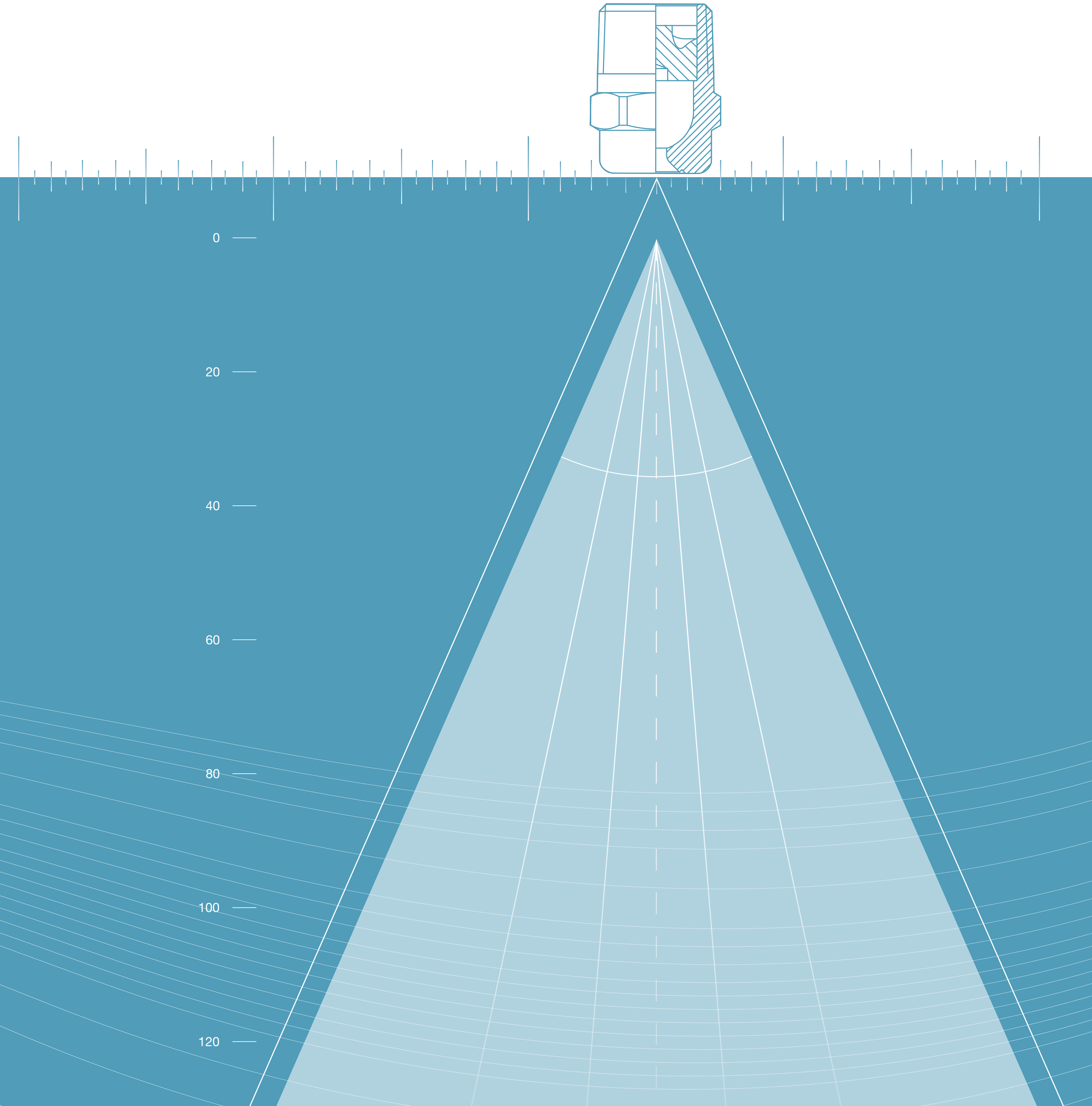
ENGINEERING
YOUR SPRAY SOLUTION

LECHLER TECHNICAL PLANNING GUIDE



TECHNICAL PLANNING GUIDE
YOU CAN COUNT ON OUR SUPPORT

In order to achieve optimum spray nozzle performance for your application, various influencing factors need to be considered. Some of the considerations listed below are key influencing parameters that can effect your process. For support you can count on, contact Lechler for help in selecting the ideal nozzle for your process needs.

