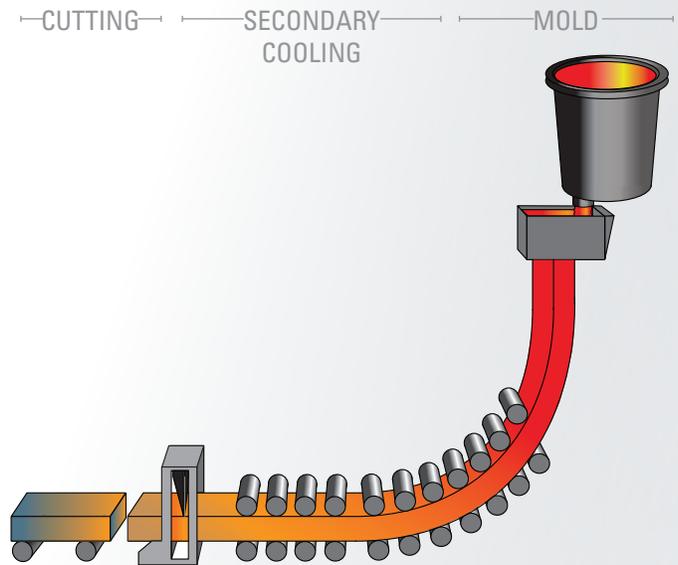


SOLUTIONS FOR STEEL APPLICATIONS



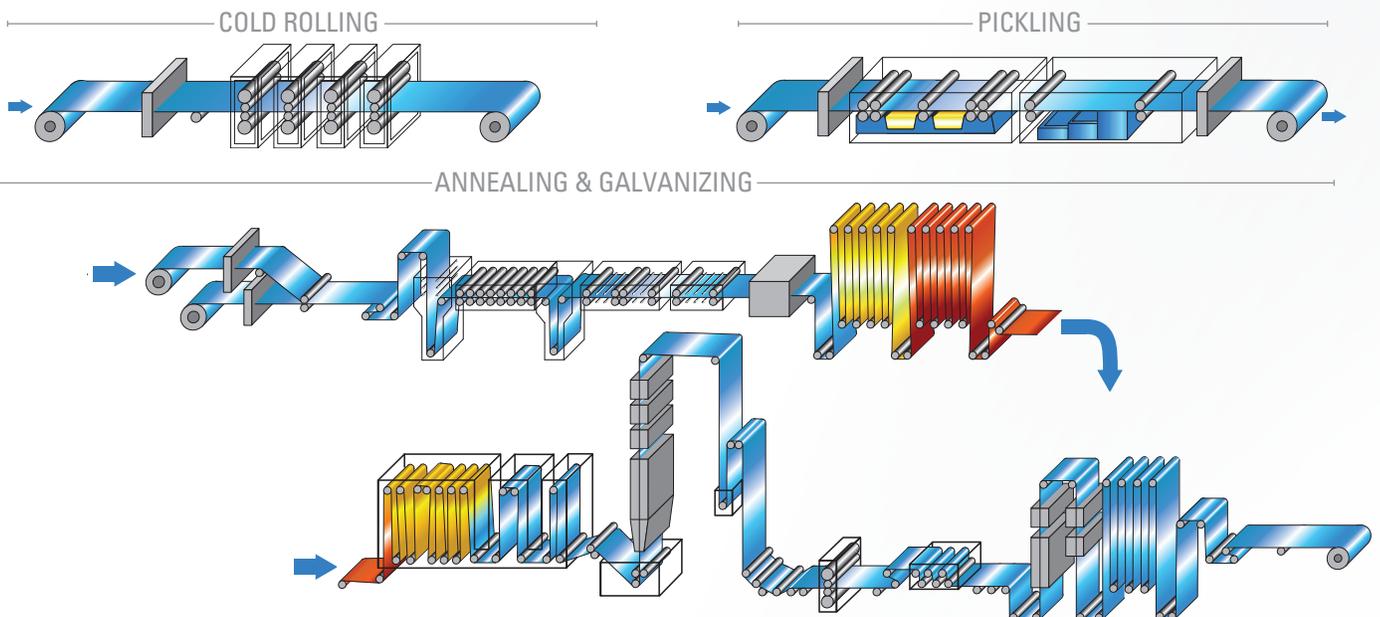
SECTION B CONTINUOUS CASTING

- CasterJet® nozzles
- FlatJet® nozzles
- FloodJet® nozzles
- FullJet® nozzles
- VeeJet® nozzles



