the CDV stage and therefore a draft version, the standard can be expected to be finalised in 18 months to 2 years from voting.

1.2.1.1 Mandates issued by the European Commission to the European Standardisation Organisations (ESOs)

There are no specific standardisation mandates issued by the EC for this product category. General mandates that apply include the Commissions standardisation requests:

- M/556 COMMISSION IMPLEMENTING DECISION C(2017) 7926 of 1.12.2017 on a standardisation request to the European Committee for Standardisation and to the European Committee for Electrotechnical Standardisation as regards compliance with maximum content criteria of Polycyclic Aromatic Hydrocarbons in rubber and plastic components of articles placed on the market for supply to the general public in support of Regulation (EC) No. 1907/2006 of the European Parliament and of the Council (REACH)
- M/552 COMMISSION IMPLEMENTING DECISION C(2016) 7641 final of 30.11.2016 on a standardisation request to the European Committee for Standardisation, to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards harmonised standards in support of Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility.
- M/543 COMMISSION IMPLEMENTING DECISION C(2015)9096 of 17.12.2015 on a standardisation request to the European standardisation organisations as regards ecodesign requirements on material efficiency aspects for energy-related products in support of the implementation of Directive 2009/125/EC of the European Parliament and of the Council. Work under the Joint Research Centre, Seville⁶, provides input to the standardisation under this mandate.

The following regulation covers all standardisation requests. The latest Union Work Program for standardisation was published in August 2017.

- Regulation (EU) No 1025/2012 of the European Parliament and of the Council of 25 October 2012 on European standardisation, amending Council Directives 89/686/EEC and 93/15/EEC and Directives 94/9/EC, 94/25/EC, 95/16/EC, 97/23/EC, 98/34/EC, 2004/22/EC, 2007/23/EC, 2009/23/EC and 2009/105/EC of the European Parliament and of the Council and repealing Council Decision 87/95/EEC and Decision No 1673/2006/EC of the European Parliament and of the Council Text with EEA relevance
- Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions The annual Union work programme for European standardisation for 2018 (COM/2017/0453 final) <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=COM:2017:453:FIN>

1.2.1.2 Member States

The Safety and Electromagnetic compatibility (EMC) standards listed above are harmonised and are utilised as the basis of a Presumption of Conformity with the applicable directives by all member states.

Annex ZB of EN 60335-1:2012+A13:2017 lists 'National Deviations'. Both UK and Ireland list deviations related to statutory requirements for plugs fitted to this type of appliance.

1.2.1.3 Third country test standards

In **Table 5** third country test standards are presented. Relevant standards have been found in USA, Canada, Australia and New Zealand.

⁶ <http://susproc.jrc.ec.europa.eu/E4C/index.html>

It should be noted that there are differences between IEC/EN standards and the North American standards. IEC and EN standards consider all reasonably foreseeable hazards but leave the means of achieving the essential requirements open to the creativity of the designer. IEC and EN standards define requirements and stimuli that must be applied to verify compliance. ANSI/UL (US) and CAN/CSA (Canada) standards on the other hand, tend to be prescriptive in construction, methods and choice of wiring, components etc. The standards focus on Construction and the Performance sections cover how testing must be carried out to verify the construction. In this context 'performance' does not relate to the user experience of product performance or resources usage

Table 5: Overview of relevant third country test standards

Standard	Title	Content and scope
US STANDARDS		
ANSI/UL 60335-1 (2016)	Household and similar appliances – Safety: Part 1: General requirements	This national standard is based on publication IEC 60335–1, Edition 5.1 (Edition 5:2010 including corrigendum 1:2010, corrigendum 2:2011, and amendment 1:2013) issued April 2014.
ANSI/UL 1776 (2013)	Standard for Safety High pressure Cleaning Machines	<p>This standard covers electrically operated, high pressure cleaning machines in which the discharge line is hand-supported and manipulated, that use water as the cleaning agent for household and commercial use. The products may use either hot or cold water, and they may be portable, stationary or fixed.</p> <p>A product listed by a Nationally Recognised Test Laboratory (NRTL) is deemed to meet the requirements of approval as defined in the National Electrical Code NFPA 70.</p> <p>Products which incorporate heating must be further evaluated to the UL 499 standard</p> <p>Parameters and</p>

