

ENGINEERING
YOUR SPRAY SOLUTION



SCALEMASTER HPS

NOZZLES FOR
HYDROMECHANICAL DESCALING

METALLURGY



Lechler has the leading experience

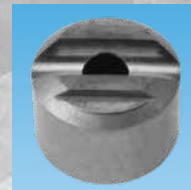
- Of being the leading supplier for descaling nozzles to rolling mill builders globally
- Of supplying SCALE-MASTER nozzles to over 500 rolling mills worldwide
- Of having re-engineered and optimized more than 200 descaling systems
- Of having been the pioneer in descaling in thin slab rolling plants



The unique coreless stabilizer eliminates turbulences.



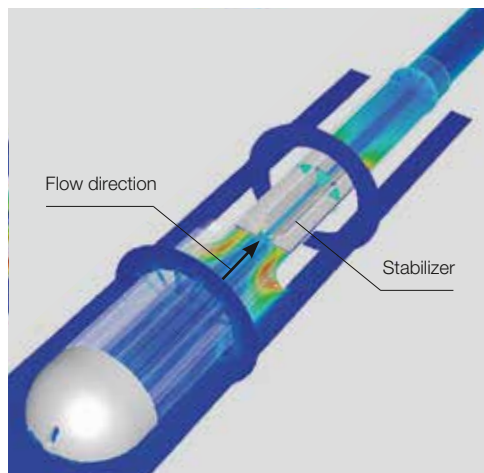
Single part stabilizer – filter unit completely made from stainless steel reduces pressure losses.



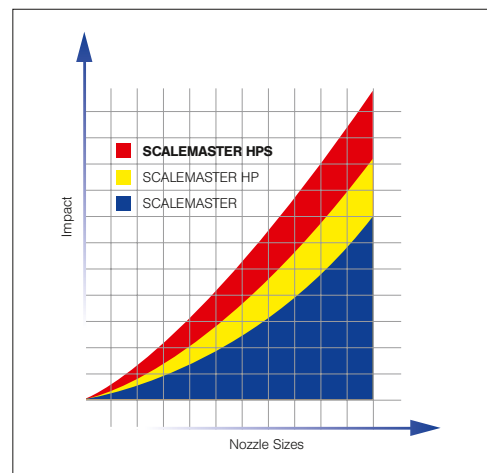
Nozzle tip with tungsten carbide insert.

ROLLED SURFACE QUALITY AND ENERGY SAVINGS

- **SCALEMASTER HPS** is fully compatible with all other SCALEMASTER nozzles (check overall length) No header modifications necessary
- Optimized stabilizer design reduces the spray footprint area resulting in a higher impact
- An increased spray impact can lead to an improvement of the surface quality at no additional energy input
- A nozzle family providing higher impacts allows the use of a smaller nozzle size so that the impact can be maintained at a lower water flow and reduced energy consumption



CFD turbulence simulation of the **SCALEMASTER HPS** showing optimal turbulence free inner flow conditions (dark blue area) right to the tip



Impact evolution of Lechler SCALEMASTER descaling nozzles against nozzle sizes

IMPROVE SURFACE QUALITY

Objectives: Clear focus on maximizing the spray impact at given system water pressure and flow.

Analyze

- Check water pressure at header (Lechler Descaling Pressure Gauge)
- Check nozzle types installed
- Check nozzle arrangement (spray overlaps, inclination angle etc.)

Contact Lechler for benchmarking with DESCAL 8.10 simulation.



Change to SCALEMASTER HPS

- Maximize Impact
- Keep water pressure
- Keep nozzle size



Additional option

- Reduce vertical spray height and increase impact even further



Contact Lechler for DESCAL 8.10 simulation and re-engineering of header.

SAVE ENERGY

Objectives: Clear focus on reducing the descaling water flow.

Analyze

- Check water pressure at header (Lechler Descaling Pressure Gauge)
- Check nozzle types installed
- Check nozzle arrangement (spray overlaps, inclination angle etc.)

Contact Lechler for benchmarking with DESCAL 8.10 simulation.



Change to SCALEMASTER HPS

- Maintain impact values
- Install smaller nozzle size and reduce water flow
- Keep nozzle size and reduce water pressure



Additional option

- Reduce vertical spray height allowing to further reduce the water flow



Contact Lechler for DESCAL 8.10 simulation and re-engineering of header.

NOZZLE DATA

When a descaling system is being designed the following nozzle performance parameters must be known:

- The water flow rate at a given pressure
- The spray width at a given vertical spray height (this defines the spray angle)
- The spray impact and its distribution across the spray width

The impact (also called impact pressure) is the momentum or force distribution over the spray foot print area. Therefore the impact can be defined as $I = F/A$.

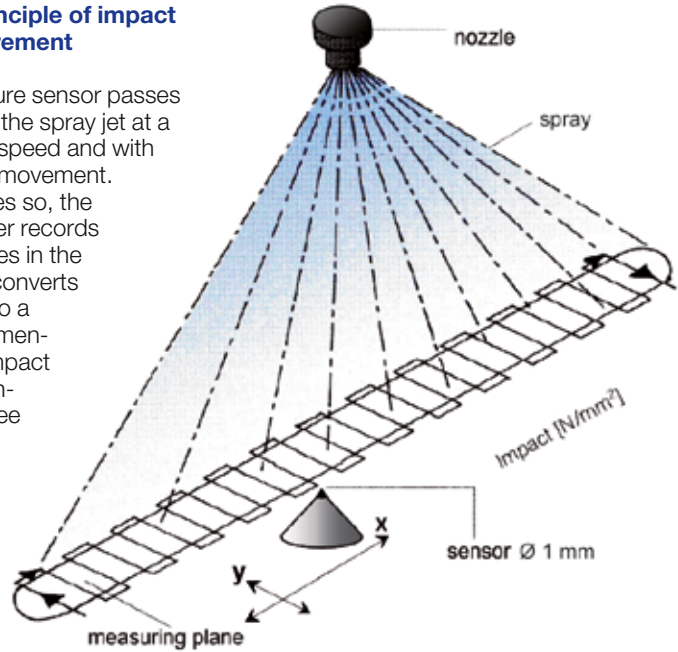
$I = \text{Impact [N/mm}^2\text{]}$
 $F = \text{Force [N]}$
 $A = \text{Area [mm}^2\text{]}$

When turbulent free descaling nozzles such as the Lechler **SCALEMASTER HPS** and lower spray heights are being combined, spray foot print thicknesses of only 3 mm become a challenge for the impact measurement facilities. Spray overlaps below 10 mm also require a much higher precision of the spray width data.

