



OPTIMIZING DESCALING OPERATIONS

A GUIDE TO SPRAY TECHNOLOGY FOR
EFFECTIVE & EFFICIENT SCALE REMOVAL



Spraying Systems Co.
Experts in Spray Technology





DESCALING SOLUTIONS FROM SPRAYING SYSTEMS CO.

THE PERFECT BLEND OF THERMAL SHOCK AND IMPACT IS REQUIRED FOR EFFECTIVE DESCALING. BUT, ACHIEVING THIS BALANCE IS JUST THE BEGINNING. THERE'S MUCH MORE TO OPTIMAL DESCALING WITH WATER SPRAYS THAN UNDERSTANDING HYDROMECHANICS.

WE APPROACH DESCALING WITH A UNIQUE COMBINATION OF SKILLS AND EXPERTISE:



DESIGN

It all starts with the nozzle – and no one has as much experience in this area as we do. All of our descaling nozzles are designed to:

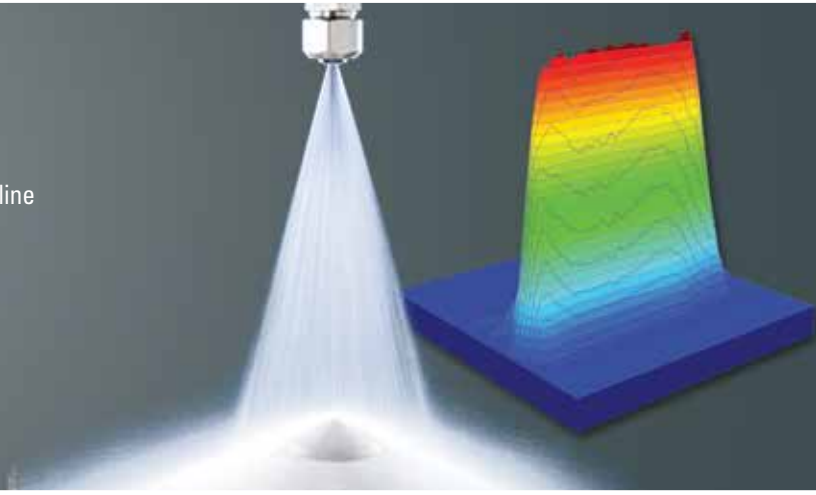
- Minimize water and pressure use without compromising impact
- Minimize turbulence
- Maximize effective coverage area



DATA COLLECTION AND ANALYSIS

Understanding nozzle performance is key to achieving optimal descaling. Our approach includes:

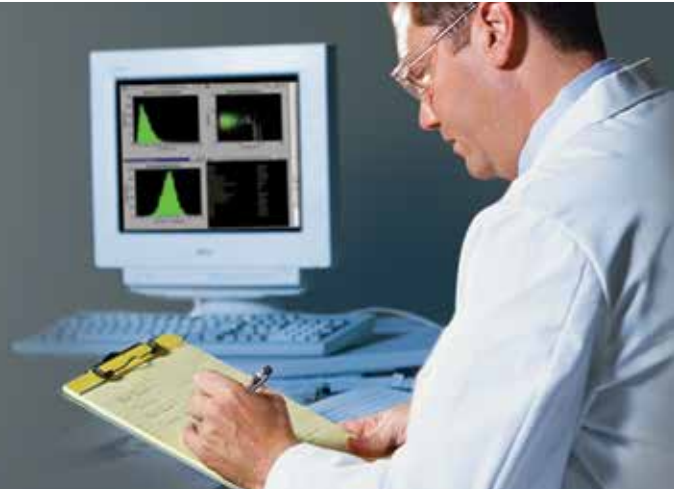
- Using theoretical calculations of impact and coverage as a baseline
- Conducting coverage and impact testing in our spray labs using a proprietary impact tester to validate performance
- Using computational fluid dynamics (CFD) to determine spray performance in complex applications
- Using this data to design headers and optimize spray layouts for our customers



SPRAY EXPERTISE

Our unique qualifications include:

- Sole focus on spray technology for more than 70 years
- Global manufacturing, factory support and engineering
- No-cost optimization, inspection, maintenance and other educational programs for customers
- Local sales engineers that specialize only in spray technology and help mills improve operations on a regular basis



PROVEN SUCCESS

Mills and equipment manufacturers around the world turn to us for application support because of reasons like these:

- Proven track record of success – just ask for references
- Successful solutions for all areas of the mill – descaling, continuous casting, cooling, lubrication, strip wash-off and blow-off, dust control, gas cooling and more
- Application details and references provided upon request





SUPERIOR DESCALING SOLUTIONS

The performance of our individual descaling nozzles varies. However, all of our descaling nozzles provide the following:

- High-quality descaling resulting in smooth, streak-free surfaces
- Efficient use of energy and water to reduce operating costs
- Long service life to minimize nozzle expense
- Easy maintenance and tip replacement to reduce labor costs

DESCALING NOZZLE SELECTION GUIDE

	Product Name	Steel Type				
		Thin Strip	Slab	Plate	Rounds	Billets
	DescalJet® Pro Nozzles	•	•	•	•	•
	26180/26190 DescalJet and AA218/AA219 DescalJet Nozzles	•	•	•	•	•
	AA214 DescalJet and Compact DescalJet Nozzles	•			•	•
	HiScaleJet and HSJ Nozzles	•	•	•	•	•
	Mini HiScaleJet Nozzles	•	•	•	•	•



