



Automated Waterjet Cutting of Deep Slots in Granite



Photographs provided courtesy of Ned-Jet Cutting Systems, Inc., Worcester, MA.

Ned-Jet Cutting Systems, Inc., of Milbank, South Dakota, has operated its Ned-Jet 2000 slot cutting system in Cold Spring Granite Company's Milbank, South Dakota, quarry since 1993. The Ned-Jet 2000 contains a 250 horsepower, diesel-driven intensifier which supplies water at 37 psi at six gallons per minute to the cutting nozzle. The resulting waterjet cuts

a vertical slot (1.75 to 3" wide) 15 feet deep and to whatever length is desired.

The operation of the Ned-Jet 2000 is fully automated. The larger picture above shows three units operating automatically under the supervision of a single person. The computer-controlled waterjet lance in each of these machines automatically moves up, down and forward in the slot. The

smaller photograph shows the oscillating waterjet which cuts the granite.

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In Memoriam

Richard H. Hollinger

We are saddened to report that **Richard (Dick) H. Hollinger** passed away last year at his home in San Antonio, Texas.

Many WJTA members will remember Dick Hollinger from his research and development presentations at the 1989 and 1991 WJTA conferences. Mr. Hollinger received, at the 1993 conference in Seattle, an outstanding paper award in recognition of the 1991 presentation.

Mr. Hollinger served in the US Army from 1945-1947. In 1951 Mr. Hollinger received a bachelor of arts degree in chemistry from Temple University in Philadelphia, and he completed graduate school studies in

colloid chemistry and biochemistry from 1952-1953.

Mr. Hollinger was then associated with the Franklin Institute in Philadelphia, serving in increasingly responsible research engineering positions from 1954 to 1987 when he joined the southwest Research institute in San Antonio as a senior research scientist to carry out a specific project.

In addition to waterjet activities, Mr. Hollinger had project management responsibilities in a wide range of activities, including hydraulics, fuel and lubrication systems, metal treatment and adhesive bonding, fluids evaluation, environmental studies, cement and concrete studies and instrument development.

HydroChem Acquires Valley Systems

HydroChem Industrial Services, Inc. has acquired, effective January 1, 1999, substantially all the operating assets of Valley Systems, Inc. and Valley Systems of Ohio, Inc. The purchase price was approximately \$30 million, plus the assumption of Valley's bank debt and certain other liabilities.

Valley, based in Canal Fulton, Ohio, provides specialized industrial cleaning services, including ultra high pressure waterjetting, metal cutting and vacuum services, to the primary metals, power generation, chemical plastics and petroleum refining industries. Valley employs approximately 350 people and services customers from 18 locations. Revenue for the fiscal year ended June 30, 1998, was \$24.4 million.

"Valley brings to HydroChem additional resources in the form of experienced employees, competitive service offerings, an expanded customer base and branches in areas that broaden our geographic coverage," said Tom Carter, HydroChem chairman and chief executive officer. "This acquisition complements HydroChem's business growth plans extremely well."

With the acquisition HydroChem, based in Houston, now has 65 field locations throughout the U.S. and Puerto Rico and Singapore. The company provides industrial cleaning services, including hydroblasting, chemical cleaning and vacuum services, to the petrochemical, oil refining, electric utility, pulp and paper and metals industries.

WJTA Seeks Suggestions For Revisions To WJTA Short Course Content And Format

In order to continue to help meet the ever-changing educational needs of professionals involved in waterjet technology, the WaterJet Technology Association (WJTA) Board of Directors is considering a change in the content and format of the WJTA short course, *Fluid Jet Technology – Fundamentals and Applications*.

WJTA members are encouraged to submit suggestions for possible changes to the short course content and format.

The short course traditionally covers the fundamentals of waterjet technology, including a historical perspective, fluid mechanics of jets,

influence of basic jet parameters and physics of abrasive waterjet cutting, hydraulic mining, abrasive jets, high pressure equipment and systems, cleaning applications, industrial applications, comparison of laser and abrasive waterjet technology, high pressure safety, and construction and civil engineering applications.

In order to allow adequate time for review of suggested revisions, please submit your comments to the WJTA office **no later than March 15, 1999**, to: WJTA Short Course Revisions, 917 Locust Street, Suite 1100, St. Louis, MO 63101-1413, E-mail: wjta@primary.net, Fax: (314)241-1449