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

TECHNICAL PLANNING GUIDE
FLOW RATE

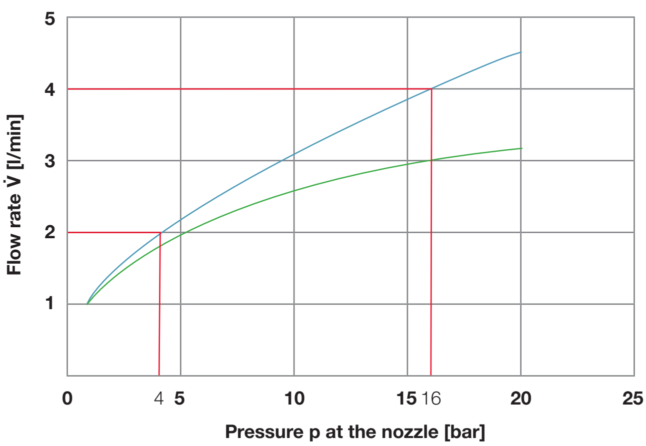
Flow rate conversion

With single fluid nozzles, the flow rate is controlled by the operating pressure.
The following correlation applies:

	Axial-flow full cone nozzles	**All other single fluid 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

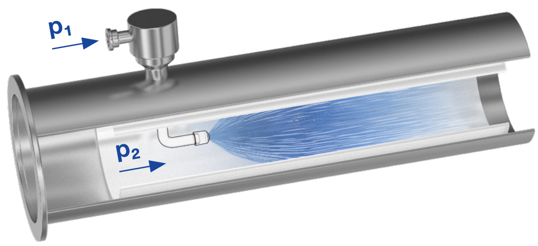
Pressure-flow rate chart for two single fluid nozzles



Axial full cone nozzle
All other single fluid nozzles

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

$\Delta p = p_1 - p_2$



As referenced in the chart above, to double the flow rate, the operating pressure must be increased by four times. This is true for all single fluid nozzles except for axial-flow full cone nozzles.

Flow rate as a function of the medium density

Specific gravity is the ratio of density compared to water. As the density for a given media decreases, the flow rate increases for operation at a given pressure.

$\dot V_W = \frac{\dot V_{Fl}}{X}$	$\dot V_W$ = flow rate of water [l/min, l/h]
$\dot V_{Fl} = \dot V_W \sqrt{\frac{\rho_W}{\rho_{Fl}}} = \dot V_W \cdot X$	$\dot V_W$ = flow rate of the liquid whose density deviates from 1,000 [kg/m³]
$X = \sqrt{\frac{\rho_W}{\rho_{Fl}}}$	X = multiplier ρ = density [kg/m³]

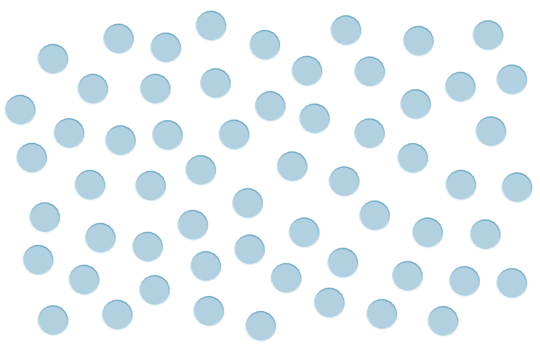
ρ_{Fl}	500	600	700	800	900	1,000	1,100	1,200	1,300	1,400	1,500	1,600	1,700	1,800	1,900	2,000
X	1.41	1.29	1.20	1.12	1.06	1.00	0.95	0.91	0.88	0.85	0.82	0.79	0.77	0.75	0.73	0.71

DROPLET SIZE

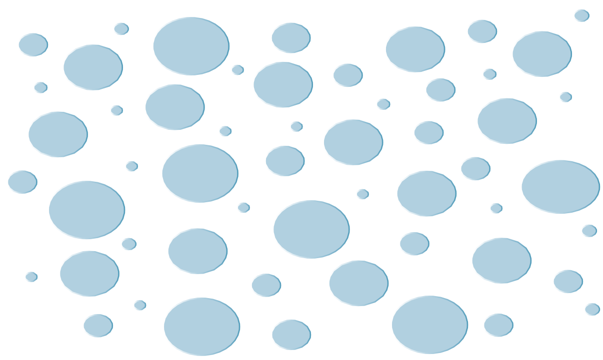
Sauter Mean Diameter (SMD or D32) is the diameter of a droplet where the ratio of volume-to-surface area is equal to the ratio of the entire spray's volume to the surface area. For many applications (e.g. evaporative cooling, absorption processes, gas cooling), the size of the total surface area of all the droplets is critical to the overall process.

In essence, if you transform the total volume of the droplets of a spray into droplets of equal size. The total sum of droplets would have the identical volume/surface ratio as the actual spray. This is better known as your SMD or D32.