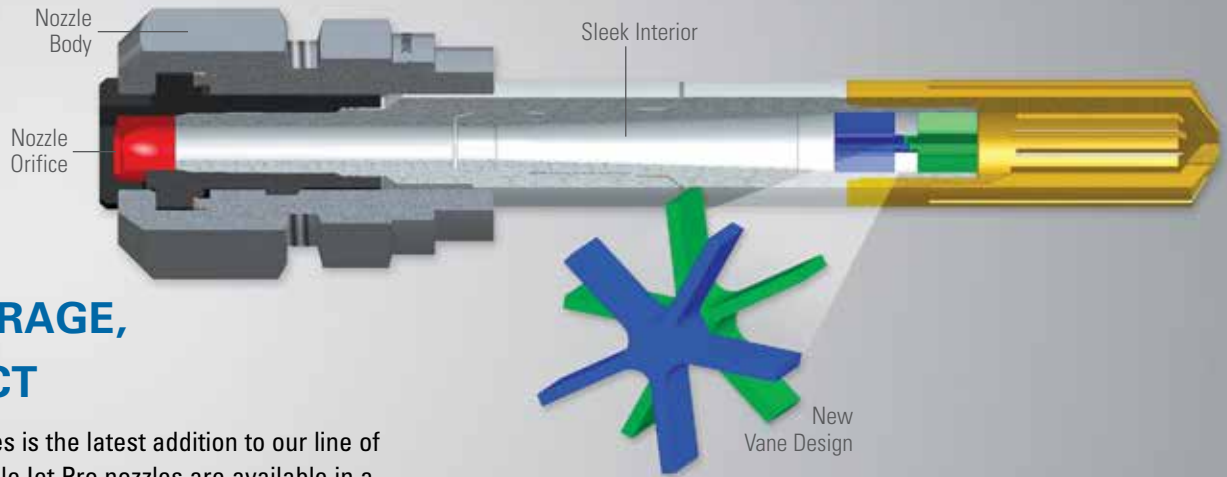


	Key Features	
Flow rate range:	3.5 to 52 gpm (14 to 196.8 lpm)	at 2000 psi (138 bar)
Max. operating pressure:	5800 psi (400 bar)	
Spray angles:	20° through 40°	
Orifice materials:	Tungsten carbide	
Flow rate range:	5.7 to 52 gpm (21.6 to 196.8 lpm)	at 2000 psi (138 bar)
Max. operating pressure:	3000 psi (207 bar)	
Spray angles:	15° through 40°	
Orifice materials:	Tungsten carbide or hardened stainless steel	
Flow rate range:	1.4 to 10.6 gpm (5.3 to 40.1 lpm)	at 2000 psi (138 bar)
Max. operating pressure:	5800 psi (400 bar)	
Spray angles:	18° through 40°	
Orifice materials:	Tungsten carbide	
Flow rate range:	4.2 to 52 gpm (15.9 to 196.8 lpm)	at 2000 psi (138 bar)
Max. operating pressure:	4350 psi (300 bar)	
Spray angles:	23° through 40°	
Orifice materials:	Tungsten carbide	
Flow rate range:	4.2 to 52 gpm (15.9 to 196.8 lpm)	at 2000 psi (138 bar)
Max. operating pressure:	5800 psi (400 bar)	
Spray angles:	20° through 40°	
Orifice materials:	Tungsten carbide	

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MORE COVERAGE, MORE IMPACT

The DescaleJet Pro series is the latest addition to our line of descaling nozzles. DescaleJet Pro nozzles are available in a variety of styles and sizes to fit any field installation.

Patent No. 7,913,937



FEATURES AND BENEFITS

- **NEW vane design** – reduces turbulence while increasing velocity for improved impact and more effective descaling
- **NEW orifice design** – large effective coverage enables use of fewer nozzles and no wasted water
- **NEW carbide material** – finer grain structure means smaller amounts of material wear with use and extended service life
- **Sleek interior design** – optimum turbulence reduction and improved impact performance
- **Wide range of tip body designs** – easy integration into existing installations

See [Capacity Overview table on page 15](#) for flow rate data at various pressures. Use [DescalWare® Software](#) for coverage data at various spray heights.

SPECIFICATIONS:

Sizes: Choice of rigid weld and threaded connections, stabilizing attachments and tip bodies

Spray angles: 20° through 40° at 2175 psi (150 bar)

Flow rate range for DescaleJet Pro: 5.7 to 52 gpm (21.6 to 196.8 lpm) at 2000 psi (138 bar)

Flow rate range for Mini DescaleJet Pro: 3.5 to 35 gpm (14 to 140 lpm) at 2000 psi (138 bar)

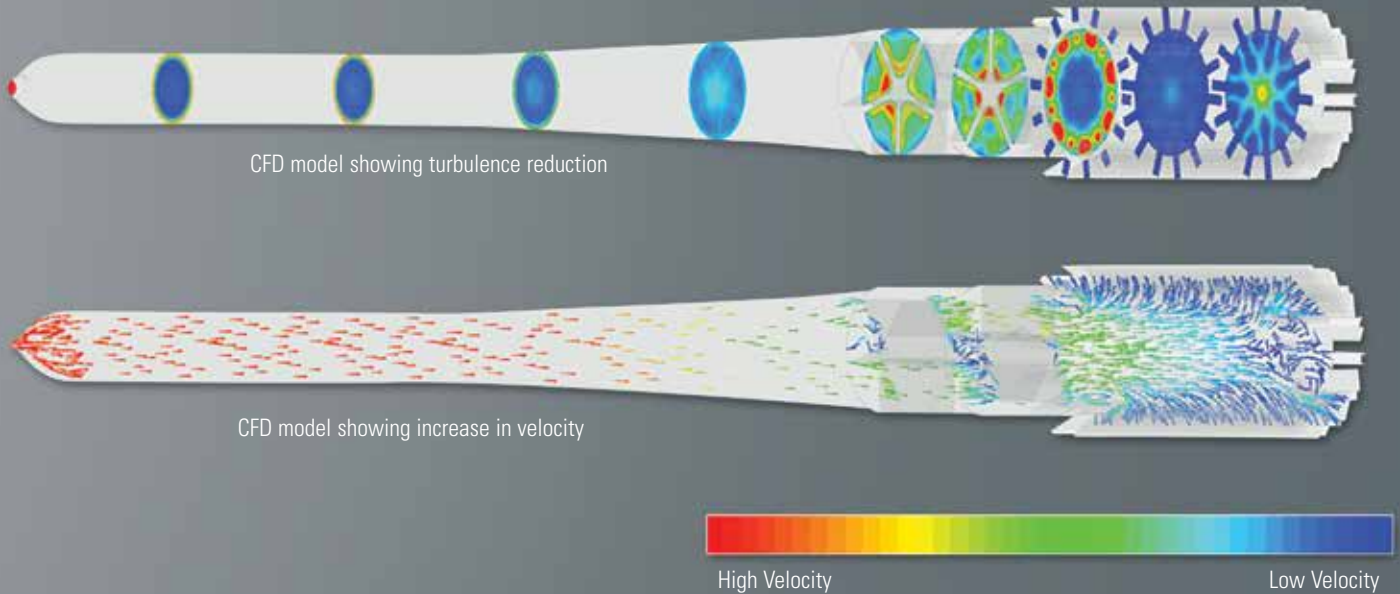
Orifice material: Tungsten carbide

Maximum operating pressure for DescaleJet Pro: 4350 psi (300 bar)

Maximum operating pressure for Mini DescaleJet Pro: 5800 psi (400 bar)

MORE EFFECTIVE DESCALING

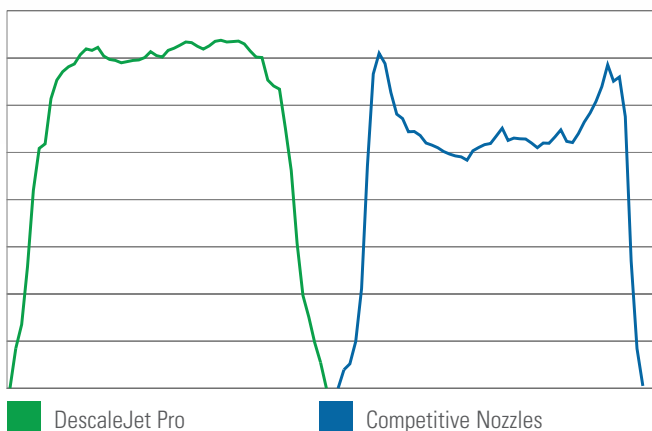
DescalJet Pro nozzles reduce turbulence and provide higher impact. The result is better descaling. The computational fluid dynamics (CFD) model on the top shows the reduction of turbulence from the entrance of the nozzle to the exit of the orifice. The model on the bottom shows the increase in velocity of the water as it passes through the nozzle.