SECTION D COLD ROLLING MILLS

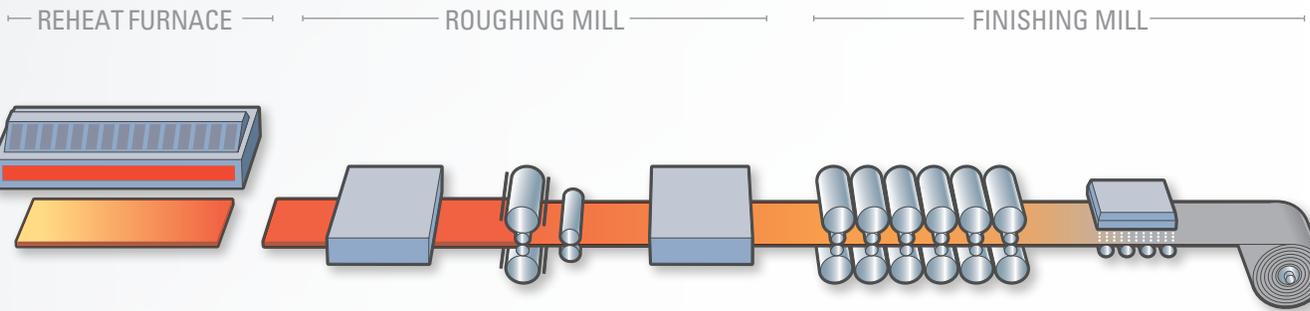
- FlatJet nozzles
- FloodJet nozzles
- FullJet nozzles
- PulsaJet® nozzles
- PVDF VeeJet nozzles and headers
- VeeJet nozzles and headers
- WindJet® nozzles
- Air headers
- Automatic and air atomizing nozzles





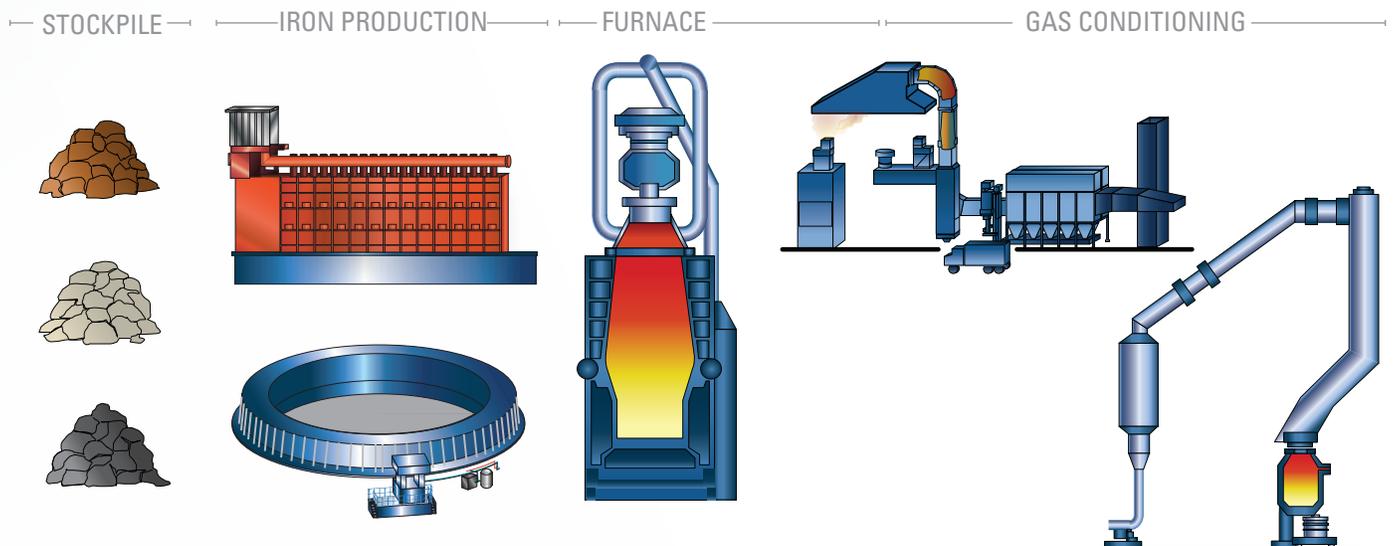
SECTION C HOT ROLLING MILLS

- DescaleJet® Pro nozzles and headers
- FlatJet® nozzles
- FloodJet® nozzles
- FullJet® nozzles
- Laminar flow headers
- MFP FullJet nozzles
- VeeJet® nozzles and headers



SECTION E IRON AND STEELMAKING

- Air atomizing nozzles
- FloMax® nozzles
- FullJet nozzles
- UniJet® nozzles
- Spray lances



TRADEMARK REGISTRATION AND OWNERSHIP

SPRAYING SYSTEMS CO.'S TRADEMARK USAGE

The following is a current list of Spraying Systems Co.'s trademarks registered in the United States. Some marks are registered in other countries as well.

