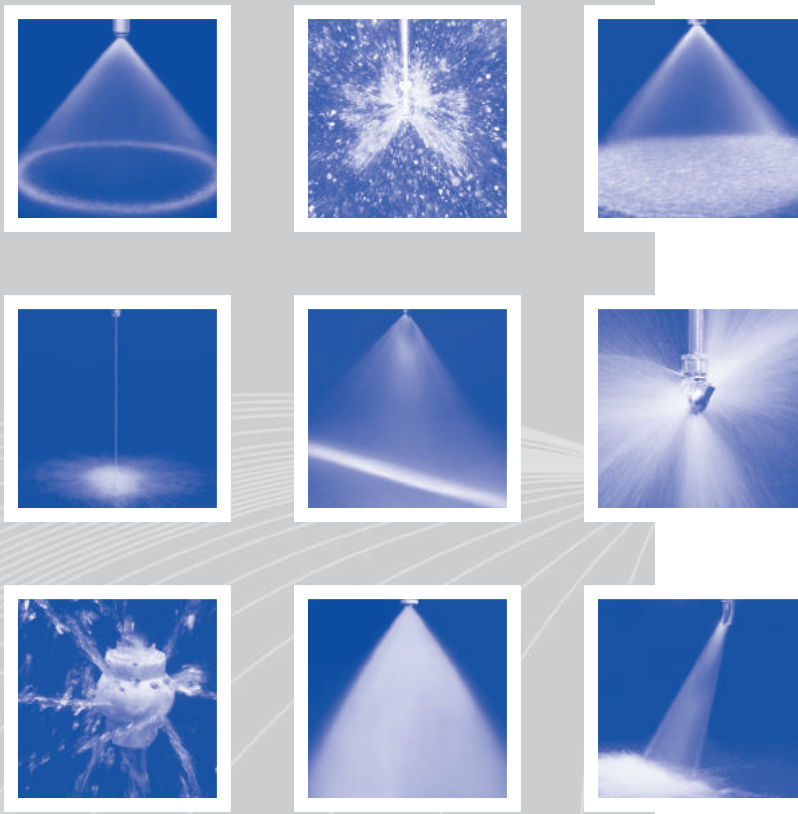
ENGINEERING
YOUR SPRAY SOLUTION

Precision Spray Nozzles and Accessories Edition 112



Spray Nozzles

OUR CORE PRODUCT LINES: BEST VALUE, PRECISION, RELIABILITY, QUICK DELIVERY.

INCREASE YOUR PRODUCTIVITY WITH LECHLER SPRAY TECHNOLOGY.

Competition is getting fiercer by the day. Your customers' requests for the highest quality and lowest price force

you to use your full potential for rationalization. Lechler spray technology helps you improve your processes and technologies.

For further information on nozzle technology please visit www.lechler.com

What really matters is that you have the competent partner for the job right from the planning stage. We supply the vital measuring data right from the beginning to ensure your process runs smoothly. Even unusual nozzles are part of our core nozzle range, therefore we can offer you a really individual solution.

Opting for an experienced partner like Lechler means that you run no risks: perfect products, unmatched quality, international know-how, straight off our stock shelves. Isn't that an offer? You should profit from this for your own sake.

Our new catalogue is a unique reference book for you that facilitates your daily work. Its clear layout and the wealth of professional information make it a valuable tool for finding a better solution.

There's a lot more information on spray nozzles, spray technologies and applications available for you which is not contained in this catalogue.

The experienced Lechler personnel is always willing to supply you additional information. Please do not hesitate to ask any time.

Table of contents

For nozzle assembly and special brochures, please refer to the final pages of the catalogue.

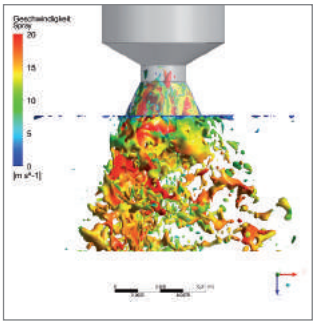
TRADITION AND PROGRESS IN SPRAY TECHNOLOGY.

The Lechler brand has an excellent reputation among experts worldwide. Unrivalled expertise, an interdisciplinary approach and the use of state-of-the-art production methods have led to superb product results in all areas. Today, the Lechler brand is synonymous with innovative spraying technology and applications that enjoy exemplary success.

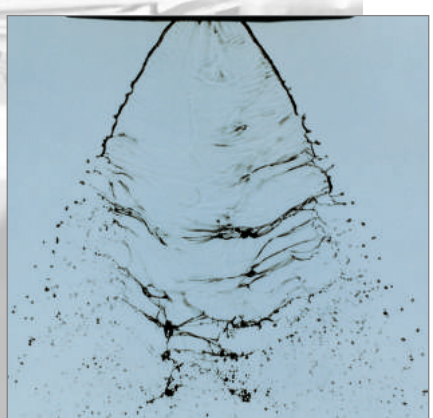
Research and development for a better future

For more than 135 years Lechler has been searching for new solutions and developed and manufactured spray nozzles for trendsetting applications. Internal and external information systems and international data bases give us the leading edge in R&D.

A comprehensive information system, connection to international databases and collaboration with external institutes supplement our own work in this area and create the broad interdisciplinary basis that is required today for excellent developments.



Ultra-modern techniques for construction and simulation are converted into products of high practical value by our staff of engineers and technicians. Full scale tests simulate real life conditions.
Only when all details comply with our requirements, production is released.



Your advantage lies in our productivity

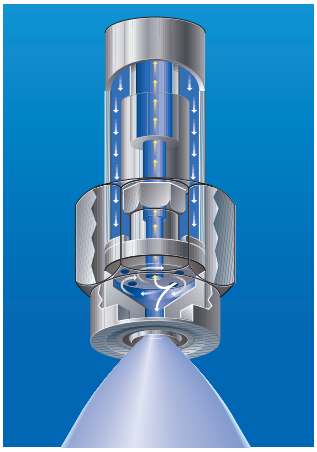
New custom-made manufacturing techniques guarantee productivity and flexibility.

Process automation ensures repeatability and steady properties. For us, this means that not only one nozzle looks like the other, but that spray patterns are identical, too. This applies to 25.000 different variants, materials and sizes.

