WJTA Jet News

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Polymeric Additives

Two jets from an OMAX® System. The jet on the right contains the polymer additive, "Super-Water" while the jet on the left contains no additive. Photographs courtesy of Dieter Moenig, DMC Satellite Systems, Inc.

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On the inside

Practices For Use Of High-Pressure Hose

By: Paul Webster, Engineering Manager, Parker Hannifin Corp., Polyflex® Business Unit and
Stephen Johns, Marketing, Parker Hannifin Corp., Polyflex® Business Unit

Ultra high pressure (UHP) hose is a key component in today's waterjetting systems. Over the next few issues, we will discuss field practices to assist users in maximizing hose life and determining when a hose should be replaced. We will also present manufacturing techniques and accessories used to build a safe and reliable product.

There are many factors that can decrease the life expectancy of a hose assembly. We will discuss the advancements in hose and fitting development along with the descriptions and use of hose accessories and how each can enhance connection technology, service life and safety.

In the February issue of *Jet News*, we discussed factors that reduce service life of high pressure hose. This month, we'll discuss practices that can improve service life.

Hose Fitting Stress

Stress at the fitting is where the hose is bent directly behind the fitting. When the hose bends, the hose is highly stressed. Reduce this stress at the fitting by using stiffeners or supporting the hose so it is straight for a minimum length of three times the hose's outside diameter. Install adapters that let the hose hang straight down as opposed to having the hose exit the pump or gun horizontally and then drooping down to the ground.

If the hose is hanging from a great height, use support grips to support the weight of the hose rather than having the fitting support the weight. Do not torque or twist the hose assembly.

Pressure Spikes and Pulsations

Minimize pressure spikes and pressure pulsations as much as possible. Pressure spikes are internal to waterjetting systems and cause internal damage to all working components of the system.

Pressure spikes are often created when the gun or lance is pressured up. The release of pressure by the relief valve is not instantaneous, so there is a moment when the pressure exceeds the relief set point and creates a pressure spike. Pressure spikes are often higher than the rated working pressure of the hose assembly and overly stress the hose construction.

UHP hose typically contracts upwards of 2%. For each pressure pulsation, the hose contracts and elongates. Use accumulators or pressure pulsation dampeners, if available from the manufacturer, to smooth out the pressure wave. Operate the pump at the manufacturer's recommended revolutions per minute (RPM). Operators must not decrease the pump speed (RPM) to lower the flow rate, as this will create severe pressure pulsations.

Bending and Flexing

UHP hose is designed to bend and flex under high pressure. However, bending the hose in a tight bend radius is not recommended. Keep the hose in large gentle bends (24-inch radius or more). Before beginning to pressure up the hose, pull the hose out straight. Do not have the hose coiled and then pull it out straight while it is pressurized.

Abrasion

A primary source of hose failure is abrasion resulting from cuts, friction caused by the hose rubbing on the ground or against objects in the operating environment. As previously mentioned, prevention of cover abrasion is critical to hose life.

New hoses coming onto the market may have two layers of dissimilar colored covers. When the outer cover is worn down to the sublayer, the color change becomes evident, and immediate action can be taken to prevent further abrasion.

Several accessories offer additional protection to the hose cover. Abrasion shields are commonly installed on the hose at the factory to prevent abrasion. Nylon spiral guards, which can be applied in the field, are especially good at preventing initial abrasion or stopping further abrasion once it has begun.

Other types of shields can be wrapped around the hose and secured with tie wraps for localized abrasion resistance. Ask your hose supplier what abrasion accessories are available for the hose you are using.

For more information on Parker Polyflex, call (281) 530-5300 or visit www.parker.com.

Reprinted by permission from *BIC Magazine*, November 2007.

This article is part two of a series of articles. In the June 2008 issue of *Jet News*, Paul Webster, engineering manager, and Stephen Johns, Marketing, at Parker Hannifin Corp., Polyflex® Business Unit, will address hose safety.