WaterJet Technology Association

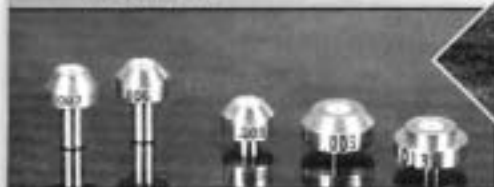
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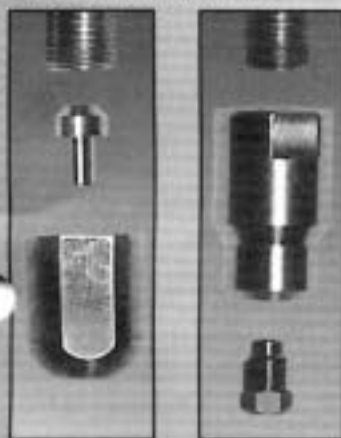
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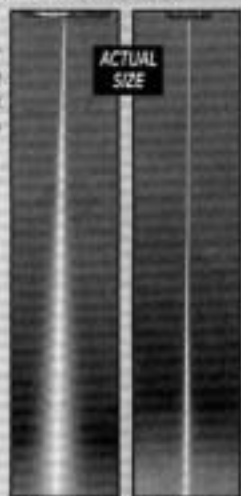
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Flow International Introduces New Intensifier Pump

Flow International Corporation recently introduced its new 20XW intensifier pump, with features designed to increase pump life and to provide customers with ease of operation and reliable performance of their waterjet machines.

The 20XW is a high-output, high-pressure pump for waterjet and PASER® abrasivejet cutting applications. The 20XW pump features a single, electronically-shifted 55,000 psi extended life seal (ESL) intensifier with ceramic plungers to minimize seal wear and improve durability, an integrated kidney loop that filters oil to ISO code 15-12 or better to extend pump life, a standard



dual-pressure control, and comes CE approved.

Flow's ultrahigh-pressure waterjet shapecutting systems are known worldwide for many applications. Flow's abrasive waterjet cutting systems are ideally suited for cutting

tough and lucrative applications and materials such as titanium, Inconel, brass, steel, aluminum, glass, stone, composites, and other materials from 1/16 inch to 8 inches thick to accuracies between +/- 0.003 and +/- 0.010 inch.

Flow International is a leader in the development and manufacturer of ultrahigh-pressure waterjet technology, and a leading provider of factory automation systems. Flow's primary markets include automotive, aerospace, job shop, food processing, paper and surface preparation.

For more information, contact Mike Ruppenthal, (253)850-3500.

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- Preconference Workshops
- Exhibits
- Research & Development Sessions
- Contractor Sessions
- Live Waterjet Demonstrations
- Tours of Houston-area Waterjet Businesses

To register and make hotel reservations, see page 14.

To reserve an exhibit booth or to demonstrate equipment on the technical tour, contact Ken Carroll at (314)241-1445.

Protective Apparel For Waterjet Operators

WaterArmor™, a new line of protective apparel for high-pressure waterjet operators — available exclusively from NLB Corporation — offers increased protection at 10,000 psi (700 bar), yet is exceptionally lightweight and comfortable.

WaterArmor™ consists of replaceable sections that cover an operator from the chest down, leaving his arms free to work effectively. These sections are made by Warwick Mills of tough, flexible Turtleskin®, a patent-pending, multi-layered fabric that features a grade of DuPont's KEVLAR® fiber commonly used in bullet-proof vests. The TurtleSkin® is covered by a waterproof, abrasion-resistant outer shell.

WaterArmor™ weighs just 2.5 pounds (1.1 kg) and allows air circulation that keeps operators cool. The one-size-fits-all apparel includes a vest and replaceable panels that can be worn comfortably under any standard wet suit. Shoulder and leg straps feature quick-connect buckles, while VELCRO® hook and loop fasteners make thigh protectors easily adjustable for long or short legs. Flexible knee joints allow easy bending and kneeling.

WaterArmor™ can also be cleaned easily with just a garden hose and mild soap and water.

In field and laboratory tests performed by NLB and waterjet users,

(continued on page 13)



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Aqua-Dyne's New Soliton Gun


Aqua-Dyne, Inc. has introduced its patent pending **Soliton Gun**.

The lightweight Soliton Gun is the first waterjetting gun to provide oscillating (up and down) nozzle movement instead of traditional fixed or rotating nozzle action. The oscillating wave action provides concentrated, overlapping coverage as opposed to the circular, non-even coverage associated with rotary nozzle systems. The difference is significantly quicker and more uniform cleaning or coating removal which results in increased productivity.

The Aqua-Dyne Soliton Gun has a maximum working pressure of 60,000 psi. Nozzle oscillation is powered by compressed air with a built-in air dump valve. Maximum water flow is 30 gallons per minute (113 l/min). The gun can be configured for single or multiple jets on a hand held or machine mounted unit.

For additional information Aqua-Dyne can be reached by telephone at 800-324-5151 or 713-864-6929, by fax: 713-864-0313 or website: www.aqua-dyne.com.






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WJTA Request For Proposals

The Waterjet Technology Association (WJTA) is requesting proposals for the preparation of reports on topics of interest to our membership. These reports will be literature searches, surveys, and data gathering activities only, not research and development work. These reports will then be made available to WJTA members at a minimal cost.

The following topics are of interest:

1. Spark hazard, or lack of, with abrasive waterjets.
2. The use of pipe threads and other pipes found in high pressure connections.
3. Concrete demolition rates using waterjets.
4. Market size for waterblast equipment or services.
5. An index of papers in WJTA publications, cross-referenced by subject and author.
6. Types of abrasives — characteristics and applications.

