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# Fire service equipment — Summary of water pressures specified in published CEN/TC 192 standards



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# CEN/TR 16099

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English Version

# Fire service equipment - Summary of water pressures specified in published CEN/TC 192 standards

Equipement des services d'incendie - Bilan des pressions hydrauliques spécifiées dans les normes publiées du CEN/TC 192

Ausrüstung für die Feuerwehr - Zusammenfassung von Festlegungen zum Wasserdruck in veröffentlichten Normen von CEN/TC 192

This Technical Report was approved by CEN on 30 August 2010. It has been drawn up by the Technical Committee CEN/TC 192.

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## Foreword

This document (CEN/TR 16099:2010) has been prepared by Technical Committee CEN/TC 192 “Fire service equipment”, the secretariat of which is held by BSI.

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

# Introduction

Primarily this Technical Report is intended for use by the relevant CEN/TC 192 Working Groups when preparing new standards or revising existing ones. The Technical Report may also be of value to fire and rescue services when designing, selecting, operating or maintaining extinguishing equipment and also to other CEN committees or other organisations who may work on related matters.

The aim of this Technical Report, as well as providing a collation of existing water pressures contained in published CEN/TC192 standards, is to assist in working towards preparing more common definitions, values and descriptions within new or revised TC 192 standards and to ensure such definitions are clearer, more consistent and easier for the users of the standards.

NOTE Terms and definitions for pressures are given in the relevant EN standards listed in Clause 3. The equivalent definition for the terms within each section may not be identical.

## 1 Scope

This Technical Report identifies the various elements of fire ground operations which work together to form a system for the delivery of water or other extinguishing media. The Technical Report also identifies the CEN/TC 192 Working Groups responsible for the standard(s) for that specific item(s) of equipment.

The pressures at which these various items of equipment operate at, as described in their respective standard, are identified and collated and an explanation as to what such pressures relate to is given.

Recommendations are provided in relation to the revision of existing standards and the preparation of new ones in respect of water pressures.

## 2 Fire ground system of operation

A schematic representation of a typical water delivery system for firefighting operations is shown in Figure 1, with following sections:

— Section 0: Hydrants (for information only);

— Section 1: Layflat hose for water supply;

— Section 2: Fire pump;

— Section 3: Fire appliance – plumbing & valve installation;

— Section 4: Semi rigid hose – to go on hose reel;

— Section 5: Layflat hose for fire attack;

— Section 6: Nozzles;

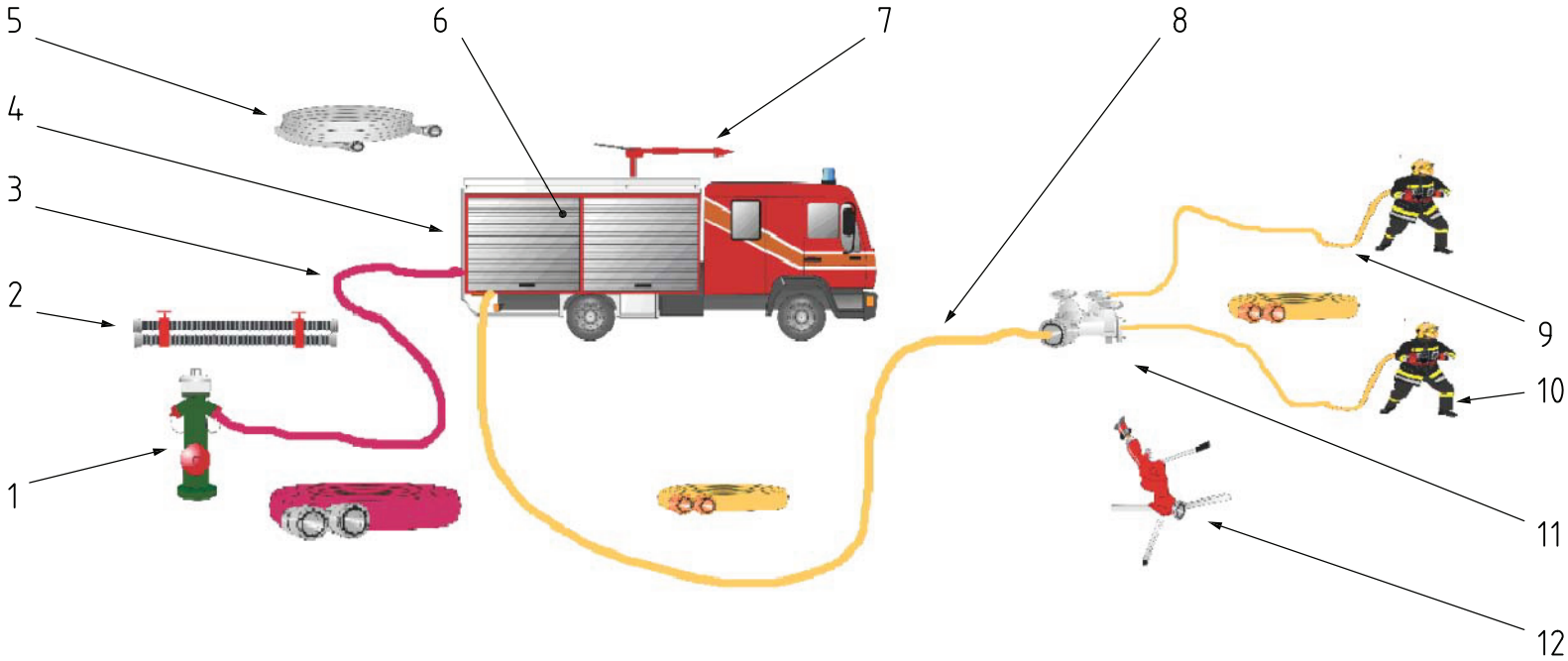
— Section 7: Fire ground equipment, dividers, etc.;