Lechler is one of the most important spray nozzle manufacturers world-wide. High production quantities allow us more easily to amortize costly research and development and machinery. That's why even a complicated nozzle can be offered at a reasonable price. At the known Lechler quality!

A few words on quality

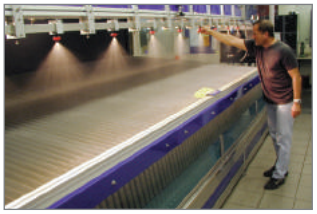
Lechler products are used in many different industries and applications.
Therefore, the requirements of the products have to meet certain specifications. Lechler define »quality« as the ability of our products to surpass the customers individual requirements for performance.



Lechler is certified by ISO 9001:2008. Lechler staff have always worked carefully and carried out permanent quality control from material reception through manufacturing to shipment.
Our products will keep in daily service what we are promising here and now.

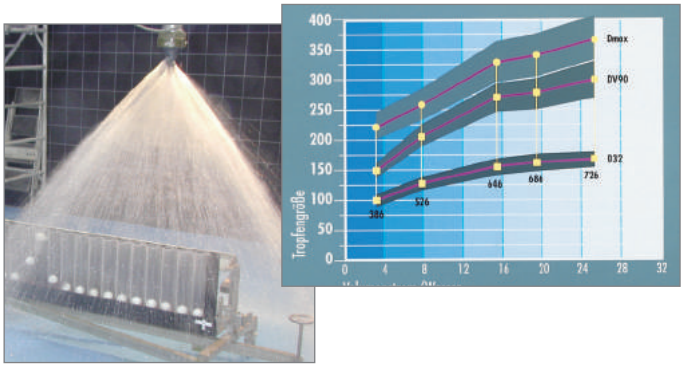
What can be measured, can be documented

Already a long time before its daily use, we know the exact flow rate, spray angle and uniformity of distribution of each Lechler nozzle.



Right from the beginning, functions and spray characteristics are accurately defined and recorded by our sophisticated measuring techniques and reliable documentation.

Our computer-controlled measuring facilities such as the Laser-Doppler Particle Analyzer, the spray jet measuring device with 3D presentation, liquid distribution systems, and many more are the essential prerequisite for precise measuring data.



Thanks to this data we can help solve your spraying problem.

We offer reliability

Our computer-controlled inventory ensures rapid delivery of your nozzles. Stock items ordered before 2 p.m. will leave our factory the same day. Yet, our real service starts much earlier: technical advice on spray applications and assistance by our experienced Lechler sales representatives. Actually, there is always a Lechler sales office or representation close by, wherever you are in this world. And it goes without saying that there is always a competent technical advisor in our head-quarters who is pleased to help you even a long time after the sale. You can rely on our word.

PERFECT NOZZLE TECHNOLOGY TO SOLVE MANY INDUSTRIAL TASKS.

In many industries there is a number of tasks that can be economically accomplished with the aid of spraying techniques. However, optimum effects only can be achieved when a spray nozzle manufacturer's wide knowledge of specific requirements and particular service conditions is taken into account, too – right from the project stage. Where this is not the case, a job may quickly end up in a costly experiment for the user.

Lechler, aware of this risk, has put up special teams for the various fields of applications. These teams are joined by external consultants for various industries. In addition, there is the know-how Lechler has accumulated over many years of direct activity in all industries. These synergies are also useful for other, new spray applications. That's why our spray nozzle specialists are often asked to participate as competent consultants in the first planning phases.

As a result, solutions are found that are technically perfect as well as economically sound.

This catalogue contains a wide selection of nozzles that can be used in many different areas of industry. Where special information is useful for special applications, we would be happy to send you our trade brochures.

Surface treatment

- Degreasing
- Phosphating
- Spray painting
- Galvanizing
- Cleaning

etc.

Paper industry

- Foam suppression
- Jet cutting
- Humidification
- Cleaning

etc.

Chemical and Pharmaceutical industry

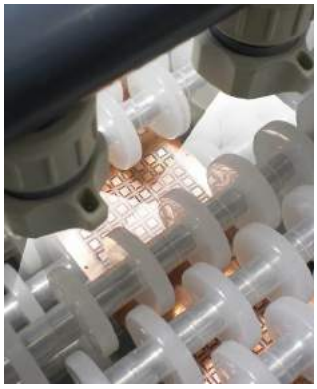
- Cleaning
- Humidification
- Coating
- Mixing
- Disinfection
- Atomization of viscous liquids

etc.

Food and beverage industry

- Cleaning
- Pasteurisation
- Conveyor belt lubrication
- Disinfection
- Humidification
- Cooling

etc.



Electronic industry

- Circuit board cleaning
- Spray etching
- Coating

etc.

Fire protection

- Tank cooling
- Spraying aboard ships
- Water curtains
- Shavings hopper

etc.

Automotive industry

- Degreasing
- Cleaning
- Preservation
- Coating
- Cooling
- Lubricating
- Drying

etc.

Machine tools

- Cooling
- Lubricating
- Cleaning
- Blowing off

etc.

You can use the order form in Chapter 10 to request specific, special information on nozzles and their areas of use that are not covered in this catalogue.

SPECIAL TASKS REQUIRE SPECIAL SOLUTIONS.

Very individual demands are placed on nozzle technology in the metallurgical industry, environmental engineering and agriculture. That's why Lechler maintains specialist teams who have the specific expertise in these areas. We have compiled product information in separate brochures for these specialist areas, which can be requested by using the form at the end of this catalogue.

Metallurgical industry

A whole range of specially developed and proven nozzles in different versions and materials is available to meet the special requirements of this specialist area.
Descaling, secondary cooling in continuous casting systems and roll cooling are just a few of the many different applications. Nozzles and nozzle systems play a crucial role in all production stages in terms of process optimisation aimed at increasing quality and perfecting production.

A wide range of standard nozzles is supplemented by the possibilities that are available for individual special solutions. At the same time, customers have at their disposal a competent team of experienced specialists employing state-of-the-art design and production methods.

Environmental technology

Flue gas desulphurisation, gas treatment and droplet separation are important areas of work in energy and environmental technology in which Lechler nozzles, systems and droplet separators are used.
Internationally, our wide-ranging expert knowledge and experience has made Lechler a competent partner in this sector.