Please submit your proposals to: WJTA, 917 Locust Street, Suite 1100, St. Louis, MO 63101-1413.

Include a description of the scope of work to be performed, total cost, author's credentials and anticipated time to complete the work. Proposals will be evaluated and funds committed by the WJTA Monograph Committee (John Wolgamott, Thomas J. Kim, Ph.D., Lydia Frenzel, Ph.D., and Mohamed Hashish, Ph.D.). Once a topic has been assigned, it will be announced in *Jet News* and members will be encouraged to submit information to the author(s). Proposals for reports on other topics will also be considered.

A total of \$5,000 has been budgeted for the first reports. The number of topics this will fund will depend on the cost of each report. If the initial reports are judged as worthwhile, more funding will be made available and additional reports will be solicited. WJTA members are encouraged to submit ideas for other topics to study.

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Jet Edge Acquires Chukar Industries

Jet Edge, a leading Minneapolis based designer and manufacturer of ultra-high-pressure (UHP) waterjet systems and components for cutting, cleaning, and coating removal applications, has acquired Chukar Industries.

Chukar Industries, a Washington based manufacturer of waterjet motion control systems was founded in 1989. The Chukar tables are designed specifically for waterjet cutting, which makes them a leading table manufacturer for the waterjet industry. With the acquisition of Chukar, Jet

Edge gains total control over the start-to-finish design and production of its entire systems.

"We have worked closely with Chukar for six years to provide customers the highest quality systems," said Jude Lague, president of Jet Edge. "Acquiring Chukar will enhance our ability to support our customers and maintain our position as a leader in the waterjet industry. Our motion control systems are available in standards sizes from 24 inches x 30 inches to 14 feet x 14 feet which

complements our wide variety of pump sizes."

Ultra-high pressure waterjet system combine a small amount of water and garnet to cut through materials considered "un-machinable" by conventional methods. The Jet Edge process eliminates friction caused by conventional tool-to-part contact which, in turn, eliminates toxic fumes, airborne particles, and thermal stresses.

For more information, contact Dan Gotzat, Jet Edge, (800)JET-EDGE.

Welcome WJTA New Members

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Fax: (518)434-2527

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High Pressure, High Flow Hydrostatic Test Unit

Houston-based Aqua-Dyne, Inc. offers a hydrostatic test unit for pipeline, oilfield or petrochemical applications.

The unit has a range of performance from 5,000 psi at 51.4 gallons per minute to 20,000 psi at 12.0 gallons per minute. Models are available with diesel, gasoline, or electric power drivers, mounted on either a skid or trailer. A 400-600 gallons per minute pre-fill pump is an optional feature as are a hose rack, pipe manifold, suction and discharge hoses, tool box and jib crane (raises and lowers pipe manifold on and off the unit). The optional high flow manifold connects both the pre-fill and high pressure pump to the pipe. A high-pressure, high-flow closure

valve isolates the high flow pump during final high pressure testing.

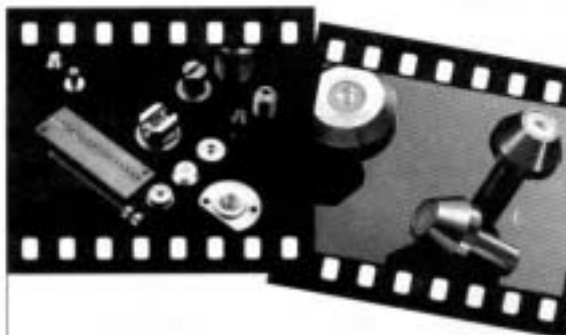
The test unit uses a horizontal, triplex positive displacement pump rated to 100 horsepower with integral gearbox. The plunger pump consists of valve-in-line, sectionalized stainless steel valves and seats with self-adjusting spring loaded chevron packing.

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Conjet Appoints Distributor For North America

Conjet and has formed a new distributor organization to cover the USA and Canada. The new distribution is a collaboration between National Hydro Inc., of Detroit, Michigan, Hammelmann Corp., based in Dayton, Ohio, and Conjet AB of Sweden. Responsible for the operation in North America will be Stephen Toms based at National Hydro Inc.

Conjet is a leading specialist for the design, development and manufacture of hydrodemolition equipment. Conjet offers an extensive range of remotely operated, computer controlled robots and Jetframe systems with cutting widths up to 7m which have been used on numerous and varied concrete repair projects all over the world.

For more information, contact: Lars-Göran Nilsson or Carl Strömdahl, Conjet AB, P.O. Box 507, S-136 25 Haninge, Sweden, telephone: [46](8)741-3940, fax: [46](8)741-3960, e-mail: conjet@conjet.se, website: www.conjet.com, or Stephen Toms, National Hydro Inc., 5643 Warner Road, Fowlerville, MI 48836, USA, telephone: (517)223-0915, fax: (517)223-9525, e-mail: toms@imsi.com.

