



## Waterjets Open Clogged Blood Vessels

**AngioJet®**  
Rapid Thrombectomy System

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REMOVES THROMBUS  
IN JUST MINUTES

**P**ossis Medical, Inc. of Minneapolis, Minnesota has devised and is marketing a non-surgical system for rapidly removing clots from blood vessels. It is a catheter which is introduced into the body using a standard vascular access approach and delivered to the diseased vessel over a guidewire.

Once at the site of the clot, the AngioJet® System employs a jet pump which passes about 50cc of pressurized saline at 2,500 psi through tiny high velocity jets. These jets create a low pressure region around the catheter tip. The difference between this low pressure at the catheter tip and the higher pressure present in the blood vessel creates a 360 degree suction force of about 860mm Hg which draws the thrombus material into the jet pump. Once in the jet pump, the clot

(continued on page 10)

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*See flier enclosed...*

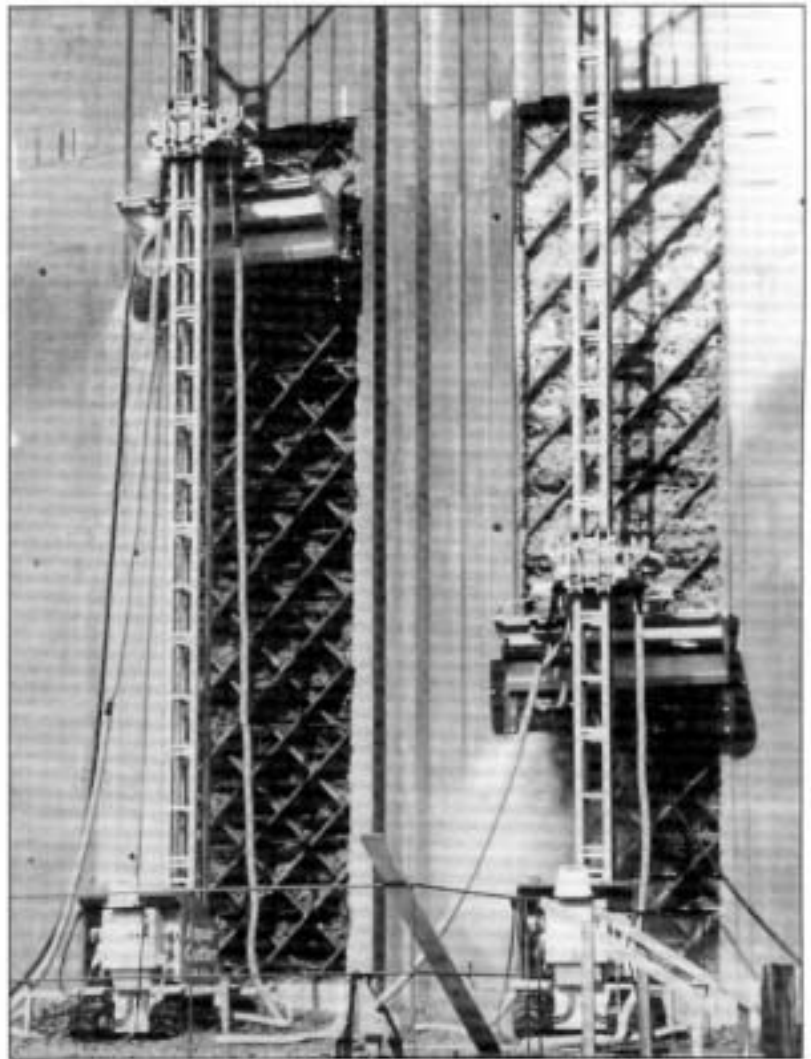
## Hydrodemolition At A Nuclear Power Plant In Almaraz, Spain

**T**he Steam Generators Replacement Project of the C.N. Almaraz Nuclear Power Plant, designed and fulfilled by C.N. Almaraz and CONBEG (Consortium Constituted by Bechtel, Entrecanales and Gestec), required an opening in the containment building wall of the two units of the plant to allow the withdrawal and the introduction of the steam generators and the vessel head. The wall, 1.4 meters thick, is built with eight layers of 57.3 millimeters (#18) rebar, concrete of 400 kilograms/centimeter<sup>2</sup> (5690 psi) of compressive strength and a 10 millimeter (3/8 inch) thick metallic liner-plate on the inner side of the wall, fixed with Nelson studs. The dimensions for the opening to allow movement of the steam generators, are 7.60 x 8.20 meters (24.93 x 26.9 feet), located at a level of 14.60 (48 feet) in the containment building. It was, therefore, necessary to erect a working platform 12 meters (39 feet) above the ground level from which the movement of the above equipment could be accomplished.