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Waterjet Rock Scaling In Underground Mining And Construction Applications

By: Hugh B. Miller, Ph.D., and Mark Kuchta, Ph.D., Colorado School of Mines, Mining Engineering Department, Golden, Colorado

The scaling of loose rock in underground mines is a fundamental activity integral to the safe execution of nearly every unit operation. Geologic structure, in-situ stresses, chemical and physical decomposition, and fractures caused by blasting are but a few of the many factors contributing to rock falls in underground workings. While most operators emphasize the importance of scaling as part of their employee safety training programs, rock falls still account for a significant portion of total fatalities and lost-time accidents incurred in underground work environments. A recent review of U.S. Mine Safety and Health Administration (MSHA) accident statistics for underground metal/nonmetal mines showed that nearly 25 percent of all fatalities were related to rock falls [(1)]. Of these fatalities, approximately one-third involve activities associated with scaling. In addition, employee injuries associated with the actual process of scaling are quite common. These occupational hazards only increase as the size of these workings get bigger and spans between support members get larger, as is often the case in bulk underground mining methods and urban construction projects.

The equipment and techniques used in scaling have remained essentially unchanged over the last twenty years. While the use of mechanized scalers with boom mounted hydraulic hammers and mobile diesel-powered carriages are common in many large mining operations and construction projects, manual scaling bars are still the standard throughout most of the hard-rock mining industry (see Figures 1 & 2). While scaling must be periodically performed on all unlined rock surfaces, special emphasis is given to production areas where blasting occurs. In these locations, manual scaling is typically conducted off of freshly blasted rock (muck), in order to pry and knock down fractured and loose material from the back (top) and ribs (sides) of underground workings. In some mining methods, the height of production areas necessitates the use of man-lifts, where miners are required to scale rock surfaces twenty or more feet off the ground. In most cases, scaling is performed before the removal of muck and the installation of rock support and utilities. A scaling bar consists of a hollow aluminum or fiberglass pipe with a steel pry tip attached to one end. The length of the bar corresponds to the size of the underground workings, with common lengths ranging from 6 to 12 feet. The weight of these bars, coupled with the physical nature of the work, makes scaling an arduous activity even for seasoned professionals. Beyond physical exertion, hazards commonly associated with manual scaling stem from the close proximity of the activity to unstable rock conditions, the potential of falling while working on muck piles or elevated platforms, and the limited ability for rapid egress in the event of rock failure.

Figure 1. Manual Scaling [(4)]

Figure 2. Mechanized Scaling [(4)]

The drawbacks of manual scaling have led to the use of mechanized scalers in many applications. Unfortunately, these units also have a number of major shortcomings. Mechanized scalers are notorious for inadvertently digging into soft materials and often create and/or propagate additional fractures in the rock contributing to structural instability. Furthermore, these scalers are confined by the specific operating envelope for which they are designed and are limited by height, access, and floor conditions. These units are also

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expensive to buy and operate, are often plagued by poor mechanical availability, and require sufficient ventilation capacity to offset the exhaust, heat, and particulate matter produced by the machine's diesel power plant.

The high frequency of accidents and the limitations associated with current scaling practices have led to a number of research activities that focus on the development of practical solutions that minimize the exposure of miners to the hazards of rock falls. Of the techniques and equipment currently being investigated, waterjet technology presents one of the most promising alternatives for developing a safe, low-cost scaling system that can operate remotely in a wide range of work environments. Advantages of this technology include:

- No direct mechanical contact between the scaling apparatus and the rock,
- Ability to focus tremendous force over small surface areas at long standoff distances with relatively low reactive force,
- Highly amenable to remote control and automation,
- Omni-directional (jets can operate in any direction without appreciable power losses),
- Highly selective (jet impingement can precisely target specific areas without damaging neighboring rocks and rock structures),
- Scarification and cleaning of rock surfaces prior to shotcrete placement,
- Environmentally safe, emitting no hazardous dust, fumes, or high velocity rock debris/chips, and
- Operating parameters can be dynamically adjusted for different rock types and scaling conditions by changing fluid pressure, flow rate, and traverse motion/velocity.

Since the early 1980's, a number of organizations and companies have engaged in research activities that focused on waterjet applications related to rock scaling with varying degrees of success. Most notably, these groups include LKAB, Skanska, Falconbridge Limited, MIRARCO, Fluidyne, and International Engineering Technology. Each of these groups employed different research methodologies, nozzle types, operating parameters, and motion strategies.

