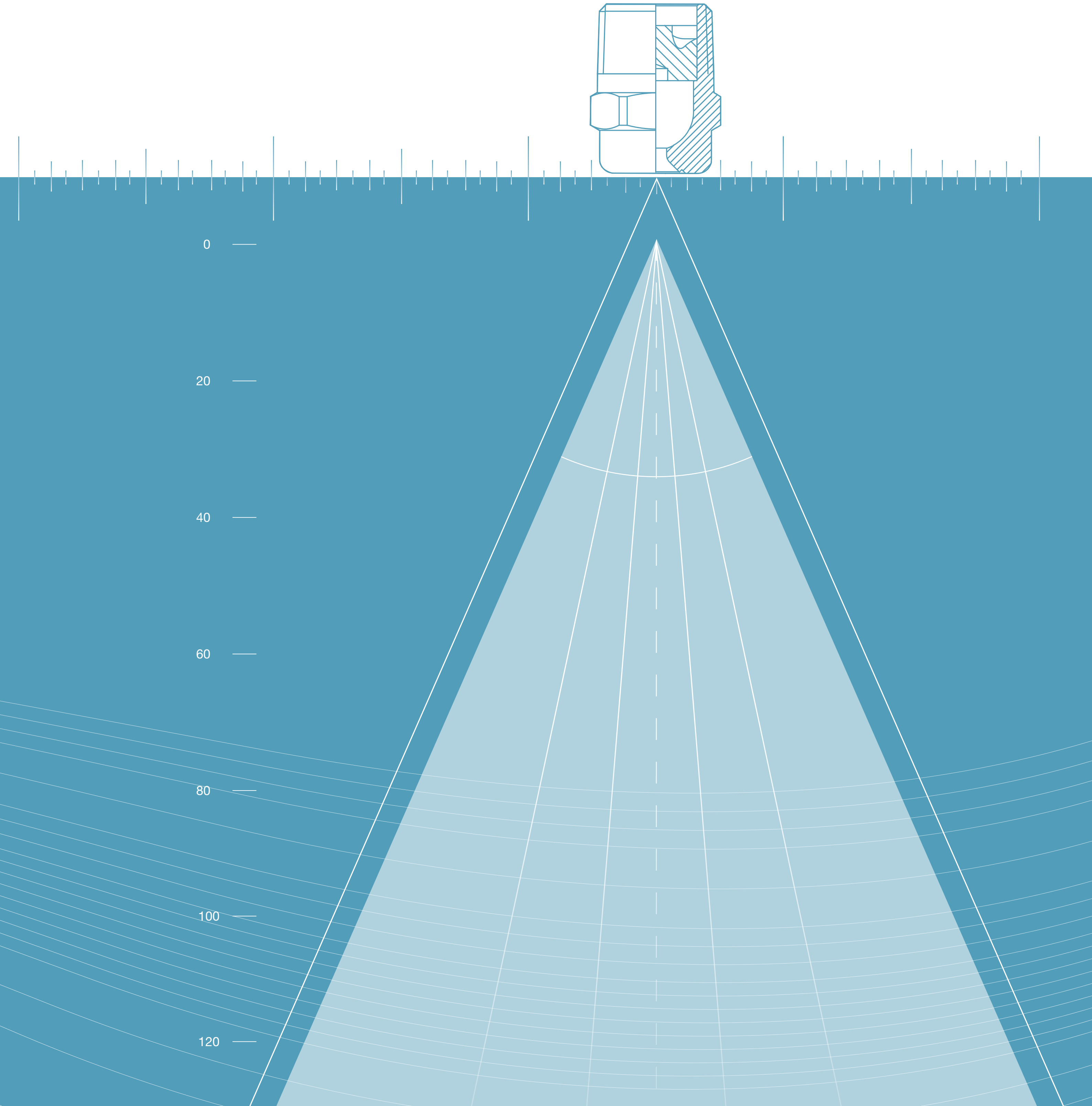
PLANNING AIDS



PLANNING AIDS
YOU CAN COUNT ON OUR SUPPORT

To achieve the optimum spray pattern for your application, numerous influencing factors must be taken into account. The following provides an overview of the key parameters. Needless to say, we will be more than happy to help you find the ideal nozzle.

- **Flow rate**
- **Droplet size**
- **Spray angle**
- **Viscosity**
- **Impact**
- **Nozzle arrangement**
- **Determination of the pipe diameter**
- **Conversion tables**
- **Lechler online services**
- **Certificates and declarations**

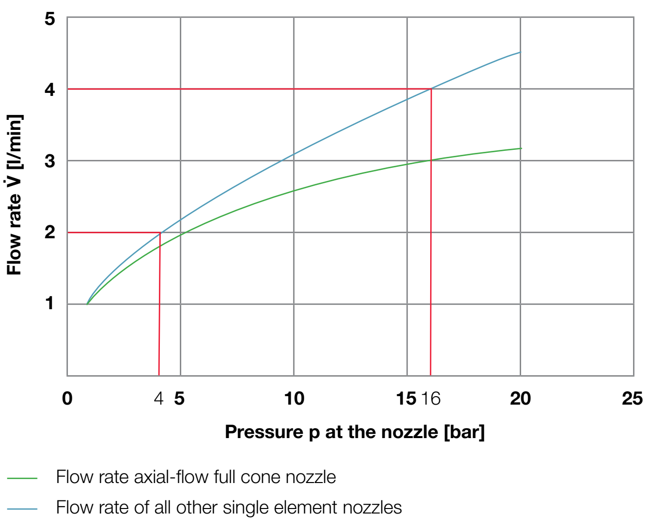
Flow rate conversion

With single element nozzles, the flow rate is controlled exclusively via the connection pressure.
The following correlation applies:

	Axial-flow full cone nozzles	All other single element nozzles
Calculation of the flow rate $\dot{V}$ [l/min] at a given pressure p [bar]	$\dot{V}_2 = \left(\frac{p_2}{p_1}\right)^{0,4} \cdot \dot{V}_1$	$\dot{V}_2 = \sqrt{\frac{p_2}{p_1}} \cdot \dot{V}_1$
Calculation of the pressure p [bar] at a given flow rate $\dot{V}$ [l/min]	$p_2 = \left(\frac{\dot{V}_2}{\dot{V}_1}\right)^{2,5} \cdot p_1$	$p_2 = \left(\frac{\dot{V}_2}{\dot{V}_1}\right)^{2} \cdot p_1$

Flow rate via pressure

Pressure-flow rate chart for two single element nozzles



All pressure values refer to the difference Delta p between the connection pressure and the ambient pressure.

$\Delta p = p_1 - p_2$

To double the flow rate, four times the connection pressure is, thus, required for all single element nozzles, except for axial-flow full cone nozzles.

Flow rate as a function of the medium density

For media with a lower density than water, the volume rate increases.

$\dot{V}_W = \frac{\dot{V}_{Fl}}{X}$	$\dot{V}_W$ = flow rate of water [l/min, l/h]
$\dot{V}_{Fl} = \dot{V}_W \sqrt{\frac{\rho_W}{\rho_{Fl}}} = \dot{V}_W \cdot X$	$\dot{V}_{Fl}$ = flow rate of the liquid whose density deviates from 1,000 [kg/m^3]
$X = \sqrt{\frac{\rho_W}{\rho_{Fl}}}$	X = multiplier ρ = density [kg/m^3]

ρ_{Fl}	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000
X	1.41	1.29	1.20	1.12	1.06	1.00	0.95	0.91	0.88	0.85	0.82	0.79	0.77	0.75	0.73	0.71

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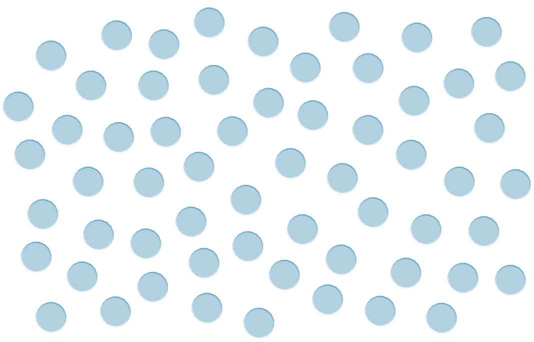
DROPLET SIZE

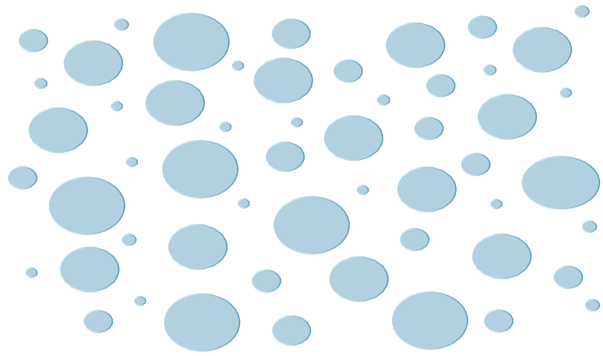
Each nozzle produces a spray of differently sized droplets (polydisperse spray). For many applications (e.g. evaporative cooling, absorption processes), the size of the total surface area of all the droplets is crucial. The Sauter mean diameter (D_{32}) was defined for this reason.

If you transform the total volume of the droplets of a spray into droplets of equal size, which in sum would have the identical volume/surface ratio as the actual spray, these droplets would have the Sauter mean diameter.

Monodisperse spray
(quite rare in reality)