		<p>attributes covered:</p> <p>Construction (All products), Electrical Systems and Devices (including assembly, cord connections, access to live parts, insulation etc), Mechanical Systems and Devices (Fuel Fired Products), Protection against injury, Performance – all products (includes normal operation tests, temperature, abnormal tests, materials etc), Performance – Fuel fired (similar topics and tests to above), Manufacturing and production tests, Instructions and manuals.</p> <p>Use Performance parameters are not covered.</p>
ANSI/UL499	Standard for Electric Heating Appliances	These requirements cover heating appliances rated at 600 V or less for use in unclassified locations in accordance with the National Electrical Code (NEC), ANSI/NFPA 70.
FCC Part 15b (CFR 47)	Federal Communications Commission (FCC) requirements for 'unintentional' radiators	<p>A household appliance using digital logic (an unintentional device or system that generates and uses timing signals or pulses at a rate in excess of 9 000 pulses or cycles per second, and uses digital techniques as defined in Section 15.3 (k)) is classified under Part 15 Subpart B as a Class B digital device (as defined in Section 15 101) requiring an equipment authorization under the Verification procedure (Section 2 902).</p> <p>The FCC rule part 15b</p>

		focuses on "unintentional" radiation or noise generated by a digital device. This noise could potentially impact the operation of other devices in a close proximity and therefore requires testing of the unintentional radiators.
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CANADIAN STANDARDS

CAN/CSA C22.2 NO. 60335-1:16	Safety of household and similar appliances - Part 1: General requirements (Tri-national standard, with NMX-J-521/1-ANCE and UL 60335-1)	Comments as per ANSI/UL 60335-1 There are national differences against the IEC version of the standard.
CAN/CSA E60335-2-79-09 (R2013) (Adopted IEC 60335-2-79:2002+A1:2004+A2:2007, edition 2.2, 2007-09)	Household and similar electrical appliances - Safety - Part 2-79: Particular requirements for high pressure cleaners and steam cleaners (Adopted IEC 60335-2-79:2002+A1:2004+A2:2007, edition 2.2, 2007-09)	Aligned with IEC standard.
CAN/CSA B140.11-M89 (R2014)	Oil/Gas-Fired Commercial/Industrial Pressure Washers and Steam Cleaners	Covers the performance, construction, testing, marking, installation, operation, and servicing of complete commercial and industrial pressure washers and steam cleaners that are either gas-fired or oil-fired. Hot water up to 100°C.

AUSTRALIAN and NEW ZEALAND STANDARD

AS/NZS 60335.1:2011	Household and similar electrical appliances - Safety General requirements (IEC 60335-1 Ed 5, MOD)	Australian/New Zealand version based on IEC Edition 5 but with modifications. National differences apply for New Zealand.
AS/NZS 60335.2.79:2017	Household and similar electrical appliances - Safety Particular requirements for high pressure cleaners and steam cleaners	An adoption with national modifications of the fourth edition of IEC 60335-2-79, Household and similar electrical appliances - Safety - Part 2-79: Particular requirements for high

		pressure cleaners and steam cleaners. Takes into account Australian and New Zealand conditions.
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Furthermore, two American voluntary industry standards are identified:

Test standard CETA Performance Certified Standard

The Cleaning Equipment Trade Association (CETA) in the USA has developed a test standard, CPC 100 (CPC: Cleaning Performance Program), in collaboration with Intertek US to provide a uniform method for testing and rating pressure washers. The tests calculate a maximum working pressure (MWP); the pressure at the pump cylinder head, and maximum working flow (MWF); the flow of water expressed as gallons per minute.

The definitions and scope are taken from American UL standard UL 1776 and the program allows for third party verification and certification of the products performance. Products must be listed to UL 1776 to be eligible.

The CETA CPC -100 does not prohibit manufactures, retailers or users from advertising, marketing or using products if they have not conformed to the uniform testing method (it is not mandatory). The goal is to have a standard to evaluate pressure washer specifications used in advertising.