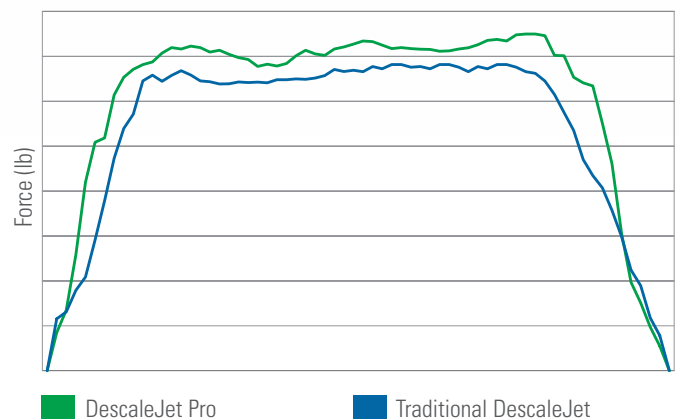
DESCALEJET PRO VS. COMPETITIVE NOZZLES

DescalJet Pro nozzles provide streak-free descaling because of even impact distribution. Competitive nozzles with non-uniform spray patterns typically cause striping and overcooling.

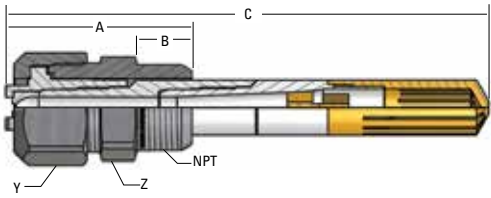
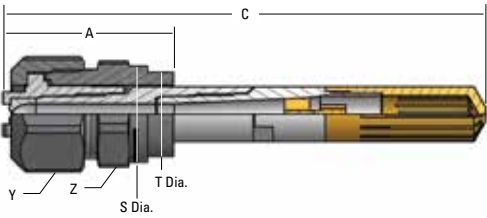
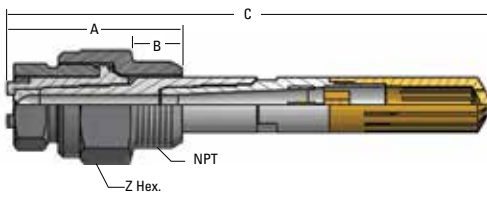
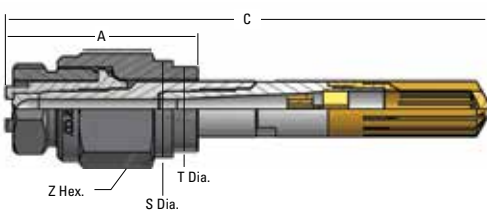
Impact Profiles of DescaleJet Pro vs. Competitive Nozzles



Coverage for DescaleJet Pro vs. Traditional DescaleJet Nozzles

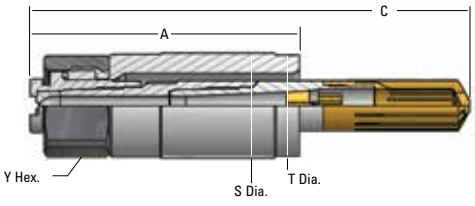
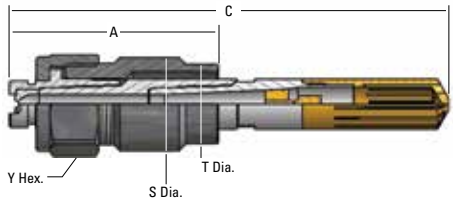
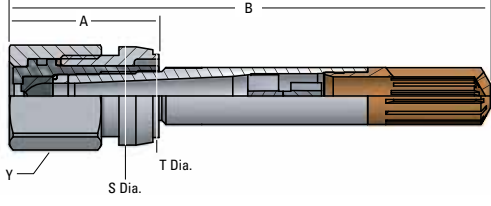


DIMENSIONS

Nozzle	Nozzle Version	A (mm)	B (mm)	C* (mm)	Y Hex. (mm)	Z Hex. (mm)	NPT	S Dia. (mm)	T Dia. (mm)
	98015-1-T-SS	2.87" (72.9)	.84" (21.4)	5.59"-7.48" (142 to 190)	1-5/8" (41.3)	1-1/2" (38.1)	1"	—	—
	98015-1-W-SS	2.63" (66.7)	—	5.59"-7.48" (142 to 190)	1-5/8" (41.3)	1-1/2" (38.1)	—	1.48" (37.7)	1.30" (33.0)
	98015-2-T-SS	2.70" (68.7)	.84" (21.4)	5.59"-7.48" (142 to 190)	—	1-5/8" (41.3)	1"	—	—
	98015-2-W-SS	2.97" (75.4)	—	5.59"-7.48" (142 to 190)	—	1-5/8" (41.3)	—	1.48" (37.7)	1.30" (33.0)

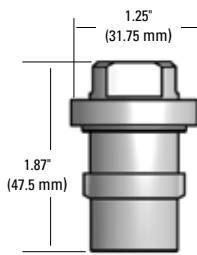
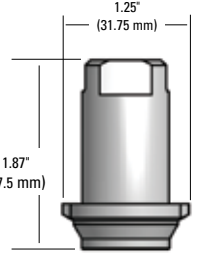
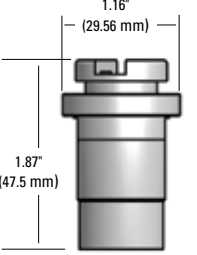
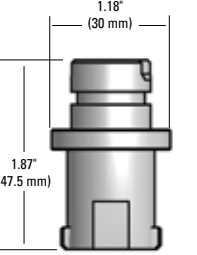
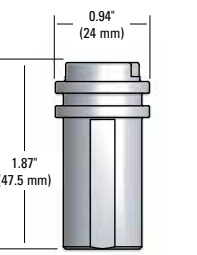
*Minimum length is 142 mm. Maximum length is 190 mm. Nozzles can be ordered in any length between the minimum and maximum. Longer lengths are available upon request.

DIMENSIONS

Nozzle	Nozzle Version	A (mm)	B (mm)	C* (mm)	Y Hex. (mm)	Z Hex. (mm)	NPT	S Dia. (mm)	T Dia. (mm)
	98015-3-W-SS	4.57" (116.0)	—	5.59"-7.48" (142 to 190)	1.6" (41.0)	—	—	1.8" (45.0)	1.7" (43.4)
	98015-4-W-SS	3.55" (90.1)	—	5.59"-7.48" (142 to 190)	1.6" (41.0)	—	—	1.57" (40.0)	1.34" (34.0)
	98015-5-W-SS	1.5" to 4.2" (38 to 106)**	6.12" (155)	—	1.25" (31.7)	—	—	1.26" (32)	1.06" (27.0)

*Minimum length is 142 mm. Maximum length is 190 mm. Nozzles can be ordered in any length between the minimum and maximum. Longer lengths are available upon request.

**Customer specified.

DescalJet Pro Tip Bodies				
Tip Body used with 98016-1-_-SS	Tip Body used with 98016-2-_-SS	Tip Body used with 98016-3-_-SS	Tip Body used with 98016-4-_-SS	Tip Body used with 98016-5-_-SS
				

For complete ordering information contact your local sales engineer or request data sheet PL98015.

DURABLE DESIGN ENSURES TROUBLE-FREE, HIGH-IMPACT PERFORMANCE

Our standard DescaleJet nozzles are designed to maximize service life with hardened stainless steel or tungsten carbide inserts. A stainless steel body and spray tip holder provide heavy protection from splashback wear and flying debris. Plus, all working parts are positioned internally for maximum protection.