The opening and later closure of the containment building to obtain the original configuration, using the same materials that in the construction were used, lies directly on the critical path of the project. So the correct achievement of this activity was essential in the project realization.

After studies in great detail of several known techniques for removal or demolition of huge concrete blocks, highly reinforced, and after diverse trials performed with mock-ups, some in full size, the decision to use the hydrodemolition system was taken. This decision takes into account the great advantages that this method brings, like the total absence of noise, the resultant debris size and the low incidence of the equipment weight on

(continued on page 13)



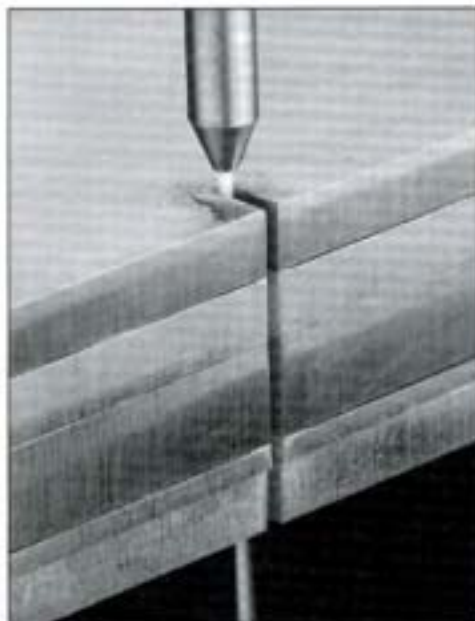
Hydrodemolition in the wall of a containment building at the nuclear power plant at Almaraz, Spain.



# Why Not Waterjet?

Waterjet cutting has carved a legitimate niche in material fabrication. This article looks at the process with an eye toward how waterjet can work for your shop.

By J.A. Schmidlin  
Waterjet Connection  
Richel, Incorporated



Photograph courtesy of Jet Edge.

**Manufacturing** is always looking for ways to lower its costs and increase its throughput while maintaining quality. The drivers for these continuous improvements come from customers who are themselves driven by market forces beyond their control. The impact is a general and universal acceleration of the manufacturing process—from design to delivery—across the manufacturing landscape.

In response, shops of all types are looking for ways to satisfy these customer-driven demands. For metalcutting shops, the search often takes them beyond the realm of what many consider traditional metalcutting technology.

Abrasive waterjet technology is one of the newer cutting systems available in today's market. It is quick, flexible and effective in meeting a wide variety of challenges among manufacturers. Years of development have resulted in improved wearability and control technology, making waterjet cutting systems competitive with other cutting methods.

## Materials and Capabilities

The list of materials that a waterjet system will penetrate is significant. To date, applications have been used with foam, G10 phenolic, steel, armor plating, urethane, titanium, Kevlar, aluminum, linen phenolic, brass, neoprene, copper, stainless steel, spectra, fiberglass, corrugated cardboard, acrylic, ceramic tile, wood, rubber, glass, marble and granite.

Waterjet systems are also an attractive alternative to surface preparation. They strike a surface with such impact that coatings are instantly removed without the side effects of noxious dust that other methods may create.

The advantage of a waterjet cutting system is not limited to the wide variety of materials through which it cuts. Its effectiveness comes not only from what it does, but also from what

it does not do. Waterjet systems are an ideal process solution for cutting materials that are heat sensitive. Because it produces no HAZ (heat affected zone), waterjet is a candidate for applications where thermal induced micro-fractures or distortions are unacceptable. Waterjet's relatively cool cutting makes it temper neutral. Its cutting action will neither harden nor anneal an application material.

Environmental concerns related to the cutting of hazardous materials such as asbestos and fiberglass are reduced through the use of a waterjet cutting system. Airborne contaminants and fumes are significantly reduced or eliminated.

(continued on page 4)

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## Why Not Waterjet, from pg. 3

The erosion process of abrasive waterjet cutting creates no burring or rough edges. Often the necessity of additional finishing operations is eliminated.

There are no start holes created and parts can be optimally placed to fully utilize a piece of material. It also eliminates the distortion from compression that is created by traditional die cutting methods.