Leading system manufacturers and operators all over the world have opted to become Lechler partners because they have been impressed by our innovative strength, our high level of competence in solving problems and our global organisation.

Find out about the possibilities for collaboration, and how you can profit from our expert knowledge.

Agriculture

All over the world, Lechler agricultural nozzles and accessories are synonymous with efficiency and economy, while also taking account of environmental aspects.
Lechler has taken a leading role in drift reducing technology in particular.
Lechler nozzles ensure that the pesticide lands on the plant exactly where it's needed.

This makes a decisive contribution towards optimising the use of pesticides and protecting the environment.

A comprehensive range of nozzle accessories and some useful tools help the farmer to optimise the application technology and thereby increase his earnings.

Lechler teams with specialist knowledge will support you in your work. We would also be happy to provide you with specialist product information.

WHICH (SPRAY) CHARACTER GOES WITH YOU?

Spray technology has its own rules

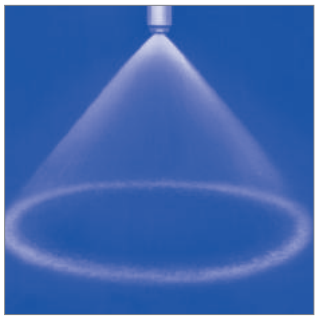
When a liquid flow is made to disintegrate into more or less fine droplets, this is called atomization. The necessary prerequisites are mainly reached by the following principles of atomization:

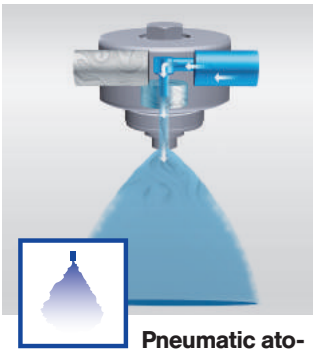
Single-fluid atomization

By narrowing the cross-sections of passage within a nozzle, flow speed increases. Static energy is transformed into kinetic energy (speed). When tension is released at the nozzle orifice, a laminar liquid flow with aerodynamic waves is produced, causing the liquid flow to disintegrate into droplets of different sizes.

Pneumatic atomization

The different flow speeds of gas and liquid generate pressure waves, breaking up the liquid into extremely fine drop particles. The different relative speeds allow atomizing e.g. of viscous liquids at low pressure. Pneumatic atomizers operate both according to internal and external mixing principles, whereby gas and liquid mix inside or outside the nozzle. Depending on the nozzle design, liquid is either supplied by siphon action or by gravity. According to the configuration of the nozzle tip, different spray patterns may be obtained.





Pneumatic atomizing nozzles

Hollow cone spray

Full cone spray

Pneumatic flat fan atomizing nozzles
produce a flat spray pattern with extremely fine droplets and spray angles up to 80°. These nozzles are particularly suited for applications requiring fine droplets and a wide linear impact.

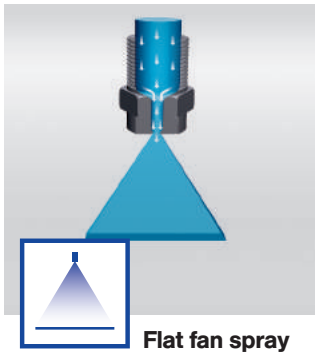
Pneumatic full cone atomizing nozzles,
however, are preferably used for applications demanding uniform circular impact patterns or larger spray distances. Generally, a narrow full cone with approx. 20°-30° is formed. Wider spray angles can be achieved by using special multi-orifice designs.

Axial-flow hollow cone nozzles
The liquid supply is axial, rotary motion of the liquid is generated by so-called swirl inserts or vanes. Axial-flow hollow cone nozzles allow to produce the finest droplets achievable with pressure-operated nozzle designs. This is also called hydraulic atomization.

Eccentric-flow hollow cone nozzles
The liquid supply, which is tangentially positioned to the mixing chamber, causes the liquid to rotate. A liquid layer forms around the inside walls of the nozzle which influences heavily the drop size.
A rotary motion of the liquid flow is transformed at the nozzle orifice into axial and tangential speeds.
A circular liquid screen is formed which disintegrates into fine droplets soon after leaving the nozzle orifice. This nozzle design has wide free cross-sections making it highly clog-proof.

Axial-flow full cone nozzles
achieve a uniform liquid distribution over a circular area. A rotary motion of the liquid is achieved with the aid of swirl inserts inside the free cross-section of the nozzle. Spray formation, liquid distribution, and shaping of droplets are influenced by the dimensioning and functional coordination of the rotary motions and the swirl chamber. Turbulent flows with different axial and tangential speed components lead to overall coarser droplets than with a comparable hollow-cone nozzle.

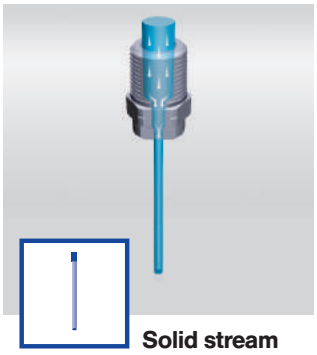
Tangential-flow full cone nozzles
are free from swirl inserts. Therefore, they are not at all prone to clogging. The full cone spray pattern is produced by grooves milled into the bottom of the nozzle which provide a defined deviation of the liquid flow to the mixing chamber's center, whereby an extremely uniform area distribution of the atomized liquid is obtained.



Flat fan spray

The spray pattern of **flat fan nozzles** features a sharply delimited line due to internal flow characteristics.
The coverage width can be varied by modifying the geometric configuration of the nozzle orifices, where the liquid is shaped into flat, fan-like spray patterns. The flat liquid body takes on a laminar form and disintegrates into droplets as its distance from the nozzle orifice increases. Parabolic, trapezoidal or rectangular impact areas are achieved by adequately determining the functional and geometric dimensions.

Tongue-type nozzles are of a special kind.
The flat fan pattern is generated by a solid stream, impinging upon an external deflector plate (»the tongue«). Tongue-type nozzles are particularly clog-proof and produce a sharply delimited flat fan pattern.