26180 and AA218
DescaleJet Nozzles
and Sub-Assemblies

FEATURES AND BENEFITS

- Internal vane stabilizes the spray for higher impact
- Tight spray pattern increases impact
- Self-aligning spray tips reduce maintenance/replacement time
- Designed to withstand damage
- Choice of two series: 26180/26190 features a flat seat to expedite maintenance; AA218/AA219 has an internally threaded cap to protect the nozzle from splashback damage
- Use at spray heights from 6 to 12" (152 to 305 mm)

See Capacity Overview table on page 15 for flow rate data at various pressures. Use DescaleWare® Software for coverage data at various spray heights.

SPECIFICATIONS:

Sizes: 1" inlet connections, choice of weld or threaded bodies

Spray angles: 15° through 40° at 40 psi (3 bar)

Flow rate range: 5.7 to 52 gpm (21.6 to 196.8 lpm) at 2000 psi (138 bar)

Materials: Stainless steel with hardened stainless steel or tungsten carbide inserts

Maximum operating pressure: 3000 psi (207 bar)

CONFIGURATION OPTIONS



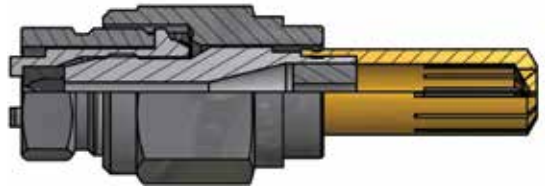
AA218 DescaleJet®
Nozzle with Cap



AA218 DescaleJet
Nozzle with Strainer



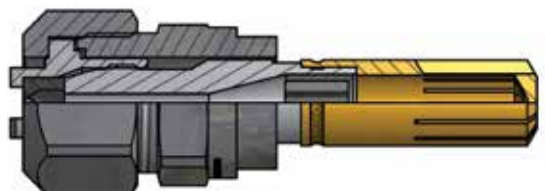
AA219 DescaleJet
Nozzle with Cap



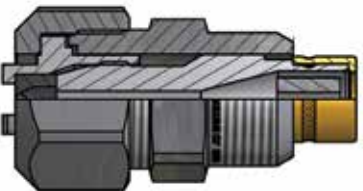
AA219 DescaleJet
Nozzle with Strainer



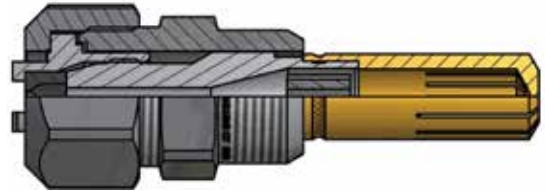
26180 DescaleJet
Nozzle with Cap



26180 DescaleJet
Nozzle with Strainer



26190 DescaleJet
Nozzle with Cap



26190 DescaleJet
Nozzle with Strainer

HIGH IMPACT, LOW FLOWS, SMALL SIZE

A unique combination of features in our AA214 and Compact DescaleJet nozzles provides better surface cleaning. Used at low spray heights and placed close together on a header, these nozzles operate at lower flow rates and higher pressures producing a tight spray pattern and higher impact per unit area. Less water can be used to achieve the same impact level offered by higher capacity nozzles – an especially important attribute when line speeds are high.



AA214
DescaleJet Nozzle
and Sub-Assembly

FEATURES AND BENEFITS

- Fluid passages designed to minimize turbulence produce thin, high-impact sprays
- Tungsten carbide inserts, pressed directly into nozzle bodies, provide long wear life, reduced maintenance time and lower replacement costs
- Use at lower spray heights – 2 to 6" (50 to 150 mm) – to reduce water use and obtain the same impact provided by high-capacity descaling nozzles

SPECIFICATIONS:

Sizes: Rigid weld configuration fits any pipe assembly

Spray angles: 18° through 40° at 40 psi (3 bar)

Flow rate range: 1.4 to 10.6 gpm (5.3 to 40.1 lpm)
at 2000 psi (138 bar)

Materials: Stainless steel with tungsten carbide orifice insert

Maximum operating pressure: 5800 psi (400 bar)

See Capacity Overview table on page 15 for flow rate data at various pressures. Use DescaleWare™ Software for coverage data at various spray heights.

CONFIGURATION OPTIONS



AA214 DescaleJet
Threaded Version with Strainer



AA214 DescaleJet
Welded Version with Strainer

SAME PERFORMANCE, DIFFERENT BODY STYLES

HiScaleJet, HSJ and Mini HiScaleJet nozzles provide comparable performance to the AA218/AA219 and 26180/26190 series but each version features a different body style. With a full range of styles, you'll find one to match your header design.

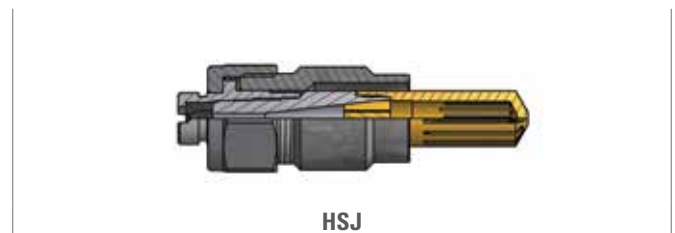


FEATURES AND BENEFITS

- The HiScaleJet, HSJ and Mini HiScaleJet nozzles feature a higher rating on the spray angle of 2175 psi (150 bar) than AA218/AA219 and 26180/26190 nozzles
- Choose from two tip body designs:
 - The HiScaleJet and the Mini HiScaleJet nozzles have a flat seated surface and a long alignment flat down the sides of the tip body for positive alignment
 - The HSJ nozzle also features a flat seating surface but with larger and durable alignment lugs at the base of the tip holder

See Capacity Overview table on page 15 for flow rate data at various pressures. Use DescalWare™ Software for coverage data at various spray heights.

CONFIGURATION OPTIONS



ADD CVCN CHECK VALVES TO DESCALJET NOZZLES TO ELIMINATE DRIPS AND ENHANCE PERFORMANCE

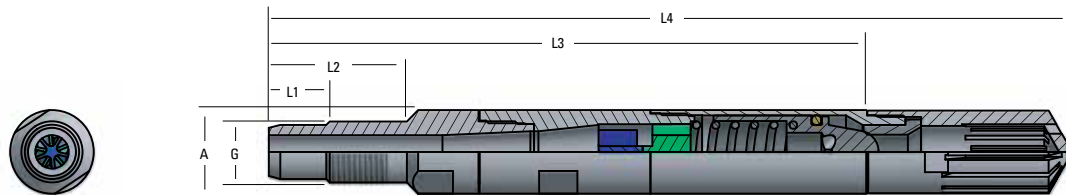
FEATURES AND BENEFITS

- Prevents water from dripping after descaling and overcooling steel
- Allows faster sequencing of plates – no delays waiting for nozzles to shut-off
- Eliminates water hammer effect by reducing nozzle turbulence and controlling turbulence in the header
- Minimizes pressure drop
- Fits existing DescaleJet nozzles



DescaleJet Pro nozzles with CVCN Check Valves

DIMENSIONS



Model	Part No.	A Dia. (mm)	L1 (mm)	L2 (mm)	L3 (mm)	L4 (mm)	G
DescaleJet Pro 98015-*	98019-CVCN-194 98019-CVCN-220F 98019-CVCN-240 98019-CVCN-267F	.85" (21.5)	.59" (15)	1.28" (35)	4.49" (114)	7.4" (187) 8.6" (220) 9.4" (240) 10.5" (267)	5/8-18-UNF
Mini DescaleJet Pro 98015-5 Mini HiScaleJet 41832	41883-10-SS-F	.73" (18.5)	.18" (4.5)	.55" (14)	4.61" (117)	6.18" (157)	M16 x 15
HiScaleJet 41883-1-SS-F	41883-**-SS-F 41883-**-B-SS-F	.73" (18.5) .86" (21.9)	.37" (9.5)	.89" (22.5) 1" (25.5)	4.61" (117)	6.18" (157) 6.8" (172.5)	M18 X 1

*Indicates DescaleJet Pro style (1, 2, 3 or 4). See pages 8 and 9.