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The WaterJet Technology Association's

10th American Waterjet Conference

August 14-17, 1999

JW Marriott Hotel • Houston, Texas

Preliminary Schedule of Events

Saturday, August 14

8:30 a.m.-Noon

WJTA Concurrent Seminars

- Short Course on the Fundamentals and Applications of Waterjet Technology
- Recommended Practices Seminar (Safety)
Speaker: Larry Moers
Resource Management Strategies, Inc.
- Advanced Topics in Surface Preparation
Speaker: Dr. Lydia M. Frenzel
Advisory Council
San Marcos, TX

Noon-1:30 p.m.

Luncheon for course participants

1:30 p.m.-4:30 p.m.

Concurrent Sessions (cont.)

6:30 p.m.-9:30 p.m.

Welcoming Reception In The Exhibit Hall — Exhibit Opens

Sunday, August 15

8:30 a.m.-11:30 a.m.

Concurrent Sessions

- Research & Development Sessions I
- Research & Development Sessions II

9:30 a.m.-5:00 p.m.

Exhibits

11:30 a.m.-2:00 p.m.

Exhibit Hall Viewing
(Lunch served Noon-1:30 p.m.)

2:00 p.m.-5:00 p.m.

Concurrent Sessions (cont.)

5:30 p.m.-6:30 p.m.

WJTA Biennial Business Meeting

Monday, August 16

8:30 a.m.-11:30 a.m.

Concurrent Sessions

- Contractor's Program
- Research & Development Sessions I
- Research & Development Sessions II

9:30 a.m.-2:30 p.m.

Exhibits

11:30 a.m.-2:00 p.m.

Exhibit Hall Viewing
(Lunch served Noon-1:30 p.m.)

2:00 p.m.-5:00 p.m.

Concurrent Sessions (cont.)

6:30 p.m. - 11:00 p.m.

Awards Presentation/Party

Tuesday, August 17

8:00 a.m.-3:00 p.m.

Technical Tour and Field Demonstrations

Hydrodemolition Robot

Conjet AB will use the World of Concrete exhibition in Las Vegas to add the compact Conjet Robot 322 to its comprehensive range of high pressure waterjet concrete hydrodemolition equipment. The new Conjet Robot 322 is a remotely operated hydrodemolition robot aimed at smaller contractors entering the market.

The compact, lightweight Robot 322 is exceptionally maneuverable and ideal for working in confined spaces and areas inaccessible to larger equipment. It is very narrow and can pass through a 31.5 inch to 39.4 inch (0.8m to 1m) wide opening, depending on attachment tool, making the Robot 322 ideal for operating in tunnels as small as five feet, seven inches (1.7m) diameter with rotor attachment, culverts, inside concrete box girder bridge decks and under bridge and quay decks. The Robot 322 is also exceptionally efficient for use in numerous industrial cleaning applications. It has been designed to operate with existing 134 horsepower to 470 horsepower (100kW to 350kW) diesel driven high pressure pumps feeding water to the nozzle.

The Robot 322 consists of a self contained, crawler-mounted undercarriage, electrically powered with an integral control system. This allows the hydrodemolition process to be remotely and safely controlled and monitored away from the hazardous cutting area. The Robot 322 can adjust the width of its undercarriage to improve stability when operating and is equipped with a single oscillating nozzle.

The nozzle, set at a predetermined angle of attack, is mounted on a traversing cradle running back and forth along a five-foot-long (1.5m) feed beam. Safety is paramount which is why the entire nozzle assembly is covered by a protective shroud.

The feed beam is attached to an arm mounted on a rotating turntable fixed to the Robot's crawler-based undercarriage. The feed beam and oscillating nozzle can be replaced with an hydraulically driven rotor for cleaning and scarifying concrete surfaces.

The Robot 322 is very easy for the operator to use and optimize production. This ensures that only weak and damaged areas of concrete are selectively removed in a continuous, uniform and safe operation to a predetermined "quality depth" above or below any steel reinforcement, which, if exposed, is also cleaned of rust.

The Robot 322 tool carrier is easily adaptable to take a variety of hydrodemolition tools. It will also enable hydrodemolition contractors to mechanize and replace the far less efficient and less productive hand lancing and jack hammering techniques. Hand held methods are known to be exceptionally tiring,



stressful, noisy and dangerous for operators to use. Removal of concrete with a jack hammer or hand lance is also much slower and not as selective as a Robot. In addition, hand lances are very inefficient with their use of water. They need far more water than the robots to remove a specific amount of concrete.

For more information, contact: Lars-Göran Nilsson or Carl Strömdahl, Conjet AB, P.O. Box 507, S-136 25 Haninge, Sweden, telephone: [46](8)741-3940, fax: [46](8)741-3960, e-mail: conjet@conjet.se, website: www.conjet.com, or Stephen Toms, National Hydro Inc., 5643 Warner Road, Fowlerville, MI 48836, USA, telephone: (517)223-0915, fax: (517)223-9525, e-mail: toms@imsi.com.