By partnering with Intertek (ETL) or CSA, CETA Performance Certification is issued and controlled by a third party testing program. The certification is issued by CETA based on test data provided by the third party laboratory. The authorisation to use the CETA Performance Certified is granted by CETA. The basic process, when a manufacture has a pressure washer to be tested for certification listing, is:

1. Manufacture: test a sample of pressure washer according to the instructions (3.0) in the CPC-100 standards
2. Manufacture prepare specifications list: (Model number, Gallons Per Minute, Pounds Per Square Inch and Horse Power/Engine CC) of machines to be inspected
3. Manufacture: Call Intertek or CSA and request an inspection per the CETA Performance Standard CPC-100, in addition to the routine certifications. (i.e. mandatory safety evaluation to UL 1776)
4. Intertek or CSA: provides a quote and establishes a project number
5. Intertek or CSA: arrives at manufacture's location to perform testing
6. Manufacture: ships designated units to Intertek or CSA
7. Intertek or CSA: test random sample or units chosen by manufacture's specification list
8. Intertek or CSA: provides manufacture with approval for certification to the CETA CPC-100 (in addition to routine safety certification).
9. Manufacture: submits Intertek or CSA's approval to CETA
10. CETA: provides manufacture with a letter of compliance and permission to use CETA Performance Standards Logo on the product and sales literature

The program and certification cover maximum pressure and maximum flow as the primary performance parameters but also verify additional specifications submitted by the manufacturer (e.g. horsepower, kW rating, rpm (rounds per minute) etc).

PW101 Standard for testing and rating performance of pressure washers

The Pressure Washers Association (PWMA) in the USA has published a performance standard PW101-2010: Standard for Testing and Rating Performance of Pressure Washers: Determination of Pressure and Water Flow. This standard is intended to provide a uniform method for testing and rating the performance of pressure washers with respect to maximum pressure and water flow rate, but not the in-use performance and efficiency of the cleaner. The PWMA also offer a voluntary certification program which is managed by a third party (Intertek).

The standard applies to pressure washers intended for household, farm, consumer or commercial/industrial markets. Products are portable and may be engine or electric motor driven.

The standard defines:

- Test preparation requirements including initial running in of the machine for a set period (minimum 2h and maximum 5h)
- Instrumentation and calibration requirements for pressure, flow, rpm (for engine driven) and voltage/current (for electric motors)
- Conditions for the tests (e.g. operation at factory settings, or for user settable, at maximum settings)
- The positional requirements for pressure and flow instruments and measurement points
- Stability of supply voltage over measurement period
- Inlet water pressure range, water source temperature, ambient temperature range permitted
- Information required to be provided by the manufacturer
- Test reporting format
- Rounding methods for test data
- Rating and labelling requirements (based on average of at least 3 samples tested in accordance with the test method)

The test method includes:

- Test duration is 30 minutes of continuous operation
- Readings recorded at 5 minutes intervals and average values calculated
- Average values used to assess performance and compliance to ratings
- Pressure and flow ratings not greater than the average of 3 samples divided by 0.9 (allows 10% tolerance)

1.2.2 Comparative analysis for overlapping test standards on performance, resources use and emissions

The standards described in 1.2 do not overlap on performance, resources use and/or emissions. All the standards listed in section 1.2 are called up in Annex CC of EN 60335-2-79. The 2 standards on acoustical methods (ISO 3743-1:2010 and ISO 3744-1:2010) are specified to allow manufacturers to choose a hard-walled room or free field environment to perform the tests. ISO 4871 describes how the Sound Pressure Level (SPL) should be declared.

1.2.3 Analysis of test standards on performance, resources use

There are no current EN/IEC performance testing standards for high pressure cleaners.

As stated in section 1.2 regarding test standard prEN 62885-5:2018 Surface cleaning appliances - Part 5: High pressure cleaners and steam cleaners - Methods of measuring the performance (IEC 62885-5:201X) is currently under parallel vote in CENELEC and IEC. The intent in the standard is to serve the manufacturers in describing parameters that fit in their manuals, and in their literature. This may include all or some of the parameters listed in the standards definition document. When any of the parameters listed in the document are used, they shall be noted as being measurements made in accordance with the document.

Some manufacturers include specifications on performance in their technical data sheets, e.g. area performance (m^2/h) indicating in-house test protocols at their disposal.

Various test laboratories have also carried out test on behalf of consumer organisations. Measurement of energy and water consumption is essential, but in order to generate comparative testing data, and enable the relative performance of high pressure cleaners to be compared, it is a necessity to measure the speed and quality of removal of soiling from surfaces.