**Consult with your local sales engineer to ensure proper sizing of valve to tip capacity.

DESCALE NOZZLE CAPACITY OVERVIEW

Flow Rate at Stated Pressure

Capacity Code	AA214 Compact	DescalJet® Pro	Mini DescalJet Pro	26180/26190	AA218/AA219	HiScaleJet	HSJ	Mini HiScaleJet	PSI (Flow rate in gpm)										BAR (Flow rate in lpm)							
									1000	1500	2000	2500	3000	3500	4000	4500	5000	70	100	150	200	250	300	350	400	
-02	•								1.0	1.2	1.4	1.6	1.7	1.9	2.0	2.1	2.2	3.8	4.6	5.6	6.4	7.2	7.9	8.5	9.1	
-03	•								1.5	1.8	2.1	2.4	2.6	2.8	3.0	3.2	3.4	5.7	6.8	8.4	9.7	10.8	11.8	12.8	13.7	
-04	•								2.0	2.4	2.8	3.2	3.5	3.7	4.0	4.2	4.5	7.6	9.1	11.2	13.0	14.5	15.9	17.2	18.4	
-05	•		•						2.5	3.1	3.5	4.0	4.3	4.7	5.0	5.3	5.6	9.5	11.4	14.0	16.2	18.1	19.9	21	23	
-06	•		•					•	3.0	3.7	4.2	4.7	5.2	5.6	6.0	6.4	6.7	11.4	13.7	16.8	19.5	22	24	26	28	
-07	•		•					•	3.5	4.3	4.9	5.5	6.1	6.5	7.0	7.4	7.8	13.3	16.0	19.5	23	25	28	30	32	
-08	•	•	•	•	•	•	•	•	4.0	4.9	5.7	6.3	6.9	7.5	8.0	8.5	8.9	15.2	18.2	22.5	26	29	32	34	37	
-09	•	•	•	•	•	•	•	•	4.5	5.5	6.4	7.1	7.8	8.4	9.0	9.5	10.1	17	20.6	25.3	29	33	36	39	41	
-10	•	•	•	•	•	•	•	•	5.0	6.1	7.1	7.9	8.7	9.4	10.0	10.6	11.2	18.8	23	28	32	36	40	43	46	
-12	•	•	•	•	•	•	•	•	6.0	7.3	8.5	9.5	10.4	11.2	12.0	12.7	13.4	23	27	33	40.5	45	50	54	58	
-15	•	•	•	•	•	•	•	•	7.5	9.2	10.6	11.9	13.0	14.0	15.0	15.9	16.8	29	34	42	49	54	60	64	69	
-20		•	•	•	•	•	•	•	10.0	12.2	14.1	15.8	17.3	18.7	20	21	22	38	46	56	64	72	79	85	91	
-25		•	•	•	•	•	•	•	12.5	15.3	17.7	19.8	22	23	25	27	28	48	57	70	81	90	99	107	114	
-30		•	•	•	•	•	•	•	15.0	18.4	21	24	26	28	30	32	34	57	68	84	97	108	118	128	137	
-35		•	•	•	•	•	•	•	17.5	21	25	28	30	33	35	37	39	67	80	98	113	126	138	149	160	
-40		•	•	•	•	•	•	•	20	24	28	32	35	37	40	42	45	77	91	112	129	144	158	171	182	
-50		•	•	•	•	•	•	•	25	31	35	40	43	47	50	53	56	95	114	140	161	180	197	213	228	
-55		•		•	•	•	•	•	28	34	39	43	48	51	55	58	61	105	125	154	177	198	217	235	251	
-60		•		•	•	•	•	•	30	37	42	47	52	56	60	64	67	114	137	167	193	216	237	256	274	
-70		•		•	•	•	•	•	35	43	49	55	61	65	70	74	78	134	160	195	226	252	276	299	319	

SPECIFICATION TIP

The relationship between flow rate and pressure is:

$$\frac{Q_1}{Q_2} = \frac{(P_1)^n}{(P_2)^n}$$

Q: Flow rate (in gpm or lpm)
P: Liquid pressure (in psi or bar)
n: Exponent apply to the specific nozzle type

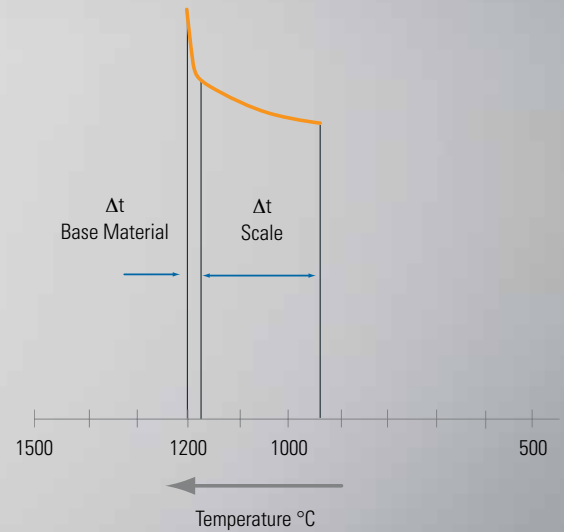
The capacity data in this bulletin is based on water. The specific gravity of a liquid affects its flow rate so be sure to consider the specific gravity of the liquid being sprayed if it isn't water.

DESCALING: UNDERSTANDING IMPACT

In order to effectively remove scale, it is important to understand the role water plays in the process. The water applied to the surface causes both the scale and the base material to shrink. This shrinkage forms cracks in the surface and separation between the scale and the base material. The force of the spray produced by the nozzles causes the water to penetrate the cracks and reach the base material.

The heat from the steel surface causes a local explosion of the water as steam is formed. The combination of the explosion and the impact force detaches the scale from the steel surface and the water washes away the scale.

Steel grade, furnace temperature, soaking time and other factors all play a role in scale formation and how difficult it will be to remove. The effectiveness of the removal process is dependent on the impact and spray pattern of the water applied by the nozzles on the moving strip of steel.