Only the new Lechler 3D impact measurement technology utilizing a sensor with only 1.0 mm diameter provides the resolution required for the design of an optimal nozzle arrangement. The impact distribution is measured and documented 3-dimensionally throughout the entire spray in one sensor scan.

The principle of impact measurement

A pressure sensor passes through the spray jet at a defined speed and with defined movement. As it does so, the computer records the pulses in the jet and converts them into a three-dimensional impact representation (see below).

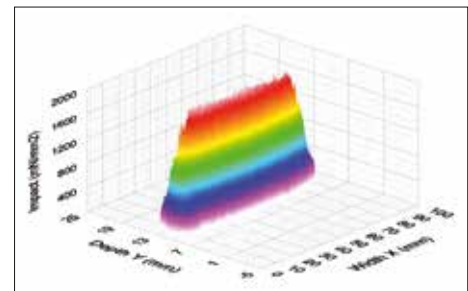


Lechler high pressure spray lab

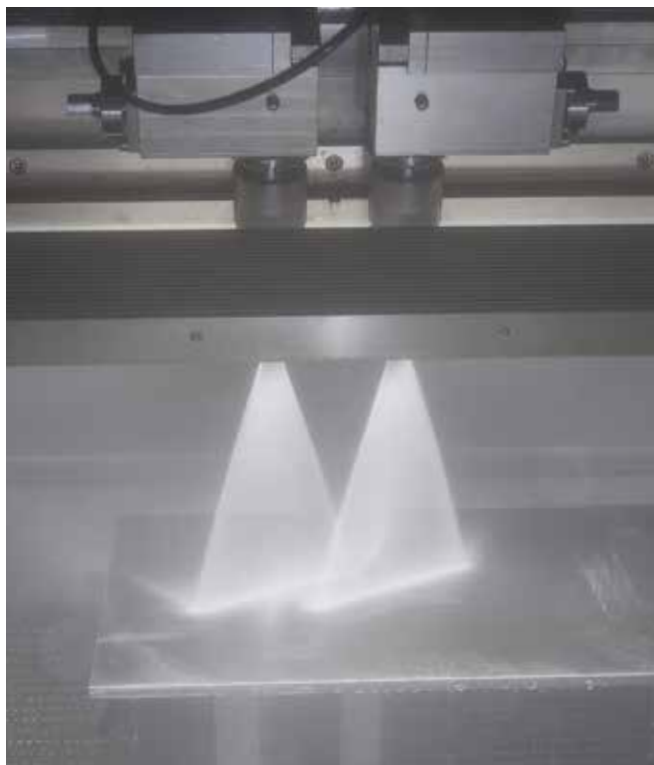
Impact measurements under real installation conditions in terms of nozzle inclination and offset angles can now be performed with the new Lechler high pressure spray lab. Additionally the well proven sensor technology (1 mm diameter) has been integrated into a plate, allowing the measurement of two adjacent sprays. With such a descaling nozzle arrangement Lechler can now investigate the effect on various spray overlap situations in order to fight surface striping especially on rolled plates. Impact measurements up to 500 bars water pressure can be performed.



Lechler high pressure spray lab



3D measurement protocol, impact measurement

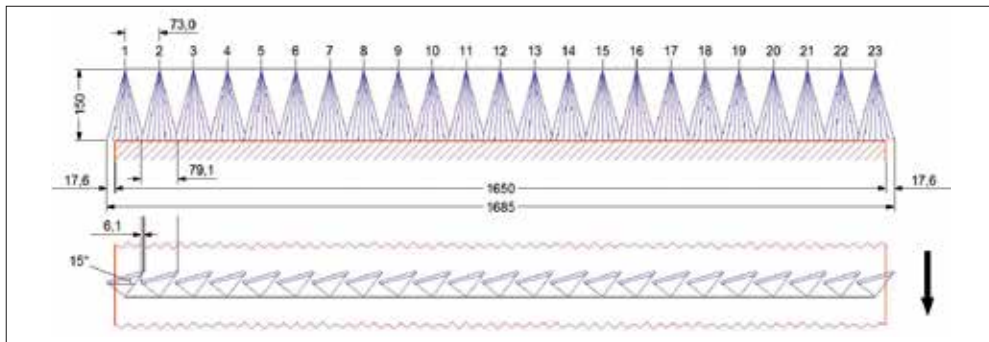


Impact measurement with twin nozzle arrangement

OPTIMAL NEW NOZZLE ARRANGEMENT DESCALING SYSTEM OPTIMIZATION

System Study

A descaling system study with the Lechler DESCALE software is a systematic and structured procedure for defining how an existing nozzle and header arrangement performs regarding the surface quality of the rolled product. Since 1992 the Lechler DESCALE software has made crucial contributions towards increasing of surface quality and plant efficiency.



Example of optimization with Lechler DESCALE software

The Lechler DESCALE 8.10 software

The perfect tool to benchmark the performance parameters of the existing situation and to quickly design a new or optimized nozzle arrangement, no matter if billets, blooms, slabs or strips have to be descaled. For the first time and exclusively from Lechler the DESCALE 8.10 can generate a nozzle arrangement for round billets and blooms.

Lechler Descaling Pressure Gauge for precise pressure data

With the new Lechler DESCALING PRESSURE GAUGE the water pressure can be measured directly at the spray header in front of a descaling nozzle by simply taking one nozzle out and putting the pressure sensor in instead.