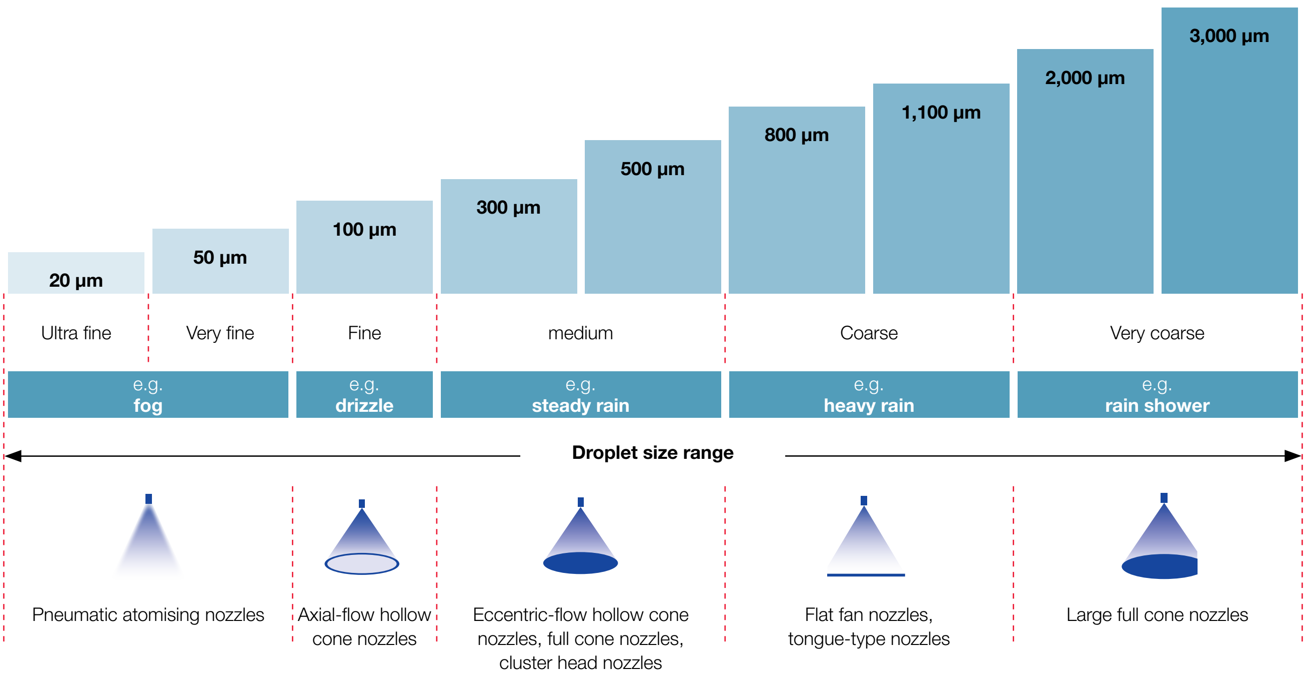


Typical droplet distribution of the spray of a single element nozzle

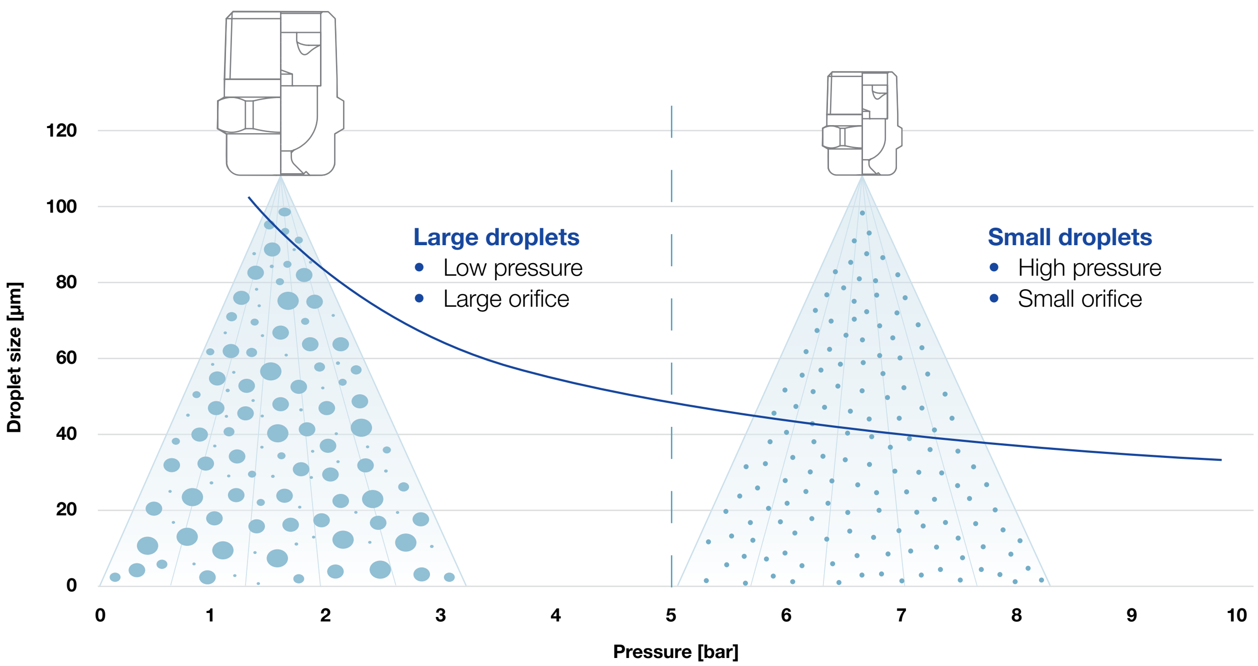


The sprays have varying droplet sizes. However, the ratio of surface area to volume is the same for both and thus also their Sauter mean diameter.

Rough classification of droplet sizes



Droplet diameter as a function of the operating pressure



Influences on the droplet size

The following applies in general to all single element nozzles:

- The higher the **operating pressure**, the finer the droplets.
- The smaller the **nozzle outlet bore**, the finer the droplets.
- The higher the **viscosity** of the medium being atomised, the larger the droplets.

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SPRAY ANGLE

Cone and flat fan nozzles are available with varying spray angles. The spray angle can significantly influence the result of the process and should, therefore, be chosen carefully. The angles specified in the tables apply to operation with water at the respective design pressure. In case of deviating operating conditions, the angle may deviate from this value.

Influences on the spray angle

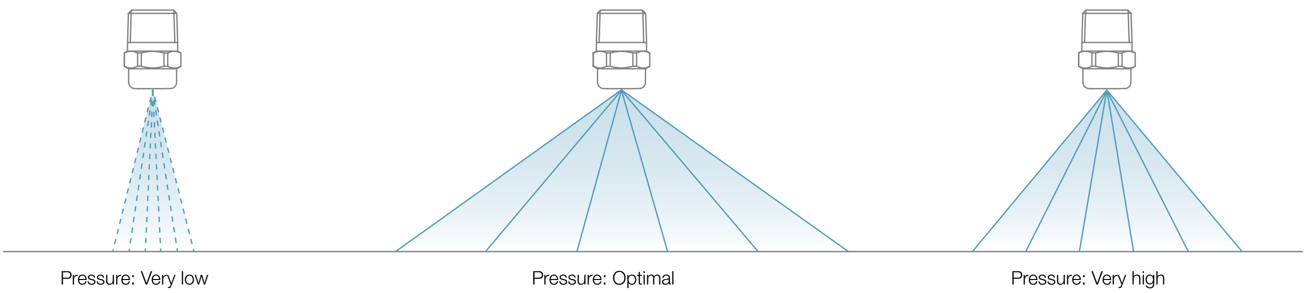
The following factors influence the size of the spray angle:

- **Pressure**
  The operating pressure has a significant influence on the spray angle. At very low or very high pressure levels, the spray angle is smaller than at the optimum operating pressure.