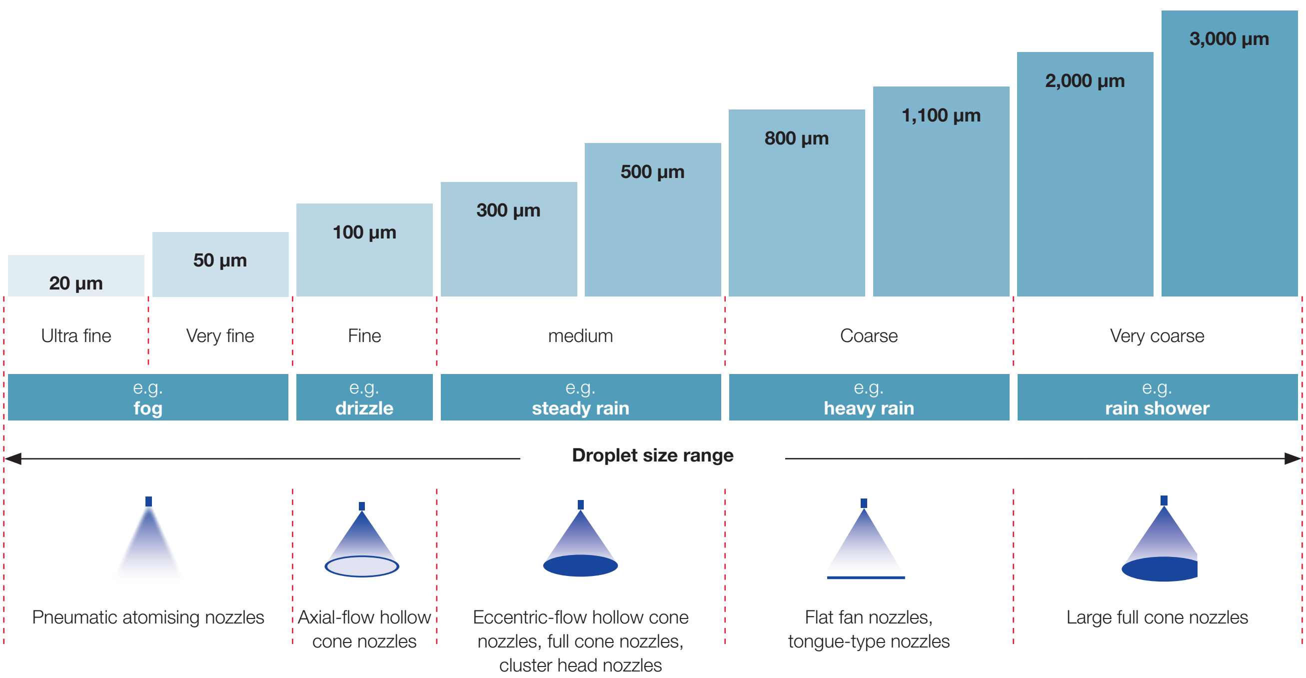
Monodisperse spray
(uncommon)



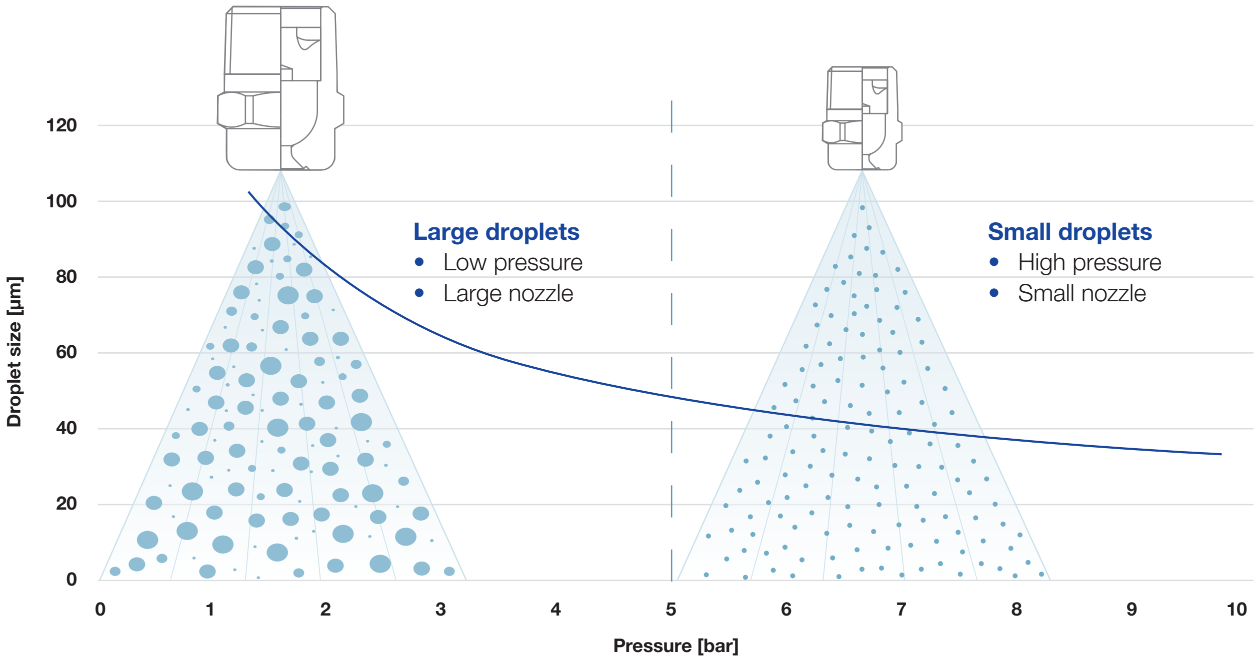
Typical droplet distribution of the spray of a single fluid nozzle



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 fluid nozzles:

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

SPRAY ANGLE

Flat fan nozzles and cone shaped nozzles are available with a wide selection of different spray angles. Careful selection of the spray angle is critical towards process performance. The spray angles specified are in accordance to the spraying of water at ambient temperatures for its designed pressure. It is important to note, that if the operating conditions change, the spray angle value and performance characteristics will also change.

