



Sprinkler Pumps

Requirements and test methods

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VdS-Guidelines for water extinguishing systems

Sprinkler Pumps

Requirements and test methods

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Declaration of non-binding status

These VdS-Guidelines for water extinguishing systems, Sprinkler Pumps, VdS 2100-07en, are binding only if their application has been agreed on an individual basis.

1 Scope

These guidelines specify requirements and test methods for fire pumps (traditionally called sprinkler pumps) for use in extinguishing systems according to e.g. VdS CEA 4001, VdS 2109 and VdS 2108 fest.

Moreover, these guidelines define regulations for the approval procedure of sprinkler pumps applicable in addition to the procedure guidelines VdS 2344 and VdS 2841.

These guidelines are applicable to centrifugal pumps of the following types: above ground pumps, submersible motor pumps and vertical shaft turbine pumps. The use of submersible motor pumps at water temperatures exceeding 25°C is not regarded.

Note: The delivery head is limited inherent to the design. Therefore it is assumed that the rated pressure does not exceed 80 bar.

For other pump constructions, these guidelines can serve as a guide. In each such case it has to be assessed whether additional tests and/or measures are necessary.

2 Normative references

These guidelines incorporate, by dated or undated references, provisions from other publications (e.g. European Standards EN or International Standards IEC), which are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to these guidelines only when incorporated in them by amendment or revision. For undated references the latest edition of the publication referred to applies.

VdS CEA 4001	Guidelines for sprinkler systems – Planning and installation
VdS 2109	Guidelines for water spray systems – Planning and installation
VdS 2108	Guidelines for foam extinguishing systems – Planning and installation
DIN EN ISO 9906 : 2002-08	Rotodynamic pumps. Hydraulic performance acceptance test. Grades 1 and 2 (ISO 9906:1999); German version EN ISO 9906:1999
EN 12723	Liquid pumps – General terms for pumps and installations – Definitions, quantities, letter symbols and units
ISO 7-1	Pipe threads where pressure-tight joints are made on the threads – Part 1: Dimensions, tolerances and designation
EN ISO 228-1	Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation
EN 1092	Flanges and their joints – Circular flanges for pipes, valves, fittings and accessories, PN designated

3 Definitions

For the use of these guidelines the following definitions apply:

Allowable pressure: Pressure specified by the manufacturer at which the component may be used. On the basis of this value the test pressures are calculated and the tests are conducted.

Note: This pressure specification limits the pressure of the medium to be pumped for all operating conditions of the sprinkler pump and must take into account the simultaneous occurrence of the highest possible delivery head at zero flow or the maximum delivery head respectively, the permitted exceedance of the rotational speed of the engine and the highest possible inlet pressure.

NPSH (net positive suction head): (see EN 12723).

NPSHR (net positive suction head required): (see EN 12723) The minimum (NPSH) at the pump inlet connection required to give rated or operating performance at the specified conditions.

Pump-H-Q-curve (also known as pump head capacity curve or characteristic curve): The relationship between the total head of the pump and the flow rate at given operating/rated conditions of speed and liquid.

Stable pump H-Q-curve: A pump H-Q-curve where the maximum head and shut-off head are coincidental and the total head declines continuously with increasing rate of flow.

Q_{zul}: Permissible delivery flow (reference value for the use in extinguishing system according to VdS-Guidelines).

Wear ring (Spaltring): Wear ring made of metal between pump casing and impeller, either fixed in the casing (cover) and/or fixed in the impeller.

Seal ring (Spaltringdichtung): Sealing ring of multistage pumps with impeller and impeller casings made of formed stainless steel sheet.

4 Requirements

4.1 Marking

Sprinkler pumps shall be marked by the manufacturer with the details according to 4.1.1 and 4.1.2.

In the case of submersible motor pumps a duplicate of the name plate shall be provided for attachment to the switch cabinet.

This marking on the pump shall be non-detachable, non-flammable and permanent. It should be well legible. Adhesive foil or similar measures are not acceptable.

