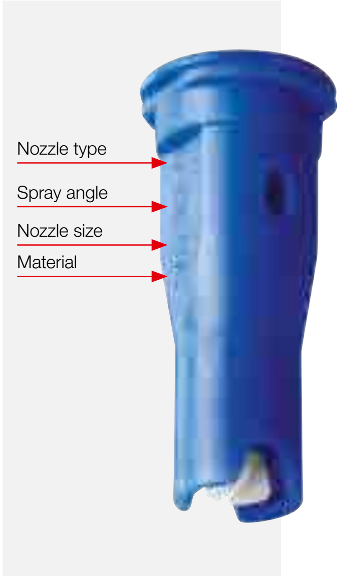
SPRAY NOZZLE TECHNOLOGY

① Identification of Lechler nozzles and filters

The performance data of Lechler nozzles is specified in accordance with international standards and contains the following information:

- Nozzle type
- Spray angle
- Nozzle size

Lechler nozzles are color-coded in accordance with ISO 10625. Each nozzle corresponds to a defined volume flow. This information is also contained in the nozzle size, e.g. -03 stands for a volume flow of 0.3 US gallons at 40 PSI. The nozzle material is coded with the letters S (stainless steel) or C (Ceramic).



Color code for filters and strainers according to ISO standard 19732 since 2011

Old color code Lechler	Old color code ARAG	ISO 19732 New color code	Mesh
yellow		red	25
	white	red	32
	blue	blue	50
red		blue	60
	grey	yellow	80

Conversion table of old and new ISO color code

② Flow rate

The flow rate of a nozzle changes as a function of the spray pressure. Expressed in simplified terms, the flow rate (l/min) is doubled if the spray pressure (bar) is quadrupled.

The following formula applies:

$$\dot{V}_2 = \sqrt{\frac{p_2}{p_1}} \times \dot{V}_1 \text{ (l/min)}$$

③ Density

All table values for flow rate are based on water (density 1.0 kg/l).

In the case of liquids with a different density, the correction factors stated in the table must be taken into account.

④ Conversion factors for different densities

Density of sprayed liquid	0.84	0.96	1.00 Water	1.11 Urea	1.24 ASL	1.28 UAN (28) UAN +S	1.32 UAN (30)	1.38 NP-solution	1.44	1.50
Conversion factor	1.09	1.02	1.00	0.95	0.90	0.88	0.87	0.85	0.83	0.81

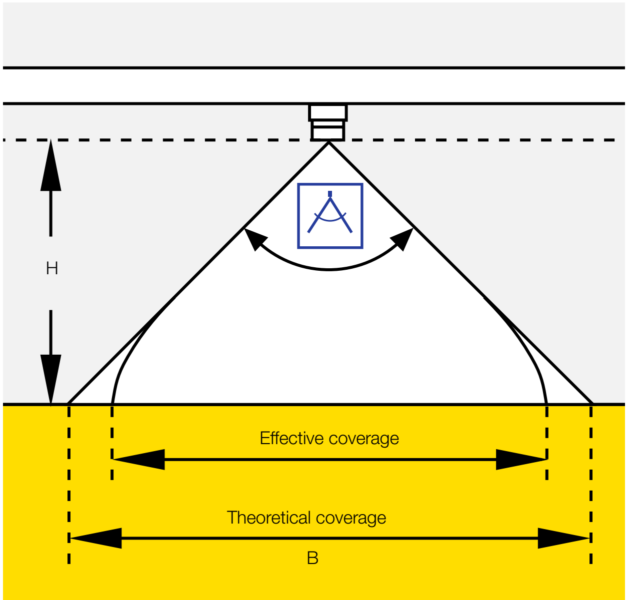
Converts as follows:

flow rate of water (see table)	x	**Conversion factor**	=	**Actual flow rate of medium**

⑤ Coverage

The theoretical coverage of a nozzle is essentially determined by the spray angle and spray height above the target.

Depending on nozzle type and nozzle size, the spray pressure can also influence the spray angle and distribution accuracy. Prerequisites for uniform liquid distribution in the spraying system are in compliance with the recommended spray pressure at the nozzle as well with the minimum spray height for a given nozzle spacing.



Due to the physically caused collapse of the jet, the effective coverage is less than the theoretical coverage stated below particularly with low pressures and large spray heights.