Influences on the spray angle

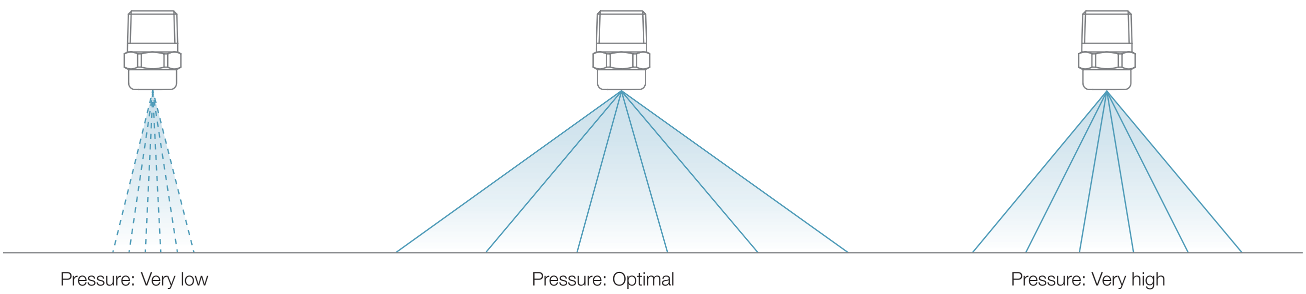
The following factors influence the size of the spray angle:

- **Pressure**
  The operating pressure will have a significant influence on the spray angle. At low or high pressure levels, the spray angle will be smaller than at its optimum designed operating pressure.

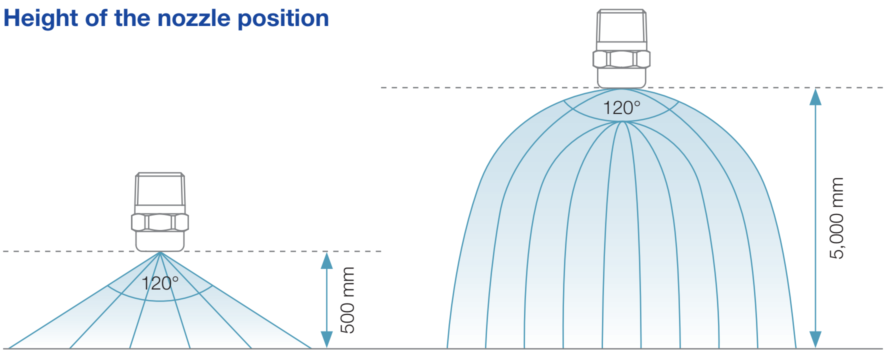
- **Distance**
  At closer spraying distances, the spray width initially increases with the distance and can be determined easily using the trigonometric function. Straight-line pattern can be assumed. With greater spraying heights, the trajectory points increasingly downwards, thus reducing the effective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

- **Viscosity**
  If viscous fluids are sprayed, the spray angle selection needs to be carefully considered. Typically a result of a smaller spray angle will be witnessed with the spraying of high viscous fluids. The viscosity of the media begin sprayed can usually be reduced by increasing the temperature of the fluid.

Change of operating pressure



Height of the nozzle position

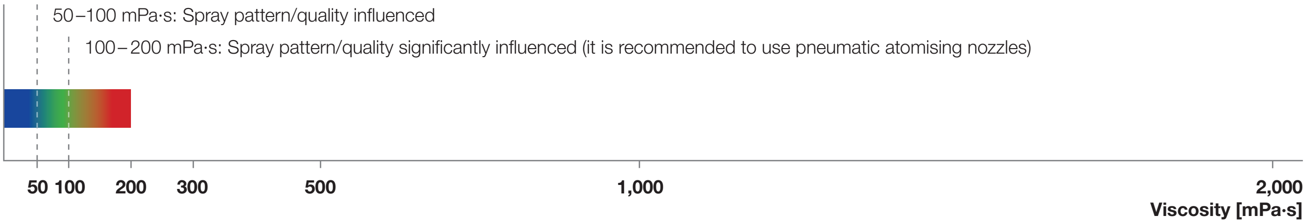


TECHNICAL PLANNING GUIDE
VISCOSITY

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.