In early 1999, work began at the Colorado School of Mines (CSM) to investigate whether scarifying rock surfaces with continuous waterjets could improve the adhesion characteristics of shotcrete. Shotcrete is commonly used in mining and construction as a means of providing support and stability to underground excavations. Using a concrete test wall as a target, experiments showed that the adhesion strength of shotcrete could be vastly improved by cleaning the surface with a 3,000 psi waterjet prior to shotcrete installation [(2)]. A follow-up study concluded that the removal of loose rock, dust, oil, and other contaminants from rock surfaces was a superior alternative to increasing the application thickness of shotcrete in instances where the interface strength between the rock and shotcrete was poor [(3)].

Building on this work, a research grant was obtained from the U.S. National Institute for Occupational Safety and Health (NIOSH) to conduct a preliminary evaluation of using waterjets for the scaling of loose

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rocks in underground mine openings. A prototype waterjet scaling system was constructed utilizing a 100-hp quintuplex pump with a designed operating pressure of 3,500 psi at a discharge flow rate of 30 gpm. The nozzle and motion assemblies were supported by a carrier vehicle donated by Climax Molybdenum's Henderson Mine. The vehicle consisted of a refurbished shotcrete rig with a hydraulically actuated boom (see Figure 3). Modifications to this rig allowed the operator to remotely control and position the boom and nozzle assembly. Under the testing methodology, a total of 10 slash rounds were drilled and blasted to provide fresh rock surfaces for scaling. Each round consisted of between 25 to 30 drill holes, with an average length of 10 feet. Consistent with current industry practices, two types of blasting methods were used. The first five experiments were charged exclusively with ANFO and stick emulsion in a conventional blasting pattern. The second five experiments utilized a smooth-wall blasting configuration, where the perimeter holes were stemmed and the explosive charge was comprised of a primer, a small amount of ANFO, and approximately 6 feet of 200-grain detonation cord.

Figure 3. CSM Waterjet Scaler [4]

A number of different nozzle configurations were tested, including a conventional single orifice carbide nozzle, a dual orifice self-rotating nozzle with replaceable inserts, and an acoustic pulsed jet nozzle. The single orifice and self-rotating nozzles were both purchased from StoneAge Waterjet Tools Inc. The acoustic nozzle was designed and manufactured by Dynaflow Inc. For each nozzle configuration, steps were

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taken to minimize any up-stream fluid turbulence and maximize jet coherency. The operating pressure and flow rate used were based upon previous experiments conducted on the rock type in order to optimize shotcrete adhesion strength. The standoff distance during the scaling tests was approximately 36 inches, where the rake and pitch angles varied continuously throughout the scaling process. Based on previous experiments, jet motion was known to be a critical factor in scaling productivity and operating efficiency. While the hydraulic boom and end-effector provided gross motion control of the nozzle assembly, nozzle rotation was also believed to be important in order to achieve sufficient area coverage. Three different rotation mechanisms were used in the study; a pneumatically-powered swivel assembly, an externally-driven hydraulic oscillator, and a self-rotating, duel orifice nozzle.

Figure 4. Waterjet Scaling Experiment [4]

The results of the testing program overwhelmingly supported the contention that waterjets could be effectively used in developing a reliable, remotely operated scaling system [4]. Despite the limited amount of data and variations in rock structure, each of the nozzle configurations used showed scaling productivities that were comparable to or exceeded the baseline standards established by experienced miners using manual scaling bars (see Figure 4). Despite this success, concerns were raised over the ability of waterjets to liberate tightly wedged rocks and slabs (a rock with large surface dimensions). These concerns were based upon a single occurrence during testing, where manual scaling produced large rocks in an area that had been previously scaled

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Effects Of Waterjet Cleaning On Surface Preparation

Dr. Lydia Frenzel* presented a summarizing paper on the effects of waterjetting on the surface and surface preparation. Here are the highlights of her paper.

In waterjet cleaning, the jet has two effects on the surface: direct impact that is controlled by the velocity of the jet and shear that is controlled by the volume of the jet. Direct impact causes erosion to break down the cohesion of the coating to be removed. Shear stress overcomes the adhesion forces. A higher velocity produced with a smaller orifice tends to erode the surface while a higher volume from a larger orifice tends to shear or hydraulically lift the coating.

Compared to grit blast, waterjetting gives comparable adhesion values to the treated surface even though it does not create detectable profile and produces very smooth comparable surfaces. Experimental results indicated that waterjetting increased the wettability of the surface, which leads to a better contact between the coating and the bare steel and thus a better adhesion. Waterjetting can induce surface plastic deformation similar to shot peening and thus enhance the fatigue strength of treated parts by 20-30%. This indicates that waterjetting changes the surface energy, which may be also the explanation for the enhanced wettability.