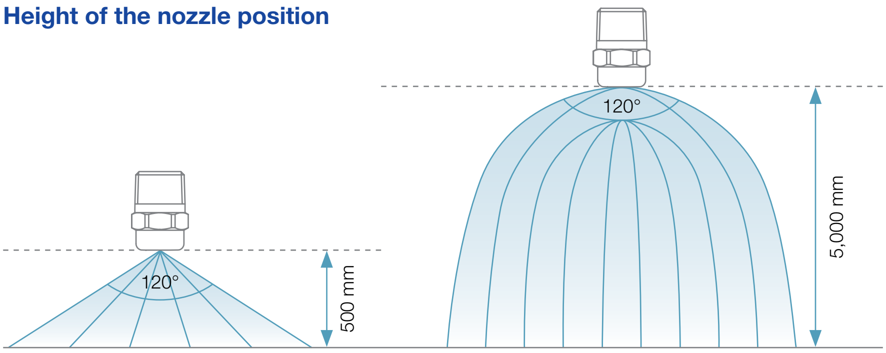
- **Distance**
  At small distances, the spray width initially increases with the distance and can be determined easily using the trigonometric function. Straight-line pattern can be assumed. With greater spraying heights, the trajectory points increasingly downwards, thus reducing the effective spray angle.

- **Viscosity**
  The higher the viscosity of the liquid being sprayed, the smaller the spray angle. The viscosity of liquids can usually be reduced by heating them up.

Change in the spray pressure



Height of the nozzle position

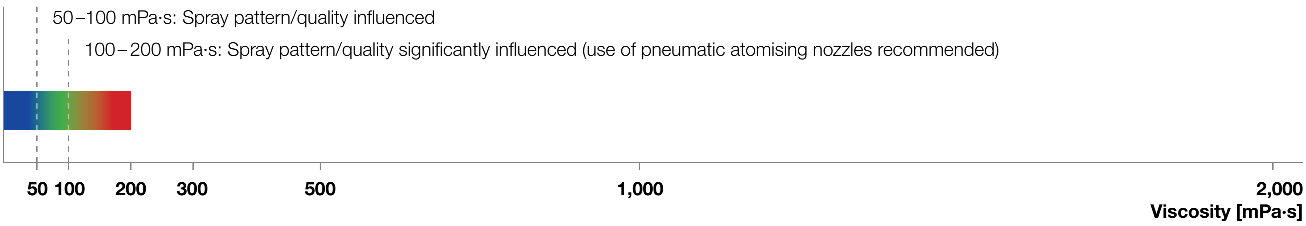


VISCOSITY

The viscosity of a liquid has a significant influence on the spray behaviour of the nozzle. When selecting the right nozzle, the viscosity must, therefore, be taken into account.

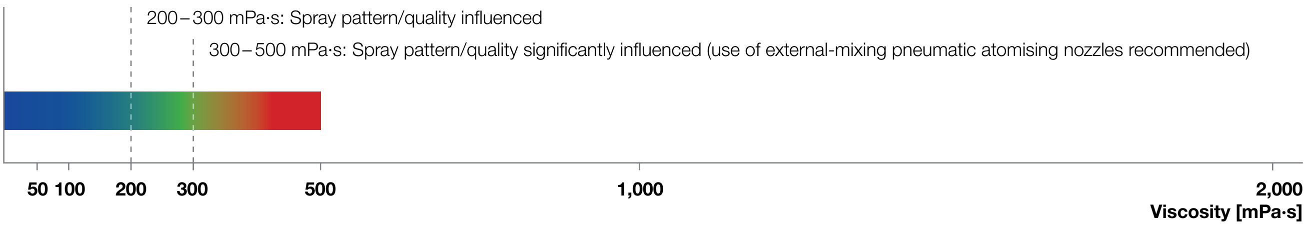
Single element nozzle

Example: Hollow cone, full cone, flat fan nozzles



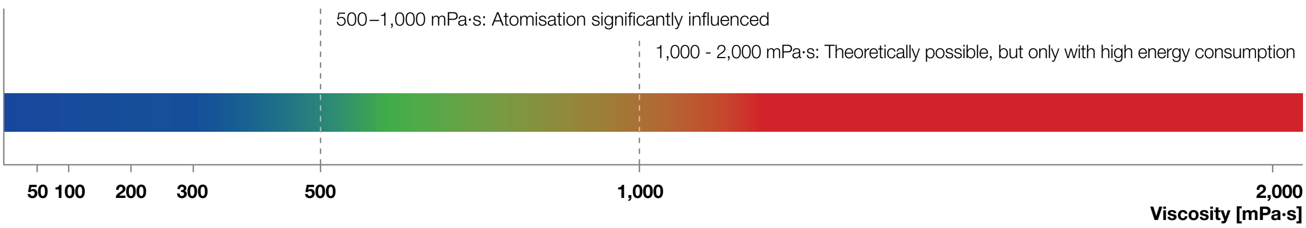
Pneumatic atomising nozzles (internal mixing)

Example: Series 136.1, 136.2, 136.4, 136.5, 166.1, 166.2, 166.4, 140



Pneumatic atomising nozzles (external mixing)