— Section 8: Portable monitors;

— Section 9: Suction hoses;

— Section 10: Vehicle mounted monitors.

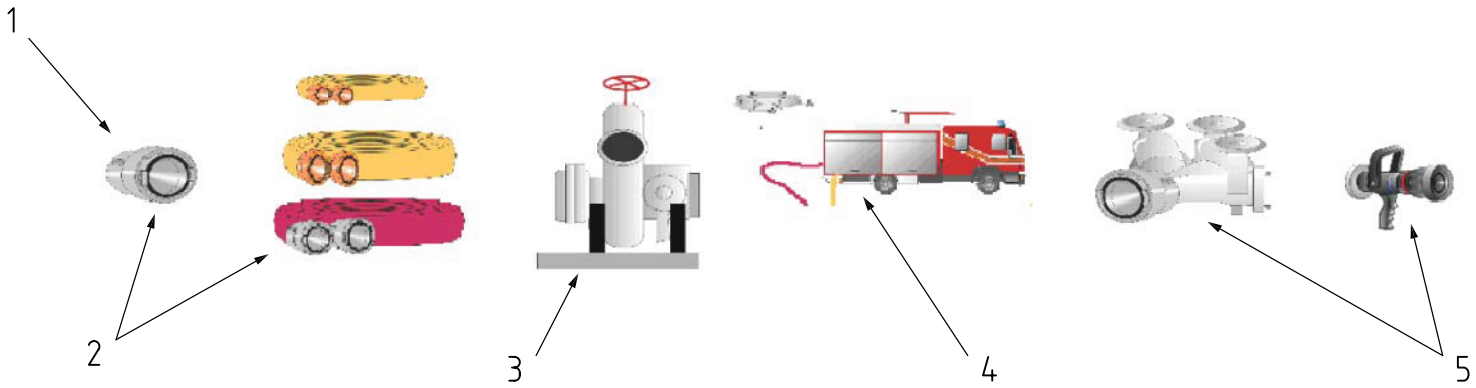
Figure 2 identifies the individual components that form the system, the appropriate European Standards and the Working Groups of CEN/TC 192 responsible for preparing those standards.