AutoJet®	FullJet®
CasterJet®	IMEG®
DescaleJet®	PulsaJet®
DescaleWare®	SpiralJet®
DistriboJet®	UniJet®
FlatJet®	VeeJet®
FloMax®	WashJet®
FloodJet®	WhirlJet®
	WindJet®

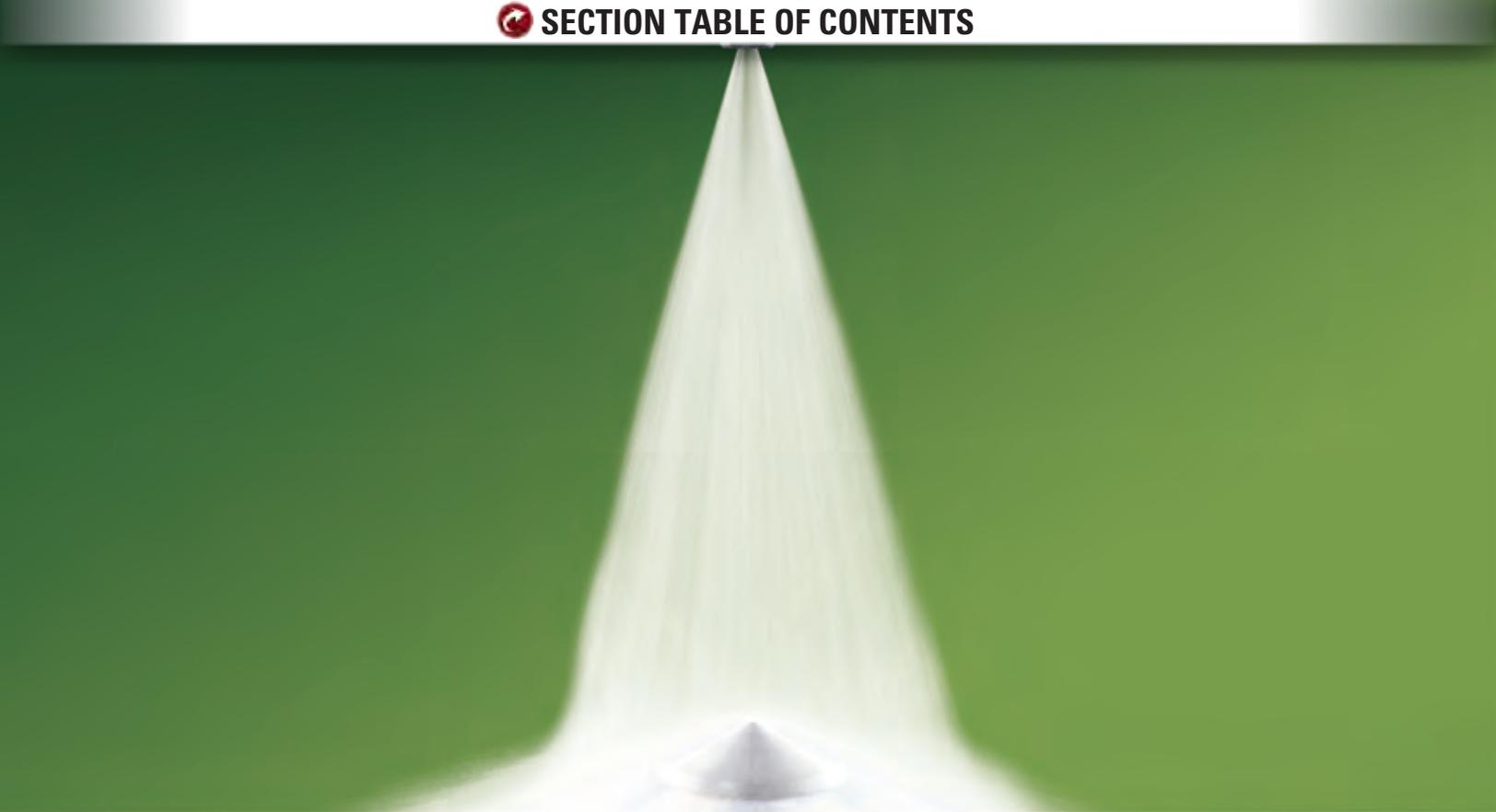
REGISTERED TRADEMARK CREDITS

The following trademarks are registered to other entities in the US and may be registered in other countries as well.