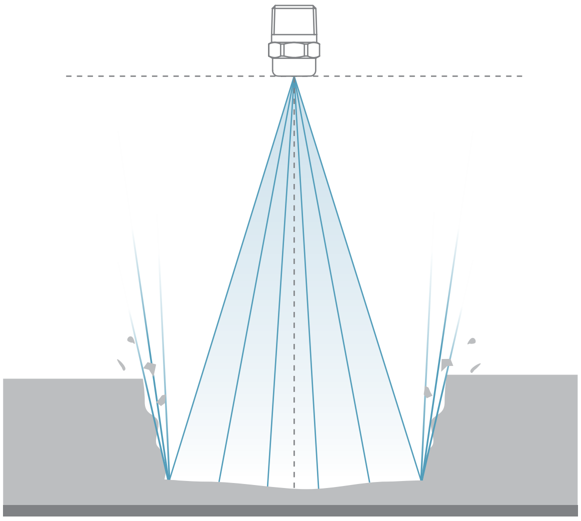
Example: Series 136.3, 136.6, 166.6, 176



- No influence on the spray pattern
- Influence on the spray pattern
- Significant influence on the spray pattern

Medium	Temperature [°C]	Viscosity [mPa·s]
Water	20	1
Milk	20	2
Olive oil	20	108
Olive oil	60	20
Sugar solution 65° Bx	20	120
Sugar solution 70° Bx	20	400
Gelatine	45	1,200

IMPACT



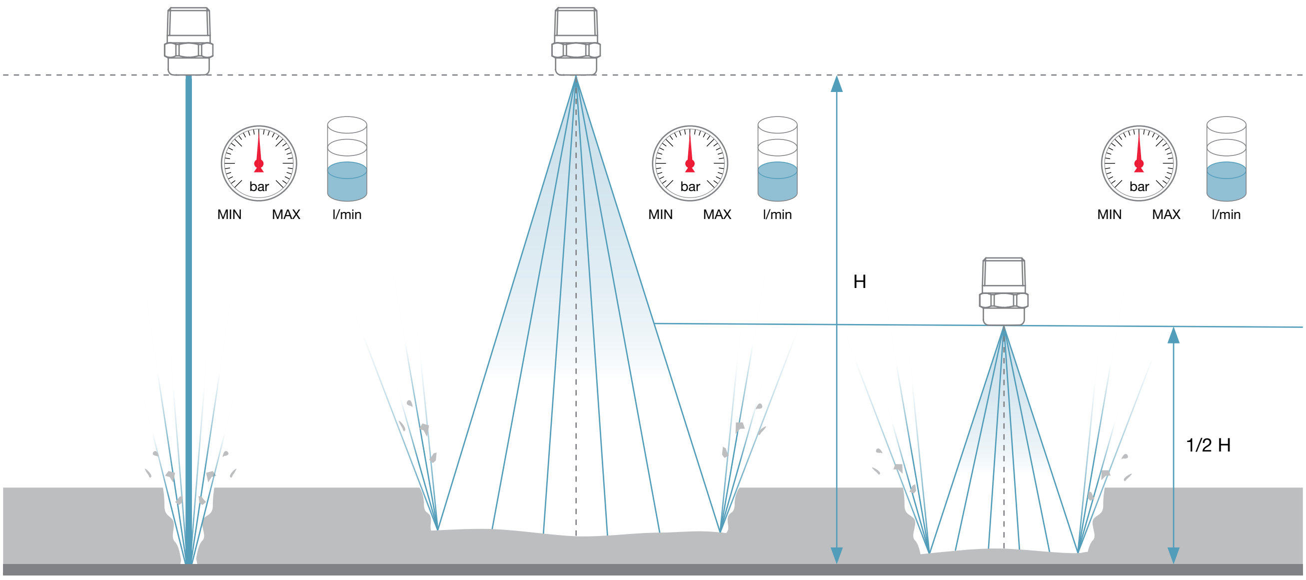
Impact is the pressure in N/mm² that the spray jet generates as its strikes the surface. This is crucial for the majority of cleaning tasks. The greater the impact, the better the cleaning result. Lechler high pressure nozzles are characterised by a uniformly high impact across the entire spray width.

$$I = \frac{\text{Impact force}}{\text{Impact surface}} = \frac{F}{A} \ [N/mm^2]$$

Influences on the impact

The following factors influence the size of the impact:

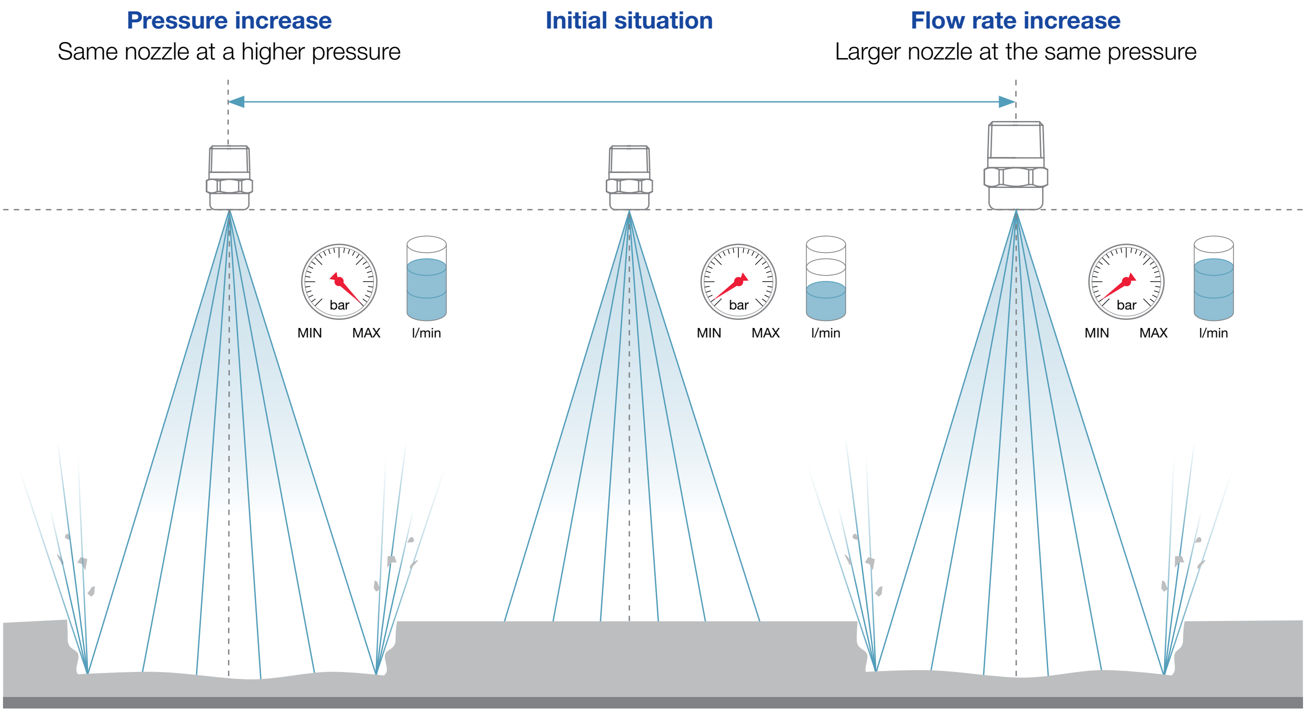
- **Impact surface and jet shape**
  The impact surface is the area where the spray jet strikes. The smaller the impact surface, the greater the impact. The highest impact values can be achieved with solid stream nozzles and flat fan nozzles with a small spray angle.