There are two approaches that can be used, one on pre-soiled and aged surfaces and one on artificial test surfaces. See details in the following.

Pre-soiled and aged surfaces

Measurement of performance of HPC can of course be performed using pre-soiled and aged surfaces that were available to the laboratory, such as concrete walkways, car parks and block paving around the building, but there is fundamental problem with this approach, which is that these surfaces by their nature tend to be rather variable. To counter the effects of this variability, techniques such as randomisation of the test areas, using multiple test assessors and statistical analysis of the results may be used. Unfortunately, this tends to lead to the need for a large number of test samples and the necessity of time and labour-intensive test work.

Artificial test surfaces

Amongst the manufacturers and product testing industry, it is occasionally necessary to devise artificial methods to test products that reproduce the practical usage as much as possible but permit more consistent homogeneous substrates to be used. This enables a far more empirical measurement of performance. In the case of high pressure cleaners, it is known that one leading manufacturer in particular has used this approach, and independently a similar method was established in order to test large numbers of

products for the European consumer magazines. The method involves moving the gun across the surface of pre-painted building insulation tiles. The removal of the paint approximates to the removal of the soiling on outdoor surfaces rather well, but has the obvious advantage that these substrates can be controlled, largely eliminating any variability in the substrate.

Defining a test protocol for assessment of high pressure cleaners requires a *comparative* performance element to be considered. This may include:

1. Primary performance/technical criteria e.g. total power and motor power at different modes and loads and at minimum and maximum water pressure
2. Secondary performance/technical criteria e.g. minimum and maximum flow rate (l/h)
3. Cleaning time for a specific and specified *application with a specific surface and specific area* (e.g. simulating car washing, cleaning of pavement).
4. Resources used for a specific and specified *application with a specific surface and specific area* (e.g. simulating car washing, cleaning of pavement) – Energy usage, detergent usage, water usage

Environmental performance indicators may include resource consumption / cleaned surface area for predefined surfaces. This can then be translated also to impact/m² (LCA) and euro/m² (LCC)

Measured parameters for predefined surfaces may include:

- Cleaning time
- Flow rate (for water consumption)
- Electricity measurements (for electric engines, and for hot water)
- Fuel consumption for hot water and/or combustion engines
- Compressed gas/water consumption (for pneumatic/hydraulic motors respectively)
- Detergent consumption
- Type of fuel (biofuel, gas, diesel) and detergents

Experience from developing test protocols and standards for other washing appliances including washing machines and dishwashers will be reviewed as part of this process. It is acknowledged that these are automated, pre-programmed washing cycles and that standard, loads, material types/deposits and reference machines and detergents are well established. In contrast, a major consideration is that HPC performance will in part include a 'user' element; how the HPC is used and the application (e.g. car washing, patio cleaning etc). Test protocols will need to consider standardised methods with performance related to a given reference or base machine. When evaluating the HPC performance, the 'user' variables such as the distance the lance is held from the target cleaning area and the speed at which the lance is moved across the surface has to be controlled, e.g. by fixing the position of the lance and head and move the sample at a set rate.

Performance criteria will need to consider cleaning performance levels similar to 'wash performance' with cleaning performance assessed to a defined soiling level.

The Technical Committee responsible for the development of performance testing standards is IEC TC 59 'Performance of Household and Similar Appliances'. This TC handles all non-safety standard development. Details of current TC59 projects may be found on the IEC website⁷:

1.2.4 Tolerances, reproducibility and real-life simulation

Many of the standards listed (including EN 60335-1 and EN 60335-2-79) reference ISO standards for *tolerances* which may include dimensional or other product characteristics. These standards also define the tolerance (or range) of operating conditions.

All measurements have a degree of *uncertainty* regardless of precision and accuracy. This is caused by three factors, the limitation of the measurement instrument (systematic error), the skill of the operator making the measurements and the environmental conditions in which the measurement is made (random error).

The standard EN60335-2-79 includes an annex for noise emission measurements and this describes the requirements for taking measurement uncertainty into account for this particular parameter.

The measurement uncertainty is developed using statistical techniques and many methods adopt a Root Sum of Squares (RSS) approach to distribution. Laboratories have developed Measurement Uncertainty models as a requirement of accreditation by Accreditation Bodies such as UKAS. This knowledge will be applied during the development of any test protocols.