IMPACT BASICS

The total impact from a spray can be estimated by using this equation:

$$\text{Total Force} = \rho \cdot Q \cdot v$$

Ft: Total Force

ρ : Fluid Density

v: Exit Velocity of Spray

Q: Total Volume Flux

$$F = .0527 \cdot \text{gpm} \cdot \text{psi}_g^{-.5}$$

$$F = .24 \cdot \text{lpm} \cdot \text{bar}^{-.5}$$

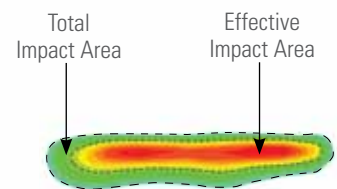
F is total impact and is expressed in units of lbs. (N).

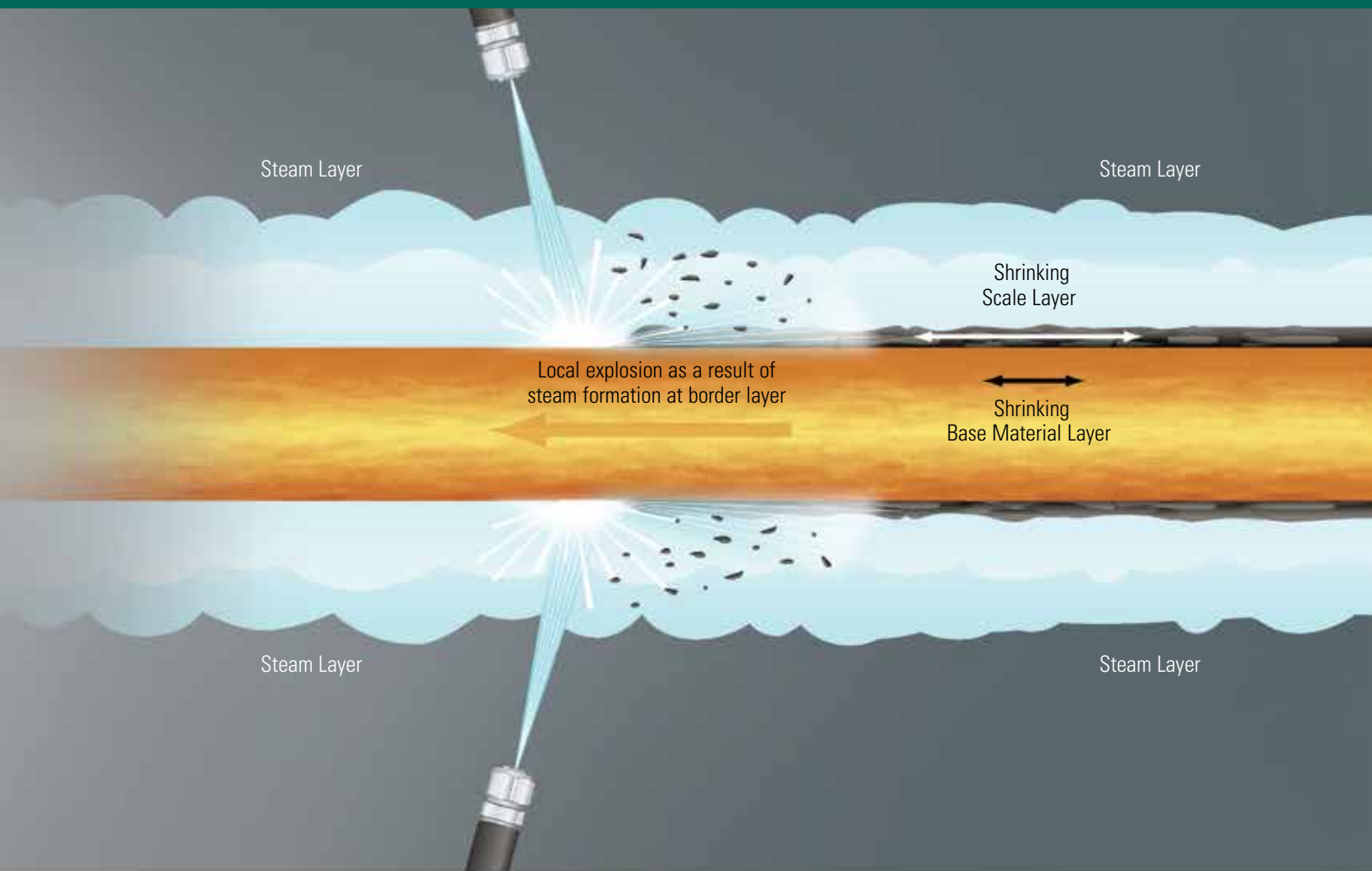
There are two types of impact:

1. Lateral impact, sometimes called lineal impact, is force per unit width and shows the volumetric distribution pattern and the evenness of the impact across the spray.
 - It is usually expressed in lb./in. or kg/cm
 - It provides a relative indication of cleaning effectiveness
2. Specific impact is the total impact force divided by a unit area.

Area = coverage • thickness

- Average specific impact is the total impact force/total impact area
- Maximum specific impact is the total impact force/effective impact area





SPECIFIC IMPACT CAN BE REDUCED BY A NUMBER OF FACTORS:

- **Loose soil**
- **Standing liquid**
- **Deceleration** – As sprays travel through the air to reach the target surface, drops decelerate and the momentum of the spray is reduced. Nozzle size, pressure, spray style and spray height all play a role in deceleration and how to overcome it
- **Spray height** – Closer target distances result in higher normalized impact pressure. It also results in smaller coverage area per nozzle. Lowering spray height is not a quick and easy way to achieve better descaling
- **Pressure** – Increasing pressure will also increase total impact, but it also affects spray pattern. The increase in impact pressure is often not as much as expected
- **Nozzle turbulence** – Turbulence has a negative impact on nozzle performance, the wear life of the nozzle and header and descaling effectiveness. Increasing pressure increases nozzle turbulence

All of these factors affect impact and descaling effectiveness so it is important to achieve balance between them to optimize your system. To accomplish this, we head to our spray laboratories to measure the impact and spray patterns of our descaling nozzles. We use proprietary equipment to collect and analyze data. We do not rely on calculated data because theoretical equations cannot factor in the effects of turbulence, spray rebound or splashback – all which can have a significant effect on impact.

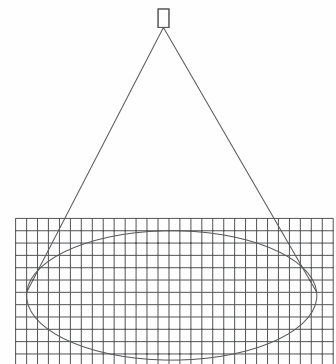
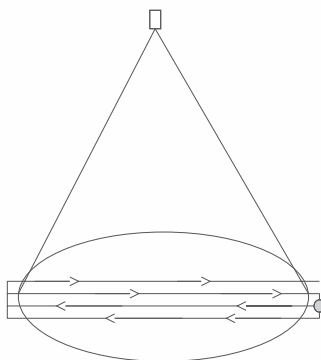
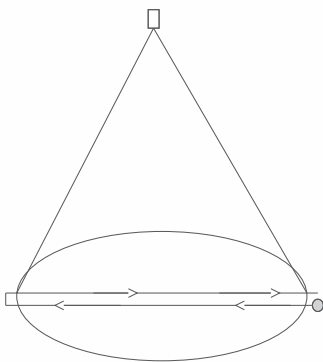
WHY AND HOW WE MEASURE IMPACT