Comparison of the cleaning result of three nozzles at an identical pressure level and flow rate.

- **Pressure**
  An increase in the connection pressure leads to an increase in the impact.

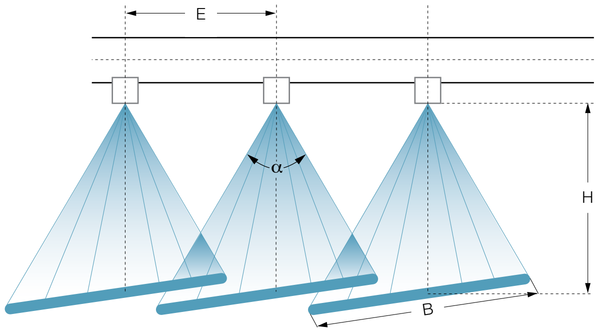
- **Flow rate**
  An increase in the flow rate by using a larger nozzle leads to a higher impact with otherwise unchanged parameters (spray angle, pressure and medium).



Comparison of the cleaning result of three nozzles with an increase in the pressure level and flow rate.

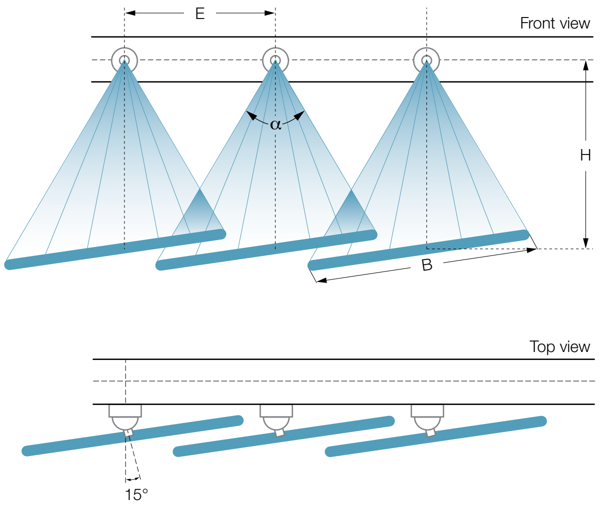
PLANNING AIDS
NOZZLE ARRANGEMENT

Arrangement of flat fan nozzles with parabolic liquid distribution



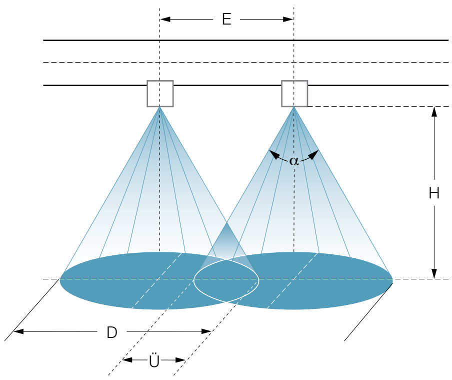
Lechler flat fan nozzles ensure consistent, uniform coverage over the impact surface. For this purpose, the spray widths B should overlap by approx. 1/3 to 1/4. To stop the sprays interfering with each other, the nozzles should be aligned at an angle of approx. 5-15° to the longitudinal axis of the pipe.

Arrangement of tongue-type nozzles



To achieve uniform impact surface coverage, the tongue-type nozzles must be arranged in such a way that the spray widths B overlap by 1/3 to 1/4. Therefore, the nozzles should be inclined at an angle of 15° to the vertical of the longitudinal axis of the pipe (either with a nipple welded on at an angle or a Lechler ball joint) to prevent interference of the spray.

Arrangement of full cone nozzles and hollow cone nozzles

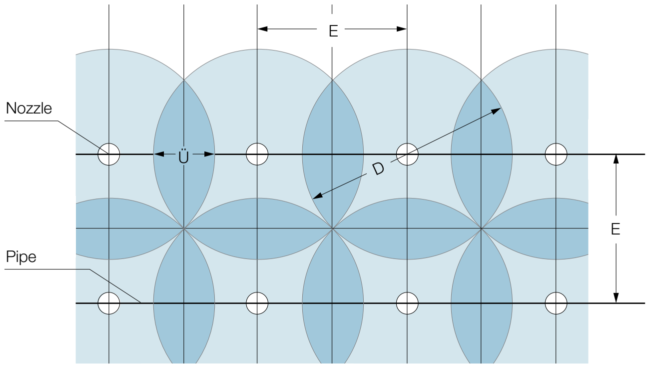


With full cone and hollow cone nozzles, the size of the nozzle distance E must ensure that the circular impact surfaces overlap by approx. 1/3 to 1/4.