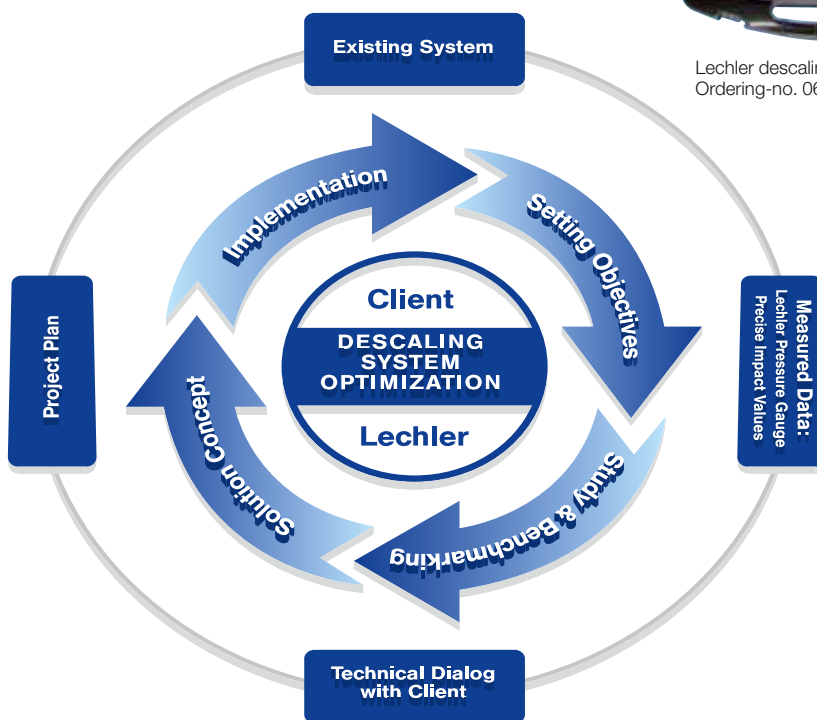
With the exact value of the water pressure available at the nozzle a much more accurate simulation of the existing situation and the proposed modification can be made with the Lechler DESCALE 8.10 software. It is also possible to detect potential pressure losses in the pipe work.



Lechler descaling pressure gauge
Ordering-no. 06P.M00

Precise impact data

For the DESCALE 8.10 all nozzle types of all SCALEMASTER nozzle families have been impact measured with the new 1 mm diameter sensor technology providing Lechler with the most accurate process data on the market.



SCALEMASTER HP SUPERIOR



- Improved rolled material surface
- Saves on pump energy
- Splash water quantity reduced

The window design of the new tip in combination with the new stabilizer-filter unit make the **SCALEMASTER HPS** a nozzle for every modern hot rolling mill which offers the following benefits:

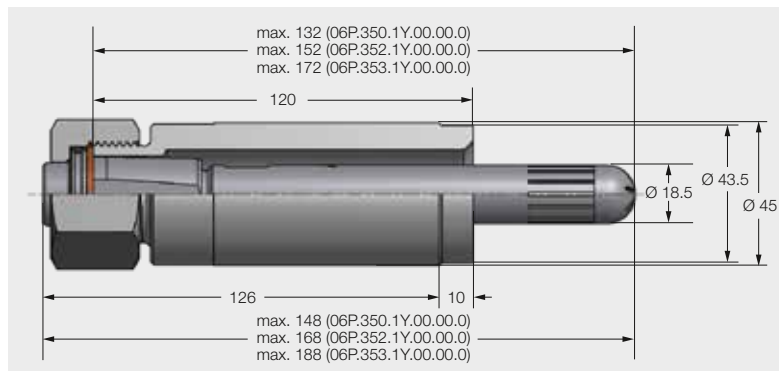
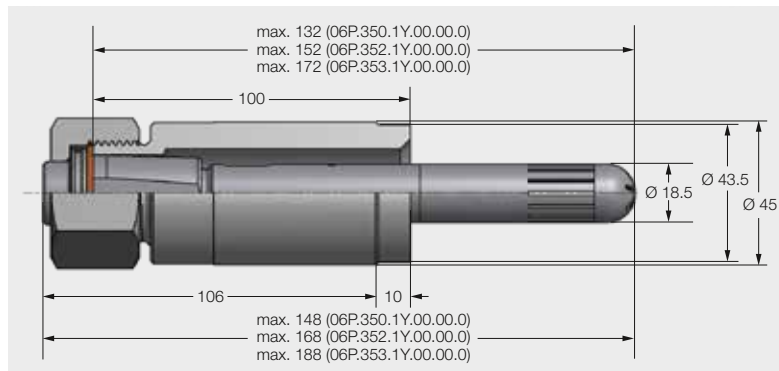
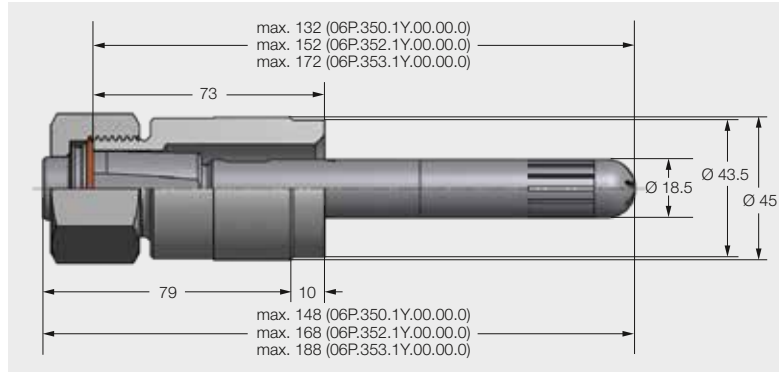
The **SCALEMASTER HPS** is the ideal nozzle for descaling in conventional hot strip mills when the vertical spray height is not below 150 mm.

The proven **SCALEMASTER HP** tungsten carbide insert geometry combined with the new coreless stabilizer and the optimized filter design form the next step in the evolution of the **SCALEMASTER** family of descaling nozzles.

- Remarkable increase of impact for better descaling
- Better product surface quality due to higher impact
- Reduction of descaling water flow rate possible
- Potential of energy savings due to reduced slab/strip cooling
- More durable tip with high mechanical strength due to window design
- Interchangeable with all other **SCALEMASTER** nozzles (check overall length)

No.	Component		Order no.	Weight
1	Welding nipple Material: AISI 304	Length L = 73 mm	069.410.1C.73 069.410.1C.00 069.411.1C.00	0.490 kg 0.710 kg 0.830 kg
		L = 100 mm		
		L = 120 mm		
		Other length on request		
2	Filter stabilizer unit Material: Stainless steel	With filter S = 110 mm	06P.350.1Y.00.00.0 06P.352.1Y.00.00.0 06P.353.1Y.00.00.0	0.100 kg 0.130 kg 0.155 kg
		S = 130 mm		
		S = 150 mm		
3	Gasket Material: Copper		095.015.34.04.02.0	0.005 kg
4	Nozzle tip		6P4.XXX.XX See order table	0.140 kg
5	Nut (standard) Material: AISI 430 F	Hex 41 Max. torque 200 Nm	069.400.11	0.150 kg