4.1.1 The name plate shall bear the following information:

- Manufacturer's name or trademark; location of the company headquarters
- Model designation
- Serial number/Year of manufacture
- "VdS" or VdS-Logo, and VdS Approval number
- Permissible delivery flow Q_{zul} in [l/min]
- Delivery head H in [m] at permissible delivery flow
- Rated speed nN in [1/min], at which the pump is driven. This value shall not exceed 3600 1/min.
- Required motor output PM in [kW] as per section 4.8

- Diameter of the impeller mounted in [mm]; In the case of angled blade ends, the largest and smallest impeller diameters are to be indicated (e.g. 280/270 mm)
- Maximum starting current in [A] (if necessary; see 4.8.1)

4.1.2 The pump shall be provided with the following markings and information:

- Direction of rotation
This information needs not to be present on submersible motor pumps.
- Maximum allowable pressure in [bar]
- Abbreviation identifying the alloy from which the pump casing was manufactured (e.g. JL 1040)

Note: This information need not to be present on the name plate.

4.2 Technical documentation

The manufacturer shall provide the following documents:

- General drawings together with parts list and material specifications of the following major parts, if existent: pump casing with pressure cover, pump shaft, shaft protection sleeves, impeller/impellers, impeller mounting components (impeller nut, locking plate or washer and key), wear rings (if existent).
- List with the following information:
 - Pump type, e.g. above ground centrifugal pump, with indication of the number of stages (one figure or range)
 - Allowable pressure in [bar] according to clause 4.4
 - Casing material and breaking elongation of the casing material according to clause 4.5.2
 - Material of the single parts according to clause 4.5.2
 - Standard of connections according to clause 4.3
 - Minimum bypass flow in [l/min] or [m³/h] according to clause 4.7.4
 - Maximum starting torque and torque at maximum power consumption (as graphic presentation or as table of values)
- Charts for characteristic curves
- The operating manual to be supplied with every pump
- Image/drawing of the name plate

The following data shall appear in the charts of the characteristic curves:

- Model designation
- VdS Approval number with or without VdS-Logo
- Delivery flow in [l/min] and [m³/h]
- Delivery head in [m] and guaranteed delivery head design tolerance for the whole delivery flow range

Note: Maximum permitted tolerances in the range 50% to 100% of the permissible delivery flow are in case of double-sided tolerance $\pm 5\%$ and in case of single-sided positive tolerance $+6\%$. Outside of this range, tolerances up to $\pm 6\%$ or $+7\%$ respectively are permitted.

- Permissible delivery flow Q_{zul} in [l/min] or [m³/h], at least as marking on the curve(s) in the approved impeller range, with wording „Zulassungsgrenze“ (“Rated Capacity”).
- Required power in [kW]
- If applicable, maximum current load in [A] (see 4.8.1)
- NPSHR in [m]
- Rated speed in [1/min]

- Impeller diameter in [mm]
- Minimum water coverage depth in [m] for submersible motor pumps
- Minimum bypass flow in [l/min], [m³/h] or % of Q_{zul}
- Nominal diameter of the pump inlet, not applicable to submersible motor pumps
- Nominal diameter of the pump outlet.

Delivery flow, delivery head, power requirements and NPSHR are guaranteed values according to DIN EN ISO 9906, at least grade 2.

Note: This means that for all pumps produced

- *the delivery head is within the guaranteed tolerance in the whole delivery flow range; and*
- *the required power does not exceed the guaranteed required power; and*
- *NPSHR does not exceed the guaranteed NPSHR.*

4.3 Connections

The inlet and outlet connections should preferably be designed according to EN 1092. Threaded connections shall be designed according to ISO 7-1 or EN ISO 228-1.

Sprinkler pumps having leakage water due to the design must be equipped with a connection to drain the leakage water.

Further connections due to the design are allowable.

4.4 Resistance to pressure

The manufacturer shall specify the allowable pressure (according definition in section 3) of the pump casing. The allowable pressure shall be at least 10 bar.