E = nozzle distance H = nozzle installation height B = spray width α = spray angle Ü = overlapping of the spray angle D = spray diameter

Square and offset arrangement of full cone nozzles and hollow cone nozzles

Square arrangement

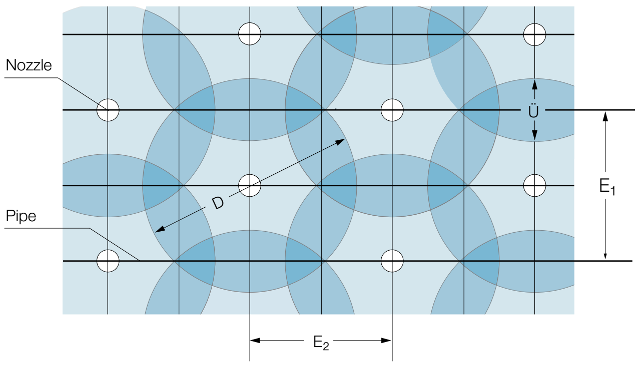


Nozzle distance: $E = \frac{D}{\sqrt{2}}$

Overlapping: $Ü = D - E$

In addition to these arrangement suggestions, please note the information on the spray angle on Page 264 and request a detailed spray width diagram, if required.

Offset arrangement

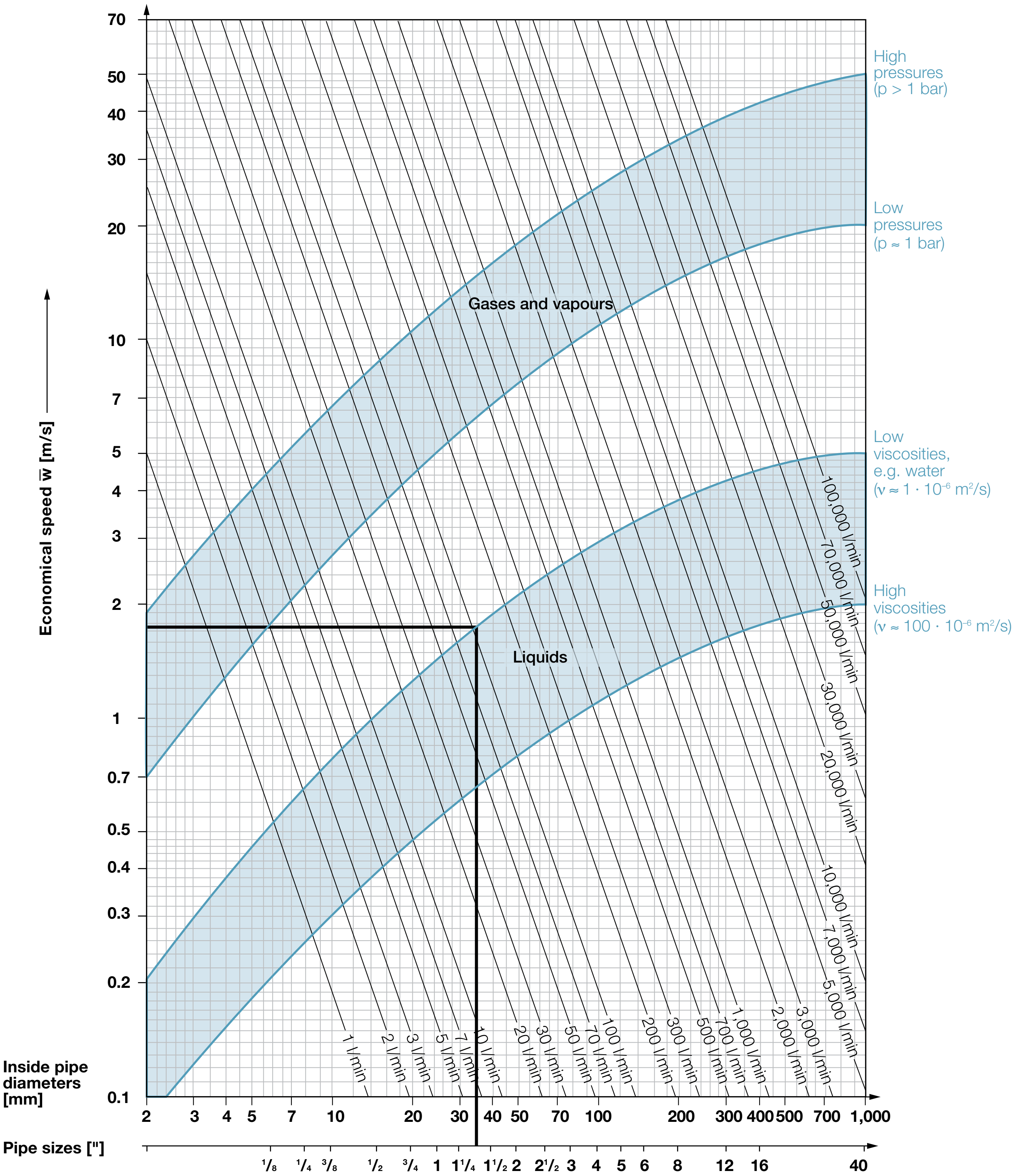


Nozzle distance: $E_1 = \frac{D}{2} \cdot \sqrt{3}$

Nozzle distance: $E_2 = \frac{3}{4} \cdot D$

Overlapping: $Ü = D - E_1$

DETERMINATION OF THE PIPE DIAMETER



The flow rate data in the diagram refers to gases and steam in operating condition.