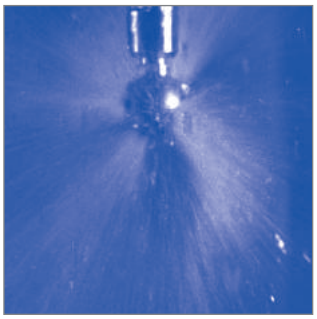


Solid stream

The smooth solid stream is also known as the so-called »primary jet«. Actually, the solid stream nozzle is not supposed to produce an atomized spray pattern, because it has been designed for maximum jet power. Here, the skill of Lechler design engineers was challenged to prevent concentrated, straight jets from disintegrating into drops at large distances.

Air nozzles

Air nozzles are used for dispersing air or steam in a concentrated and straight fan. Generally, air nozzles have a flat fan or solid stream spray pattern. When using conventional air nozzles, air is blown through a single hole. Often a loud, ear-splitting and hissing noise is produced. To avoid this unpleasant noise, Lechler has designed special **multi-channel air nozzles**. Sound level and air consumption of these nozzles are very low.



Tank cleaning nozzles

Tank cleaning nozzles can be used for both small and large tanks and are available as both rotating and static sprays. The **rotating nozzles** (rotational cleaners) are driven by the cleaning liquid by means of specially positioned nozzles or by turbine or internal gears. Rotational cleaners achieve very good cleaning of the entire tank surface as rapid-repetition impact loosens the dirt and washes it off of the inside tank surfaces.

Static spray balls do not rotate. They are used primarily for washing down relatively small tanks and vessels. All tank cleaning nozzles are operating at low pressures.

NOZZLE PERFORMANCE AND SERVICE DATA.

The essential operating data of spray nozzles is

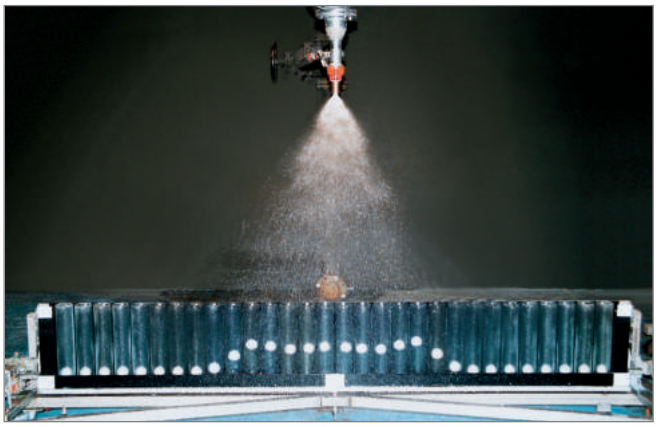
- Flow rate
- Spray angle
- Liquid distribution
- Spray impact
- Droplet size and droplet spectrum

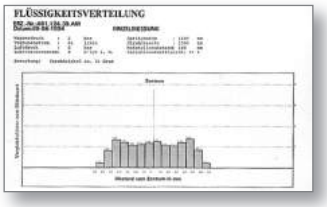
Flow rate, pressure and spray angle

Flow rates and spray angles are dependent on feed pressure and viscosity of the liquid to be sprayed. We have measured the flow rates stated in the catalogue with painstaking accuracy, using inductive flow meters.
The spray angle is determined right at the nozzle's orifice. The indications given on spray widths and coverage diameters are more useful at larger distances from the orifice. Air friction losses and ballistic phenomenons influence the spray behavior and the size of the impact area in dependence on the chosen service pressure. The pressure (p) is the feed pressure above atmospheric, which is available at the liquid inlet into the nozzle. The spraying operation is performed under counterpressure, the flow rate is dependent on the differential pressure. Minimum and maximum pressures are adjusted to the required flow rates and the spray quality.

Distribution of liquid

A uniform distribution of liquid is of paramount importance, e.g. for coating. We have developed special measuring methods which instantaneously deliver test results that are repeatable any time. Thanks to our electronic image processing measurement accuracy is approx. +/- 1 %. The test results are documented and made available to customers for design and construction tasks.





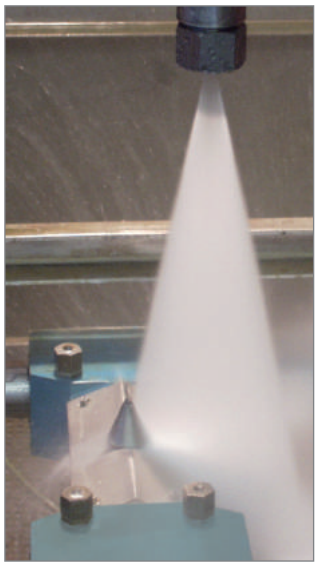
Thus they'll be sure in advance that Lechler spray nozzles exactly comply with their requirements.

Spray impact

For **measuring the jet distribution of the spray impact and the impact itself** a highly sensitive device is guided through the jet pattern. The measuring values detected by the sensor are transformed into electric signals and stored in a computer. Jet impact measurements show how uniformly the jet impact is acting on the impacted area. This data is very useful, in particular for high pressure applications where a maximum of pump energy has to be transformed into cleaning power.

Jet pressure (impact)

In the case of nozzles, the jet pressure (i.e. the effect of a spray jet on a surface) is normally referred to as the impact and is expressed in N/mm^2. This is the conversion of the jet force on the impacted surface.
In the jet pressure measurement, a highly sensitive sensor with a defined surface area is guided through the spray jet. The spray jet exerts a constantly changing force on the sensor, which is saved in the computer. The jet pressure can be determined from the force measured at the respective location and the surface of the sensor.



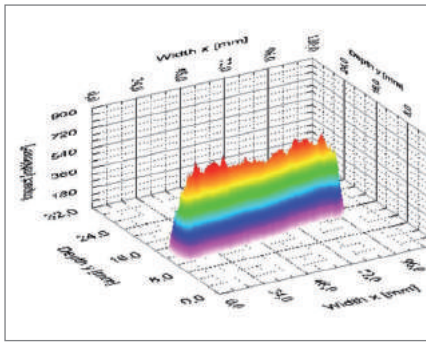
Jet pressure distribution measurements show the regularity of the jet force curve on the impacted surface. In high-pressure applications in particular, this data is of great practical use because it relates to the maximum conversion of pump energy into cleaning effect.