Spray angle	Theoretical coverage B for different spray heights H [cm]											
	10	15	20	25	30	40	50	60	70	80	100	120
20°	3.5	5.3	7.1	8.8	10.6	14.1	17.6	21.2	24.7	28.2	35.3	42.0
30°	5.4	8.0	10.7	13.4	16.1	21.4	26.8	32.2	37.5	42.9	53.6	64.0
45°	8.3	12.4	16.6	20.7	24.9	33.1	41.4	49.7	58.0	66.3	82.8	99.0
60°	11.6	17.3	23.1	28.9	34.6	46.2	57.7	69.3	80.8	92.4	115.0	(138.0*)
90°	20.0	30.0	40.0	50.0	60.0	80.0	100.0	120.0	140.0	160.0	200.0	(240.0*)
120°	34.6	52.0	69.3	86.6	104.0	139.0	173.0	208.0	242.0	277.0	(346.0*)	(416.0*)
140°	55.0	82.4	110.0	137.0	165.0	220.0	275.0	(330.0*)	(385.0*)	(440*)	(550.0*)	(660.0*)

* Parentherized data: mayor difference between effective and theoretical coverage.

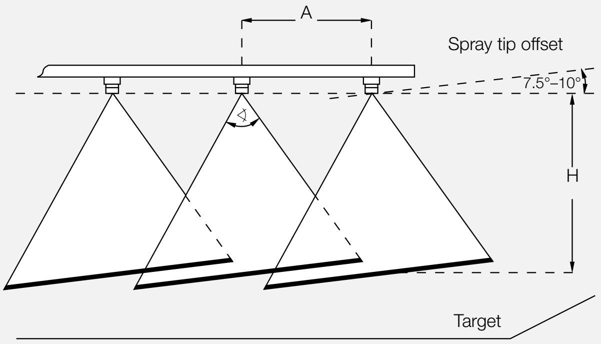
SPRAY NOZZLE TECHNOLOGY

⑥ Nozzle arrangement in the system

Flat-jet nozzles

In order to avoid mutual spray jet interference, the jet plane of flat spray nozzles is rotated by around 7.5° – 10° with respect to the pipe axis. This takes place automatically with Lechler diaphragm valves and Lechler assembly clips with TWISTLOC/Multijet bayonet cap.
The Lechler nozzle adjusting gauge (Order No. 065.231.02) is available for systems with screw/union nut fastening.

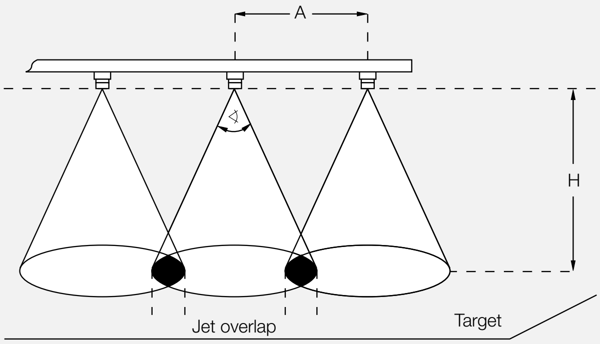
Arrangement of flat-jet nozzles



Hollow cone nozzles

Hollow cone nozzles must be arranged so that the jet cones just overlap immediately before the target surface.

Arrangement of hollow cone nozzles



Spray height H: min.-**optimal**-max. [cm] for different nozzle spacings A [m]

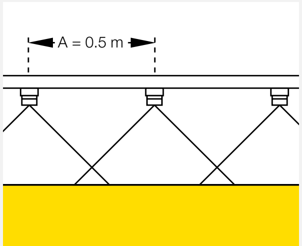
	Flat spray nozzles											Hollow cone	Stream jet
Type of jet Spray angle	**IDTA/ID3/IDKT AD/DF 120°**	**PRE 130°**	**IDK/IDKN 120°**	**ID/IDK/AD/ LU 90°**	**LU 120°**	**ST 110°**	**QS 80°**	**ST 80°**	**FD 130°**	**FT 90°**	**FT 140°**	**TR/ITR 80°**	**FL 160°**
A = 1.0 m	-	-	-	-	-	-	-	-	-	-	*75	-	-
A = 0.5 m	40-**50**-60	40-**50**-60	40-**50**-60**/90	60-**75**-90	40-**50**-70	40-**50**-60	60-**75**-90	60-**75**-90	50-70	60-75-90*	*40	-	100
A = 0.25 m	20-30	-	20-45	30-45	20-35	20-30	30-45	30-45	-	30-45*	-	50-**65**-80	-

* In the case of flood nozzles, the spray height is also a function of orientation. Uniform cross distribution requires at least a single overlapping.
**IDK 120-06

⑦ Calculation formula for field spraying

Application parameters

The table values in the technical part of the catalog apply for field spraying booms with a lateral nozzle spacing of A = 0.5 m. The adjacent formula apply for other lateral nozzle spacings.



