Nozzles for hydromechanical Descaling
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
### 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

### 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.)

**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 benchmarking with DESCALE 8.10 simulation.

### 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.)

**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 benchmarking with DESCALE 8.10 simulation.

### Impact evolution of Lechler SCALEMASTER descaling nozzles against nozzle sizes

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
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 $I = \frac{F}{A}$.

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

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.
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.

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.

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.

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.
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.

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:

- 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)

---

### Table: Components and Specifications

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Order no.</th>
<th>Weight</th>
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<tbody>
<tr>
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<td></td>
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<td>Filter stabilizer unit</td>
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<td>4</td>
<td>Nozzle tip</td>
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<td>Material: AISI 430 F</td>
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<tr>
<td>5</td>
<td>Nut (standard)</td>
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<tr>
<td></td>
<td>Material: AISI 430 F</td>
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</tbody>
</table>

Max. permissible operating pressure: 450 bar
Nozzle data
Correct nozzle arrangement

<table>
<thead>
<tr>
<th>Order No. for nozzle tip</th>
<th>Water flow rate (V)</th>
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<tr>
<td>Type</td>
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<td>506</td>
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</tbody>
</table>

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

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 to the header’s longitudinal axis – see Fig. 1) 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. 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.

Flow rate conversion for table

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

\[ p_2 = \left( \frac{\dot{V}_1}{\dot{V}_2} \right) \cdot p_1 \quad \text{[bar]} \]

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

Fig. 1: Alignment tips
Order no. 069.490.01 (for series 6P4)
Order no. 069.490.02 (for series 6P4)
Order no. 069.490.03 (for series 6P4)

Fig. 2: Alignment tip/dummy part
Fig. 3: Installation example for welding nipple
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)

The window design of the new tip in combination with the new stabilizer-filter unit makes 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:

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

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- Interchangeable with all other SCALEMASTER nozzles (check overall length)
Nozzle data
Correct nozzle arrangement

<table>
<thead>
<tr>
<th>Series Code</th>
<th>Nominal spray angle</th>
<th>Material code</th>
<th>Water flow rate (V)</th>
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<td>26°</td>
<td>30°</td>
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<tr>
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<td>6P3 499</td>
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<td>41.34</td>
</tr>
</tbody>
</table>

Ordering Series + Code + Mat.-Code = Order No.

Example: 6P3 + 495 + 27 = 6P3.495.27

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 to the header’s longitudinal axis - see Fig. 1) 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.

Flow rate conversion for table

\[ V_2 = \sqrt{\frac{p_2}{p_1}} \cdot V_1 \]

where \( V_1 \) is the water flow rate at 100 bar (1,450 psi), \( p_1 \) is the pressure in bar, \( p_2 \) is the pressure in bar, and \( V_2 \) is the water flow rate at the pressure \( p_2 \).

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)
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**

Dimensions:
- WSV with nozzle 6P4: Ø 21.5, L 186, D 172
- WSV (for series 6P4) without nozzle: Ø 21.5, L 148
- WSV with nozzle 6P3: Ø 18.8, L 178, D 164
- WSV (for series 6P3) without nozzle: Ø 18.8, L 140
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.

### Advantages for users

<table>
<thead>
<tr>
<th>Very large internal free cross sections</th>
<th>Non clogging design</th>
<th>High operation safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available for nozzle series 6P4 and 6P3</td>
<td>Can replace former Scalemaster series</td>
<td>No modification of header required</td>
</tr>
<tr>
<td>Simple design</td>
<td>Components can be replaced</td>
<td>Easy maintenance</td>
</tr>
<tr>
<td>Extended service life</td>
<td>Less maintenance</td>
<td>Low maintenance costs</td>
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<table>
<thead>
<tr>
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<td>14</td>
<td>10</td>
<td>Stainless steel</td>
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</table>
**NOZZLE ARRANGEMENT ON THE SPRAY HEADER**