**Key**

1 Section 0: Hydrants (for information only)
2 Section 9: Suction hoses
3 Section 1: Layflat hose for water supply
4 Section 2: Fire pump
5 Section 4: Semi rigid hose – to go on hose reel
6 Section 3: Fire appliance – plumbing & valve installation
7 Section 10: Vehicle mounted monitors
8 Section 5: Layflat hose for fire attack
9 Section 5: Layflat hose for fire attack
10 Section 6: Nozzles
11 Section 7: Fire ground equipment, dividers, etc.
12 Section 8: Portable monitors

**Figure 1 — Fire ground operation as a system**




**Key**

| | | | | |
|---|---|---|---|---|
| 1 | – | Couplings for hose assembly: | National standards apply | |
| 2 | Working Group 1: | Sections 1, 4, 5[1)] and 9: | EN 694, EN 1947, EN ISO 14557 and EN 14540 | See Table 1 |
| 3 | Working Group 2: | Section 2: | EN 1028 (all parts), EN 14710 (all parts) and EN 14466 | See Table 2 |
| 4 | Working Group 3: | Sections 3 and 10: | EN 1846-3 | See Table 3 |
| 5 | Working Group 8: | Sections 6, 7[2)] and 8: | EN 15182 (all parts), EN 15767 (all parts) | See Table 4 and Table 5 |

**Figure 2 — Fire fighting components and relating Working Groups of CEN/TC 192**

1) National standards apply. A European Standard for layflat hoses for fire attack does not exist. The Final Draft FprEN 1924, *Fire-fighting hoses — Non-percolating layflat delivery hoses and hose assemblies for pumps and vehicles* failed at Formal Vote and the standardization project was cancelled in 2004.

2) Possible future standardization projects in CEN/TC 192/WG 8.

## 3 Published water pressures

Table 1 to Table 5 provide various information related to the pressure designations, descriptions and values abstracted from the relevant published standards of CEN/TC 192.

**Table 1 — Pressures abstracted from CEN/TC 192 hose standards**

| European Standard | Pressures | Comment |
|---|---|---|
| EN 694 | Maximum working pressure for 19 mm and 25 mm diameter = 12 bar<br><br>Maximum working pressure for 33 mm diameter = 7 bar | Semi-rigid hoses for fixed systems.<br><br>Not relevant for mobile application. |
| EN 1947 | Maximum working pressure for Category 1 = 15 bar<br><br>Maximum working pressure for Category 2 = 40 bar | To be considered for hoses on hose reels installed into fire appliances. |
| EN 14540 | Maximum working pressure = 15 bar<br>NOTE Can be exceeded by 2 bar for a short period of time during pumping against closed valves. | Non-percolating layflat hoses for fixed systems in buildings.<br><br>Not relevant for mobile application.<br><br>Base to start from as for example the 17 bar test pressure on the pumps can be covered. |

**Table 2 — Pressures abstracted from CEN/TC 192 pump standards**

| Symbol, abbreviation | Term | Definition in accordance with EN 1028-1 and explanation |
|---|---|---|
| $p_e$ | Inlet section pressure | Inlet pressure, measured at the measurement point specified in Annex B of EN 1028-2:2002+A1:2008.<br><br>Explanation: Pressure applied to the pump suction from a hydrant or another pump. The pressure may be zero (operation from vehicle tank) or negative (draft from open water). |
| $p_a$ | Outlet section pressure | Outlet pressure, measured at the measurement point specified in Annex B of EN 1028-2:2002+A1:2008.<br><br>Explanation: Pressure measured at the pump outlet and indicated to the operator by the appropriate gauge. During an operation the pump operator controls the pump speed in order to maintain a certain outlet pressure to provide sufficient pressure at the nozzle. The calculation is based on friction and elevation losses. Common pressures to achieve 7 bar at the nozzle are 7 bar to 10 bar during a "regular" operation. However, during certain operations the pressure may be raised up to $p_{a\,lim}$. |
| $p_{a\,max}$ | Maximum pressure | Maximum pressure that can be attained in the outlet section at geodetic nominal suction height $H_{S\,geoN}$ and maximum speed $n_0$.<br><br>Explanation: Maximum achievable pressure at nominal lift and maximum speed. This pressure results in the typical performance curve of a pump. This pressure will be almost identical to $p_{a\,lim}$ at low flows and drop once the flow increases. |
| $p_{a\,lim}$ | Limit pressure | Maximum permissible outlet section pressure $p_a$ during operation.<br><br>Explanation: Maximum permissible pump pressure ($p_a$) during operation (i.e. see Table 3 to Table 6 in EN 1028-1:2002+A1:2008). As a matter of protection the engine governors are adjusted not to exceed this pressure. However a positive inlet pressure may cause pressures in excess of $p_{a\,lim}$ once the operator does not take the appropriate action i.e. reduce pump speed. The pump operator is supposed to maintain pump- speed in a way that $p_{a\,lim}$ is not exceeded. |
| $p_{a0}$ | Closing pressure | Steady state pressure in the outlet section with a delivery flow rate $Q = 0$, at geodetic nominal suction height $H_{S\,geoN}$ and maximum speed $n_0$.<br><br>Explanation: This is the pressure the pump will achieve at maximum speed with all deliveries closed (zero flow). Engine governors are adjusted not to exceed this pressure during pump operation. During day to day operation this pressure may be applied to a pump while feeding into high risers. It is also a common field test point as lower pressures over the years at the same speed may indicate wear of internal parts. |