Safety Committee Solicits Comments On *Recommended Practices*

The Safety Committee hereby solicits comments regarding improvements to the publication, *Recommended Practices For The Use Of Manually Operated High Pressure Waterjetting Equipment*. The *Recommended Practices* is reviewed periodically at the biennial conferences of the WaterJet Technology Association. The next review will be at the 10th American Waterjet Conference, August 14-17, 1999, in Houston, TX. We invite your comments and recommendations for consideration.

Please address your suggestions to: Safety Committee, c/o WJTA, 917 Locust Street, Suite 1100, St. Louis, MO 63101-1413.

A New Work Cell For The Auto Industry

As interior automotive designs have become more sophisticated molded shapes are being produced that require a great deal of flexibility of motion to cut them out. Robots are providing the needed accuracy and flexibility, waterjet cutting the needed productivity and cost efficiency.

As an example, ABB I-R Waterjet Systems, 28031 Grand Oaks Court, Wixom, Michigan, 48393, telephone (800)286-2971, fax (248)449-6707, recently designed and built a special waterjet cutting work cell that uses what ABB calls a Cutting Box® equipped with a rotating work table and six axis articulated servo-driven robot to cut around the edge and cut out a variety of hole shapes in fabric covered formed fiber headliners. Waterjet cutting is performed at a cycle time of one minute or 50 to 60 parts per hour.

The Cutting Box® work cell included a heavy structural steel weldment that mounts an inverted ABB IRB 2400L articulated six axis AC servo-driven robot equipped with a high pressure waterjet nozzle assembly, and a two position 180-degree reciprocating indexing turntable. The cell is completely enclosed with an insulated sound enclosure that features a self-draining stainless steel floor, safety interlocks for the access doors and a water collection drain pan under the load/unload station including a screen filter to collect scrap.

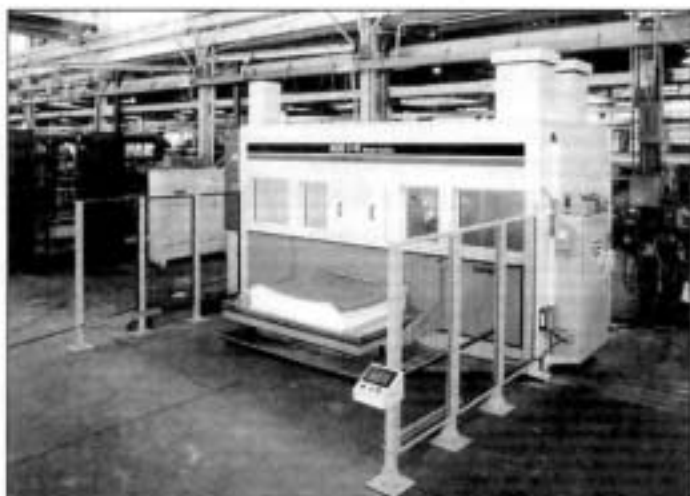
The indexing turntable has steel weldment members with extensions from each side of the center of the turntable as supports for the cutting fixtures. Steel panels form a solid wall that rotates about its own center axis. The drive for the turntable is an ABB servo motor that can rotate the turntable 180-degrees in less than six seconds from shot-pin-shot-pin. The

shot pin devices insure durable and repeatable turntable locations while reducing the load requirement on the drive unit. The servo drive motor is located above the turntable isolated from the cutting and outside environment, eliminating any water or dust from affecting the motor or bearings.

The ABB IRB 2400L robot is designed for maximum repeatability and durability through lightweight, rigid construction and directly coupled axes. An absolute encoder position system on all axes eliminate the need for zero return. All axes utilize mechanical brakes with a brake release button. A full 360-degrees of rotation of the first axis with no dead space in the working envelope. Reach is 70-inches when measured from back to front of the work area. Repeatability is $\pm .002$ -inches. ABB Quickmove™ self-optimizing motion control provides fast acceleration and constant high speed. Truemove™ functions ensure high precision and repeatability at all positions and all paths regardless of the robot's speed.

The robot controller is an AAB S-4C and is mounted in a self-contained cabinet. It uses menu-driven basic style language with windows-style communication and multi-tasking function support.

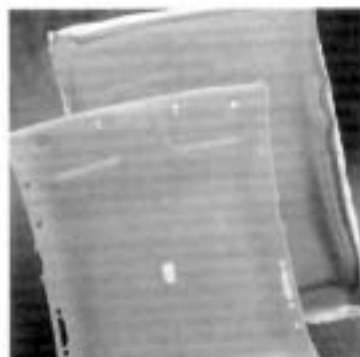
The high pressure water is fed to the robot through an Ingersoll-Rand variable displacement Streamline IV 50 horsepower intensifier system that provides 1.0 gallons per minute flow



New ABB I-R Cutting Box is equipped with a rotating work table and six axis articulated servo driven robot to cut around the edge and cut out a variety of hole shapes in fabric covered formed fiber automotive headliners.

rate at the maximum operating pressure of 55,000 psi. A high pressure interface kit is provided to optimize articulation features of the robot while providing high pressure water to the cutting nozzle head.