Low jet pressures are obtained by using full-taper or wide-angle flat jet nozzles (120°). **High jet pressures** are produced by flat jet nozzles with narrower jet angles (15° to 60°). Full-jet nozzles produce **maximum jet pressures**.

Droplet sizes and droplet spectrum

For many areas of use, it is necessary to know the size of the droplet spectrum produced by the nozzle.

One of the most precise measuring devices for this is the laser doppler particle analyser. Since this measuring method simultaneously measures both droplet size and droplet velocities, we obtain a complete description of the atomization characteristic. Since the atomized liquid does not dissipate into droplets of a uniform size, we document the droplet size



YOUR REQUIREMENTS DEFINE THE NOZZLE MATERIAL.

distribution by stating the **Sauter mean diameter d_{32}**. This shows the relationship between the total surface area of all droplets and the volume enclosed by it. This enables conclusions to be readily drawn about the expected reaction behaviour of a spray.

This makes this key indicator very important in process technology in particular. Other droplet size definitions can also be derived from the measured values, e.g. the arithmetical mean d_{10}, the mean volume diameter MVD, the logarithmic standard deviation LS and other variables. These must be known for a complete description of a measured droplet spectrum.

All operating data of nozzles have been measured with water.

There are more than 100 materials for you to choose from.

Brass nozzles, now as before, are commonly used for many applications, such as low pressure and humidification processes. We commonly use brass grade C38500.
It is necessary to use chemically resistant stainless steel grades, hastelloy, titanium, tantalum, as well as plastic materials, such as PVC, PP, PVDF and TEFLON for spraying corrosive liquids or for the use in aggressive environments.
If materials that are highly resistant to wear are required, quality nozzles in hardened stainless steel, oxide ceramics or silicon carbide are available.

Many nozzles of our range are available in high-grade thermoplastics. These nozzles are produced by injection moulding on process-controlled machines.

Service life

Material	Factor
Brass	1
Stainless steel	4-6
Hardened SS	10-15
Carbide	30-40
Ceramics	90-200

The service life of nozzles is dependent on various circumstances such as spray applications, service conditions, the quality of the liquid to be sprayed – to quote just a few. According to the material used, service life of nozzles can considerably differ.

This short survey is just to give you an idea on service life of some metallic and ceramic nozzle materials commonly used. Depending on service conditions, plastic materials have very different service lives. Hence, a classification is hardly possible.

Stainless steel

Silicon carbide

Brass

Plastic material

ACCESSORIES MAKE YOU BENEFIT FROM OUR KNOW-HOW, TOO.

Our comprehensive range of accessories significantly contributes to optimizing the adaptability of Lechler nozzles to special requirements and prerequisites.

No matter whether you want to change nozzles easily, to provide sealing or just to have an alternative fixing facility, you'll profit in every respect from Lechler's technical know-how and practical experience with accessories. As a result, your work is made easier, your capacity is better utilized and you'll be saving cost to an extent you wouldn't have thought possible.
As you see, it's worthwhile spending a few thoughts on the subject.

Now a short survey on the various Lechler fixing system:

Standard fixing accessories
The great variety of mounting clamps, bases, ball joints etc., available in a multitude of designs, models, sizes and materials, allow accurate matching of nozzles and fixing accessories to meet your spray applications, your liquid and its properties.

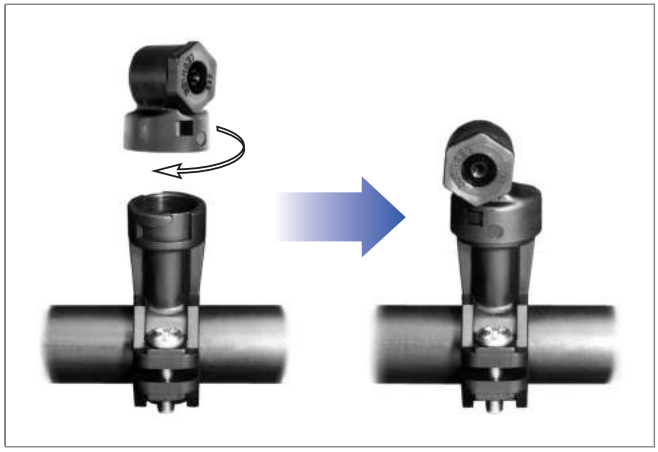
Special accessories for flat fan nozzles with dove-tail guide
(positive guide) provide a perfect presetting of the spray alignment and a quick nozzle change.

TWISTLOC and Bayonet - Assembly systems for changing nozzles in less than no time
The Lechler invention for quick nozzle change without any tool. Additionally, a correct spray alignment is always guaranteed.

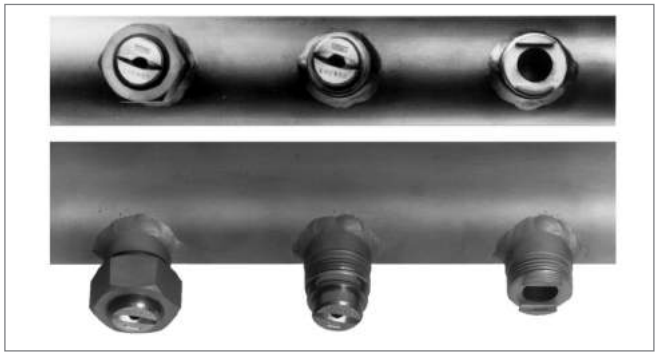
Nozzle filters and strainers to prevent clogging
The advantages:
Steady spray quality, cost reduction because of less maintenance, and, above all, a better quality of your finished products.

Professional sealing material
Lechler offers special proven sealing materials to stop unnecessary sprinkling or dripping: gaskets, Teflon sealing tapes, Teflon glue and a lot more.

For your daily work with the Lechler catalogue, all fixing possibilities are clearly listed in the folded page at the end of the catalogue. You'll find the complete accessory range, detailed descriptions and full technical data under the heading »Accessories«.



Bayonet quick-release system

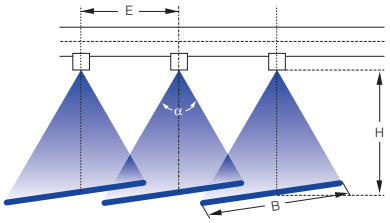


Dove-tail guide

EXAMPLES FOR NOZZLE ARRANGEMENT.