4.5 Design requirements

4.5.1 In the interest of achieving the shortest possible repair periods, it shall be possible – using standard tools only – to replace all essential functional components or subassemblies at the installation site.

Parts replaceability shall be guaranteed by the specification of appropriate tolerances.

The design of the bearings and shaft seals as well as the play in the rotating parts shall be such as to permit trouble-free operation even after extended periods out of service (maximum 6 months). This requirement is normally fulfilled with the use of proven and tested elements, such as ball-bearings, gland packings, mechanical seals, wear rings (see 4.5.2).

If axial choke gaps, necessary by the design, are present at the impeller, then the section of the casing affected is to be fitted with wear rings (see 4.5.2).

4.5.2 The pump casing shall be made of cast steel, ductile cast iron, aluminium bronze, gunmetal, red bronze or another metal with at least equivalent characteristics. The elongation at break of these materials shall be at least 15%. In case the delivery head does not exceed 110 m and the allowable pressure does not exceed 12 bar, then cast iron JL 1040 or at least equivalent material is sufficient.

Pump shafts, shaft protection sleeves, impellers, impeller mounting components (impeller nut, locking plate or washer and key) and wear rings shall be made of non-rusting metal with a melting point > 800°C.

Seal rings (see also section 3) shall be made of adequate material – e.g. designed as flat plastic ring, equal/higher quality as PTFE (Teflon) or elastomer O-ring, equal/higher quality as EPDM, VITON, HNBR.

4.5.3 The connection of pumps to motors shall be made separably by a coupling.

As to horizontally mounted single-stage above-ground pumps including pumps in Back-Pull-Out-design, the coupling between motor and pump shall be designed in such a way that both can be removed independently, with the pump casing staying in the pipeline during inspection and replacement of parts.

4.6 H(Q) characteristic curve, delivery flow and delivery head

4.6.1 H(Q) characteristic curves (pump choke curves) of sprinkler pumps should be stable (i.e. the delivery head should have its maximum value at zero delivery flow or minimum bypass flow and should decline with increasing delivery flow) and flat. An instability is only allowable as follows. The delivery head at zero delivery flow or minimum bypass flow may be up to 5 % (however no more than 5 m) below the maximum delivery head.

4.6.2 The deviations between the characteristic curve specified by the manufacturer and the values recorded during the test according to 5.2 may be 5% of the maximum delivery head in the flow range from the minimum bypass flow up to 0.5 permissible delivery flow (Q_{zul}). In the range of 0.5 Q_{zul} until the end of the characteristic curve the values recorded during the test according to 5.2 have to be transferred unchanged (without deviation) into the characteristic curve.

4.6.3 The permissible delivery flow (Q_{zul}) is determined as delivery flow at 4.5 m NPSHR, in the case of submersible motor pumps and vertical shaft turbine pumps in feed operation at 8.5 m NPSHR.

When delivering at 1.2 times the permissible delivery flow, an NPSHR of 5.5 m shall not be exceeded (in the case of submersible motor pumps and vertical shaft turbine pumps in feed operation 9.5 m).

The criterion for NPSHR is a 3% drop in the delivery head for the first stage of multi-stage pumps or for single-stage pumps operating at fixed speed and constant delivery flow.

4.6.4 The manufacturer shall specify the minimum bypass flow in order to reduce a possible pump breakdown with closed valve. The minimum bypass flow has to be proved by a test according to 5.2.6.

The manufacturer may provide a connection on the pump for the bypass flow.

4.8 Drive power and torque

4.8.1 The power provided by the drive motor shall be sufficient in the whole range of the H(Q) curve.

Note: The VdS-Guidelines for planning and installation contain the following requirements for the selection of motors which will be considered during the test of submersible motor pumps where pump and motor are clearly specified.

Overload values or values for short time operation which are allowed in the standards for electric or diesel motors shall not be applied.