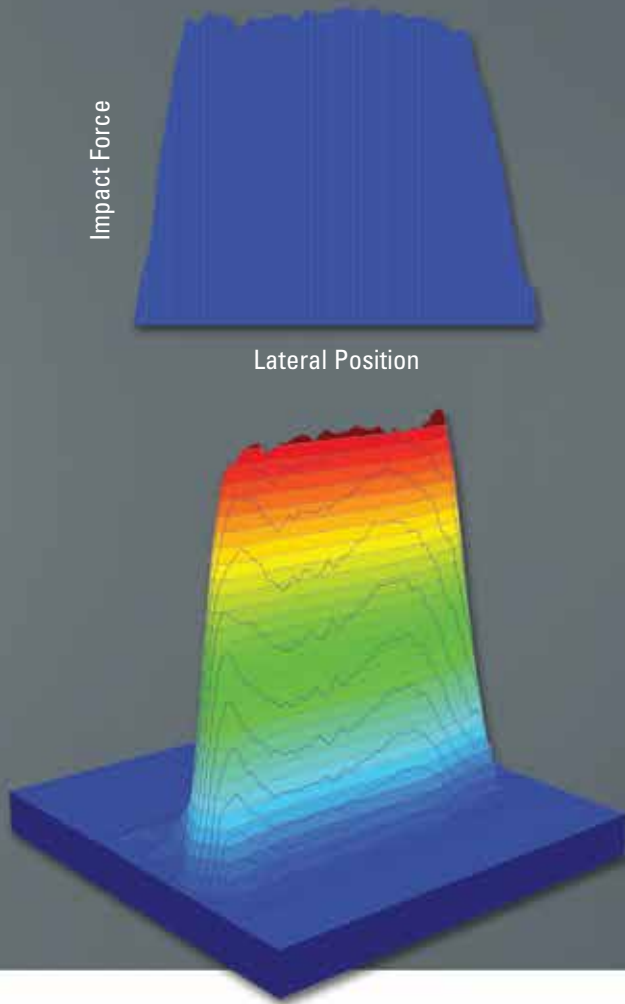
As noted earlier, calculated data doesn't account for splashback. We know this because we compare theoretical data to measured data. To ensure accurate impact measurement, we designed test equipment that measures data in two axes so we can precisely determine impact in pounds force, lateral distribution, coverage, transverse distribution and spray thickness.



HERE'S HOW OUR IMPACT TESTER WORKS:

1. The load cell first moves to the outside of the spray pattern.
2. Then it transverses through the spray, taking measurements at predetermined intervals.
3. The load cell continues going back and forth through the spray unit until the entire spray area has been covered.





DATA FROM OUR TESTING LOOKS LIKE THIS:

Impact Line Plot

The lateral impact plot provides accurate coverage information – both total coverage and effective coverage. It also shows the evenness of the impact distribution across the spray pattern.

Impact Profile

Our data also shows a 3D isometric view of the spray. This is the data in raw form. There is no smoothing nor fitting.

In addition, we produce a contour plot which provides the total spray thickness and area. A view of the specific impact provides the impact pressure values.

WHAT YOU NEED TO KNOW TO ANALYZE IMPACT DATA

1. Is impact calculated or measured? Measured data is always superior.
2. When looking at specific impact values, what spray area footprint dimensions were used? Total spray area or effective spray area? Was this area measured or calculated?

Even if all values are measured, they are not measured the same way. Nozzle feeds are different, impact equipment is different and analysis methodology varies. It is not possible to compare the values collected by one manufacturer to the values collected by another manufacturer. The best way to compare nozzle performance is to run tests on the same equipment.

We invite you to use our laboratories for your analysis.

HEADER DESIGN AND SPECIFICATION GUIDELINES

Selecting the best nozzle for your operation is just the first step in successful descaling. All the factors below also play a role. Ultimately, it is achieving a balance between the impact and overall system efficiency.

KEY CONSIDERATIONS IN DESCALE HEADER DESIGN:

FLOW RATE

- Higher flow rates provide greater total impact forces
- Higher operating costs result since higher capacity pumps that use more energy are required

PRESSURE

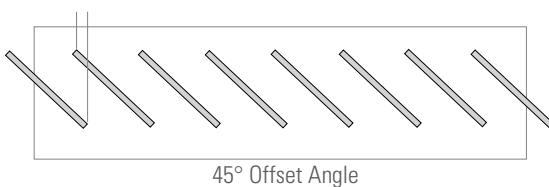
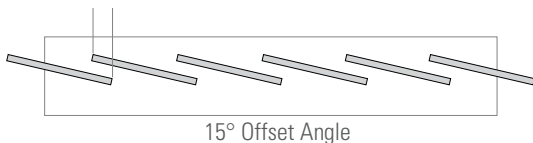
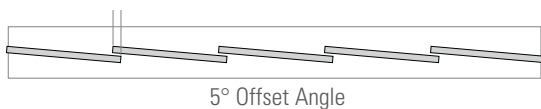
- Higher operating pressure provides greater total impact force
- Nozzle wear increases along with pressure and nozzle costs and maintenance time will be higher

SPRAY DISTANCE

- Impact decreases as the distance from the target increases
- As distance increases, fewer nozzles are required reducing purchase cost and maintenance time. The risk of nozzle damage is also decreased
- Closer spray distances result in higher impact but also require tighter tolerances in spray coverage. If coverage is not precise, stripes of scale may not be removed or striping may occur in areas over-cooled because of too much water overlap

OFFSET ANGLE

- Nozzles should be positioned to prevent interference from adjacent sprays and maintain overlap – 15° is typical

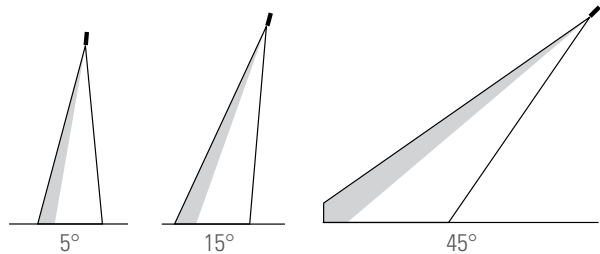


OVERLAP

- Standard overlap is considered ¼" to ½"
- 100% overlap equals ½ coverage

LEAD ANGLE

- Nozzles should be positioned so that force has both a horizontal and vertical component – 15° is typical



SPRAY PATTERN

- Nozzles that produce smaller patterns at equivalent conditions to other nozzle styles are desirable. The smaller the area of the spray, the more force per unit area. For example, if a 40 capacity nozzle produces 42 lbs. (19 kg) of total force and the area being sprayed is 1 sq. in. (6.5 sq. cm) compared to 1.5 sq. in. (9.7 sq. cm) the force is 42 psi (3 kg per sq. cm) compared to 28 psi (2 kg per sq. cm)

JET STABILIZERS

- Use jet stabilizers to reduce turbulence in the nozzle for improved impact performance

HEADER DESIGN

- To minimize spray instability, headers must be sized properly to minimize liquid velocity changes. Multiple feed points should be considered and feeds at the end of headers should be avoided
- Avoid designs that may create internal swirl near nozzle feed points and/or increase feed turbulence
- To minimize velocity changes and eliminate pressure drop across the header, velocity should be kept to less than 12 ft./sec. (3.7 m/sec.) for optimal results

HEADER DESIGN, MODELING AND FABRICATION

PROPRIETARY DESCALEWARE® SOFTWARE SIMPLIFIES HEADER DESIGN AND ENSURES PERFORMANCE

Our proprietary software uses impact and coverage data collected in our spray laboratories to determine header layout and nozzle selection. User-specific conditions such as slab or billet width, overlap, lead angle, twist angle, flow rate and pressure are entered. The software determines which nozzles provide the desired performance and graphically displays the header layout. Nozzle type, spacing, coverage, spray height, lead angle and impact values are shown on the layout.