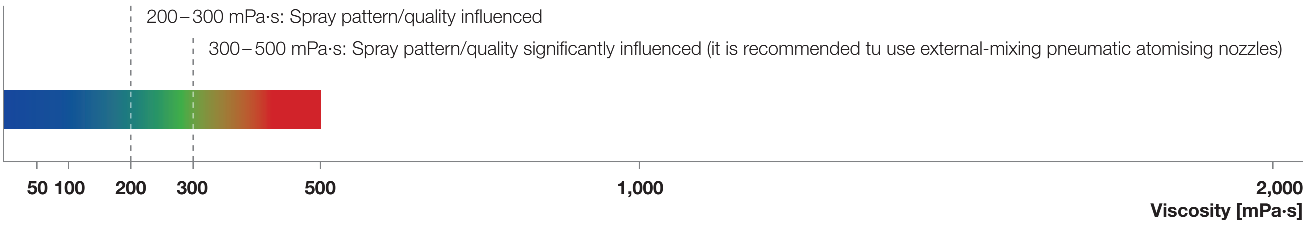
Single fluid nozzle

Example: Hollow cone, full cone, flat fan nozzles



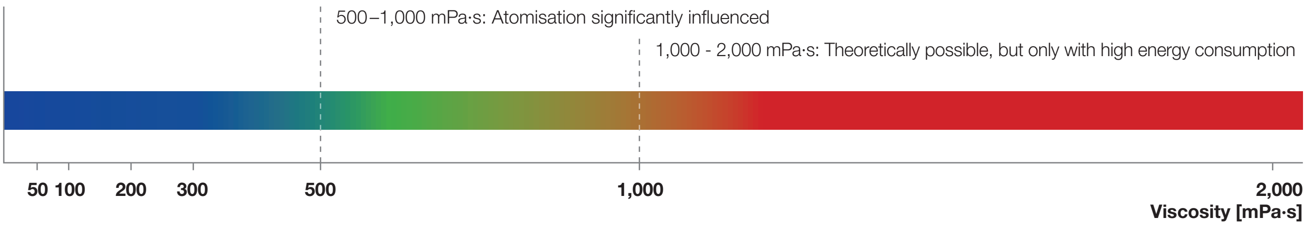
Pneumatic atomising nozzles (internal mixing)

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



Pneumatic atomising nozzles (external mixing)

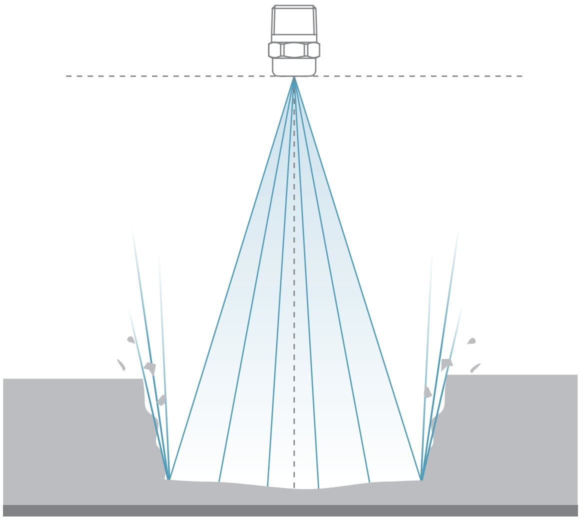
Example: Series 136.3, 136.6, 166.6, 176



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



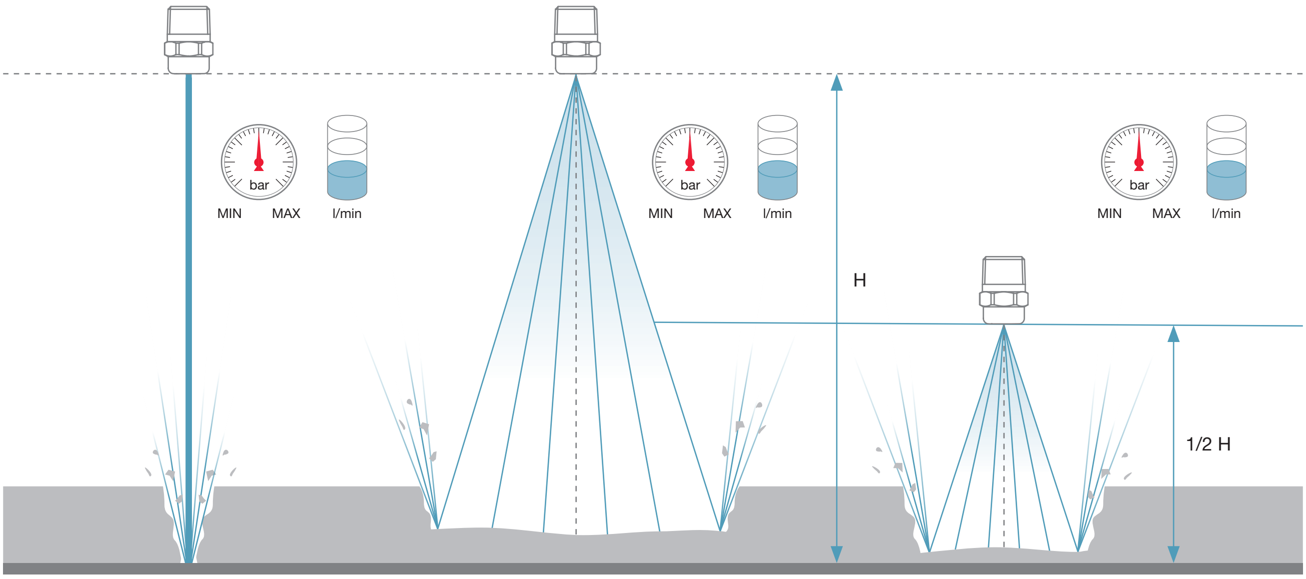
Lechler high pressure nozzles are characterized by a uniformly high impact across the entire spray width. Impact of the spray is commonly known as the spray force distribution over the area sprayed and is calculated as a pressure measurement in N/mm^2 or Lbs/in^2. Impact is critical for many applications that are traditionally used for cleaning. The greater the impact, the better cleaning result will be realized.