The torque of the drive motors shall be greater as the countertorque exerted by the pump all the way from standstill to rated speed. Maximum pump power requirements are to be taken as the basis for determining the countertorque.

As to submersible motor pumps where pump and motor are clearly specified the maximum current drawn during starting has to be stated on the name plate (the current surge in the star-delta changeover phase shall be taken into consideration!).

Note: Drive power may be provided by an electric motor with direct coupling. The motor speed may not exceed 3600 1/min (r.p.m.).

4.8.2 In the case of pumps which exhibit an output curve which continues to rise when operating in the overload range, the output of the drive motor shall be such that it is equivalent to not less than delivery flow corresponding to an NPSH value of 15 m.

Note: An additional output dimensioning for a NPSH value of 16 m can be made on request of the manufacturer.

Note: No safety factor is included in the characteristic curve itself.

Note: In the VdS-Guidelines for planning and installation it is required, when using pumps with output curve increasing in the overload area, that the motor power has to be increased to 1.2 times the motor power according to the charts of the characteristic curves if the operational pressure at the inlet port equals or exceeds 0.5 bar.

4.8.3 In the case of pumps having a demonstrable peak along the output curve (non overloading curve), a value 1.05 times this peak value is to be used for the determination of the motor power.

Note: The safety factor of 5 % is not included in the characteristic curve itself, but in the motor power specification in the charts of the characteristic curves.

4.8.4 The manufacturer shall specify the motor power determined according to 4.8.2 or 4.8.3 – whichever applies – as "necessary motor power [kW]", rounded up to the next IEC standard motor power* (does not apply to submersible motor pumps), on the charts of the characteristic curves allocated to the individual impeller diameters. In addition there shall be a remark that with the use of an electric motor this motor power has to be rounded up to the next higher power according to IEC standard motor powers.

- For the marking of the required power on the name plate the following applies:
- Pumps for electric power: required power according 4.8.2 or 4.8.3 rounded up to the next IEC standard motor power* (does not apply to submersible motor pumps).
- Pumps for diesel power: required power according 4.8.2 or 4.8.3.

* The motor power determined according 4.8.2 or 4.8.3 is rounded first. If the rounded value does not coincide with an IEC standard motor power, the next higher IEC standard motor power must be specified as required power. If the standard motor power contains a decimal place, the rounding of the motor power determined according 4.8.2 or 4.8.3 refers to this decimal place.

5 Tests

5.1 Test conditions

The tests are conducted at a temperature of (25 ± 10) °C unless specified otherwise for a specific test.

The tolerance of all test parameters is ± 5 % unless specified otherwise.

5.2 Type testing

5.2.1 Type testing is conducted with tests – by VdS or in presence of VdS at the test facility of the manufacturer or at a test facility accepted by VdS – according to DIN EN ISO 9906 at least class 2.

5.2.2 Before testing the details in the documents submitted are checked for compliance with these guidelines and the referenced guidelines and standards.

5.2.3 During the tests the pumps with maximum and minimum impeller diameter and with the impeller diameters in between which are matching the IEC standard motor powers are tested.

The measurements required for the test evaluation according to DIN EN ISO 9906 are done at 7 points equally distributed over the delivery range.

NPSHR has to be determined in five usefully distributed points between $0.3 Q_{zul}$ and the maximum delivery flow to be measured.

The maximum delivery flow to be measured is a result from the values to be determined for the required power in consideration of the addition of 1.0 m to the NPSH value.

Note: See section 6.2 for the issue of additional charts of the characteristic curves for deviating impeller diameters.

5.2.4 In case of a range of speeds the pumps with maximum and minimum impeller diameter are tested each with the minimum and maximum speed.

Note: See section 6.3 for the issue of additional charts of the characteristic curves for deviating speed.

5.2.5 In case of multi-stage pumps the NPSHR test is done with the minimum number of stages and the Q-H-P test with the maximum number of stages.

Note: Approval tests which had been carried out with other numbers of stages before the publication of these Guidelines do not have to be repeated with the numbers of stages required here.