Max. permissible operating pressure: 450 bar



Nozzle data

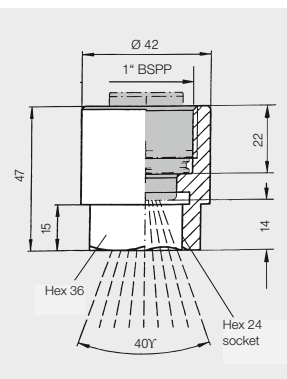
Correct nozzle arrangement

Order No. for nozzle tip							Water flow rate (V̇)						
Series	Type					Material code	A Ø [mm]	p = 100 bar (1,450 psi)		p = 200 bar (2,900 psi)		p = 400 bar (5,800 psi)	
	Nominal spray angle							[l/min]	[US Gall./min]	[l/min]	[US Gall./min]	[l/min]	[US Gall./min]
	22°	26°	30°	34°	40°								
6P4	495	496	497	491	498	27	1.50	12.00	3.17	16.97	4.50	24.00	6.34
6P4	535	536	537	531	538	27	1.75	15.00	3.96	21.21	5.60	30.00	7.92
6P4	565	566	567	561	568	27	2.00	18.00	4.76	25.46	6.73	36.00	9.52
6P4	605	606	607	601	608	27	2.10	23.00	6.08	32.53	8.59	46.00	12.16
6P4	645	646	647	641	648	27	2.50	28.00	7.40	39.60	10.46	56.00	14.80
6P4	685	686	687	681	688	27	2.80	36.00	9.51	50.91	13.45	72.00	19.02
6P4	725	726	727	721	728	27	3.00	45.00	11.89	63.64	16.81	90.00	23.78
6P4	765	766	767	761	768	27	3.50	58.00	15.32	82.02	21.67	116.00	30.64
6P4	805	806	807	801	808	27	3.80	72.00	19.02	101.82	26.90	144.00	38.04
6P4	845	846	847	841	848	27	4.30	89.00	23.51	125.87	33.25	178.00	47.02
6P4	885	886	887	881	888	27	4.70	112.00	29.59	158.39	41.85	224.00	59.18
6P4	-	906	907	901	908	27	5.00	125.00	33.03	176.78	46.70	250.00	66.06
6P4	-	916	917	911	918	27	5.20	134.00	35.40	189.50	50.07	268.00	70.80

Flow rate conversion for table

$$\dot{V}_2 = \sqrt{\frac{p_2}{p_1}} * \dot{V}_1 \text{ [l/min]}$$

$$p_2 = \left(\frac{\dot{V}_2}{\dot{V}_1}\right)^2 * p_1 \text{ [bar]}$$



Ordering Series + Code + Mat.-Code = Order no.
example: 6P4 + 495 + 27 = 6P4.495.27

A Ø = equivalent bore diameter
 Material code 27: Stainless steel nozzle tip with tungsten carbide insert

Special nut with hexagon socket for very narrow distances between nozzles (Order no.: 069.402.11)

Nozzle spray positions

1. All nozzle jets turned parallel in one direction.
2. Nozzle jets, half of them turned outwards in opposite directions. This directs the spray water to both sides (see Fig. 1).

No. 069.490.01). To do this, it is inserted into the flat nipple opening. A rule (or similar) can now be used to easily bring the nipple into the correct parallel position where it can be welded in place (see Fig. 3).

Alignment tip

The installation aid (Fig. 2, Order No. 069.490.01) is also used as a dummy part to shut off nozzle connections or for hydrostatic pressure testing.

Nipple installation

So that the correct alignment of the nozzle mouthpiece (15° offset angle of all jets in one direction to the header's longitudinal axis – see Fig. 1 nozzle at right side) is guaranteed, the welding nipple on the spray header must be positioned so that its flat inner surfaces are parallel to the header's longitudinal axis. This is best achieved with the alignment aid supplied as an accessory (Fig. 2, Order

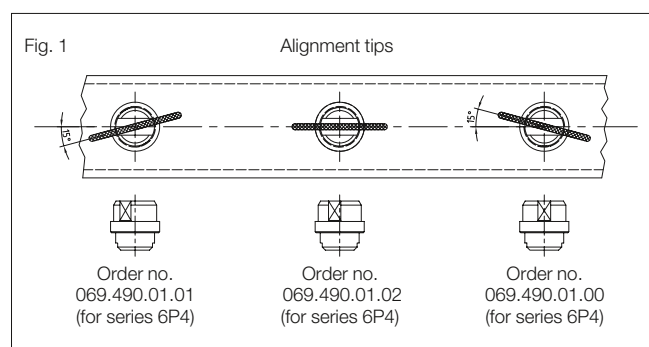


Fig. 2: Alignment tip/dummy part

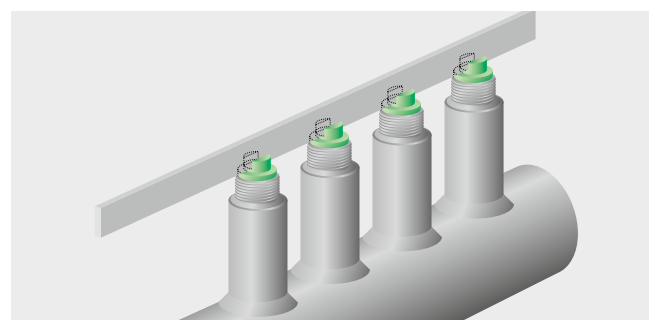


Fig. 3: Installation example for welding nipple

MiniSCALEMASTER HP SUPERIOR



- Spray height reduction
- Improved rolled material surface quality
- Saves on pump energy
- Water flow rate reduced
- Less cooling of rolled product

The window design of the new tip in combination with the new stabilizer-filter unit make the **MiniSCALEMASTER HPS** an ideal nozzle for every **thin slab hot rolling mill, plate mill** or any other hot rolling mill and which offers the following benefits:

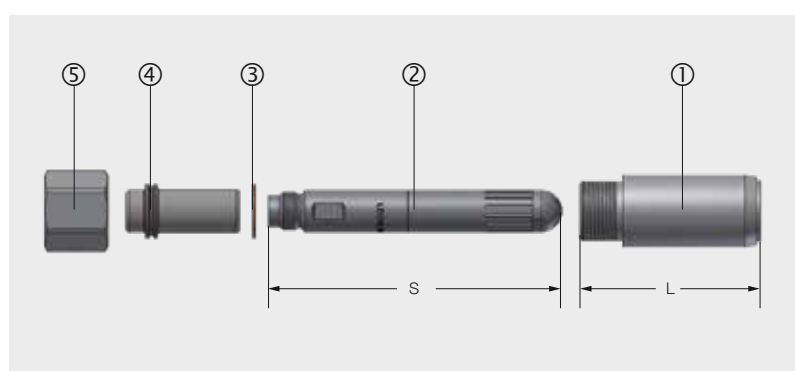
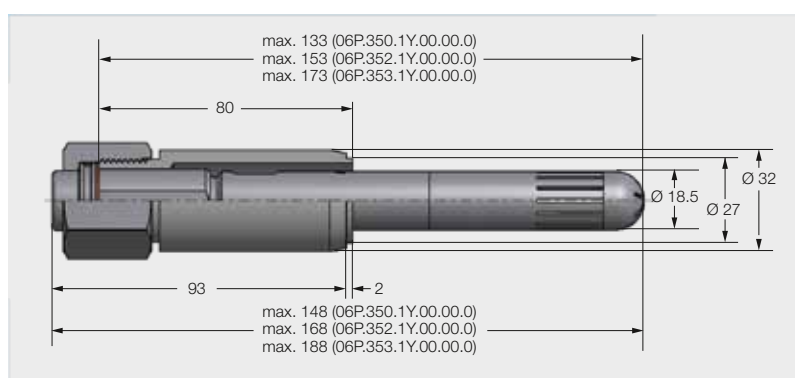
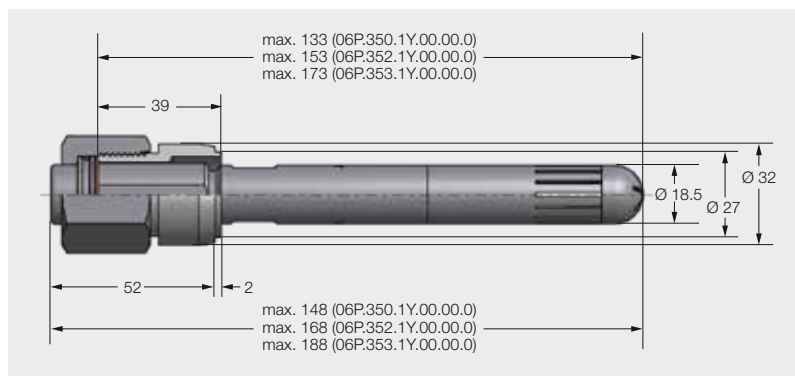
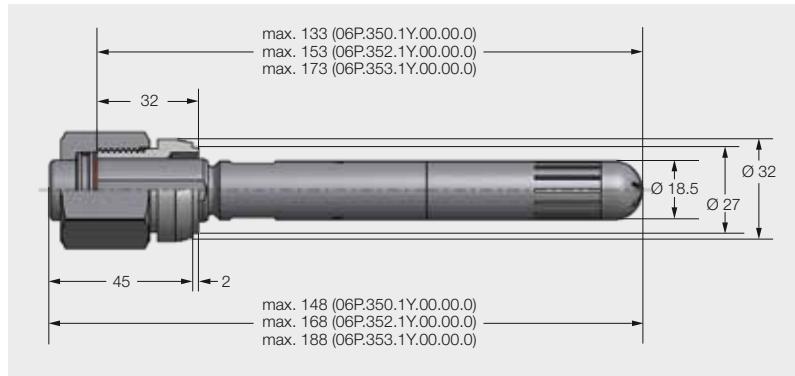
The **MiniSCALEMASTER HPS** is the ideal nozzle for descaling in conventional hot strip mills when the vertical spray height is typically below 150 mm and where the nozzle pitch requires a smaller nozzle size.

The proven SCALEMASTER HP tungsten carbide insert geometry combined with the new coreless stabilizer and the optimized filter design form the next step in the evolution of the MiniSCALEMASTER family of descaling nozzles.

- Remarkable increase of impact for better descaling
- Better product surface quality due to higher impact
- Reduction of descaling water flow rate possible
- Potential of energy savings due to reduced slab/strip cooling
- More durable tip with high mechanical strength due to window design
- Interchangeable with all other SCALEMASTER nozzles (check overall length)

No.	Component	Order no.	Weight	
1	Welding nipple Material: AISI 304	Length L = 32 mm	060.020.1C.01	0.060 kg
		L = 39 mm	060.020.1C.00	0.080 kg
		L = 80 mm	060.020.1C.02	0.190 kg
2	Filter stabilizer unit Material: Stainless steel	With filter S = 110 mm	06P.350.1Y.00.00.0	0.100 kg
		S = 130 mm	06P.352.1Y.00.00.0	0.130 kg
		S = 150 mm	06P.353.1Y.00.00.0	0.155 kg
3	Gasket Material: Copper	095.015.34.02.07.0	0.001 kg	
4	Nozzle tip	6P3.XXX.XX See order table	0.140 kg	
5	Nut (standard) Material AISI 430 F	Hex 32 Max. torque 180 Nm 064.400.11	0.085 kg	