$$I = \frac{\text{Impact force}}{\text{Impact surface}} = \frac{F}{A} \quad N/mm^2 \,/\, Lbs/in^2$$

Influences on the impact

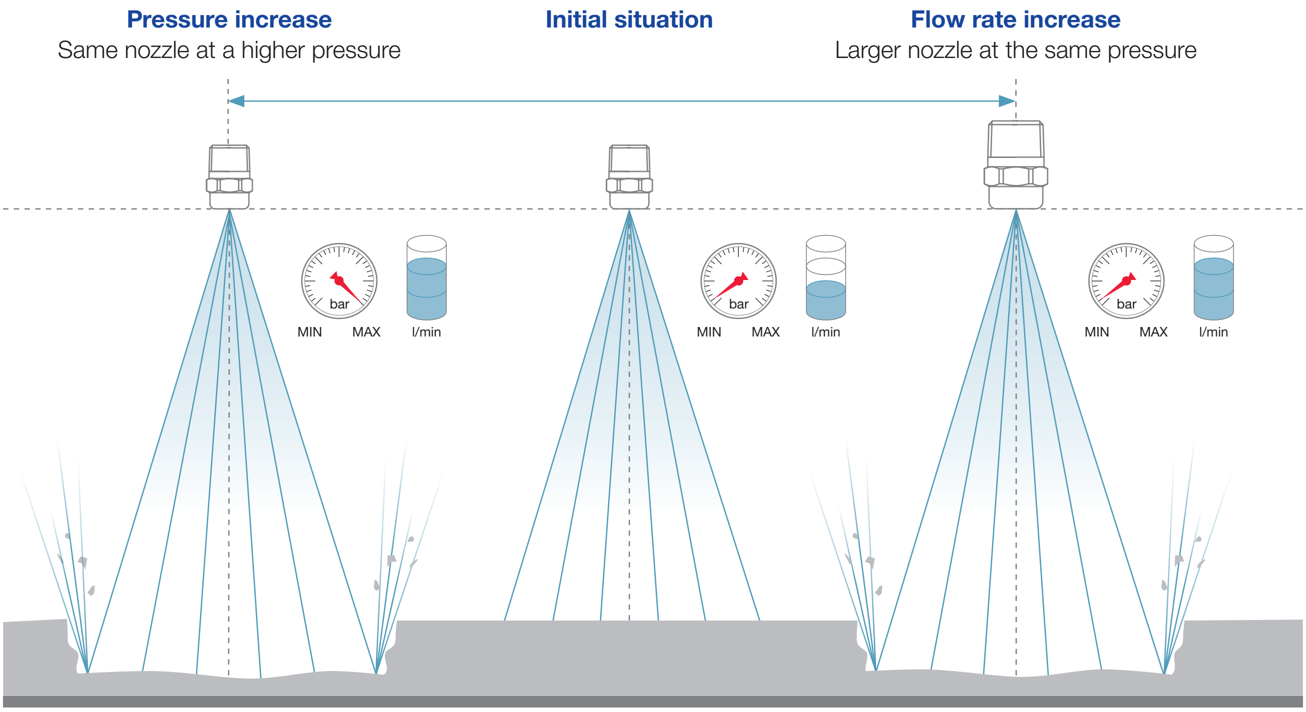
The following factors influence the size of the impact:

- **Impact distance to surface and spray pattern**
  The impact surface is the area where the spray pattern impinges onto a surface. Concentrating more flow in a given area of surface, greater impact will be achieved. The greatest impact values can be realized with solid stream nozzles, however the total overall coverage can be compromised. Flat fan nozzles can also achieve good impact results where coverage needs to be considered. If coverage needs to be considered, smaller spray angles should be selected to achieve the greatest impact desired.



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

- **Pressure**
  Increasing the operating pressure at the nozzle will directly correlated to an increase in impact.
- **Flow rate**
  Increasing the flow rate of the nozzle selected will directly correlate to an increase in impact.



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

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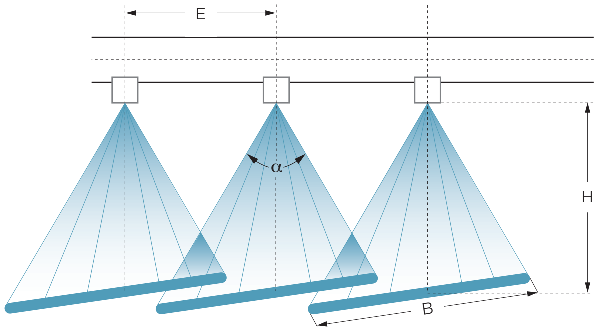
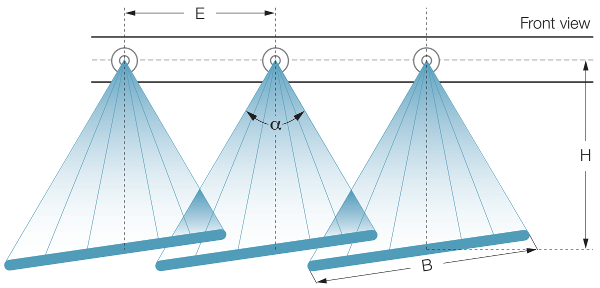
NOZZLE ARRANGEMENT