### Applications

The spectrum of applications for waterjet cutting ranges from the delicate to the stubborn. U.S. Food and Drug Administration regulations allow the use of waterjet technology in cutting food items such as cakes, french fries, steak, poultry and fish. Waterjets have proven themselves as both efficient and sanitary. On the other extreme, abrasive waterjet systems (AWJ) bombard armor plating used in the assembly of M1 tanks and Bradley fighting vehicles. In between lies a wide spectrum of other applications. Artists, interior designers and shipbuilders are among the many who are embracing waterjet technology. Industries such as paper, textile, aeronautics and steel are routinely incorporating the technology into their manufacturing processes.

Thin, delicate rubber gaskets, previously cut by hand, are rapidly produced under the auspices of a waterjet.

Metal fabricating has been quick to reap the benefits of waterjet technology. In an arena fraught with the woes of heat affected zones, burring, excessive fixturing and tooling requirements, increased costs due to excessive kerf with a lack of nesting capability, waterjet technology shows its true colors.

### Waterjet Technology Versus Alternatives

Not all cutting methods are created

equal. Traditional methods such as punching and plasma cutting will retain

(continued on page 6)

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## Why Not Waterjet, from pg. 4

a place in the metal shop. They remain an economical method for certain applications.

These traditional methods, however, cannot compete with waterjet technology in several critical areas. Kerf width is a serious consideration when cutting expensive materials such as titanium, alloy steel, Inconel alloy and Hastalloy. Reduced kerf width allows parts to be positioned closer

together resulting in a net savings on materials. Other savings result from the nesting capability, which is an integral part of waterjet technology not normally associated with traditional cutting methods. Parts and pieces can be placed within unused space on the metal plate and bars. Material that would have been wasted if cut by traditional methods, is profitably used by waterjet technology.

Waterjet cutting expends minimal force upon the material being cut. The result is a significant reduction in fixturing (it is recommended that an operator still provide a limited amount of fixturing as a safety precaution).

The force exerted by traditional methods can be excessive and require extensive time in fixturing. That same force may cause compression in some materials, reducing the precision of the cut. In other applications, the force causes the material to shift, thereby reducing the accuracy of the cutting medium. A waterjet does not move the material and can be relied upon to produce the same cut time after time.

Quite often, the contenders in the duel between cutting methods are reduced to laser cutting and waterjet cutting. Pitted against each other, it becomes an issue of time and the quality of the edge cut. Figure 1 depicts the quality of the edge cut provided by an abrasive waterjet. Quality can range from minimal (Q=1) to excellent (Q=5). The quality is dependent upon the feed rate. Thinner materials can be fed faster than thicker materials and still achieve a high quality edge cut. Thicker materials can also achieve the same high quality edges, but the feed rate will be reduced.

Speed is certainly a concern in the high paced workplace. Normally there are significant reductions in cutting

times with the use of an abrasive waterjet and there are instances where lasers retain an advantage.

### Taking The Plunge

Change. We cannot ignore it, and we can only attempt to keep up with it. Materials and methods previously relegated to the traditional cutting methods are being sliced, diced and packaged using waterjet technology.

To help shops take advantage of waterjet technology, service centers have been formed to allow shops to determine the viability of waterjet processing before making the necessary capital investment.

Richel Inc. is set up to provide training for shops looking to take on the waterjet process. That training includes new process techniques and applications for waterjet cutting. Richel also provides a means for shops to share their knowledge.

As with most commercial technology, waterjet cutting services are only as good as the provider. A variety of parameters are configured for each project. Optimum type and flow of abrasive is determined. The orifice size, which regulates the volume of water flowing through the nozzle, needs to be set and decisions must be made regarding the height placement of the nozzle above the part. Determination of travel rates and resultant edge quality are critical.

Manufacturers of waterjet systems provide recommendations and databases for the parameters required in a variety of applications. However, a certain union of art and technology is what truly generates a quality product. The technicians bring to each project a certain expertise and experience.

(continued on page 12)