AMPCO®	INCONEL
ANSI®	MONEL®
ASTM®	REFRAX®
CARPENTER®	Stellite®
CUPRO®	Viton®
HASTELLOY®	

Spraying Systems Co. reserves the right to make changes in specifications or design of the products shown in the catalog or to add improvements at anytime without notice or obligation.





FABRICATION AND TESTING

IMPACT • DROP SIZE • DISTRIBUTION
HEADERS • LANCES • HEAT TRANSFER
COMPUTATIONAL FLUID DYNAMICS
COOLING CALCULATIONS • WEAR
TESTING • HEADERS • LANCES





FABRICATION AND TESTING
INTRODUCTION



UNIQUE MODELING, TESTING AND FABRICATION SERVICES HELP ENSURE OPTIMAL PROCESS QUALITY

The most critical components in any spray system are the spray nozzles. Choosing the nozzles that will deliver the precise performance required for your operation is essential to quality. Impact, flow rate, coverage, heat transfer and other factors can make the difference between clean, scale-free steel and dirty, streaky, dimpled and uneven products that require rework or have to be scrapped.

Once the nozzles are selected it is just as important to evaluate placement/positioning and the equipment that feeds the nozzles. Having properly designed headers/manifolds and lances is also essential to producing high quality products. Inadequate fluid flow or improper placement of the nozzles can result in inadequate cooling, descaling and coating.

We work closely with customers to optimize quality and efficiency. This begins with nozzle selection and header design. In some cases, we use our spray laboratories to validate performance or troubleshoot existing problems. When actual operating conditions cannot be simulated in our labs, we often use sophisticated modeling tools such as Computational Fluid Dynamics (CFD) and proprietary software for gas cooling to help predict performance once installed in the mill.

In addition to assisting with nozzle selection, we often fabricate the headers and lances required to ensure optimal performance. Single source supply of nozzles and headers provides convenience in addition to eliminating any equipment compatibility issues.

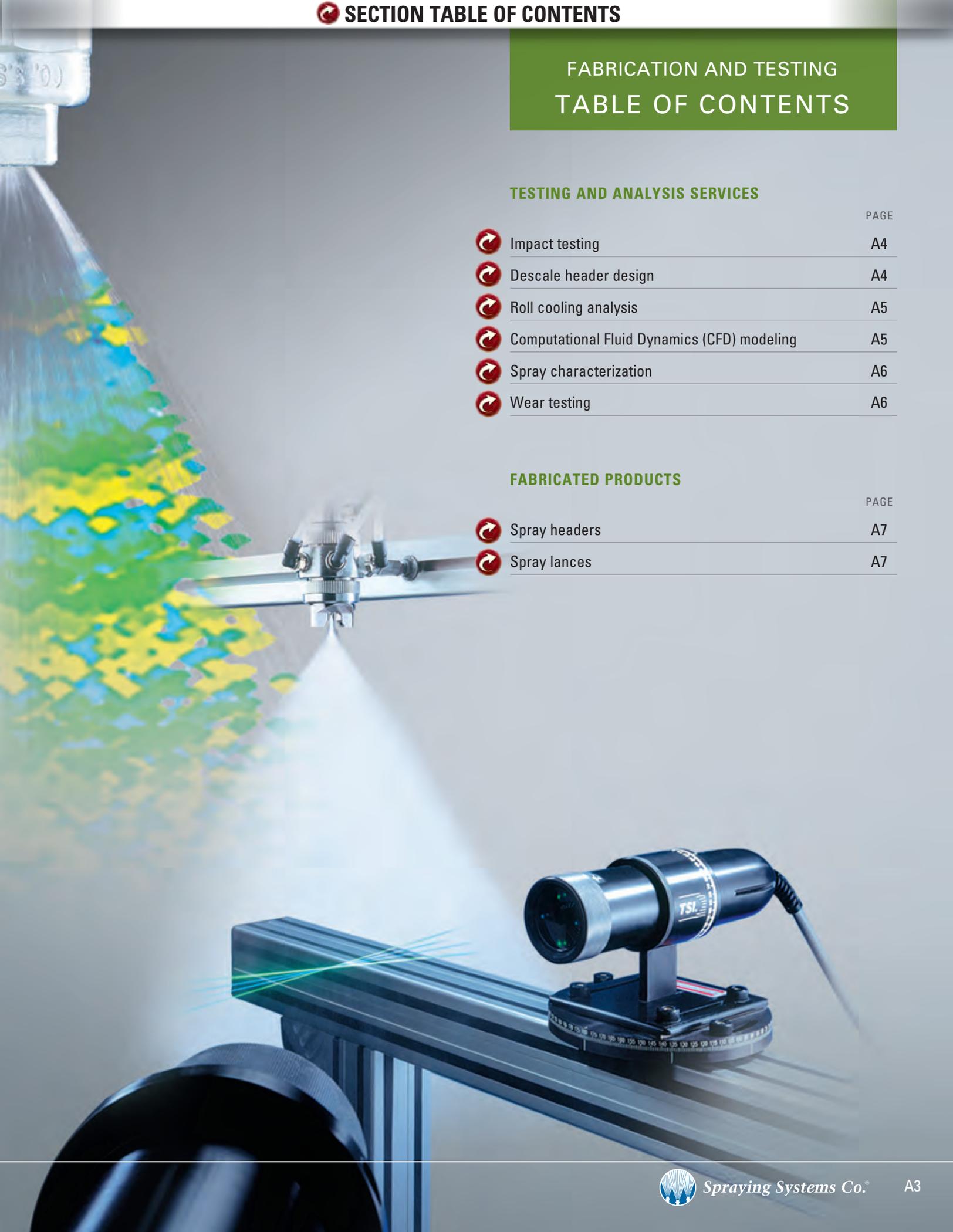
FABRICATION AND TESTING TABLE OF CONTENTS