Example

You want to atomise 100 litres of water a minute. The viscosity of water is $\nu \approx 1 \cdot 10^{-6}$ m²/s. In the diagram above, look for the intersection of the corresponding viscosity curve and the flow rate lines. Using the coordinates of this point, you can discover the correct inner pipe diameter or pipe size and the most efficient speed.

PLANNING AIDS
CONVERSION TABLES

All the flow rate data in this catalogue is based on measurements with water and takes into account the individual flow parameters of the various nozzle designs.

p pressure

Unit	Conversion			
	bar	Pa = N/m^2	psi	lb/sq ft.
1 bar	1	100,000	14.5	2,089
1 Pa	$1 \cdot 10^{-5}$	1	$14.5 \cdot 10^{-5}$	0.0209
1 psi	0.06895	6,895	1	144
1lb/sq ft.	$0.479 \cdot 10^{-3}$	47.9	$6.94 \cdot 10^{-3}$	1

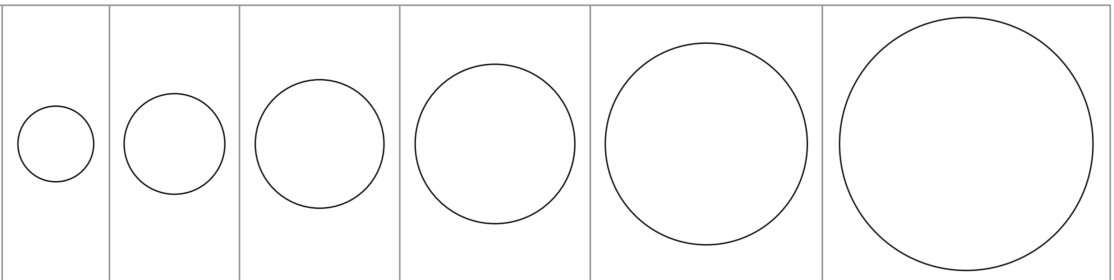
V volume

Unit	Conversion			
	l	m^3	Imp. gal	US gal
1 l (1 dm^3)	1	$1 \cdot 10^{-3}$	0.22	0.264
1 m^3	1,000	1	220	264.2
1 Imp. gal	4,546	$4{,}546 \cdot 10^{-3}$	1	1,201
1 US gal	3,785	$3{,}785 \cdot 10^{-3}$	0.8327	1

$\dot{V}$ flow rate

Unit	Conversion				
	l/s	l/min	m^3/h	Imp. gal	US gal
1 l/s	1	60	3.6	15.85	13.2
1 l/min	0.0167	1	0.06	0.2642	0.22
1 m^3/h	0.2778	16.67	1	4.4	3.66
1 Imp. gal/min	0.0631	3.785	0.227	1	0.8327
1 US gal/min	0.076	4.546	0.273	1.201	1

Determination of the external thread diameter



Nominal size of thread ["] for ISO 228 and EN 10226	1/8	1/4	3/8	1/2	3/4	1

ISO 228 threads are cylindrical and usually require a separate flat gasket or R-ring for sealing.
EN 10226 threads are conical and can be sealed with sealing tape, etc.

LECHLER ONLINE SERVICES

You can find all the latest information about Lechler, our products and services at any time at www.lechler.com.

3D design data

With the free 3D design data of Lechler nozzles and accessories, we support your design needs at every step.

After registering free of charge, you can download the required data packs in all common CAD formats at **http://lechler.partcommunity.com**.

- Time-saving, direct download of construction drawings and technical data
- Simple product selection similar to the Lechler print catalogue
- Preview function with product photo and 3D graphics
- Available in all common 3D file formats

Always at hand – the Lechler industry app

The Lechler industry app provides all important calculation and conversion programs combined in one interface:

- Unit calculator for pressure, volume and flow rate
- Pressure/Flow rate calculator for single element nozzles, including axial-flow full cone nozzles
- Determination of the pipe diameter

Available free of charge in the Apple App Store and the Google Play Store.

iOS (Apple)

Android (Google)

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CERTIFICATES AND DECLARATIONS

We can issue various certificates and attestations for our products. Whether the desired document can be issued for a specific product must be checked in advance. We will be more than happy to inform you of the conditions for the documents upon request.

Declaration of Compliance EN 10204 - 2.1

This declaration of compliance confirms that the products supplied have been manufactured and tested in accordance with the relevant specifications.

Test Report EN 10204 - 2.2

The test report can be issued either with regard to the material (including the non-specific material certificate of the supplier) or with regard to the spray parameters (spray angle and flow rate, without an additional document).

Inspection Certificate EN 10204 - 3.1

The inspection certificate is usually issued with regard to the material. In this case, the parts are manufactured order-related with re-stamping.

However, a specific certificate can also be issued with regard to the flow rate, spray angle, dimensions of nozzles, etc.

FDA Declaration of Conformity

Confirmation that the material used complies with FDA regulations.

Declaration of Conformity to regulation (EC) no. 1935/2004 and (EC) no. 10/2011

Confirmation that the product supplied is suitable for use with foodstuffs and that the material complies with the stated regulations.

Supplier’s Declaration

Certificate issued by Lechler confirming that the products have been wholly produced or originate in the European Union. A supplier’s declaration can be issued in relation to a specific order (individual supplier’s declaration) or as a long-term supplier’s declaration that remains valid for two years.

Certificate of Origin

Official confirmation of the origin of a product, certified by the Chamber of Commerce and Industry.

GREAT ATTENTION TO DETAIL
PRECISION BY LECHLER

ENGINEERING
YOUR SPRAY SOLUTION

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