Liter per hectare rate, M (l/ha)

$$M = \frac{600 \times \dot{V}}{A \times v_F}$$

Flow rate/nozzle $\dot{V}$ (l/min)

$$\dot{V} = \frac{1}{600} \times M \times A \times v_F$$

Lateral nozzle spacing A (m)

Sprayer speed v_F (km/h)

Sample for calculation of flow rate per nozzle:

A = 1 m, v_F = 6 km/h,

M = 400 l/ha

$$\dot{V} = \frac{400 \times 1 \times 6}{600} = 4 \text{ l/min}$$

As a general rule: of the four parameters driving speed (km/h), application rate (l/ha), flow rate (l/min) and nozzle spacing (m), three are normally known. The frequently unknown variables (l/ha; l/min) are also calculated using the adjacent formulae.

Band width B [m]
Lateral nozzle spacing or row spacing A [m]

$\frac{B}{A} \times 100 =$ treated (sprayed) area as a percentage of total gross covered area

Example:

$$\frac{0.2}{0.5} \times 100 = 40\ \%$$

Calculation of the actual application rate for banding or row spraying is based on the ratio of the treated area to the area to be driven over. The application rate in l/ha corresponds to the percentage (e.g. 40 %) of the application rate for broadcast spraying.

⑧ Calculation formula for applications for wine and orchards

Use of nozzles with identical nozzle sizes

The total nozzle output of the crop protection equipment is calculated in accordance with the following formula:

$$\dot{V} = \frac{M \times V_F \times B}{600}$$

$\dot{V}$ = Total nozzle output, l/min

M = Liter-per-hectare rate, l/ha

v_F = Sprayer speed, km/h

B = Working width, m

The flow rate of the individual nozzles is calculated by dividing the total nozzle output by the number of working nozzles.

The nozzle size and pressure are determined from the flow rate on the basis of the tables (see pages 59-67).

The working width corresponds to the distance between the driving lanes, i.e. the row spacing if every driving lane is used. If only every second driving lane is used, the working width corresponds to double the row spacing.

Use of nozzles with different nozzle sizes

If nozzles with different sizes are used simultaneously in one sprayer, the nozzle size is first determined that would be obtained in the case of equipment with nozzles offering identical performance.

The number of nozzles of the next-smaller nozzle size is taken into account corresponding to the total number of nozzles.

In order to achieve the given liquid application rate (required value), the pressure must be increased in accordance with the adjacent formula.

$$\textbf{Pressure-setpoint} = \textbf{Pressure-actual value} \times \left[\frac{\textbf{Total nozzle output setpoint}}{\textbf{Total nozzle output actual value}}\right]^2$$

Example
At a sprayer speed of 6.5 km/h, 600 l/ha should be applied. The working width is 2.0 m. The total nozzle output is then:

$$\frac{600 \times 6.5 \times 2.0}{600} = 13.0 \text{ l/min}$$

If 10 nozzles of the same size are used, the flow rate of each nozzle is
13.0 : 10 = 1.3 l/min.
➔ nozzle/pressure as per Table see above:

ID 90-02/yellow at 8 bar

Instead of nozzle ID 90-02, the lower and two upper nozzles with the next smaller size

6 x ID 90-015/green should be fitted on both sides of the sprayer.
The total nozzle output (actual value) is as follows at 8 bar (actual value)
(6 x 0.96 + 4 x 1.30) l/min
= 10.96 l/min.
The pressure setpoint to be set for 600 l/ha (setpoint) is then:

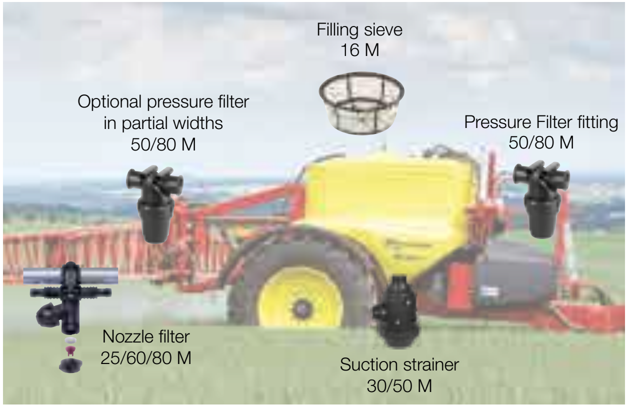
$$8 \times \left[\frac{13.0}{11.0}\right]^2 = 11.2 \text{ bar}$$