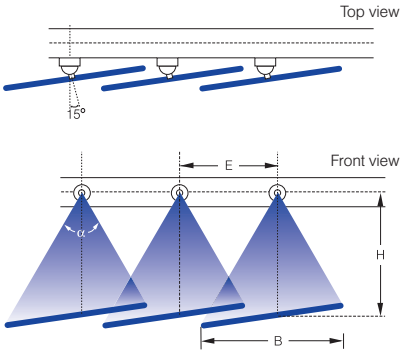
Arrangement of flat fan nozzles with parabolic liquid distribution

Lechler flat fan nozzles provide a consistent, uniform coverage over the impact area. For this purpose, the spray widths B ought to 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.



Alignment of tongue-type nozzles

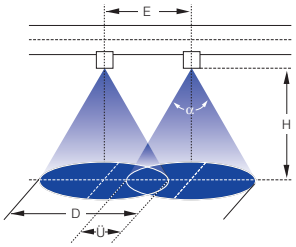
In order to achieve an even surface coverage the nozzles need to be aligned in such a way that spray widths B overlap by 1/3 to 1/4. Therefore the nozzles should be inclined in an angle of 15° to the vertical of the horizontal axis of the tube (either with a weld base at an angle or a Lechler ball joint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



Arrangement of full cone and hollow cone nozzles

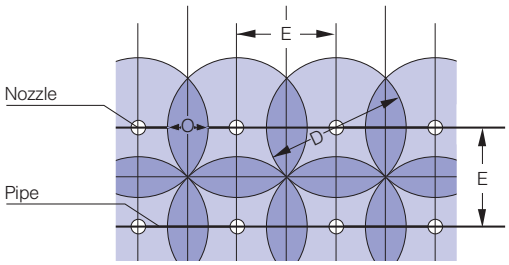
For full cone and hollow cone nozzles, the distance E should be sized so that the spray cones overlap by about 1/3 to 1/4.

O = Overlap of spray angles
D = Spray diameter
E = Nozzle distance
H = Installation distance of nozzles
α = Spray angle



Square or offset arrangement of full cone or hollow cone nozzles

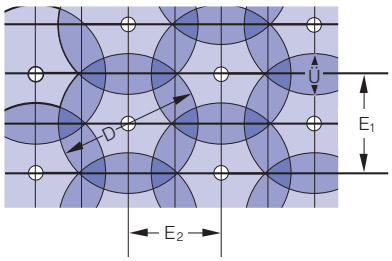
Square arrangement



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

Overlap: $Ü = D - E$

Offset arrangement



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

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

Overlap: $Ü = D - E_1$

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.

TECHNICAL INFORMATION

Here you will find explanations of the special terms and abbreviations used in the tables on the following pages.

Droplet sizes
The droplet size information refers to the Sauter mean diameter d_{32}.
This is defined as the droplet diameter measured on the basis of surface area.
The volume/surface area ratio of a droplet of this diameter is the same as for the sum of all droplets in the spray jet.

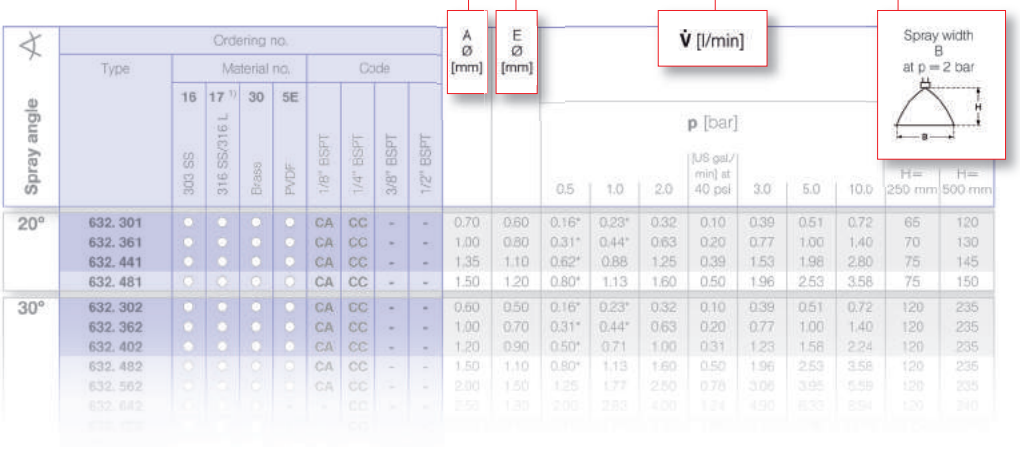
Lechler nozzles are manufactured with the highest precision and undergo permanent quality checks. Nevertheless, production-related tolerances can affect the jet angle, volume flow, droplet size and droplet distribution.

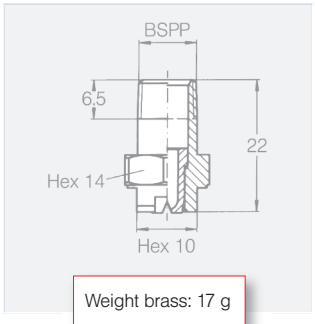
A (equivalent bore diameter)
Applies to elliptical discharge holes of flat fan nozzles.
A cylindrical hole with a diameter A has the same surface area as the ellipse.

E (narrowest free cross section of the nozzle)
Important characteristic for determining the pre-filtration.
Can be less than B due to several swirl ducts.
(Nozzle filter see page 9.8.)

V̇ (flow rate)
All 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.

B (spray width)
The spray sizes can deviate at reference pressures different to those listed in the tables.





Weight brass: 17 g

Weight
All weight information refers to brass, unless otherwise stated.
See Page 18 for conversion factors for other materials.

B (bore diameter)
This is definitive for the flow rate.

p (liquid pressure)
Pressure p is the differential pressure to the nozzle surrounding.
If you require a liquid pressure stage not given in the tables, you can calculate the flow rate with the formula at the bottom of the respective table page.