Max. permissible operating pressure: 450 bar



Nozzle data

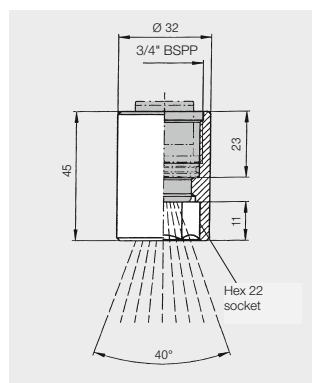
Correct nozzle arrangement

Order no. for nozzle tip							Material code	A Ø [mm]	Water flow rate (V̇)					
Series	Type					p = 100 bar (1,450 psi)			p = 200 bar (2,900 psi)		p = 400 bar (5,800 psi)			
	Code								[l/min]	[US Gall./min]	[l/min]	[US Gall./min]	[l/min]	[US Gall./min]
	Nominal spray angle													
22°	26°	30°	34°	40°										
6P3	495	496	497	491	498	27	1.50	12.00	3.17	16.97	4.50	24.00	6.34	
6P3	535	536	537	531	538	27	1.75	15.00	3.96	21.21	5.60	30.00	7.92	
6P3	565	566	567	561	568	27	2.00	18.00	4.76	25.46	6.73	36.00	9.52	
6P3	605	606	607	601	608	27	2.10	23.00	6.08	32.53	8.59	46.00	12.16	
6P3	645	646	647	641	648	27	2.50	28.00	7.40	39.60	10.46	56.00	14.80	
6P3	685	686	687	681	688	27	2.80	36.00	9.51	50.91	13.45	72.00	19.02	
6P3	725	726	727	721	728	27	3.00	45.00	11.89	63.64	16.81	90.00	23.78	
6P3	765	766	767	761	768	27	3.50	58.00	15.32	82.02	21.67	116.00	30.64	
6P3	805	806	807	801	808	27	3.80	72.00	19.02	101.82	26.90	144.00	38.04	
6P3	845	846	847	841	848	27	4.30	89.00	23.51	125.87	33.25	178.00	47.02	
6P3	885	886	887	881	888	27	4.70	112.00	29.59	158.39	41.85	224.00	59.18	
6P3	-	906	907	901	908	27	5.00	125.00	33.03	176.78	46.70	250.00	66.06	
6P3	-	916	917	911	918	27	5.20	134.00	35.40	189.50	50.07	268.00	70.80	

Flow rate conversion for table

$$\dot{V}_2 = \sqrt{\frac{p_2}{p_1}} * \dot{V}_1 \text{ [l/min]}$$

$$p_2 = \left(\frac{\dot{V}_2}{\dot{V}_1}\right)^2 * p_1 \text{ [bar]}$$



Ordering Series + Code + Mat.-Code = Order No.
example: 6P3 + 495 + 27 = 6P3.495.27

A Ø = equivalent bore diameter

Material code 27: Stainless steel nozzle tip with tungsten carbide insert

Special nut with hexagon socket for very narrow distances between nozzles (Order no.: 064.401.11)

Nozzle spray positions

1. All nozzle jets turned parallel in one direction.
2. Nozzle jets, half of them turned outwards in opposite directions. This directs the spray water to both sides (see Fig. 1).

Nipple installation

So that the correct alignment of the nozzle mouthpiece (15° offset angle of all jets in one direction to the header's longitudinal axis – see Fig. 1 nozzle at right side) is guaranteed, the welding nipple on the spray header must be positioned so that its flat inner surfaces are parallel to the header's longitudinal axis. This is best achieved with the alignment aid supplied as an accessory (Fig. 2, Order

No. 064.490.01). To do this, it is inserted into the flat nipple opening. A rule (or similar) can now be used to easily bring the nipple into the correct parallel position where it can be welded in place. (see Fig. 3)

Alignment tip

The installation aid (Fig. 2, Order No. 064.490.01 is also used as a dummy part to shut off nozzle connections or for hydrostatic pressure testing.



Fig. 2: Alignment tip/dummy part

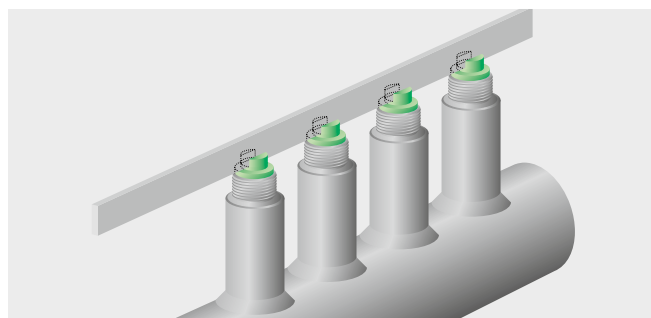
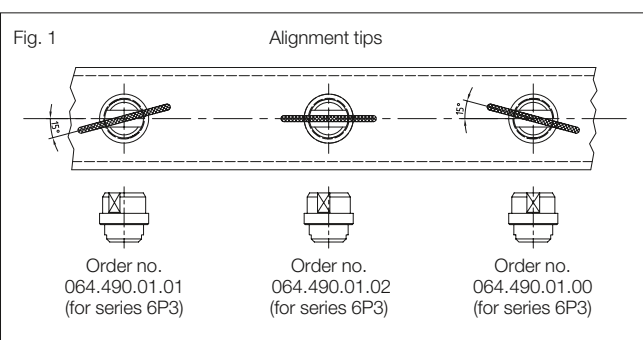
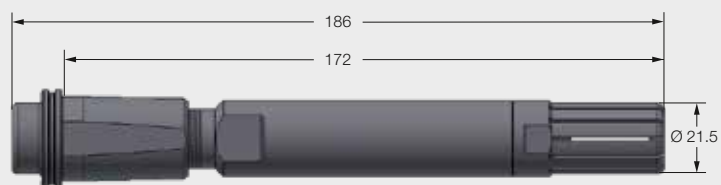


Fig. 3: Installation example for welding nipple

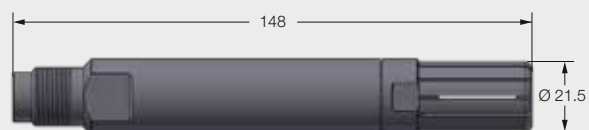
WSV Water Stop Valve for Series 6P4 and 6P3

- The WSV is a check valve which includes the stabilizer
- Every WSV comes with a filter
- Material completely made of stainless steel
- Metallic sealing
- Piston hardened