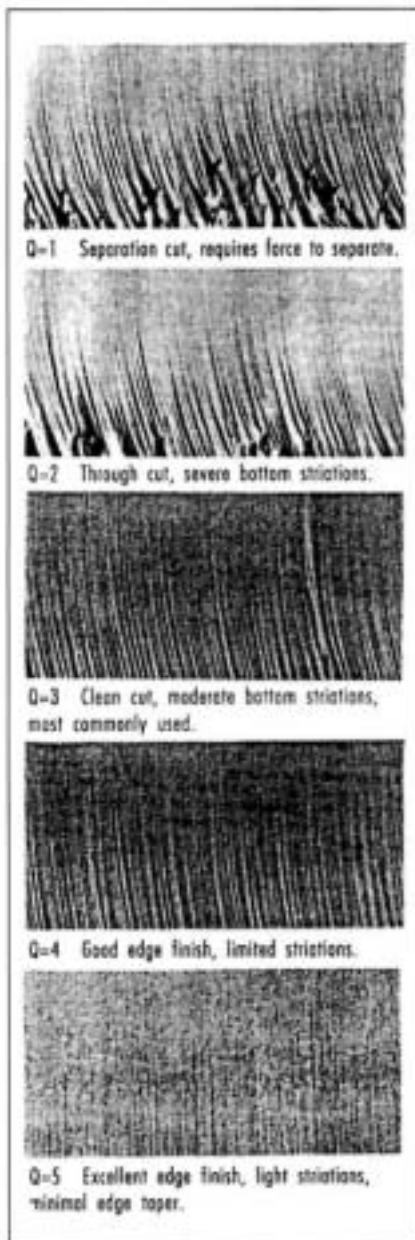


Fig. 1—These illustrations show the edge qualities of waterjet cutting.



# New Equipment, Products, Developments

## New Catalog Details High Pressure Products

High Pressure Equipment Company's new 112-page loose leaf catalog covers their complete line of pressure valves, fittings, tubing, accessories, tooling, pressure vessels, reactors, pumping systems, intensifiers, gas boosters, and pressure generators. Valve, fitting and tubing products within the catalog are grouped by pressure classes to assist users in identifying all the components necessary to plumb a complete fluid system.



HPE Catalog

This new catalog includes a quick selector guide for both the valve and reactor product lines, features, dimensional drawings, pressure ratings, connection details, and applicable performance information for all of the products, and a 16-page price list.

Complementing the product data is a technical information section structured to assist designers in properly using these high pressure products. The technical information includes conversion tables, flow

coefficients, pressure ratings for bolted closure reactors, recommended torque values, and minimum bend radius for high pressure tubing.

For more information, contact High Pressure Equipment Company, P.O. Box 8248, 1222 Linden Avenue, Erie, PA 16505, phone: (814)838-2028, fax: (814)838-6075 or e-mail: [sales@highpressure.com](mailto:sales@highpressure.com).

## Jet Edge Introduces 55-100 Intensifier Pump And Abrasive Cutting Head

Jet Edge continues to expand its line of 55,000 psi (3800 bar) ultra-high pressure (UHP) waterjet equipment for cutting virtually any metallic or non-metallic material.

The newest addition is the Model 55-100 Intensifier Pump featuring a patented intensifier design combined with a TUV certified attenuator, complying with ASME pressure vessel standards, to minimize pressure fluctuations. A 100-horsepower motor drives an axial piston, variable displacement, pressure-compensated type hydraulic pump.

The hydraulic system uses electronically shifted, plunger-style intensifiers to deliver 2.0 gallons (7.6 liters) per minute of 55,000 psi water flow to a variety of cutting or cleaning tools. The high efficiency, totally enclosed, fan cooled (TEFC) electric motor with wye-delta "soft start" ensure high reliability, long service life and minimal energy usage. A programmable logic controller (PLC) monitors and controls all machine functions, and automatically energizes relays to light the warning lamps in the event of potentially damaging conditions. The integrated water filter

and booster system eliminate connections between other filtration systems.

The Jet Edge Model 55-100—like other UHP intensifier pumps in this expanding line—offers complete flexibility for waterjet cutting, cleaning or coating removal applications.

Jet Edge has also introduced the next generation of the Permalign® Abrasive Cutting Head. The revolutionary new Permalign II Abrasive Cutting Head is a lightweight compact and versatile solution for your abrasivejet cutting needs.



Permalign® Abrasive Cutting Head

This "patent pending" design reduce the total number of components thereby minimizing overall maintenance and operational costs. Extensive in-house and Beta Site testing indicate that the consistent water stream/abrasive nozzle alignment of this new cutting head offers improved abrasivejet cutting quality, tighter cutting tolerances, and longer component life.