CONVERSION TABLES

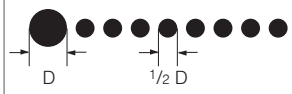
Droplet sizes

· 0,5 mm

• 1 mm

● 5 mm

1 mm = 1000 µm



The volume of a large droplet corresponds to the volume of 8 droplets of half the diameter.

The surface of the large droplet is four times as big as the one of a small droplet. The total surface of the 8 small droplets, however, is twice as big as the surface of a large droplet.

Droplet size range according to nozzle type (Sauter diameter d_{32})

Single fluid nozzles	Liquid pressure [bar]					
	1		2		5	
	Flow rate V̇ [l/min]	Droplet size [µm]	Flow rate V̇ [l/min]	Droplet size [µm]	Flow rate V̇ [l/min]	Droplet size [µm]
Axial-flow hollow cone nozzle	- -	- -	0.1 1	140 240	0.17 1.6	100 180
Tangential-flow hollow cone nozzle	- 1.8	- 700	1 25	320 640	1.44 36	240 490
Full cone nozzle	0.8 19	540 1300	1 25	400 1100	1.4 36	300 750
Cluster head nozzle	0.9 20	200 400	1,25 28	175 265	2 44	150 190
Flat fan nozzle	0.7 18	400 1200	1 25	360 1000	1.6 40	300 690

Pneumatic atomizing nozzles	Air-/water ratio [m³/h : l/min]					
	5		10		20	
	Flow rate V̇ [l/min]	Droplet size [µm]	Flow rate V̇ [l/min]	Droplet size [µm]	Flow rate V̇ [l/min]	Droplet size [µm]
others	others	90	others	55	others	40

p Pressure

Conversion / Unit	bar	Pascal [Pa] = N/m²	psi	lb/sq ft
1 bar	1	100000	14,5	2089
1 Pascal [Pa]	$1 \cdot 10^{-5}$	1	$14{,}5 \cdot 10^{-5}$	0,0209
1 psi	0,06895	6895	1	144
1lb/sq ft	$0{,}479 \cdot 10^{-3}$	47,9	$6{,}94 \cdot 10^{-3}$	1

V Volume

Conversion / Unit	l	m³	Imp. gal	US gal
1 l (1 dm³)	1	$1 \cdot 10^{-3}$	0,22	0,264
1 m³	1000	1	220	264,2
1 Imp. gallon	4,546	$4{,}546 \cdot 10^{-3}$	1	1,201
1 US gallon	3,785	$3{,}785 \cdot 10^{-3}$	0,8327	1

V̇ Flow rate

Conversion / Unit	l/min	l/s	m³/h	US gal/min	Imp. gal/min
1 l/s	60	1	3,6	15,85	13,20
1 l/min	1	0,01667	0,06	0,2642	0,22
1 m³/h	16,67	0,28	1	4,40	3,66
1 US gal./min	3,785	0,0631	0,227	1	0,8327
1 Imp. gal./min	4,546	0,076	0,273	1,201	1

ρ Change in specific weight

$\dot{V}_w = \frac{\dot{V}_{Fl}}{X}$	$\dot{V}_W$ = Flow rate (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 liquid, with a specific weight that differs from 1
$X = \sqrt{\frac{\rho_w}{\rho_{Fl}}}$	X = Multiplier ρ = Specific weight [kg/m³]

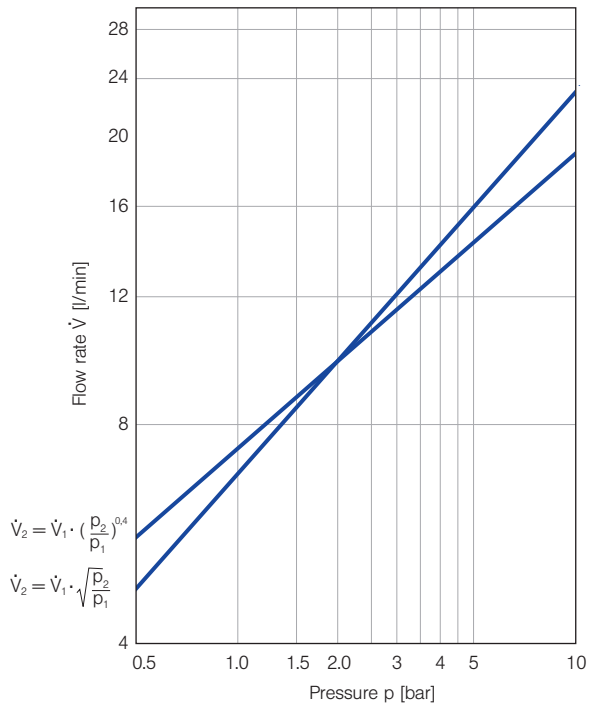
ρ_{Fl}	500	600	700	800	900	1000	1100	1200
X	1,41	1,29	1,20	1,12	1,06	1,0	0,95	0,91
ρ_{Fl}	1300	1400	1500	1600	1700	1800	1900	2000
X	0,88	0,85	0,82	0,79	0,77	0,75	0,73	0,71

p/V̇ Pressure/Flow rate

Valid for **single-fluid nozzles,** except axial-flow full cone nozzles	$\dot{V}_2 = \sqrt{\frac{p_2}{p_1}} \cdot \dot{V}_1$ [l/min]	Ratio of both, given and required pressure – flow rate values
	$p_2 = \left(\frac{\dot{V}_2}{\dot{V}_1}\right)^2 \cdot p_1$ [bar]	
Valid for **axial-flow full cone nozzles**	$\dot{V}_2 = \left(\frac{p_2}{p_1}\right)^{0,4} \cdot \dot{V}_1$ [l/min]	
	$p_2 = \left(\frac{\dot{V}_2}{\dot{V}_1}\right)^{2,5} \cdot p_1$ [bar]	

All flow rate data of the catalogue have been measured with water and consider the individual flow parameters of the nozzle designs.