TESTING AND ANALYSIS SERVICES

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FABRICATED PRODUCTS

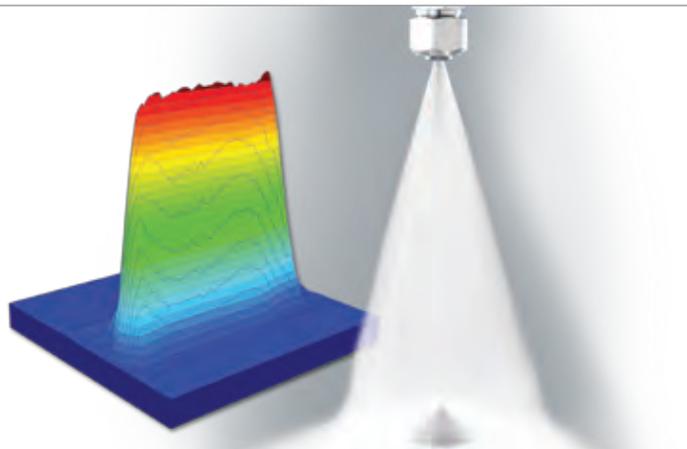
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IMPACT TESTING

OVERVIEW:

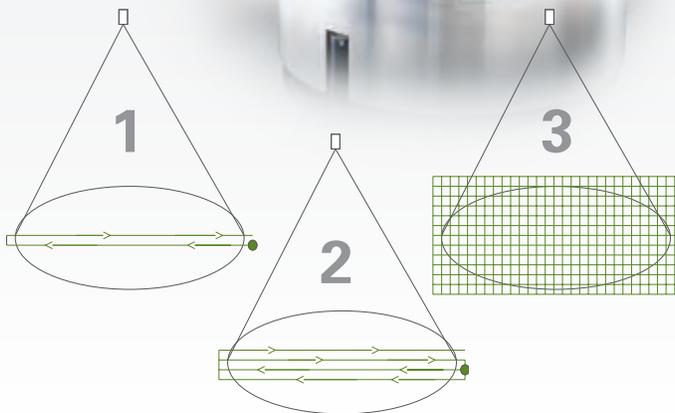
Impact can be calculated using theoretical calculations. However, these calculations do not account for turbulence, spray rebound and splash back – all of which can have a significant effect on impact. To determine actual impact, the data must be collected and analyzed. In the absence of a commercially-available piece of test equipment that measured all the required attributes, we designed our own impact tester to collect data on two axes. From this, we can determine the impact force, lateral distribution and transverse distribution.



HOW THE IMPACT TESTER WORKS:

We typically compare performance of several different nozzles using different operating conditions to ensure optimal scale removal.