A third element for consideration is *sensitivity*. The analysis of the repeatability or robustness of a given test protocol will be necessary in the case of tests for HPC performance due to the likely potential for variation. Statistical techniques will be employed to assess the validity and repeatability of results.

Performance criteria will need to consider cleaning performance levels similar to 'wash performance' with cleaning performance assessed to a defined soiling level.

1.3 Legislation (EU, Member State and third country level)

1.3.1 EU

This section presents details for all applicable European Directives, regulations and voluntary initiatives.

EU Machinery Directive

The EU Machinery Directive⁸ sets mainly safety requirements for machinery put on the market or put in service in all member states and aims to ensure their freedom of

⁷ http://www.iec.ch/dyn/www/f?p=103:23:31863158667620:::FSP_ORG_ID,FSP_LANG_ID:1275,25

⁸ Directive 2006/42/EC on machinery, and amending Directive 95/16/EC (recast)

movement within the European Union. The directive embraces the Low Voltage Directive⁹ requirements and its requirements must be met. However, any Declaration of Conformity for CE Marking purposes would be made to the Machinery Directive only.

EU WEEE Directive

The WEEE Directive¹⁰ sets selective treatment requirements for the Waste of Electronic and Electrical Equipment and its components (including all types of electrical HPCs). The Directive obligates member states to establish and maintain a registry of producers of electronic and electrical products, and the producers to register in each individual EU country. Each year, producers are required to report the amount of EEE they put on the market, as well as pay an annual registration fee, which is intended to finance the WEEE handling.

EU RoHS Directive

The RoHS Directive¹¹ restricts (with exceptions) the use of six hazardous materials in the manufacture of various types of electronic and electrical equipment. It is a sector specific directive that applies to Electrical and Electronic Equipment (EEE).

In January 2017, the Commission adopted a legislative proposal to introduce adjustments in the scope of the Directive, supported by the impact assessment. The respective legislative act amending the RoHS 2 Directive, adopted by the European Parliament and the Council, has been published in the Official Journal on 21 November 2017. The Directive covers HPCs with the amendment. The impact assessment and the legislation can be found on DG Environments website¹²

EU Battery Directive

The battery directive¹³ applies to all types of batteries and sets rules regarding placing on the market of batteries, specifically prohibiting batteries containing hazardous substances such as lead, mercury and cadmium. This means, that from January 1, 2017 it was no longer possible to place on the market battery-operated HPCs with Nickel-Cadmium batteries. Furthermore, it sets rules for collection, treatment, recycling and disposal of waste batteries.

EU Energy Labelling Regulation

The Energy Labelling Regulation¹⁴ requires producers of energy-related products to label their products in terms of energy consumption on a scale of A to G, as well as informing consumers of a number of other parameters, so that consumers could compare the energy efficiency of one product with another.

⁹ Directive 2014/35/EC on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits

¹⁰ Directive 2012/19/EU on waste electrical and electronic equipment (WEEE)

¹¹ Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)

¹² http://ec.europa.eu/environment/waste/rohs_eee/index_en.htm

¹³ Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators

¹⁴ Regulation 2017/1369/EU on setting a framework for energy labelling and repealing Directive 2010/30/EU

High pressure cleaners fall within the scope of the Energy Labelling Regulation but are not currently covered by any implementing measures.

EU Ecodesign Directive

The Ecodesign Directive¹⁵ provides consistent EU-wide rules for improving the environmental performance of products placed on the EU market. This EU-wide approach ensures that Member States' national regulations are aligned so that potential barriers to internal EU trade are removed.

The Directive's main aim is to provide a framework for reducing the environmental impacts of products throughout their entire life cycle. As many of the environmental impacts associated with products are determined during the design phase, the Ecodesign Directive aims to bring about improvements in environmental performance through mandating changes at the product design stage.

The Ecodesign Directive is a framework directive, meaning that it does not directly set minimum requirements. Rather, the aims of the Directive are implemented through product-specific regulations, which are directly applicable in all EU member states.

High pressure cleaners fall within the scope of the Ecodesign Directive but are not currently covered by any implementing measures. Water pumps and electric motors that may be used within HPCs are covered by the following implementing measures:

- Commission Regulation (EU) No 547/2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water pumps.
- Commission Regulation (EU) No 4/2014 of 6 January 2014 amending Regulation (EC) No 640/2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors.