Immediately after waterjetting, a light golden color was observed on the treated steel surface. One explanation is that ultrasonic cavitation from the droplets of the jet causes instantaneous chemical reaction and forms a thin layer of tightly adherent oxides or hydroxides, which resists new corrosion.

Waterjetting creates a micro-profile on the treated surface instead of a familiar "peak-to-valley" profile. The peak-to-peak spacing on these micro-profiles is about 20-50 microns and the peak-to-valley depth is 10-75 micron. On the contrary, the profile created by grit blast with 60 mesh crushed steel grits has a peak-to-peak spacing of 230 microns.

Waterjetting not only cleans the surface, but also attacks the pores of the microstructure and creates pits with undercuts. These pits with undercuts have excellent mechanical/adhesive qualities for coating. Experimental results showed that a higher stress (6,000 psi) was required to strip off thermal spray coating from a waterjetted surface, compared to 3,000 psi from a grit-blasted surface.

Waterjetting improves adhesion also by expanding the surface area and thus increasing number of potentially reactive sites, which allow molecular associations between the substrate and the paint. This was supported by a test that directly compared a coating over grit blasted and WJ surfaces.

** Frenzel, L. (2007) What effect does waterjet cleaning have on the surface and surface preparation? Proceedings of the 2007 American WJTA Conference and Expo, August 19-21, Houston, Texas, Paper 1-A.*

Reprinted by permission from Quality Waterjet Newsletter, February 12, 2008.

Vacuum Truck Rentals Opens Branch In South Carolina

Vacuum Truck Rentals (VTR) opened a new office outside of Columbia, South Carolina, on February 1, 2008, to further provide quality rental equipment to customers in the southeastern United States. The facility is located at 142 Access Road, Gaston, South Carolina. Some of the equipment available will include *Guzzler* air machines, *Keith Huber* liquid vacs, *Vactor* combos and hydro-excavators, *Galbreath* roll-offs, *Dragon* vacuum tankers and *Vector* stand-alone cyclones.

"We felt like this was a great opportunity to bring our level of service to a marketplace that until now had very few options," said Payton Lockey, managing member of Vacuum Truck Rentals. "This new location will show our continued commitment to our customers throughout the southeast."

"Since taking the job with VTR it is clear to me that their commitment to our customers surpasses any business that I have ever been associated with," said Les Ingram regional manager. Les has thirteen years of experience in the industrial contracting industry, having worked with several of the larger firms in the area. Les will be leading the team in South Carolina. Together with a service staff with over 40 years of experience, the new facility will be poised to serve customers in the Carolinas, Virginias, Georgia and Tennessee.

For more information about the products and services available from Vacuum Truck Rentals call 888-955-2087, or visit www.vactruckrental.com.

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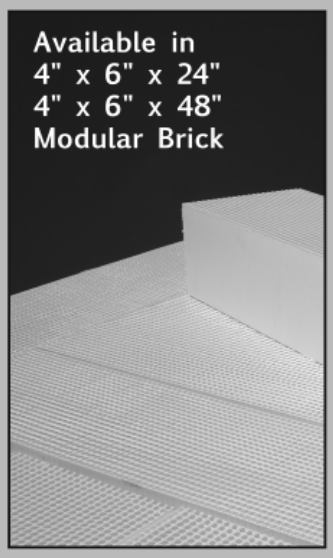

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NLB Updates Accessory Catalog, On-line Quoting

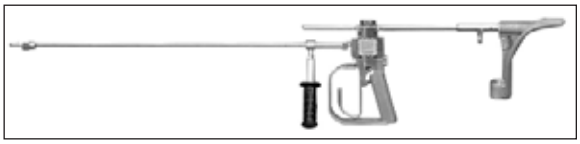
NLB Corp. has introduced a new water jet accessory catalog and updated on-line quoting system that make it easy to find the right accessory for an application. The printed catalog, 40 percent bigger than the previous edition, is available at no charge from NLB. An on-line version is posted on the company's website, www.nlbcorp.com, which also features an updated RFQ section.

Among the new accessories are field-repairable lances and rotating nozzles rated up to 40,000 psi, rotary hose devices, and 3-D tank cleaning heads. The catalog also has a greatly expanded section for couplings and fittings, a variety of application photos and hook-up drawings, and all necessary specifications and ordering information. A comprehensive reference section includes nozzle flow charts, thrust and pressure drop tables, and English/metric conversions.