- The load cell of the impact tester first moves to the outside of the spray pattern
- It then traverses through the spray taking measurements at predetermined intervals
- The load cell continues back and forth through the spray unit until the entire spray area has been covered
- The data from the testing provides coverage information, impact pressure values and the uniformity of the impact distribution across the spray pattern



For more information on impact testing and to learn more about how it can improve your descaling operations, contact your local steel specialist.

DESCALE HEADER DESIGN

OVERVIEW:

DescaleWare®, our proprietary software for header layout and nozzle selection, helps ensure the best possible results in your operating environment.

The software:

- Determines which nozzles provide the desired performance in your environment
- Graphically displays the header layout including nozzle type, spacing, coverage, spray height, lead angle and impact values
- Is suitable for use with all steel shapes



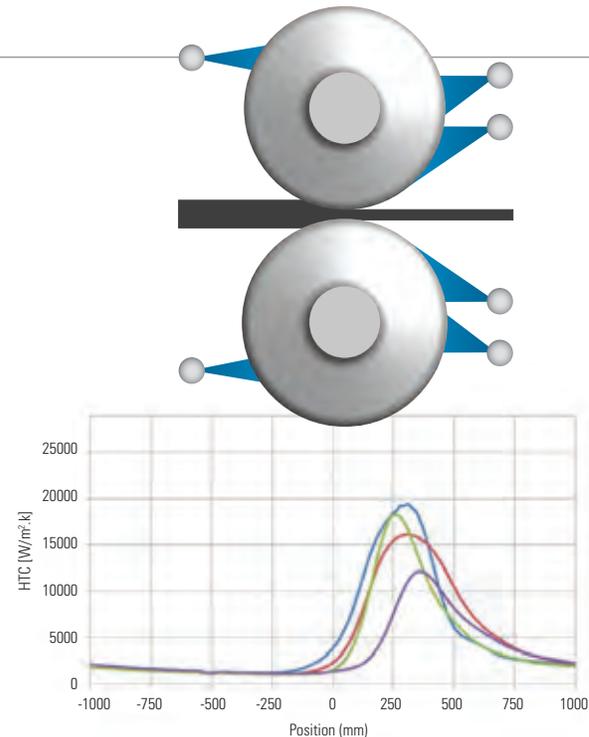
For more information about DescaleWare, contact your local steel specialist.

ROLL COOLING ANALYSIS

OVERVIEW:

We offer a full-range of services for roll cooling optimization:

- Analysis to determine the current profile and recommendations on how to improve the profile distribution. This includes evaluation of spray patterns, nozzle and header locations
- Heat transfer analysis and recommendations on possible changes to the current roll cooling configuration to improve performance including how best to use available water



COMPUTATIONAL FLUID DYNAMICS (CFD) MODELING

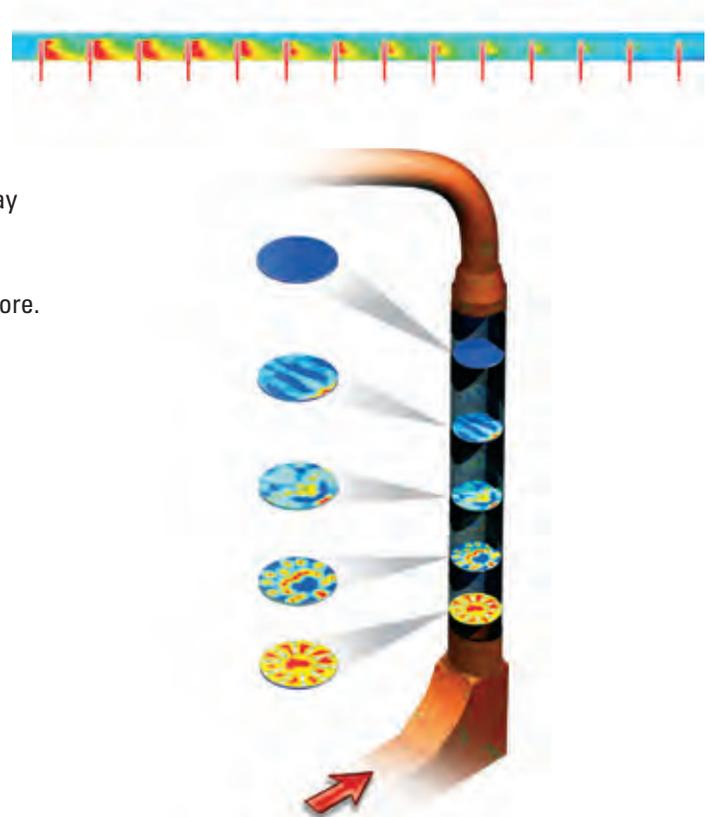
OVERVIEW:

We use Computational Fluid Dynamics (CFD) modeling to help achieve an optimized spray solution. Simulation provides more information about the key factors that impact the success of an application. Modeling allows us to investigate many parameters that may be difficult or impossible to replicate in a laboratory environment. Our models use known inputs collected in our spray laboratories instead of theoretical data. This proprietary data improves model accuracy and illustrates flow patterns, velocity, turbulence, droplet trajectories, internal system pressure and more.

Typical uses for CFD modeling include:

- Determination of optimal header size and nozzle placement
- Descale header design validation
- Turbulence analysis in descale header design
- Gas cooling/conditioning analysis to determine lance and nozzle placement in ducts, scrubbers, furnaces, cooling towers and more
- Internal flow characteristics of spray nozzles under specific operating conditions

For more information about CFD modeling, contact your local steel specialist.



SPRAY CHARACTERIZATION

OVERVIEW:

In operations where spray performance is critical, it is important to understand how factors like these affect performance:

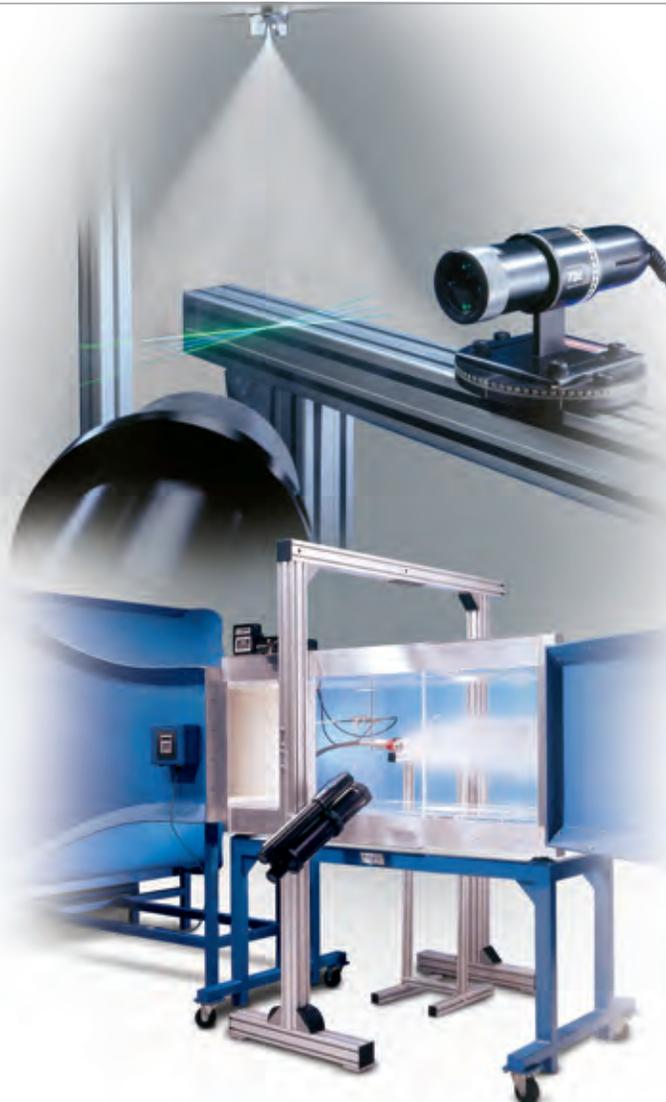
- Process conditions such as pressure, temperature and variable line speeds
- The liquid being sprayed
- The placement and position of nozzles in relation to the target

In many cases, experience and theoretical calculations can provide an indication of actual spray performance. However, testing in our spray labs determines actual performance and can eliminate costly specification mistakes or quality problems after installation.

While testing in our labs, we can adjust operating conditions and/or test different nozzles to find the exact performance required for your operation.

Common tests include:

- Spray characterization
- Spray angle
- Drop size distribution
- Evaporation rate
- Spray impact
- Residence time
- Spray pattern
- Dwell time
- Spray coverage



WEAR TESTING

OVERVIEW:

Descalé nozzles are manufactured to exacting standards to deliver very precise performance. And, like any precision component, nozzles will wear over time. This wear is not always visible – especially in the early stages. However, even slight wear (10 to 15%) can cost thousands of dollars per month in wasted water, energy and disposal costs. In addition, you may experience quality problems since wear compromises impact pressure.