Commission Regulation on Ecodesign requirements for water pumps¹⁶

Water pumps are covered by Commission Regulation (EU) No 547/2012 of 25 June 2012 implementing Directive 2009/125/EC of the European Parliament and Council.

This defines ecodesign requirements for water pumps that move clean water by means of hydrodynamic forces, including where integrated in other products.

Pumps in high pressure cleaners can be subject to this regulation if they are of one of the following designs:

- End suction own bearing (ESOB),
- End suction close coupled (ESCC)
- End suction close coupled inline (ESCCi)
- Vertical multistage (MS-V)

¹⁵ Directive 2009/125/EC on establishing a framework for the setting of ecodesign requirements for energy-related products

¹⁶ COMMISSION REGULATION (EU) No 547/2012 of 25 June 2012 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for water pumps

- Submersible multistage (MSS);

The regulation does not apply to self-priming pumps that move clean water and which can start and/or operate also when only partly filled with water. It may therefore exclude certain types of pumps used in high pressure cleaners. The requirement includes a Minimum Efficiency Index (MEI).

The regulation is currently under revision. The review study includes analysis of resource efficiency, re-use and recycling and the level of measurement uncertainty. The progress and results from the study can be found on the study website¹⁷.

Commission Regulation on Ecodesign requirements for electric motors¹⁸

Electric motors are subject to EU Ecodesign requirements that establish minimum requirements for the products in scope. The regulation covers electric single speed, three-phase 50 Hz or 50/60 Hz, squirrel cage induction motors that:

- have 2 to 6 poles;
- have a rated voltage up to 1000 V;
- have a rated power output between 0,75 kW and 375 kW;
- are rated on the basis of continuous duty operation.

The regulation covers part of the motors present in the market, although some motors designed for specific conditions, for example those that operate immersed in a liquid such as in a sewage system, are excluded from the requirements. The regulation is currently under revision. The Review study was finished in 2014 and include analyses of resource efficiency, re-use and recycling and the level of measurement uncertainty as well as an analysis of possible inclusion of more types of motors¹⁹.

Outdoor Noise Directive

The Outdoor Noise Directive²⁰ regulates the noise emissions into the environment by outdoor equipment. Some 57 types of equipment are named in the Directive, one of them is high pressure water jet machines. It refers mainly to outdoor machinery, such as those used on construction sites or in parks and gardens.

This directive is currently under revision. A study for an evaluation and impact assessment of the directive has been ongoing since May 2017. The results from this study (to be delivered by the first semester of 2018), as well as previously completed studies, will be used as the basis for the upcoming revision process. An online public consultation has been launched on 23 January 2018 and will run until 18 April 2018. The study and document on the public consultation can be found on DG Growth website²¹.

¹⁷ <http://www.ecopumpreview.eu/>

¹⁸ COMMISSION REGULATION (EC) No 640/2009 of 22 July 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for electric motors

¹⁹ <https://www.eceee.org/ecodesign/products/special-motors-not-covered-in-lot-11/>

²⁰ DIRECTIVE 2000/14/EC on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors

²¹ http://ec.europa.eu/growth/sectors/mechanical-engineering/noise-emissions_en

Non Road Mobile Machinery Regulation

The Non Road Mobile Machinery Regulation (NRMM Regulation)²² defines emission limits for non road mobile machinery engines for different power ranges and applications. It also lays down the procedures engine manufacturers have to follow in order to obtain type-approval of their engines – which is a prerequisite for placing their engines on the EU market.

NRMM covers a very wide variety of machinery typically used off the road in many ways. It comprises, for example:

- small gardening and handheld equipment (lawn mowers, chainsaws, etc.)
- construction machinery (excavators, loaders, bulldozers, etc.)
- agricultural & farming machinery (harvesters, cultivators, etc.)
- railcars, locomotives and inland waterway vessels.

Stationary machinery is excluded from the scope.

EU Packaging Directive

The Packaging Directive²³ provides a definition of the term 'packaging' and sets targets for recovery and recycling of packaging waste. The directive aims at providing a high level of environmental protection and ensuring the functioning of the internal market by avoiding obstacles to trade and distortion and restriction of competition.