The Jet Edge Permalign II Abrasive Cutting Head achieves ultimate

(continued on page 11)

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Fax: (501)474-0498

#### John Swapp

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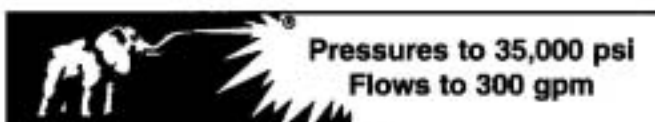
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Fax: (401)782-1066

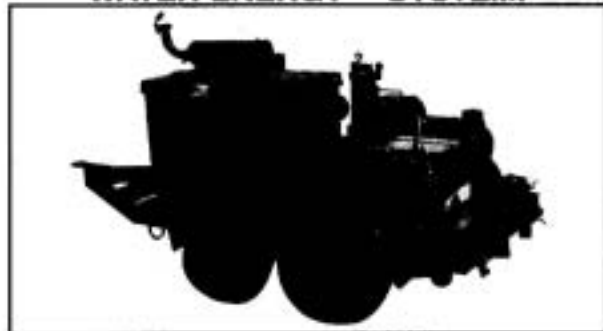
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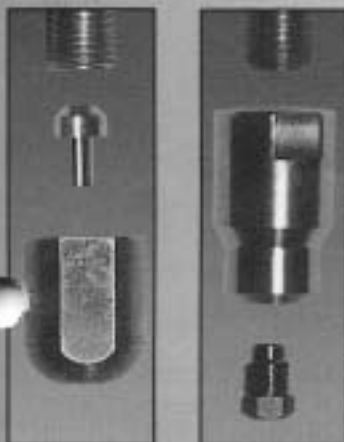
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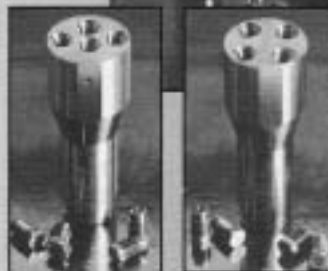
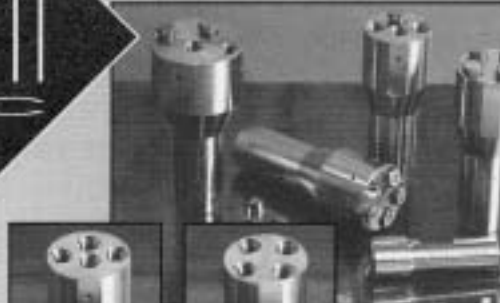
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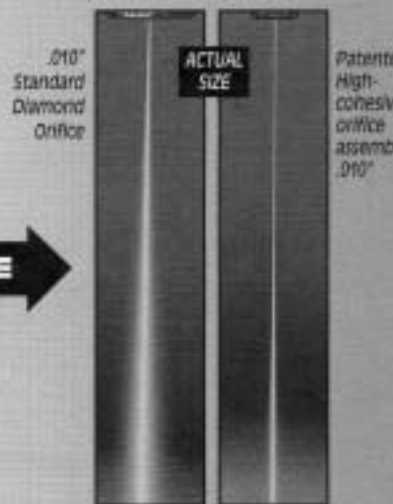
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## Waterjets Open Clogged Blood Vessels, from page 1

material is entrained into the flowing jet and broken into microscopic fragments. The effluent, made up of the saline and entrained clot material, is drawn out of the patient's body into a disposable collection bag.

The normal procedure time is only about five minutes. Clot removal by the AngioJet System has been

successful for blood vessels as large as 8 millimeters and thrombus as long as 40 centimeters. The system has been successfully used to remove thrombus in peripheral, coronary and neurovascular applications.

Possis Medical Inc. received U.S. Food and Drug Administration (FDA) clearance to market the AngioJet

System in December 1996. In addition, the company has operations in Europe and has treated over 2,000 patients on a worldwide basis. These AngioJet procedures have been done in almost every blood conduit...including treating a patient suffering a stroke.

*See photos on pages 14 and 16*

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— Advertisement —

## New Equipment, Products, Developments, from pg. 7

performance and reliability for abrasivejet cutting.

For further information, contact Jet Edge, 825 Rhode Island Avenue South, Minneapolis, MN 55426, telephone: (612)545-1477, fax: (612)545-5670.

### LAI Expands Customer Service Efforts In New England

LAI Companies, Inc. is expanding its customer service efforts in New England by basing a new sales engineer in the Boston area.

The company uses laser and abrasive waterjet technologies to process metals, composites and other materials.

Paula Bush, who has 20 years of industrial sales experience, will head up the New England office, which services six states: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island and Vermont. She can be reached at (508)688-0700.

The new sales office is part of a company-wide expansion, said Robert Ulrich, president of LAI. The company expanded its Midwest facility in Minneapolis last month and plans to increase the size of its main plant near Baltimore, MD. The company recently opened a new facility in Phoenix.

"This expansion will allow us to keep up with the rapid growth in aerospace and other industries," Ulrich said.