We offer a free nozzle wear testing program for our customers. Program details:

- Ship nozzles from various points on a single header to us after they've been in use for several months
- Tests will be conducted in our spray labs to determine the wear rate
- Your nozzles will be returned to you along with recommendations for optimal replacement intervals

Contact your local steel specialist for complete details.

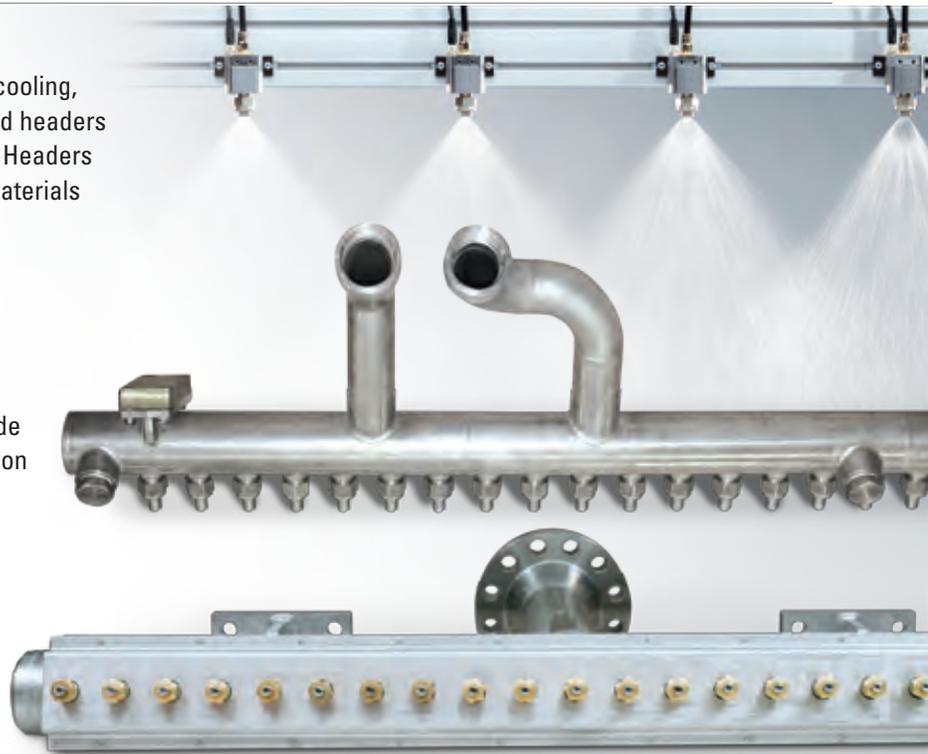
SPRAY HEADERS

OVERVIEW:

Whether you require a spray header for descaling, cooling, cleaning or rinsing we can help. We design and build headers for a wide range of operations throughout your mill. Headers can be built in a wide range of shapes, styles and materials to accommodate any nozzle type.

SPRAY HEADER TYPES:

- **Descaling headers** – round, square or straight headers designed for high pressure operation
- **Roll cooling headers** – can be equipped with a wide range of nozzles, including different sizes or types on a single header; multi-row headers also available
- **Oiling headers** – options include zone-control, heated, non-heated and recirculating designs
- **Brushless spray headers**
 - PVDF headers equipped with PVDF nozzles for use on pickling lines or prior to galvanizing
 - Stainless steel headers for strip cleaning prior to galvanizing
- **Self-cleaning spray headers with internal rotating brushes** – ideal for use with recirculated or basin water; automatic and manual versions available
- **Laminar flow headers** – standard and slit-style versions are available for efficient, cost-effective cooling



SPRAY LANCES

OVERVIEW:

Spray lances are most commonly used in conjunction with gas cooling nozzles such as our FloMax® nozzles. Typical installation is in ducts, towers and furnaces. Spray lances are built-to-order. The more common designs include:

- 0°, 45° or 90° lance configurations with quick release or bolt-on flanges and optional cooling jackets, purge tubes and protective tubes
- Multiple nozzle lances with inline or nozzles clusters

When solutions are needed to meet challenging physical spaces or hostile environments, we can design and manufacture lances in a wide range of styles including insulated, water- and steam-jacketed, recirculating and retractable, in high-temperature and corrosion-resistant materials. If required, manufacturing to meet local codes is available along with testing in accordance with ANSI® and ASTM® standards.