Voluntary burner efficiency label

EUnited Cleaning, the European Cleaning Machines Association, has set up a voluntary labelling scheme EUnited Cleaning Burner efficiency, that applies to oil-heated high pressure cleaners. The scheme sets requirements on thermal exhaust loss, burner efficiency, CO emission and dust emissions.

1.3.2 Member States

Act on the Prevention of Harmful Effects on the Environment caused by Air Pollution, Noise, Vibration and Similar Phenomena (Federal Emission Control Act)

The purpose of the Act is to protect human beings, animals and plants, the soil, water, the atmosphere as well as cultural assets and other material goods against harmful effects on the environment and, to the extent that this concerns installations subject to licensing, also from hazards, considerable disadvantages and considerable nuisance caused in any other way, and to take precautions against the emergence of any such harmful effects on the environment.

It covers establishment and operation of installations for example machines, equipment and other non-stationary technical facilities, High pressure cleaners with an internal combustion engine is included. It applies to burner efficiency, soot number, and CO emission.

²² REGULATION (EU) 2016/1628 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery, amending Regulations (EU) No 1024/2012 and (EU) No 167/2013, and amending and repealing Directive 97/68/EC

²³ Directive 1994/62/EC on packaging and packaging waste

1.3.3 Third countries

1.3.3.1 USA

American appliances must be *listed* by an appropriate Nationally Recognised Test Laboratory (NRTL) e.g. Intertek, UL (Underwriters Laboratories), Canadian Standards Association (CSA) in order to satisfy the requirements of the National Electrical Code NFPA-70 (2017). All appliances operating at 50 volts or more shall be listed.

The US Energy Star Program aims to promote the most energy efficient products through verification and labelling of products that meet the Energy Star criteria.

High pressure cleaners are not currently included within the Energy Star product categories²⁴.

1.3.3.2 Canada

Compliance in Canada is similar to the requirements for the USA. The Canadian Electrical Code is C22.1 (2015) and Rule 2-024 Use of approved equipment states:

Rule 2-024 has two requirements: equipment must be "approved" and be "approved for the specific purpose".

Natural Resources Canada (NRCan) Product categories align with the US Energy Star program.

1.3.3.3 Australia and New Zealand

On 1 October 2012, the Greenhouse and Energy Minimum Standards (GEMS) Act 2012 came into effect, creating a national framework for product energy efficiency in Australia.

Many categories of products are regulated under this Act and requirements include Minimum Energy Performance Standards (MEPS) and Mandatory Energy Performance Labelling (MEPL). Similar requirements apply for products sold in New Zealand.

At the present time high pressure cleaners are not covered by the scope of MEPS or MEPL.

1.3.4 Other studies

High pressure cleaners were one of the five product types intensively analysed and sought improved in the now 20 years old Danish "EDIP" project (Environmental Design of Industrial Products)²⁵. It was a 5-year collaboration between Danish Industry association, several companies, Danish EPA and DTU.

The method consists of 6 phases

- 1) Goal definition - identifying the specific assessment task to be solved in product development and the potential environmental scenarios related to the decisions taken during that stage of product development
- 2) Scope definition - identifying the methodological requirements for the assessment task in question and the scope of the systems to be studied

²⁴ <https://www.energystar.gov/products>

²⁵ <http://orbit.dtu.dk/files/4646274/Wenzel.pdf>

- 3) Inventory analysis - compiling an inventory of the environmental exchanges from the studied systems
- 4) Impact assessment - assessing the resource consumption and environmental impacts of the environmental exchanges identified in the inventory
- 5) Sensitivity analysis - identifying which parameters are essential, their uncertainty and the significance of their variation
- 6) Decision support - providing support to the different types of decisions to be taken during product development

As a result of the project a method was developed for Life Cycle Assessment of products - a tool for the environmental specialist and a PC-tool. Furthermore, a database with environmental information on about 400 essential materials and processes covering the life cycle of electro-mechanical products as well as other product categories was established.

The Danish study on high pressure cleaners found that electricity consumption (of which 80% is in the use stage) and chemicals (being primarily the detergents in the use stage) stand for over **90%** of the impact potential. The HPC manufacturer who participated in the study achieved large improvement by a new design of the nozzle, a combined hydraulic and mechanical shaping of the water jet implying a large improvement of the pressure drop profile of the jet. As result about **30%** savings of water and energy was achieved without reduction in cleaning effect.