The on-line catalog is posted on the Literature page of the website, conveniently divided into major product sections. At the website's Accessories page, visitors can request a quote by clicking on a button and following the prompts. Quotes are typically e-mailed within 24 hours.

Visit www.nlbcorp.com for more information.

40,000 PSI Lance Offers 60-Second Cartridge Change



A new 40,000 psi (2,800 bar) waterjet lance from NLB Corp. makes the company's popular 60-second cartridge change and other operator-friendly features available for UHP applications.

The NCG40-286 lance is light-weight and ergonomic, weighing just 13.5 lbs. (16 kg). Its patented trigger design (U.S. patent no. 5,636,789) requires just a light squeeze to initiate the waterjet action, and the operator can immediately dump pressure by pushing the trigger forward.

A one-finger latch is designed to prevent accidental actuation, and the hand grip and shoulder stock are adjustable to suit the operator. When used with NLB's Viper 40™ self-rotating head, the NCG40-286 produces rotating waterjet action without compressed air.

For more information, visit www.nlbcorp.com or call 1-877-NLB-7988.

Federal Signal Names Total Blasting Authorized Distributor For Jetstream Brand In Southern Africa

Jetstream of Houston, LLP, has announced that Total Blasting Pty Ltd., headquartered in Johannesburg, South Africa, is the authorized sales, rental and service distributor for Jetstream in the countries of Angola, Botswana, Mozambique, Namibia and South Africa.

"As we continue to provide high-pressure waterblasting solutions to Jetstream customers globally, we are very pleased to be expanding our distributor network in Southern Africa with the addition of Total Blasting as an authorized sales, rental and service distributor for Jetstream in Angola, Botswana, Mozambique, Namibia and South Africa," said Joe Varca, Global Sales Manager, Jetstream. "We are confident that Total Blasting will do an outstanding job representing the Jetstream brand in these countries."

"We are proud to have the opportunity to represent the Jetstream brand in Southern Africa," said Andy Sutherland, director, Total Blasting Pty Ltd. "With more than 30 years experience in the surface preparation industry, and with multiple locations throughout South Africa, we will be able to provide our customers in this region of Africa with a high level of sales, service and rental support for the Jetstream brand."

Based in Johannesburg, with affiliated offices in Cape Town, Durban and Port Elizabeth, South Africa, Total Blasting Pty Ltd., has more than 30 years experience in the surface preparation industry, serving the petrochemical, power generation, chemical processing, paper and pulp, sugar, mining and corrosion industries. The company's technicians provide customers with service and technical advice on all aspects related to surface preparation, including ultra high-pressure waterblasting, road marking products and industrial minerals. For more information on Total Blasting, visit www.totalblasting.co.za. For more information on Jetstream, visit www.waterblast.com.

Maxpro Technologies Appoints New Distributor

Maxpro Technologies has announced the appointment of High Pressure Technologies, LLC, as the new southwest distributor for Maxpro Technologies lines of Maximator® high pressure valves, fittings and tubing as well as liquid pumps, gas boosters and air amplifiers.

High Pressure Technologies, LLC, located in Santa Clarita, California, will distribute Maxpro Technologies products and provide repair services in the states of California, Arizona and New Mexico.

Peter Duffy, owner and president of High Pressure Technologies, has 30 years of industry experience, most recently serving as vice president of a high pressure hydraulic pump manufacturer. Mr. Duffy brings significant experience in the high pressure industry.

For more information, visit www.maxprotech.com or contact Maxpro Technologies, 7728 Klier Drive South, Fairview, PA 16415, phone: 814-474-9191, fax: 814-474-9391 or contact High Pressure Technologies, LLC, 18345 Sierra Hwy., Unit 1, Santa Clarita, CA 91351, phone: 661-251-5069, fax: 661-251-6745, www.highpressuretech.com.

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by waterjets. These rocks, however, took a considerable amount of work to free and would have probably been considered safe if shotcrete and/or rock bolts had been applied.