SPRAY NOZZLE TECHNOLOGY

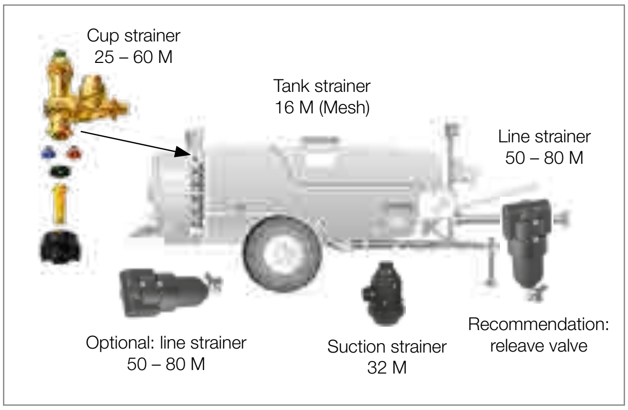
⑨ Recommendations

Correct „filtering“

Malfunctions during operation caused by coarse particles can be prevented by use of the correct filter system. In order to protect the nozzle filter, we recommend selecting a mesh filter in the pressure filter which is one category finer. The recommendations for the mesh size (M) of the nozzle filter/cup strainer are provided in the spray tables according to nozzle size.



Scheme of selecting the mesh size using the example of a field sprayer



Scheme for selecting the mesh of the filter using the example of a sprayer for wine and orchard

Avoiding nozzle blockages

Properly functioning equipment is a prerequisite for successful crop protection. Clogged nozzles are annoying because cleaning takes up valuable time. And this also does not take into account the possible consequences of incorrect spray application.

Such problems can be easily avoided by suitable measures as well as knowledge of the products and water quality:

- Observe the specified order when producing the spray mixture
- Always add only one product at a time
- Allow sufficient time to dissolve
- The mixer must guarantee good and homogeneous mixing of the plant protection product
- Match the filter in the equipment to the nozzle size
- Clean after use, e.g. with continuous internal cleaning
- Pay attention to water quality in relation to solubility of plant protection products

Measuring the driving speed

60 sec. = 6.0 km/h
45 sec. = 8.0 km/h
36 sec. = 10.0 km/h

Example

$$\frac{100\ m \times 3.6}{45\ sec.} = 8.0\ km/h$$

Nozzles troubleshooting

Nozzle clogging	cleaning
Damaged nozzle	changing
Nozzle worn out	changing
Wrong nozzle (Type/size)	changing
Filterclogging	cleaning
Diaphragm valve defective	changing

A sprayer will deliver the desired product quantity per hectare only if it is correctly adjusted.

The easiest method for checking this yourself is measurement of the individual nozzle output.
A nozzle is considered to be worn if the individual nozzle output is 10 % above the table value of nozzles of same size. The pressure range and pressure drop must be taken into account.

Even with flow-controlled devices, a water capacity test is necessary. Source: Bildungswerkstatt Mold, Pichler Herbert

⑩ Nozzle wear

- Nozzles become worn even if used properly and thus have a limited service life.
- Wear is determined by factors such as spray pressure, abrasiveness of the spray fluid and the nozzle material.
- Damage to the nozzle tip due to incorrect cleaning or handling must be avoided under all circumstances.
- A simple way of determining the wear of nozzle tips is to gauge the flow rate using a measuring jug, stop watch and pressure gauge on the nozzle line. The flow rates of used nozzles are compared with the flow rates of new nozzles of the same size.
- The nozzles must be replaced if the flow rates of nozzle that are in use exceed the value of spray table by more than 10 %.

All table values in this catalog specify the flow rates of new nozzles. In addition, equipment testing on a nozzle test bench also provides information about the nozzle condition in relation to cross distribution, whereby the quality of cross distribution and the change in volume flow may be interdependent with respect to the calculated coefficient of variation.

The wear resistance of the nozzle material increases in the following order:
- Brass
- Stainless steel
- Plastic
- Ceramic

SPRAY NOZZLE TECHNOLOGY

⑪ Thread table and pipe diameters

Compatibility of pipe threads			Female thread			
			DIN EN 10226		ISO 228	NPT
			Rc	Rp	G	
Male thread	**DIN EN 10226**	**R**	x	x	x*	-
	ISO 228	**G**	-	-	x	-
	NPT		-	-	-	x

* Leckage possible!
x = compatible
- = not compatible

Taper thread: R, Rc, NPT
Parallel thread: RP, G

Code for pipe diameters:

20 mm	**21 mm**
1/2“	**21 mm**
25 mm	**25 mm**
3/4“	**27 mm**
1“	**34 mm**

⑫ Quality means being measured by results

Approved Lechler nozzles for field spraying as well as for bush, tree and specialty crop applications always reliably meet the requirements of the Julius Kühn Institute JKI and other international standards.
All prerequisites in the sense of the German Plant Protection Act and European legislation as well as ISO 16119 (Environmental requirements for sprayers) and ISO 16122 (Inspection of sprayers in use) are therefore met.