Laser Applications Inc.—with 12 laser and 16 waterjet stations—provides laser and waterjet job-shop processing in the United States. The company manufactures parts and equipment for aviation, automotive,

computer, transportation, medical and heavy manufacturing industries.

For more information, contact LAI Companies, Inc., 7645 Baker Street NE, Minneapolis, MN 55432, phone: (612)780-0060, fax: (612)784-4740, e-mail: lai@abrasivewaterjet.com, website: www.abrasivewaterjet.com.

### NLB Corporation Introduces New Equipment

New aluminum telescopic lances from NLB Corporation make it easier to position waterjet cleaning heads inside tanks because they weigh about 80 percent less than stainless steel telescoping lances.

NLB's TL-3 series lances are available in seven standard models, for use in tanks ranging from 10 feet (3 meters) to 24.5 feet (7.5 meters) high. The shortest extends from 23.6 inches to 101.4 inches (60 centimeters to 2.8 meters), and the longest from 72.2 inches to 255.9 inches (184 centimeters to 6.5 meters). Each is designed to insert an NLB 3750 3-dimensional cleaning head into a tank or reactor, where it can be positioned to direct high-pressure waterjets to thoroughly clean all interior surfaces.

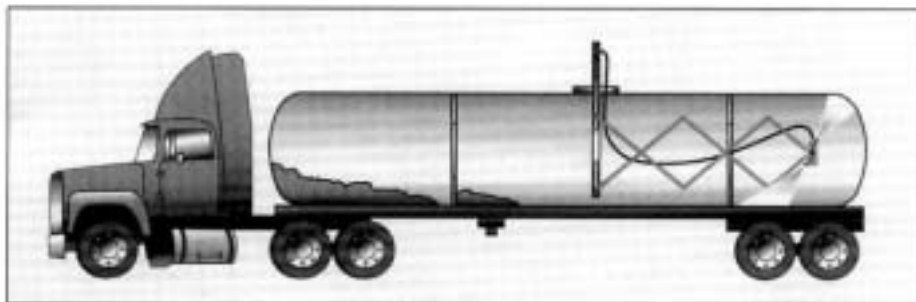
The lightweight aluminum construction makes it especially easy to maneuver the telescoping lance and



cleaning head around obstacles in a tank, using two exterior hand wheels. The lances also withstand rough handling and corrosive conditions. (While high-pressure waterjetting uses no caustics or corrosives, they are often found in the working environments where tank cleaning is performed.)

NLB's new nozzle placement system, the SpanJet™, makes it easy to clean tank trailer and rail car interiors by directing high-pressure waterjets into hard-to-reach areas. Equipped with an NLB 3750 3-D tank cleaning head, the SpanJet cleans vertical and horizontal tanks with equal effectiveness. It collapses for entry, then expands to a maximum length of 22 feet.

(continued on page 14)



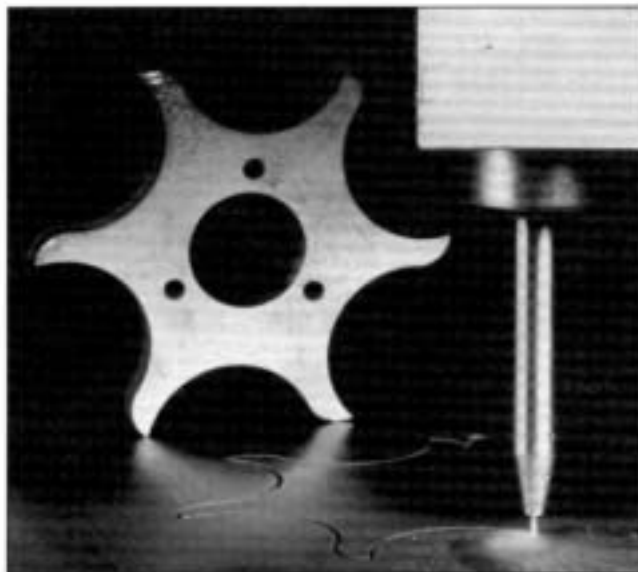
NLB SpanJet™ in tank trailer



## Why Not Waterjet, from pg. 6

For more information, contact the Waterjet Con-nection at (330)633-7698, fax (330)633-7670 or e-mail to [richel@ix.netcom.com](mailto:richel@ix.netcom.com).