Despite the fact that little effort was made to optimize the productivity of different nozzle configurations and that there was insufficient testing to conclusively evaluate each nozzle type, several conclusions could be made. While all the nozzles tested showed merit, the standoff distance strongly supported the application of a single orifice nozzle for the flow rates used. Even at a modest flow rate of 30 gpm, water disposal within a 12 ft x 12 ft drift at times became problematic. Therefore, increasing the flow rate to improve the effective standoff distance of the duel orifice, self-rotating nozzle seemed impractical. Given the ability to adjust the speed and pitch angle of rotation and the robustness and simplicity of the unit, the hydraulically-powered oscillator proved to be well-suited for this application (see Figure 5).

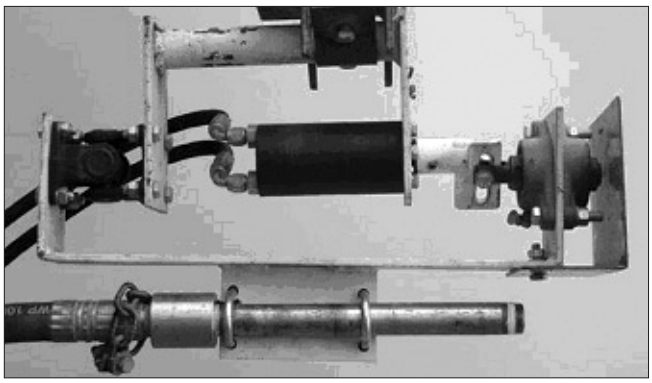

Figure 5. Hydraulically-Powered Nozzle Oscillator [4]

This research successfully demonstrated that waterjet technology is a viable alternative to conventional scaling practices and eliminates many of the inherent problems and limitations that are responsible for contributing to workplace injuries and hazards. Furthermore, the technology is fairly mature and suitable for rapid industry integration.

(1) O'Neil, T., "Technology News – Safety Training Video on Rock Scaling", *Mining Engineering*, April 2001, pg. 38.

(2) Kuchta, M., "Quantifying the Increase in Adhesion Strength of Shotcrete Applied to Surfaces Treated with High-pressure Water", *Transactions of the Society for Mining, Metallurgy, And Exploration*, Vol. 312, 2002, SME Publications, pp. 129-132.

(3) Kuchta, M., Hustrulid, W., and Lorig, L., "The importance of Surface Preparation in Shotcreting Operations", *Surface Support in Mining*, pp. 283-290. Y. Potvin et al., Eds. Netherlands: Australian Center for Geomechanics

(4) Poeck, E., 2008, A Performance Evaluation of Various Nozzle Designs for Waterjet Scaling in Underground Excavations, M.Sc. Thesis, Mining Engineering Department, Colorado School of Mines, Golden, Colorado

Jet Edge Exhibiting At EASTEC, May 20-22

Jet Edge, Inc. will showcase the High Rail Gantry precision waterjet, iP60-50 ultra-high pressure intensifier pump, and the new self-feeding pneumatic drill in booth #1065 at the EASTEC 2008 Advanced Productivity Exposition, May 20-22 at the Eastern States Exposition Grounds in West Springfield, Massachusetts.

Capable of producing complex parts out of virtually any material, the Jet Edge High Rail Gantry features a stable overhead design that allows full access to the work envelope and raises critical components out of the process environment. Jet Edge utilizes high-volume, low-pressure air around the ball screws and linear motion guides and bearings, which increases durability by preventing contamination from entering these areas. The High Rail Gantry has a +/- 0.005" accuracy of motion over the entire work envelope, +/- 0.001" linear positional accuracy over 12" travel per axis and +/- 0.001" repeatability (bi-directional). It is available in 2' (0.6m) increments from 4X4' (1.2X1.2m) to 24X14' (7.3x4.3m). Custom sizes are available, and the system can easily be expanded in place as a business grows. The system can be, and is, used in locations where it is difficult to get electricity.

The High Rail Gantry is powered by Jet Edge's intensifier pumps, which range from 30 to 280hp and operating pressures up to 75,000psi (5,200 bar). During EASTEC, show participants will have the opportunity to see the iP60-50 intensifier pump in action. Featuring the most advanced technology for extended-life hydraulics, a reliable tie-rod design and easy maintenance with no threads on the high pressure cylinders, the 50-horsepower iP60-50 produces up to 60,000 psi (4,100 bar), and provides flow rates of 0 to 1.1 gallons (5 liters) per minute to a variety of cutting, surface-preparation or cleaning tools. The iP60-50 provides easy access for all service and maintenance. It features a non-high-pressure cylinder with a warranty – even on replacement cylinders, an improved performance check valve, and low torque requirements. The Jet Edge