5.2.6 The pump shall be run for a minimum of 2 hours with the maximum impeller diameter at maximum allowable continuous speed and the minimum by-pass flow specified by the manufacturer.

The pump inlet and outlet temperatures shall be measured throughout the test.

The maximum water temperature rise across the pump shall not exceed 10 °C for the duration of the test.

Measure the delivery head, flow rate and power input throughout the test at intervals of not exceeding 15 minutes.

All parameters shall be measured in accordance with EN ISO 9906:2000 Grade 2.

Using a temperature measuring device with an accuracy of ± 2 °C. Temperature measurements shall be made:

- at the pump suction inlet; and
- at an outlet measuring section normally located at a distance of two diameters from the pump outlet casing

5.3 Other tests

Where special designs, special performance characteristics or new manufacturing methods make it necessary, additional tests will be conducted in agreement with the manufacturer.

6 Additional provisions for the approval procedure

6.1 Pump casing pressure tests by the manufacturer

The manufacturer must conduct a pressure test with each pump casing in finished condition or in assembled condition:

- Test medium: water
- Test pressure: 1,5 times allowable pressure

During and after the test no signs shall be visible for

- breaks/cracks, or
- inadmissible plastic deformation.

6.2 Pumps with not-tested impeller diameters in approved impeller range

The manufacturer is allowed to issue characteristic curves for pumps with not-tested impeller diameters and indicate the pumps as VdS-approved provided that:

- the impeller diameter is within the approved impeller range.
- the impeller diameter is not more than 5% bigger or smaller than a tested impeller diameter.
- the characteristic curves are calculated according DIN EN ISO 9906.

6.3 Pumps with not-tested speed in approved speed range

The manufacturer is allowed to issue characteristic curves for pumps with not-tested speed and indicate the pumps as VdS-approved provided that:

- the speed is within the approved speed range.
- it is proved that the NPSH-value of the pump can be converted according the formula (see DIN EN ISO 9906):

$$(\text{NPSHR})_T = (\text{NPSHR}) \cdot (n_{sp}/n)^x$$

with:

$(\text{NPSHR})_T$ = corrected NPSHR for the specified speed n_{sp}

(NPSHR) = determined NPSHR at measured speed n

n_{sp} = specified speed

n = measured speed

x = conversion exponent according manufacturer specification

- the conversion of the test data is done according to DIN EN ISO 9906 class 2.

If these conditions are fulfilled, charts of the characteristic curves can be issued down to 0.75-fold maximum and up to 1.5-fold minimum tested speed.

Annex A

Annex A.1 Example of a name plate

Manufacturer	Company logo/ Company site
„Sprinkler pump“	Model designation:
Serial number:	Year of manufacture:
Q_{zul} : l/min	„VdS“ or VdS- Logo
n_N : 1/min	H: m
Impeller diameter: mm	P_M : kW
Casing material:	max. starting current*: A

* if necessary (see 4.1.1)