**Table 2** (*continued*)

| Symbol, abbreviation | Term | Definition in accordance with EN 1028-1 and additional explanation |
|---|---|---|
| $p$ | Delivery pressure | Difference between the outlet section pressure $p_a$ and the inlet section pressure $p_e$.<br>$p = p_a - p_e$<br>Explanation: This correctly determines exact performance, however operators only use $p_a$ in day to day operation as this is the value easily read on the discharge gauge. |
| $p_N$ | Nominal delivery pressure | Delivery pressure specified for the nominal delivery rate.<br>Explanation: A necessary value to determine performance ratings for pumps. As flows, lifts, outlet pressures, etc. can be different during each operation a clear and common definition for test- conditions to determine a pump rating is necessary. |
| $p_{ps}$ | Static test pressure | Pressure used for testing the integrity of the inlet side of the pump when stationary.<br>Explanation: During a static pressure test pressure from another pump ($p_{ps}$) will be applied to the pump suction. This pressure is normally $p_{a\,lim}$ for the pump to be tested. As part of the pre-delivery test of an appliance or pump this test will be carried out after assembly at the factory. The test will not be repeated regularly in the field. The test may be applied as part of "in depth" service or after major repairs. |
| $p_{pd}$ | Dynamic test pressure | Pressure used for testing the integrity of the pressure parts of the pump with the pump running, given by $p_{a\,lim}$ + 5,5 bar.<br>Explanation: During a dynamic pressure test ($p_{pd}$), the tested pump will add 5,5 bar to $p_{ps}$. A dynamic pressure test is usually not field test but is part of the development and certification process for a pump, not to be carried out by the operator. The dynamic test pressure ($p_{pd}$) is intended to hold enough safety margin to avoid any hazards if $p_{a\,lim}$ is ever exceeded. |

**Table 3 — Pressures abstracted from CEN/ TC 192 fire appliance standards**

| Symbol, abbreviation | Definition | Description | Explanation |
|---|---|---|---|
| $Q_1$ | Specified rate(s) of the water installation | Specified rate(s) corresponding to the nearest lower value(s) in the following list:<br>— 250 l/min;<br>— 500 l/min;<br>— 750 l/min;<br>— 1 000 l/min;<br>— 1 500 l/min;<br>— 2 000 l/min;<br>— 3 000 l/min;<br>— 4 000 l/min;<br>— 6 000 l/min. | Used for operational range classification |
| $p_{a1}$ | Specified outlet pressure(s) of the water installation | Specified outlet pressure(s) corresponding to the nearest lower value(s) in the following list:<br>— 6 bar;<br>— 10 bar;<br>— 15 bar;<br>— 40 bar. | Used for operational range classification |
| $d$ | Specified height of the water installation | Specified height where $d$ equals 1,5 m or 3 m | Used for operational range classification |
| – | Installed water pump | Pump permanently installed on a vehicle and driven by the motive power of the vehicle, or a pump complete with drive motor | – |
| – | – | EN 1846-3:2002+A1:2008, 5.2.2.1:<br>All parts of the water installation designed to work at a pressure higher than atmospheric pressure shall withstand the designed maximum working pressure specific to that part of the installation plus 5,5 bar without any damage. | – |