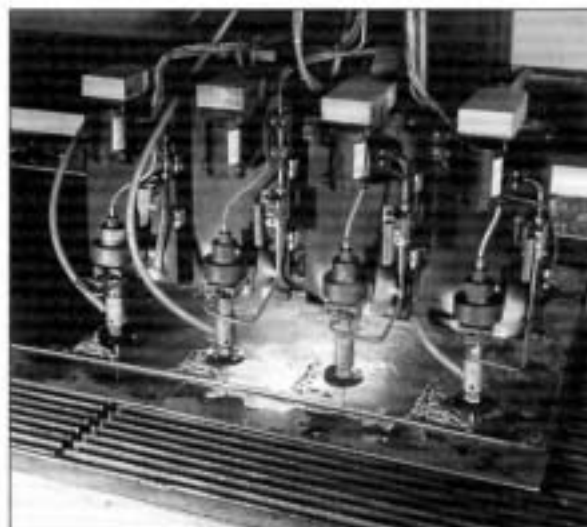
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Narrow kerf allows close nesting of work-pieces. A clean edge and no heat affected zone are process pluses for waterjet technology. Photo courtesy of Ingersoll Rand.



Abrasive waterjet cutting is not a light duty process. As shown here, the depth of cut in steel is significant. Photo courtesy of Flow International.



A production setup is shown in this photo. This system uses a 150-hp water pump that generates output pressures of 55,000 psi at the four heads. The worktable is 12 by 13 feet. Photo courtesy of Jet Edge.

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### Thank You!

Many thanks to the Geneva Tourist Office, Geneva, Switzerland, for providing photographs and background information regarding Lake Geneva's Jet d'Eau that was featured on the cover of the June 1997 *Jet News*.

For more information about Geneva, Switzerland, contact the Geneva Tourist Office, World Trade Center, P.O. Box 596, CH-1215 Geneva 15, Switzerland; phone: +41(22)929 7000; fax: +41(22)929 7011; internet: <http://www.geneva-tourism.ch>; e-mail: [info@geneva-tourism.ch](mailto:info@geneva-tourism.ch)

## Hydrodemolition At A Nuclear Power Plant, from page 2

the platform. However the main difference with the other considered methods is that the hydrodemolition does not affect the structural integrity of the containment building. That is the reason of fundamental importance for the project. The method permits, also, reuse of the existing rebar and liner-plate. All the previous considerations and the acceptable efficiency obtained in the trials resulted in the selection of the hydrodemolition system as the most suitable to achieve the goals that would determine the best course of the project.

The opening works in the wall were started at the plant shut down and concluded at the moment the equipment was ready to be withdrawn.

During the wall opening two PP-600 and one PP-480 and three Robot HV-550 were available. All hydrodemolition equipment was delivered from Aquajet Systems AB in Sweden. The working pressure of the equipment was approximately 1000 Bar (14500

psi) with a water flow rate of 14.5 meters<sup>3</sup> per hour (512 feet<sup>3</sup> per hour). The water was clarified by the plant itself.

Once the location of the opening was marked on the wall and the three machines located, the several phases of the work to be carried out commenced. Each of these phases consisted of removing the concrete with hydrodemolition and uncovering the difference rebar layers. Once uncovered, the rebar was cut and removed. This process was repeated until all the concrete was removed. Then the liner-plate was cut and removed for its later re-utilization. At this point, with effectiveness better than was scheduled, the opening in a nuclear power plant containment building was achieved for the very first time in the world, using the hydrodemolition system, which permitted the plant steam generator replacement with total success.

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## New Equipment, Products, Developments, from pg. 11

The SpanJet system lets users harness the power of high-pressure waterjetting (up to 13,000 psi) to clean a tank's interior up to 15 times faster than manual methods. No chemicals or solvents are needed, and personnel remain safely outside the tank.

The system mounts to a manway opening 18 inches to 21.5 inches in diameter, using an adapter provided by NLB. Expansion and retraction is hydraulically controlled, and NLB can also supply a hydraulic power pack. The motion is easily reversible. The arm is strong enough to support up to 100 pounds when extended, although this is not necessary for waterjet cleaning.

NLB's new, hydraulically-cushioned waterjet by-pass valve is designed to provide easier, more precise pressure adjustment for high-pressure waterjet pumps. The new valve lasts longer

than previous models and simplifies maintenance. The BV10-400 has a working pressure of up to 10,000 psi, with a maximum flow rating of 40 gallons per minute.

Adjusting pump pressure is easily accomplished without tools: the operator merely turns a T-bar, much like adjusting a faucet. Traditional by-pass valves require a wrench for adjustment, which in turn requires a pipefitter in some plants.

The new BV10-400 valve is now standard on all NLB pumps using engines of up to 200 horsepower. All major components are made of stainless steel to enhance service life.