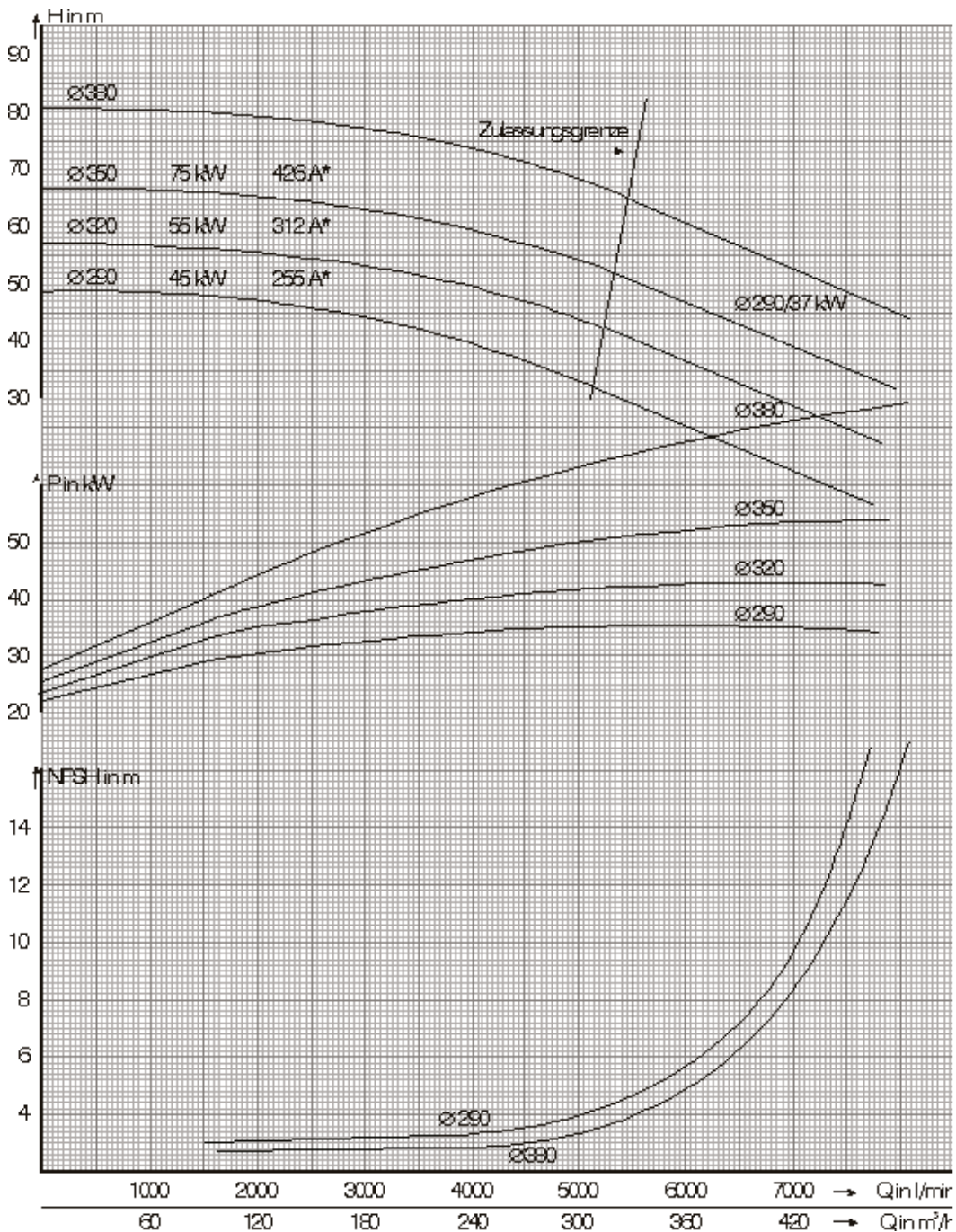
Annex A.2 Example for the H(Q) charts of the characteristic curves

Where the intention is to use electrical drive for the pump, drive speeds of 2940 1/min (r.p.m.) and 1470 1/min (r.p.m.) should be used in preparing the charts of the characteristic curves.

Where the intention is to use diesel engines for the pump, charts of the characteristic curves for the maximum and the minimum speed shall be prepared. In case of a speed in between, the charts of the characteristic curves shall be prepared for the speed ordered and attached to the sales papers of the sprinkler pump.

The speeds selected for the H(Q) curve charts may not deviate by more than 1.5 % from the speed used in nominal operation.

Example chart:



Manufacturer:	VdS-Approval number: Pxxxxxx	Impeller diameter: mm	Rated speed n_N: 1/min	Min. bypass flow: l/min m ³ /h % of Q_{zul}
Sprinkler pump, model:		DN_S :	No of stages:	
Date of drawing:		DN_D :	Minimum water coverage depth: m	

When an electric engine is used, the engine power has to be rounded up to the next higher IEC standard engine power.