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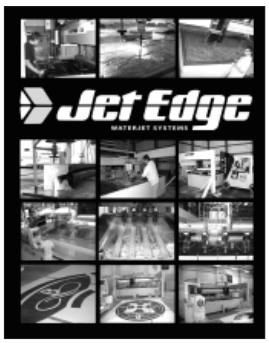
Jet Edge Introduces Diesel-Powered Waterjet Intensifier Pump, Waterjet Cutting Systems Brochure

Jet Edge, Inc. has introduced the iP55-280DS diesel-powered waterjet intensifier pump. Ideal for use in remote and/or mobile locations where electricity is scarce, the iP55-280DS is powered by a reliable 280hp Cummins turbo diesel engine that

meets domestic and international Tier 3 emissions standards. It is capable of producing a flow rate of up to 4.1 gallons (15.5 liters) per minute of 55,000 psi (3,000 bar) ultra-high pressure water for waterjet cutting, surface preparation and cleaning applications.

The iP55-280DS utilizes a pressure-compensated hydraulic system to drive dual plunger-style intensifiers. The use of hydraulic fluid power provides smooth flowing UHP water resulting in long system life. Reliable and precise control of the electronically shifted intensifiers ensures superior performance standards with reduced operating costs. The pump is built on a skid-mounted frame with lifting eyes and forklift guides provided for increased mobility.

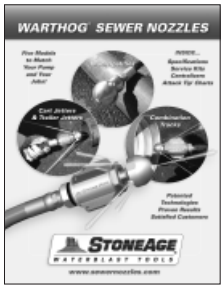
Jet Edge has also released a new precision waterjet cutting products brochure. The brochure features Jet Edge's precision waterjet cutting tables, which include an expandable High Rail Gantry available in 2' increments from 4'X4' to 24'X14', a Mid Rail Gantry available in sizes up to 30'X100' and a compact Abrasive Machining Center available in 30"X30", 30"X48" and 48"X96" models. The brochure also highlights Jet Edge's intensifier pumps, which are available in a wide range of horse powers and capable of producing pressures from 60,000-90,000psi, as well its precision cutting accessories that include cutting heads, abrasive delivery, removal and recycling systems, and a closed loop filtration system.



For more information, visit www.jetedge.com, e-mail: sales@jetedge.com or call: 1-800-JET-EDGE (538-3343).

New Warthog Catalog For 2008

StoneAge Inc. has released its first Warthog catalog. The 13-page catalog includes jetting charts, tool breakdowns with each part identified, service kit components and available accessories.



To view the catalog online visit www.sewernozzles.com and click on the "Info Center" tab or call toll-free in the U.S. 1-866-795-1586 or direct 1-970-259-2869.

Jet Edge Exhibiting At EASTEC, May 20-22, from pg. 16

iP60-50 intensifier pump leads the industry with ease of operation and low operating cost.

Jet Edge waterjet cutting systems are controlled by the AquaVision D*i*® motion controller, which guides users through the process from job set-up to production and has numerous standard features that are optional on many competitive systems. With the AquaVision D*i*, single parts, mirroring, scaling, part arrays, rotation and plate alignment are right at users' fingertips. The AquaVision D*i* is fully networkable, allowing part programs to be generated offline and easily transferred to the system's hard drive for production. Feed rate and acceleration are automatically varied, based on known features of a specific job. Dynamic tool offset, or "cutter compensation," is employed real-time, and an optional real-time pump control allows remote starting and stopping of the pump, dual pressure set points for hard-to-pierce materials, and unlimited data logging of every process parameter imaginable. The AquaVision D*i* includes a full-featured hand-held pendant that allows feed rate override, return-to-path, program zero set points, and XYZ axis control.

Jet Edge's new self-feeding pneumatic drill is available in stationary or laterally adjustable models. The drill gives waterjet operators the opportunity to expand their cutting capabilities and take in new types of work by enabling them to quickly pierce sensitive materials prior to cutting them with waterjet. It also can be used for reaming holes to a precise diameter. Its heavy-duty, corrosion-resistant design ensures a maximum operating life.