ABB I-R Water Systems L.L.C., located in Wixom, Michigan, combines Ingersoll-Rand's high-pressure intensifier and two-dimensional waterjet cutting technology with ABB's expertise in robotics and motion equipment to provide automated waterjet cutting systems.



Automotive fabric covered formed fiber headliner, foreground, shows the material removed by waterjet from the uncut headliner shown at the rear.

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Protective Apparel For Waterjet Operators, from page 5

WaterArmor™ resisted penetration by waterjets operating at pressures of 10,000 psi (700 bar) with a flow rate of 16 gpm (60 lpm). The velocity was 8.2 feet per second (2.5 m/sec.) at a nozzle stand-off of 1.25 inches (32 mm). WaterArmor™ is not intended for use above 10,000 psi (700 bar).

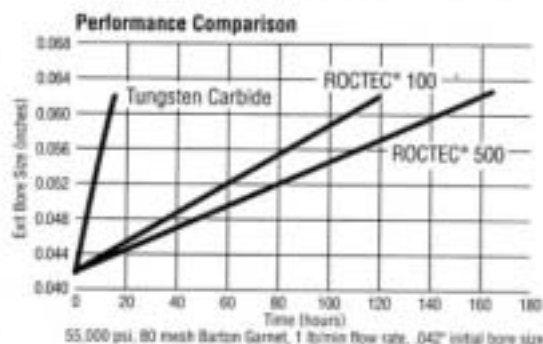
NLB, a leader in high-pressure waterjet technology, manufactures a full line of quality waterjet systems and accessories for many uses, including surface preparation, paint booth cleaning, tank cleaning, descaling, concrete demolition, concrete and pipe cutting, and more.

For more information, contact Giles Ziolkowski, (248)624-555.

WaterArmor™ and TurtleSkin® are trademarks of Warwick Mills. KEVLAR® is a trademark of DuPont.

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New ROCTEC® 500 AWJ nozzles set an even higher standard for nozzle performance and overall AWJ system efficiency. While original ROCTEC 100 AWJ nozzles outlast tungsten carbide 10 to 20 times, ROCTEC 500 nozzles increase service life approximately 30% over ROCTEC 100 nozzles. And that means lowest total cutting costs per inch by increasing average cutting speed, reducing system downtime for nozzle changeouts, and maintaining cutting precision, predictability, and consistency.

ROCTEC 500 AWJ nozzles are available exclusively from your abrasive waterjet equipment manufacturer. Or for more information, contact Boride Products, 2879 Aero Park Drive, Traverse City, MI 49686. Phone: 1-800-662-2131 (U.S. only) or 1-616-946-2100. Fax: 1-800-662-2132 (U.S. only) or 1-616-946-3025.

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Eight Easy Ways To Attend The 1999 Waterjet Conference

1. **FULL CONFERENCE**

Includes admission to all technical, scientific and contractor sessions (except preconference workshops on Saturday, August 14), pass to Welcoming Reception in Exhibit Hall (Saturday, August 14), exhibits and sponsored luncheon on Sunday, August 15, and Monday, August 16, coffee breaks, WJTA Party on Monday, August 16, and technical tour and demonstration. **Each full registration also receives one copy of the Conference Proceedings, including CD-ROM.**

2. **COMBO**

Includes everything listed under Full Conference **PLUS** your choice of preconference workshops on Saturday, August 14.

3. **SAVE \$ ON MULTIPLE EMPLOYEE FULL/COMBO REGISTRATIONS**

Companies that purchase three or more full or combo registrations receive a special discount for each additional employee registered after the first two. To take advantage of the special discount, register the first two (2) employees from your company at the regular FULL/COMBO rates and receive the discounted rate for the third and subsequent employee registrations.

4. **DAILY ATTENDANCE**

Includes admission to all technical and scientific sessions, exhibit hall, coffee breaks, and sponsored luncheon on that day. Register for one day and receive a 50% off coupon for the 1999 Conference Proceedings, including CD-ROM. Register for two days and the Proceedings are included. **NOTE:** Admission to the WJTA Party on Monday is **NOT** included in the daily registration fee, and tickets for this event must be purchased separately.

5. **PRECONFERENCE WORKSHOPS**

- **Waterjet Short Course**
- **WJTA Recommended Practices (Safety) Seminar**
- **Advanced Topics in Surface Preparation**

Includes handout materials for workshop selected, coffee breaks, luncheon, and August 14 Welcoming Reception in Exhibit Hall.

6. **EXHIBIT HALL PASS**

See waterjet equipment, supplies, and services on display. Pass includes exhibit hall admission (9:30 a.m.-5:00 p.m.) and sponsored luncheon on Sunday and contractor's program, exhibit hall admission (9:30 a.m.-2:30 p.m.) and sponsored luncheon on Monday. Does **NOT** include Welcoming Reception in Exhibit Hall on Saturday, August 14.