**Table 4 — Pressures abstracted from CEN/TC 192 branch pipe standards**

| Symbol | Term | Definition | Explanation |
|---|---|---|---|
| $p_R$ | Reference pressure | Standard working pressure used to run hydraulic tests | EN 15182-2<br>Pressures used for the determination hydraulic characteristics:<br>— reference pressure: $p_R$ = 6 bar;<br>— median pressure for type 4 branch pipes: $p_m$;<br>— nominal pressure: $p_N$ = 16 bar;<br>— test pressure: $p_t$ = 25,5 bar;<br>— burst pressure: $p_B$ = 60 bar.<br>EN 15182-3<br>Pressures used for determining hydraulic characteristics:<br>— reference pressure: $p_R$ = 6 bar;<br>— nominal pressure: $p_N$ = 16 bar;<br>— test pressure: $p_t$ = 25,5 bar;<br>— burst pressure: $p_B$ = 60 bar.<br>EN 15182-4<br>Pressures used for determining hydraulic characteristics:<br>— reference pressure: $p_R$ = 6 bar;<br>— median pressure for type 4 branch pipes: $p_m$;<br>— nominal pressure: $p_N$ = 40 bar;<br>— test pressure: $p_t$ = 60 bar;<br>— burst pressure: $p_B$ = 100 bar. |
| $p_m$ | Median pressure | For type 4 branch pipes, average pressure of the pressure control range | |
| $p_N$ | Nominal pressure | Maximum working pressure | |
| $p_t$ | Test pressure | Static pressure used for leakage tests | |
| $p_B$ | Burst pressure | Static pressure used for burst test | |

**Table 5 — Pressures abstracted from CEN/TC 192 portable equipment for projecting extinguishing agent standards**

| Symbol | Term | Definition | Explanation |
|---|---|---|---|
| $p_R$ | Reference pressure | Standard working pressure used to run hydraulic tests and dynamic leakage tests | EN 15767-1<br>Pressures used for the determination hydraulic characteristics:<br>— reference pressure (measured at the outlet of the portable monitor body): $p_R$ = 6 bar;<br>— nominal pressure (measured at the inlet of the portable monitor body): $p_N$ = 16 bar;<br>— test pressure (measured at the inlet of the portable monitor body): $p_t$ = 25,5 bar;<br>— burst pressure (measured at the inlet of the portable monitor body): $p_B$ = 35 bar.<br>EN 15767-2<br>Pressures, measured at the nozzle inlet, used for the determination hydraulic characteristics:<br>— reference pressure: $p_R$ = 6 bar;<br>— median pressure for automatic water nozzle: $p_m$;<br>— nominal pressure: $p_N$ = 16 bar;<br>— test pressure: $p_t$ = 25,5 bar.<br>EN 15767-3<br>Pressures, measured at the foam device inlet, used for the determination hydraulic characteristics:<br>— reference pressure: $p_R$ = (6 ± 0,1) bar;<br>— nominal pressure: $p_N$ = 16 bar. |
| $p_N$ | Nominal pressure | Maximum working pressure | |
| $p_t$ | Test pressure | Pressure used for static leakage tests | |
| $p_B$ | Burst pressure | Static pressure used for burst test | |
| $\Delta_p$ | Pressure loss | Difference between the inlet and the outlet pressure of the portable monitor body for a given flow | |
| $Q_{max}$ | Manufacturer's stated maximum flow | Flow under which the portable monitor assembly can be operated safely and efficiently | |

## 4 Recommendations

CEN/TC192 Working Groups are recommended to use and consider this Technical Report whenever a standard is being revised or a new standard being prepared.

The aim of the Working Groups should be to try and rationalise and simplify the variety of terms used in order to work towards a common set of definitions and values across the variety of equipment used in fire ground operations involving the delivery of water or other extinguishing agents.

Should any queries or issues be identified during the use of the data contained in this Technical Report, Working Group Convenors or other parties are advised to contact the CEN/TC 192 Secretariat in the first instance.

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EN 15767-1:2009, *Portable equipment for projecting extinguishing agents supplied by fire fighting pumps — Portable monitors — Part 1: General requirements for portable monitor assemblies*

EN 15767-2:2009, *Portable equipment for projecting extinguishing agents supplied by fire fighting pumps — Portable monitors — Part 2: Water nozzles*

EN 15767-3, *Portable equipment for projecting extinguishing agents supplied by fire fighting pumps — Portable monitors — Part 3: Foam devices*

EN ISO 14557, *Fire-fighting hoses — Rubber and plastics suction hoses and hose assemblies (ISO 14557:2002)*

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