The following apply to the arrangement on the spray header:

- \( E = C - D \)
- \( C = \cos \gamma \cdot B \)
- \( \beta = 5^\circ, 10^\circ \) 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  
\( \alpha \) = Nozzle spray angle  
\( \beta \) = Angle of inclination  
\( \gamma \) = Offset angle of the nozzle against pipe roll axis

### Vertical spraying height (\( h_2 \)), Spray length (A), Spray width (B, C), Overlap (D), Nozzle distance (E) at vertical spray height (\( h_2 \)), Nozzle spray angle (\( \alpha \)) and Angle of inclination (\( \beta \))

| \( h_2 \) \[mm\] | A \[mm\] | 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\(^3\) |
| 100              | 104    | 47     | 45     | 7      | 38\(^1\) | 56     | 54     | 5      | 49\(^4\) | 64     | 62     | 5      | 57\(^4\) | 71     | 69     | 7      | 62\(^5\) | 88     | 85     | 8      | 77\(^6\) |
| 125              | 129    | 57     | 55     | 7      | 48\(^2\) | 68     | 66     | 7      | 59\(^3\) | 78     | 75     | 7      | 68     | 87     | 84     | 9      | 75\(^4\) | 108    | 104    | 10     | 94\(^7\) |
| 150              | 155    | 68     | 66     | 8      | 58\(^5\) | 81     | 78     | 7      | 71\(^8\) | 93     | 90     | 8      | 82\(^9\) | 103    | 99     | 9      | 90\(^{10}\) | 128    | 124    | 10     | 114\(^{11}\) |
| 200              | 207    | 89     | 86     | 9      | 77\(^{12}\) | 106    | 102    | 10     | 92\(^{13}\) | 122    | 118    | 10     | 108\(^{14}\) | 134    | 129    | 13     | 116\(^{15}\) | 168    | 162    | 15     | 147\(^{16}\) |
| 250              | 259    | 111    | 107    | 11     | 96\(^{17}\) | 132    | 128    | 10     | 118\(^{18}\) | 151    | 146    | 15     | 131\(^{19}\) | 166    | 160    | 15     | 145\(^{20}\) | 209    | 202    | 15     | 187\(^{21}\) |

\(^1\) Only MiniSCALEMASTER HPS with hexagon socket nut  
\(^2\) Only MiniSCALEMASTER HPS  
\(^3\) Only with hexagon socket nut
Please fill out and send to fax number +49 7123 962-333

Company

Responsible

Address

Phone

Fax

Email

**Questionnaire about existing Descaling Nozzle Arrangement**

<table>
<thead>
<tr>
<th>Name:</th>
<th>Date:</th>
<th>Department:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of descaling installation:</td>
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<td></td>
</tr>
<tr>
<td>□ Behind the furnace</td>
<td>□ RSB</td>
<td>□ FSB</td>
</tr>
</tbody>
</table>

| Format | Dimensions [mm] | Nozzle Data | | |
|--------|-----------------|-------------|--------|
| Strip  |                 | Number of headers | |
| Slab   |                 | Nozzle type | |
| Plate  |                 | Horizontal distance (E) | mm | mm |
| Bloom  |                 | Number of nozzles | |
| Billet |                 | Vertical spray height (h₂) | mm | mm |
| Rounds |                 | Spray angle (α) | ° | ° |
|        |                 | Offset angle (γ) | ° | ° |
|        |                 | Impingement angle (β) | ° | ° |

<table>
<thead>
<tr>
<th>Material speed</th>
<th>m/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure at header</td>
<td>bar</td>
</tr>
<tr>
<td>Available max. water flow</td>
<td>l/min</td>
</tr>
<tr>
<td></td>
<td>l/h</td>
</tr>
</tbody>
</table>

Room for sketch:
ACCESSORIES AND SPRAY HEADERS

**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.

**Disassembly set**

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

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**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
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.M00.00.00.00.0)