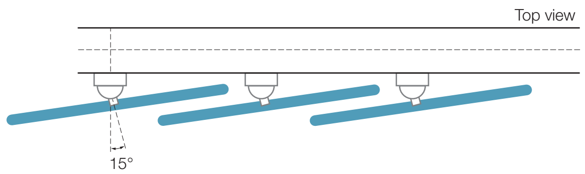
Arrangement of flat fan nozzles with parabolic liquid distribution



Lechler flat fan nozzles provide a consistent, uniform coverage over the impact area. For this purpose, the spray widths B should overlap each other by 1/3 to 1/4. To avoid interferences of the sprays, the nozzle orifices must be offset 5°-15° to the pipe axis.

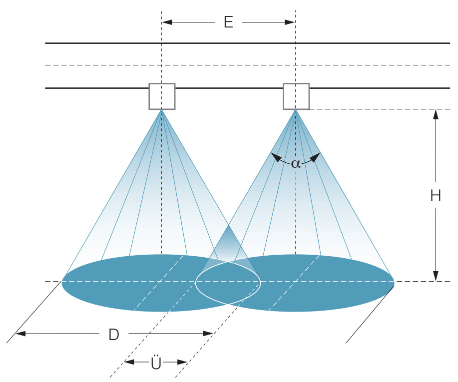
Arrangement of tongue-type nozzles





In order to achieve an even surface coverage the nozzles need to be aligned in such a way that spray widths B overlap by 1/3 to 1/4. Therefore the nozzles should be inclined in an angle of 15° to the vertical of the horizontal axis of the tube (either with a weld base at an angle or a Lechler ball joint nozzle mount) in order to prevent a disturbance of the spray.

Arrangement of full cone nozzles and hollow cone nozzles

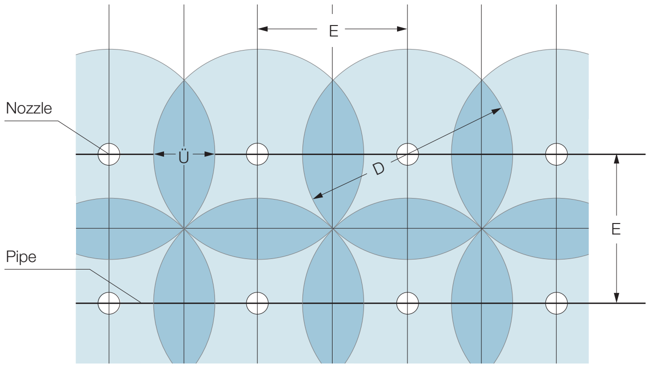


For full cone and hollow cone nozzles, the distance E should be sized so that the spray cones overlap by about 1/3 to 1/4.

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

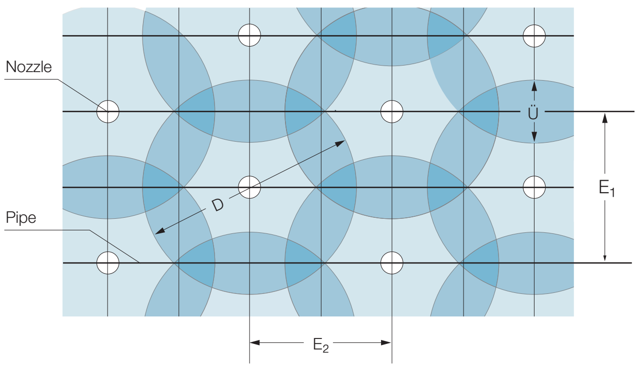


Nozzle distance: $E = \frac{D}{\sqrt{2}}$

Overlapping: $Ü = D - E$

The spray angles stated in this catalogue are based on a specific design pressure. Different pressures and production tolerances lead to differing spray angles. Please consider our adjustment proposals on this page and ask us for a detailed spray width diagram if needed.