7. **TECHNICAL TOUR**

Includes round-trip bus transportation, luncheon, and admission to several company sites where you'll see live waterjet demonstrations.

NOTE: Cameras are not permitted on technical tour.

8. **STUDENTS**

The registration fee for WJTA student members is \$20. Student registration includes admittance to technical programs and the technical tour, but does **NOT** include copies of books, Welcoming Reception in Exhibit Hall on Saturday, August 14, or admittance to any food/social functions. **NO** discount is available for students that are not members of the WJTA. WJTA student members must be enrolled full-time in a university graduate or undergraduate program.

CANCELLATION POLICY

Fees will be refunded in full for cancellations received at least four weeks prior to the Conference. Cancellations received more than 10 days and less than four weeks prior to the Conference will be subject to a \$50 charge. No refund will be made for cancellations received less than 10 days prior to the Conference. However, substitutions may be made at anytime.

Discounts for WJTA members and early-bird registrants!

WJTA members receive a special discount off the regular registration fees. You will also receive an additional discount if your registration is postmarked or received in the WJTA office by **August 2, 1999.**

WaterJet Technology Association

Telephone: (314)241-1445, Fax: (314)241-1449, Website: www.wjta.org

It's not too early to make hotel reservations for the 10th American Waterjet Conference to be held August 14-17, 1999, at the JW Marriott Hotel in Houston, Texas. The room rate is \$99 single/double occupancy. For room reservations call the JW Marriott at (713)961-1500. Be sure to identify yourself as a participant in the WJTA Conference.

1999 WJTA Conference Registration Form

Name _____ Title _____
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number at: (314)241-
1449.

By Mail: Fill out the
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payment to: **WJTA,**
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Eight Ways To Register

- ☐ **Full Conference ONLY** \$ 495 \$ 525 \$ 545 \$ 575 = \$ _____
- ☐ **Combo** (Full Conference PLUS Preconference Seminar) \$ 665 \$ 695 \$ 715 \$ 745 = \$ _____
- Specify preconference seminar:
☐ Short Course ☐ Safety ☐ Surface Prep
- ☐ **Daily**
- ☐ **Saturday** (includes lunch) \$ 295 \$ 310 \$ 345 \$ 360 = \$ _____
- Specify: ☐ Short Course ☐ Safety ☐ Surface Prep
- ☐ **Sunday** (includes Luncheon in Exhibit Hall) \$ 220 \$ 235 \$ 235 \$ 250 = \$ _____
- ☐ **Monday** (includes Luncheon in Exhibit Hall) \$ 220 \$ 235 \$ 235 \$ 250 = \$ _____
- ☐ **Tuesday, Technical Tour** (includes lunch) \$ 100 \$ 110 \$ 110 \$ 120 = \$ _____
- ☐ **Exhibit Hall Pass Sunday/Monday ONLY** \$ 20 \$ 20 \$ 20 \$ 20 = \$ _____
- Does not include Welcoming Reception on 8/14
- ☐ **Student** (WJTA members ONLY) \$ 20 \$ 20 N/A N/A = \$ _____

MULTIPLE CORPORATE REGISTRATIONS (Applies to third and subsequent registrants from same company)

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- ☐ **Combo** (Full Conference PLUS Preconference Seminar) \$ 590 \$ 620 \$ 640 \$ 670 = \$ _____
- Specify: ☐ Short Course ☐ Safety ☐ Surface Prep

WJTA MEMBERSHIP ☐ \$50 Individual membership ☐ \$20 Student membership ☐ \$350 Corporate membership = \$ _____

☐ **Conference Proceedings** Copies x \$99.00 = \$ _____

1999 WJTA Conference registrants may purchase extra copies of the Conference Proceedings (two-volume soft cover Proceedings and CD-ROM) for only \$99. Regularly priced at \$155, you will SAVE \$56. Offer valid through 8/31/99.

SPECIAL OFFER!

EXTRA TICKETS — The Full and Combo registrations include one ticket per registration for the Exhibit Hall Luncheons (Sunday and Monday) and Awards Presentation/Party (Monday evening). Each Daily registration includes a luncheon ticket for the day registered: Saturday, Sunday, Monday and/or Tuesday. Additional tickets may be purchased as follows:

- ☐ **Welcoming Reception** \$ 50 \$ 50 \$ 50 \$ 50 = \$ _____
- ☐ **WJTA Awards Presentation/Party** \$ 65 \$ 70 \$ 65 \$ 70 = \$ _____

*Non-WJTA members who are members of the International Society of Waterjet Technology are permitted a 5% discount off nonmember registration fees.

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2 inch mild steel, separation cut

Brand	Delivered Price	IPM	Cost Per Inch
PASER Plus	\$.27 lb.	2.5	\$1.53
Sandblasting Brand 1	\$.20 lb.	2.0	\$1.62
Sandblasting Brand 2	\$.20 lb.	1.9	\$1.62

For complete details on pricing and regional warehouses, please see reverse side.