WSV for series 6P4

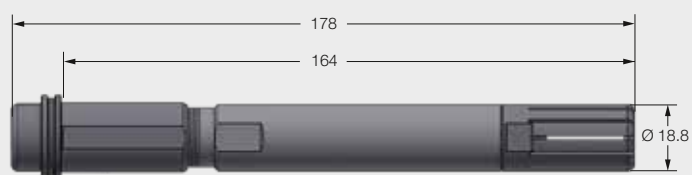


WSV with nozzle 6P4

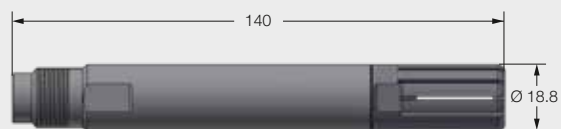


WSV (for series 6P4) without nozzle

WSV for series 6P3



WSV with nozzle 6P3

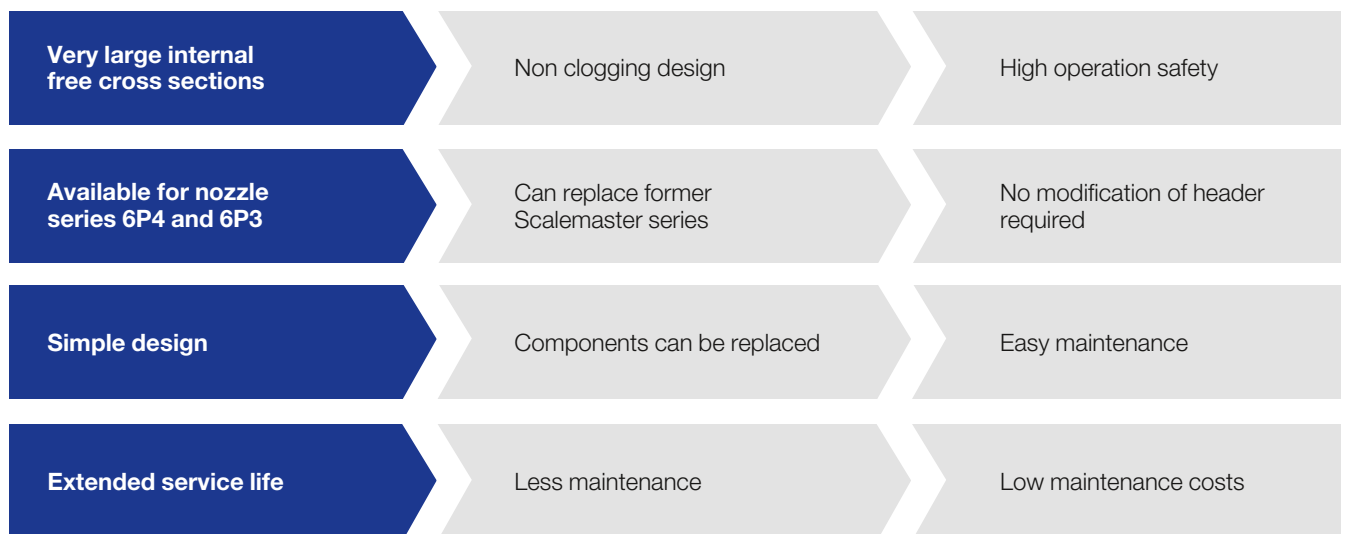


WSV (for series 6P3) without nozzle

Advantages for users

During thermomechanical rolling of steel plate and when rolling stainless steel strip, descaling is not performed for every roll pass. Nozzle check valves are used here to prevent undesired surface cooling of the rolling stock caused by the system prefilling water, which would otherwise flow unrestricted through the nozzles.

For series	Ordering no.	Opening pressure [bar]	Closing pressure [bar]	Material
SCALEMASTER HPS (6P4)	06P.470.16.00.00	14	10	Stainless steel
MiniSCALEMASTER HPS (6P3)	06P.370.16.00.00	14	10	Stainless steel



NOZZLE ARRANGEMENT ON THE SPRAY HEADER

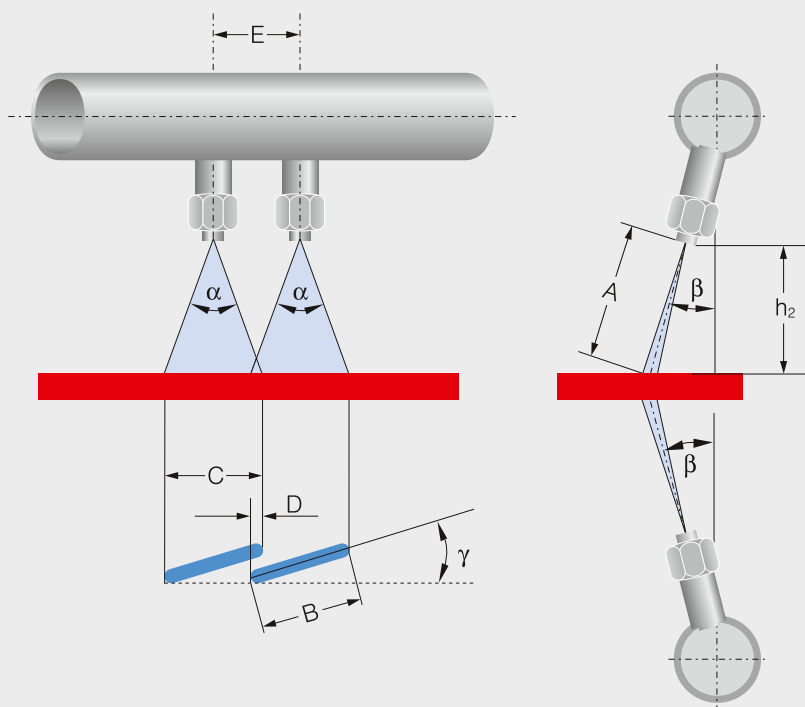
The following apply to the arrangement on the spray header:

$$E = C - D$$

$$C = \cos \gamma \cdot B$$

$$\beta = 5^\circ, 10^\circ \text{ or } 15^\circ$$

- A = Spray length
- B = Spray width
- C = Spray width in rolling direction
- D = Overlap
- E = Nozzle distance
- h_2 = Vertical spray height
- α = Nozzle spray angle
- β = Angle of inclination
- γ = Offset angle of the nozzle against pipe roll axis



Spray length (A), Spray width (B, C), Overlap (D), Nozzle distance (E) at vertical spray height (h_2), Nozzle spray angle (α) and Angle of inclination (β)