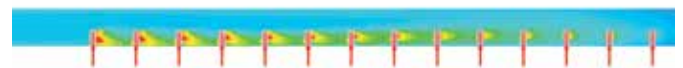
DescaleWare software facilitates header design, layout and nozzle selection.

COMPUTATIONAL FLUID DYNAMICS (CFD) MODELING DETERMINES ACTUAL PERFORMANCE PRIOR TO FABRICATION

The use of CFD in descale header design is becoming more widely used because it enables the header design to be validated using actual operating conditions. If performance expectations aren't met, alternative designs and operating conditions can be modeled to determine what modifications may be required. CFD can also be used to troubleshoot problems with existing descale headers by analyzing feeds, elbows, angles and more.



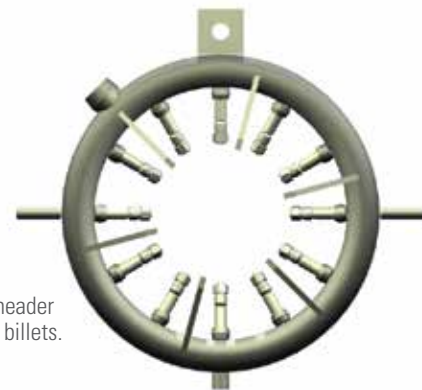
This CFD model shows a 4" dia. header with 14 nozzles. The total flow is 743 gpm (2813 lpm) at 2300 psi (159 bar). The model reveals the velocity leading into the first six nozzles exceeds the recommended maximum of 15 ft/s (4.5 m/s). In fact, the entry velocity for the first nozzle is 25.7 ft/s (7.8 m/s).



This model shows what happens when the pipe dia. is increased to 6" and operating conditions remain the same. The entry velocity of the first nozzle is now well below the recommended value at 11.3 ft/s (3.4 m/s).

FABRICATION TO MEET EXACTING STANDARDS

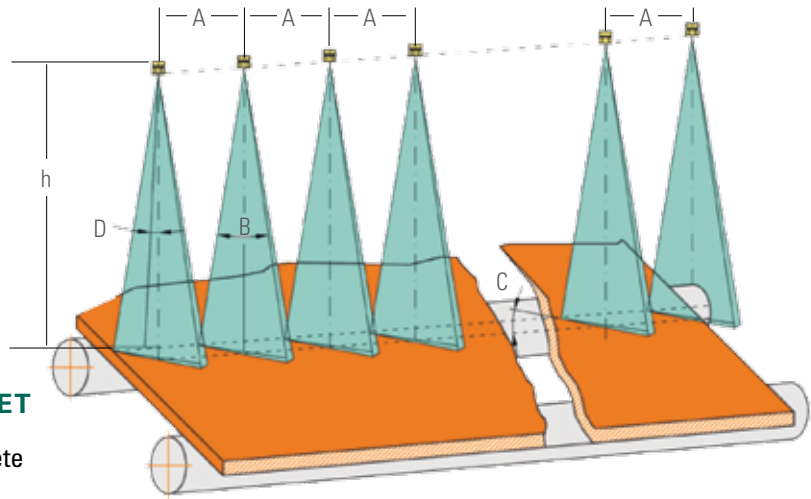
Once header layout and validation design are complete, fabrication is the next step. To ensure optimal performance and eliminate integration problems, using a single supplier for nozzles and headers is recommended. We have decades of experience with descale header fabrication for flats, billets, sheets, rounds and more in addition to our proven track record in descale nozzle design.



Descale header for round billets.



Descale header for flat products.



DESCALE HEADER SPECIFICATION SHEET

To request a quotation on a descale header, complete the information below and fax it to **1.888.95.SPRAY**.

Name: _____ Company: _____

Address: _____

City: _____ State /Province: _____

Zip/Postal Code: _____ Country: _____

Phone: _____ Fax: _____

Email: _____

Location of descaling installation: Before Furnace Roughing Stand Finishing Stand Intermediate Descaling

Roller Format	Dimensions
Strip	in or mm
Slab	in or mm
Plate	in or mm
Boom	in or mm
Billet	in or mm
Rounds	in or mm

Material speed	ft/min or m/sec
Pressure at header	psi or bar
Available max. water flow	gpm or lpm
Material	
Material no.	

	Top Header	Bottom Header
No. of headers		
Nozzle type		
Nozzle spacing (A)	in or mm	in or mm
Number of nozzles		
Vertical spray height (h)	in or mm	in or mm
Spray angle (B)	°	°
Offset angle (C)	°	°
Lead or vertical (D)	°	°

PREVENTIVE MAINTENANCE OPTIMIZE SPRAY PERFORMANCE AND LOWER OPERATING COSTS

Spray nozzles are designed for long-lasting, trouble-free performance. However, like all precision components, spray nozzles do wear over time. Descaling performance can suffer and costs can rise. How quickly wear occurs is dependent on a variety of factors. Some installations require attention every shift while others can operate for hundreds of hours without maintenance.

Nozzle wear is usually not noticeable in the early stages. As it progresses, the signs of wear are visible and costly. Operating costs will rise and product loss is likely. Monitor nozzles closely and take the appropriate action before wear affects your operations.



PREVENT PROBLEMS BY ESTABLISHING A NOZZLE MAINTENANCE PROGRAM

- Visually inspect spray patterns and watch for changes in angle and distribution. Flat spray patterns will narrow with wear and the edges of the spray will get heavier
- Check flow rate and pressure at a system level. Wear can be detected by increases in flow rate or decreases in system pressure
- Check steel quality. Wear compromises impact pressure and process changes may be detectable
- Use cleaning tools significantly softer than the construction of the nozzle. Never clean a nozzle orifice with metal objects
- Soak nozzles in mild solvents to loosen debris for easier removal
- Develop maintenance schedules and implement consistently

AVOID THE ULTIMATE MAINTENANCE NIGHTMARE: THERMAL SHOCK

Water should always be flowing through the nozzles when hot steel is passing under the header. If it isn't, thermal shock will occur in one of two ways:

1. The heat will cause the nozzle's stainless steel tip holder to expand. The carbide insert is pressed into the tip holder and expansion will loosen it. When water passes through it, the tip will spin. This is common in headers where the spray height is high.
2. The heat will cause the carbide temperature to increase to a point where it will crack when cool water passes through. The water pressure may push carbide pieces out of the nozzle. This often occurs when headers are close to the strip surface.

The best way to prevent nozzle damage due to thermal shock is to have water flowing – even a small amount – when hot steel is present. Orifice inserts are available in hardened stainless steel as an added preventive measure against thermal shock.





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Temperature Profile Detector System

Bulletin 674

VacuRoll Cleaning and Drying System

**Bulletin 673 and
video demonstration**



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