Offset arrangement

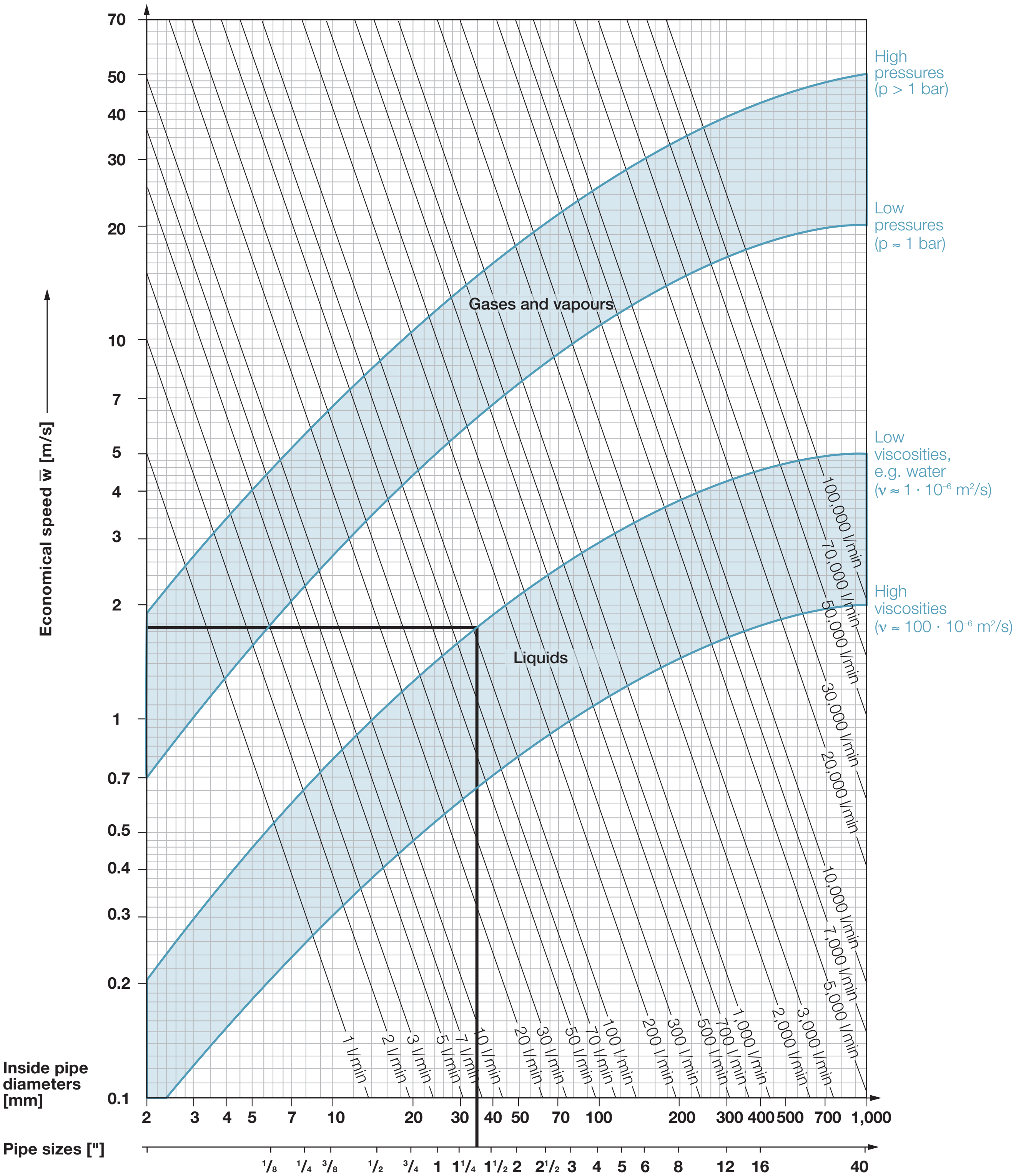


Nozzle distance: $E_1 = \frac{D}{2} \cdot \sqrt{3}$

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 spray a total of 100 l water per minute. Water has a viscosity of $\nu \approx 1 \cdot 10^{-6}$ m^2/s. So in your diagram please look for the intersection of the corresponding viscosity curve and the flow rate line. From the coordinates of this point, you gather the correct pipe inside diameter or pipe size, and the economical flow speed.

TECHNICAL PLANNING GUIDE
CONVERSION TABLES

All of the performance data shown in the tables for this catalog are based upon the spraying of water at ambient temperature.

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

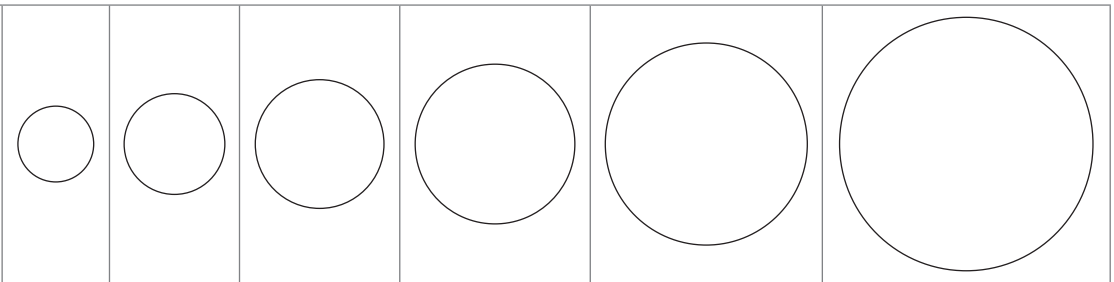
V volume

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.

TECHNICAL PLANNING GUIDE
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 fluid 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)

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.

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YOUR SPRAY SOLUTION

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