Vertical spraying height h_2 [mm]	Angle of inclination $\beta = 15^\circ$ A [mm]	Nominal nozzle spray angle α at $p = 150$ bar																			
		$\alpha = 22^\circ$				$\alpha = 26^\circ$				$\alpha = 30^\circ$				$\alpha = 34^\circ$				$\alpha = 40^\circ$			
		B [mm]	C [mm]	D [mm]	E [mm]	B [mm]	C [mm]	D [mm]	E [mm]	B [mm]	C [mm]	D [mm]	E [mm]	B [mm]	C [mm]	D [mm]	E [mm]	B [mm]	C [mm]	D [mm]	E [mm]
50	52	26	25	-	-	30	29	-	-	35	34	-	-	39	38	-	-	47	45	5	40 ¹
75	78	36	35	-	-	43	42	5	37 ¹	49	47	5	42 ¹	55	53	6	47 ²	67	65	7	58 ²
100	104	47	45	7	38 ¹	56	54	5	49 ²	64	62	5	57 ³	71	69	7	62 ³	88	85	8	77
125	129	57	55	7	48 ²	68	66	7	59 ³	78	75	7	68	87	84	9	75	108	104	10	94
150	155	68	66	8	58 ³	81	78	7	71	93	90	8	82	103	99	9	90	128	124	10	114
200	207	89	86	9	77	106	102	10	92	122	118	10	108	134	129	13	116	168	162	15	147
250	259	111	107	11	96	132	128	10	118	151	146	15	131	166	160	15	145	209	202	15	187

¹ Only **MiniSCALEMASTER HPS** with hexagon socket nut

² Only **MiniSCALEMASTER HPS**

³ Only with hexagon socket nut

QUESTIONNAIRE FOR NOZZLE ARRANGEMENT

Please fill out and send to
fax number +49 7123 962-333

Company _____

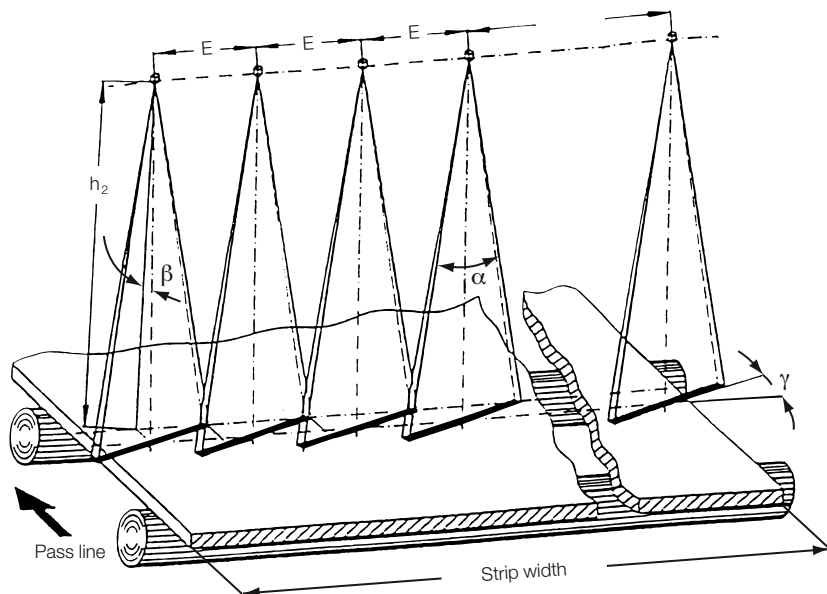
Responsible _____

Address _____

Phone _____

Fax _____

Email _____



Questionnaire about existing Descaling Nozzle Arrangement

Name: _____ Date: _____ Department: _____

Location of descaling installation: Behind the furnace RSB FSB Interstand descaling

Format	Dimensions [mm]	Nozzle Data		
Strip			top	bottom
Slab		Number of headers		
Plate		Nozzle type		
Bloom		Horizontal distance (E)	mm	mm
Billet		Number of nozzles		
Rounds		Vertical spray height (h_2)	mm	mm
Material speed	m/s	Spray angle (α)	°	°
Pressure at header	bar	Offset angle (γ)	°	°
Available max. water flow	l/min	Impingement angle (β)	°	°
	l/h			

Room for sketch:

ACCESSORIES AND SPRAY HEADERS

Disassembly set

The disassembly set is pushed onto the recess on the mouth-piece. The entire nozzle unit can be pulled out when the union nut is unscrewed.

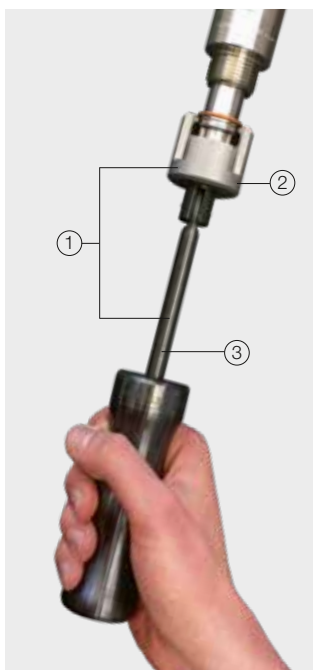


Fig. 1: Disassembly set
(data sheet on request)

For SCALEMASTER HPS

① Disassembly set

Order no. 069.492.12.00.00.0

② Tip extractor

Order no. 069.492.12.00.10.0

③ Extraction tool

Order no. 095.009.00.12.56.0

For MiniSCALEMASTER HPS

① Disassembly set

Order no. 064.492.12.00.00.0

② Tip extractor

Order no. 064.492.12.00.10.0

③ Extraction tool

Order no. 095.009.00.12.56.0

Anti-seize compound

The application of the anti-seize compound on the thread of the welding nipples is recommended and ensures easy removal of the nut. (Ordering No. 9ET.048.29.00.00.0; 80 g)



Spray headers

Next to the wide range of descaling nozzles we offer the design and production of complete spray headers or rings.



Spray ring



Spray header

DESCALING PRESSURE GAUGE



Hand held pressure reading



Installation example: pressure sensor with spray protection mounted on spray header

Hand held pressure reading

With the new Lechler descaling pressure gauge the water pressure can be measured directly at the spray header in front of a descaling nozzle by simply taking one nozzle out and putting the pressure sensor instead.

For detailed information please ask for the special product data sheet.

- Simple and user-friendly key operation
- Two sensor inputs, automatic sensor recognition

Sensor details

- Measuring range: 0...600 bar
- Burst pressure: 2,000 bar
- Accuracy of sensor: ± 0.25 % of full scale (± 1.5 bar)
- Protection class: IP67

Complete Descaling Pressure Gauge

Sensor adaptors for 6P3 (Mini SM-HPS) and 6P4 (SM-HPS) nozzle tips included.
(Ordering No. 06P.M00.00.00.00)



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YOUR SPRAY SOLUTION



Lechler GmbH · Precision Nozzles · Nozzle Systems

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