FLOW guarantees your **complete satisfaction** with PASER Plus. Try a ton of PASER Plus at FLOW's special first-time order price of 15% off list price. If you are not completely satisfied with the product, FLOW will refund your money.

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Call FLOW customer service with the name of an abrasivejet shop in your area that's not using PASER Plus Garnet and **receive 10% off** your next garnet order. Also, FLOW will reward you with a \$300 spare part credit if the user signs an annual contract for PASER Plus.



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Price of Garnet by Mesh Size

Mesh Size	1-9 Ton Price	10-19 Ton Price	20 Ton Price
50 Mesh	\$.23 lb.	\$.21 lb.	\$.20 lb.
80 Mesh	\$.27 lb.	\$.24 lb.	\$.23 lb.
120 Mesh	\$.30 lb.	\$.27 lb.	\$.26 lb.

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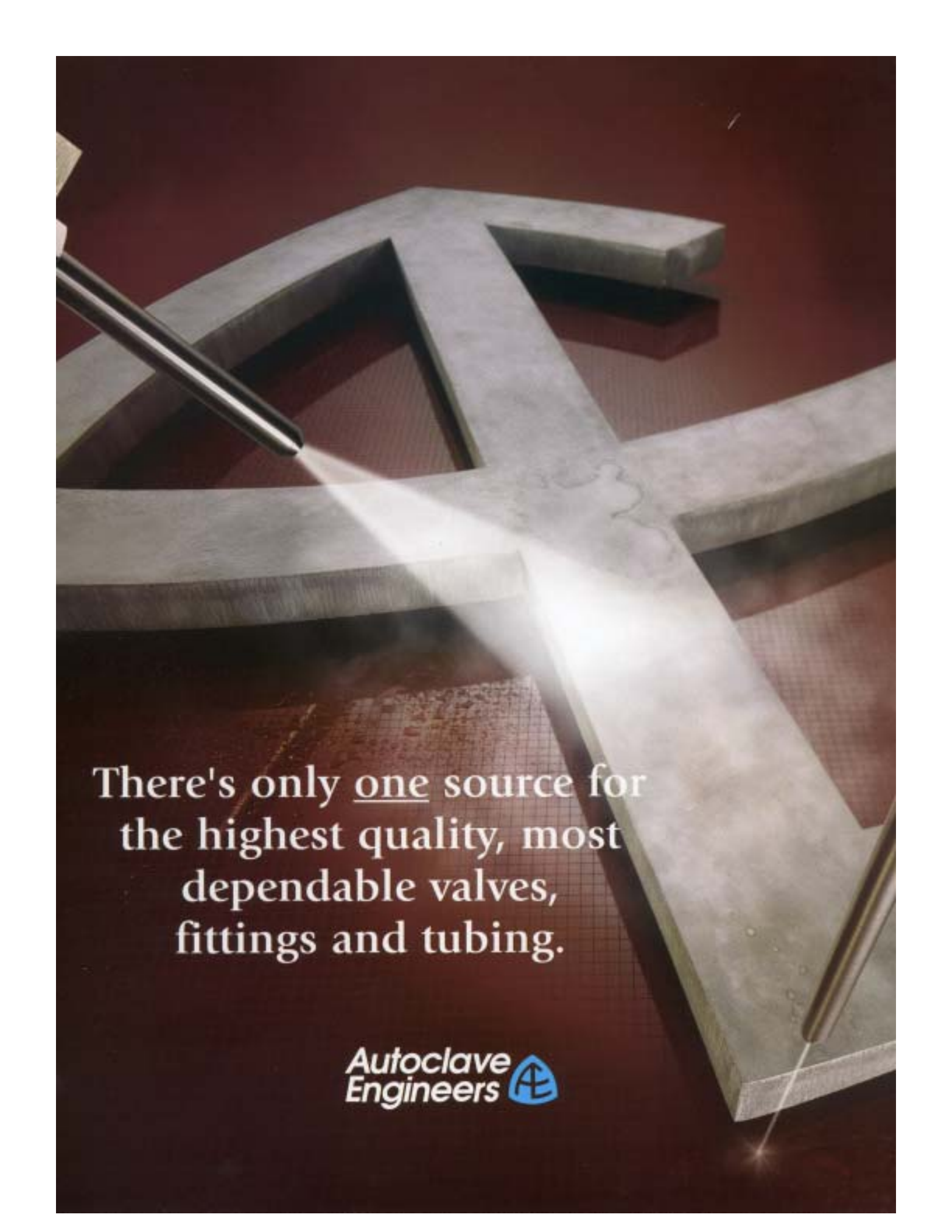
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A large, complex industrial valve is shown in a dark, industrial setting. A bright, intense flame from a welding torch is focused on a joint of the valve, creating a strong contrast with the dark background. The valve's structure is made of heavy metal, with various flanges and connecting pipes visible. The lighting highlights the texture of the metal and the precision of the welding process.

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