p/V̇ Pressure-flow rate diagram



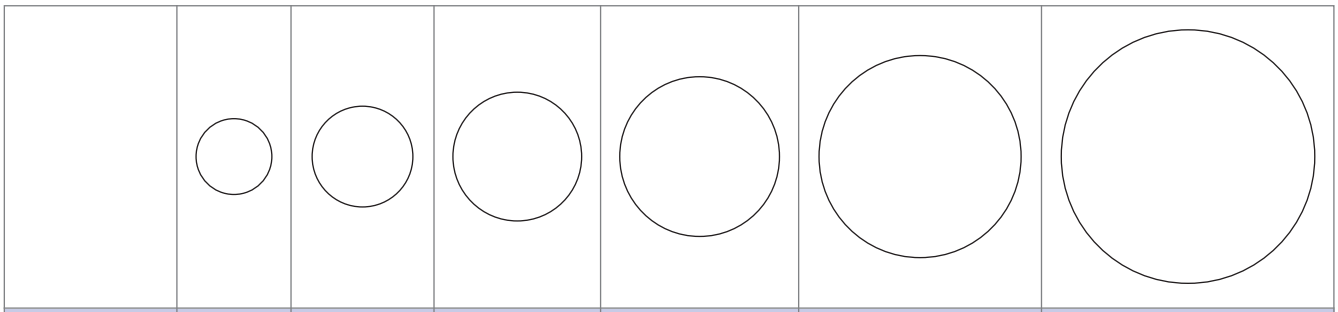
Conversion factors for determining the weight of various materials

Material	Factor
Brass	1.00
Stainless steel	0.95
Plastics (PVDF)	0.21
Aluminium	0.33
Silicon carbide	0.39
Titanium	0.54
Cast iron	0.89

As a rule, the weight indications in this catalogue refer to brass. By applying the conversion factors stated, the approximate weight of nozzles in other materials can easily be calculated.

For further information on nozzle technology please visit www.lechler.com

Determination of male thread sizes / diameters



R"	1/8	1/4	3/8	1/2	3/4	1
A Ø mm	10.2	13.5	17.2	21.3	26.9	33.7
DN	6	8	10	14	20	25

NEW

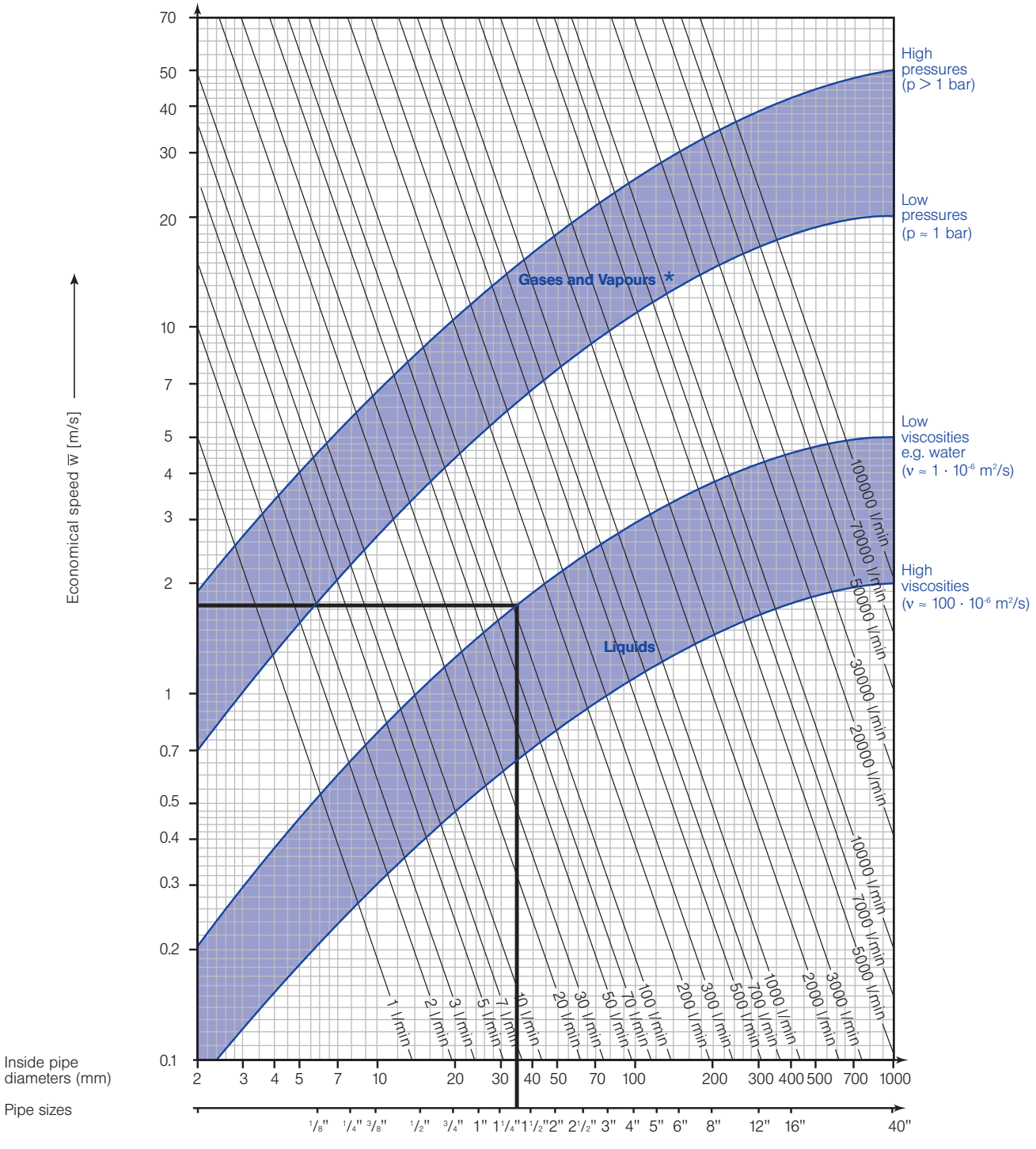
Android Apple

Online nozzle calculator

Lechler Industry App:
all important calculation and conversion programs for nozzle technology combined in one App.

- Unit converter for pressure, volume and flow rate
- Pressure/flow rate calculator for single-fluid nozzles incl. axial-flow full cone nozzles
- Calculation of pipe diameters

DETERMINATION OF PIPE DIAMETERS.



* Flow rates of gas and vapours in operating condition.

Example: You want to spray a total of 100 l water per minute. Water has a viscosity of $\nu \approx 1 \cdot 10^{-6}$ m²/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.