Annexes

Definition of key parameters:

Parameter	Definition	Source (Standard (Clause))
Supply voltage (V)	Also known as rated voltage - voltage assigned to the appliance by the manufacturer	EN 60335-1 (3.1.1)
Supply frequency (Hz)	Also known as rated frequency - frequency assigned to the appliance by the manufacturer	EN 60335-1 (3.1.7)
Power source	What the primary source of energy powering the appliance: <ul style="list-style-type: none">• Electrical – Mains• Electrical - Battery• Combustion – Petrol• Combustion – Diesel• Combustion – Gas• Combustion – Oil• Hydraulic or Pneumatic	Intertek
Rated Pressure (MPa)	Maximum working pressure at the pressure generator during normal operation	EN 60335-2-79 (3.103)
Power rating (kW or HP)	Also known as rated power input – power input assigned to the appliance by the manufacturer	EN 60335-1 (3.1.4)
Flow rate (l/m)	Also known as rated flow - maximum flow at rated pressure at the nozzle during normal operation	EN 60335-2-79 (3.105)
Maximum Flow rate (l/m)	The highest possible flow rate at the nozzle Typically, the maximum flow rate occurs at working pressures lower than rated pressure and with a nozzle designed for spraying of cleaning agents.	EN 60335-2-79 (3.106)

Parameter	Definition	Source (Standard (Clause))
Area performance (m2/h)	<p>No formal definition A relative term for describing the cleaning performance of a high pressure cleaner.</p> <p>A more formal definition should form part of the development work for test methods establishing the performance of high pressure cleaners.</p>	Intertek – Manufacturers data
Weight	<p>Several weight labelling requirements are covered:</p> <ul style="list-style-type: none"> • Packaged weight of product complete with all accessories • The weight of the high pressure cleaner complete with its primary tools is a handling requirement and form part of the product instructions 	Intertek
Dimensions	<p>Dimensions to include:</p> <ul style="list-style-type: none"> • Packaged dimensions of product complete with all accessories • Nominal size of product complete with its primary tools in use 	Intertek
Application	<p>No formal definition. A relative term for describing how the HPC is used and to provide a relative indication of cleaning capability of a high pressure cleaner.</p> <p>e.g. 'Light domestic use'</p> <p>A more formal definition should form part of the development work for test methods establishing the performance of high pressure cleaners</p>	Intertek

Parameter	Definition	Source (Standard (Clause))
Water feed and temperature	No formal definition. Source – e.g. mains fed or water butt. Generally, taken as ambient temperature of source water	Intertek
Self-priming (Y/N)	Manufacturer declared – will allow use of water butt or other reservoir for feed	-
Rated temperature	Maximum temperature of the cleaning agent during normal operation	EN 60335-2-79 (3.107)
Sound Pressure Level (dBA)	Noise emission	EN 60335-2-79 - Annex CC
Cable length (m)	Length of cable as supplied by the manufacturer	-
Protection Class (Electric Shock)	Machines shall be one of the following classes with respect to the protection against electric shock: - class I, - class II, or - class III.	EN 60335-2-79 (6)
IP Rating	Degree of protection against harmful ingress of water	EN 60335-2-79 (6.2)
Maximum supply feed length	No formal definition – only applicable if pressure drop via long house cause performance degradation	-
Maximum power (Water heater/if fitted) – (kW)	Maximum power of the water heater in kW, if applicable (for electric heaters, the input power, for gas-fired or oil-fired heaters the output power).	EN 60335-2-79 (7.1)
Cleaning agent, volume	Water with or without the addition of gaseous, soluble or miscible detergent or solid abrasive Volume to be declared by manufacturer (not a standards requirement)	EN 60335-2-79 (3.113)
Accessory types/supplied	No formal list or definition types – standard lance, turbo lance, patio cleaner, car wash brush Will need to be defined as part of any meaningful performance evaluation	Manufacturers data

Other definitions:

Parameter	Definition	Source
Commercial use	intended use of machines. These machines are not intended for normal housekeeping purposes by private persons but which may be a source of danger to the public.	EN 60335-2-79 (3Z.101)
Operator	Person installing, operating, adjusting, cleaning, moving, or performing user maintenance on the machine	EN 60335-2-79 (3.122)

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