The drill features a hydraulic feed control unit, feed stroke adjustment, exhaust collector and PLC interface manifold. A flexible bellows cover is mounted to the front of the drill to protect it from foreign material, with all controls contained internally. The drill has a free running rpm of 3,300 and can be set for any stroke from 5/16 to 3 inches. It is supplied with a ¼-inch stainless steel drill chuck. All control valves are contained within a NEMA-rated electrical enclosure.

For more information about Jet Edge, visit www.jetedge.com, e-mail: sales@jetedge.com or call 1-800-JET-EDGE (538-3343).

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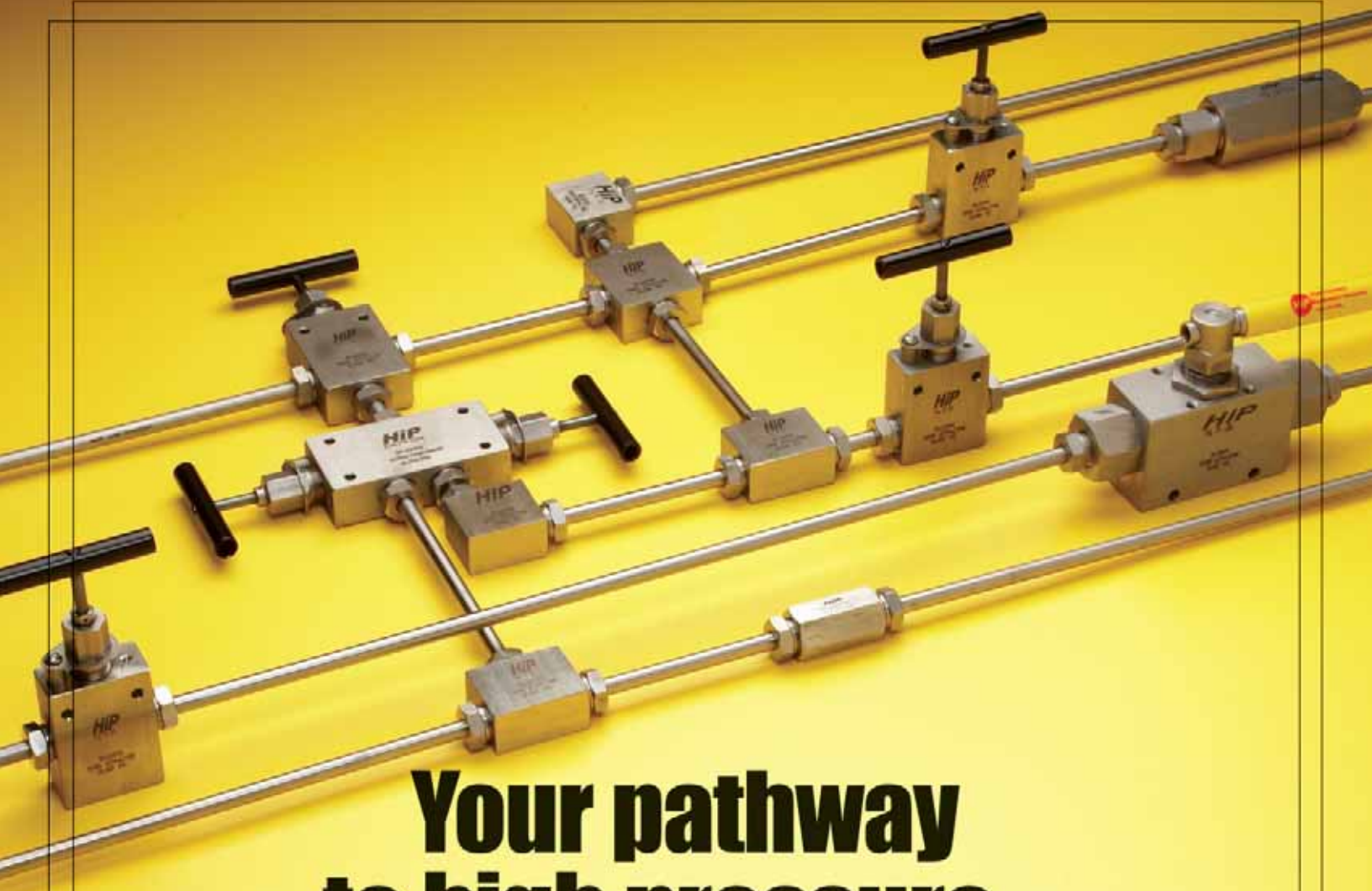

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