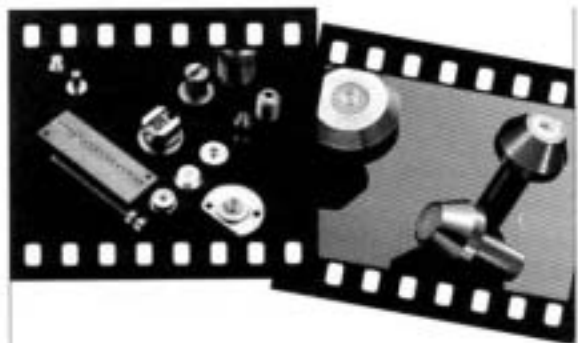
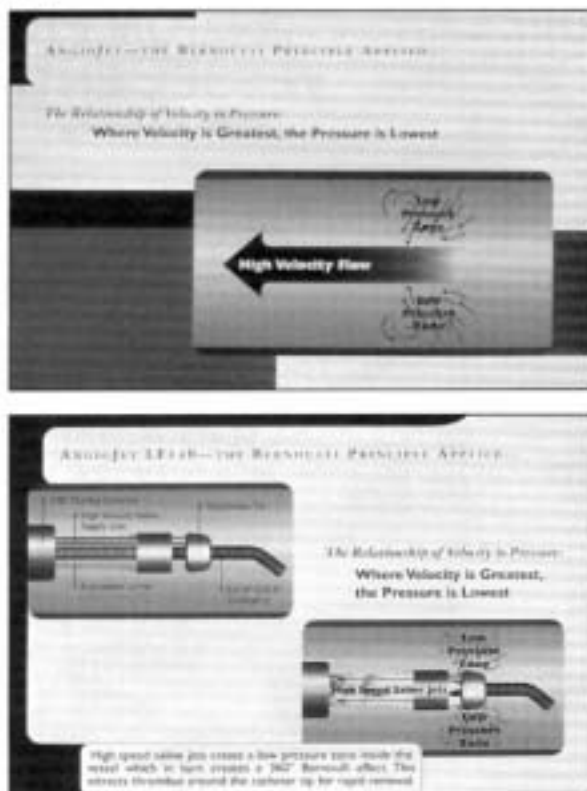


The inlet features a 1-inch NPT thread, while the outlet thread is 1/2-inch NPT (female).

The more information, contact NLB Corporation, 29830 Beck Road, Wixom, Michigan 48393-2824, phone: (810)624-55 fax: (810)624-0908.

## Waterjets Open Clogged Blood Vessels,

from pg. 10



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3. Are you presently a member of any other association within the industry?

- ☐ Yes. Please specify: \_\_\_\_\_
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4. Which committees would you be interested in serving on? Please check all that apply.

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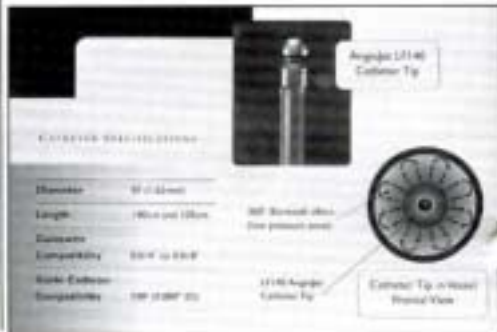
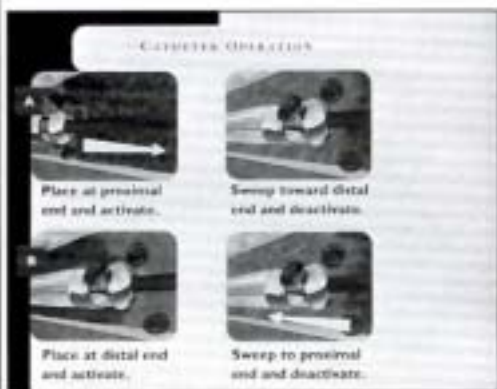
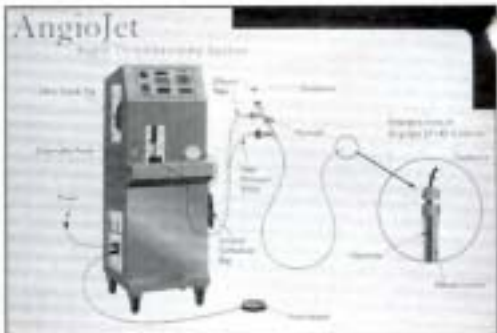
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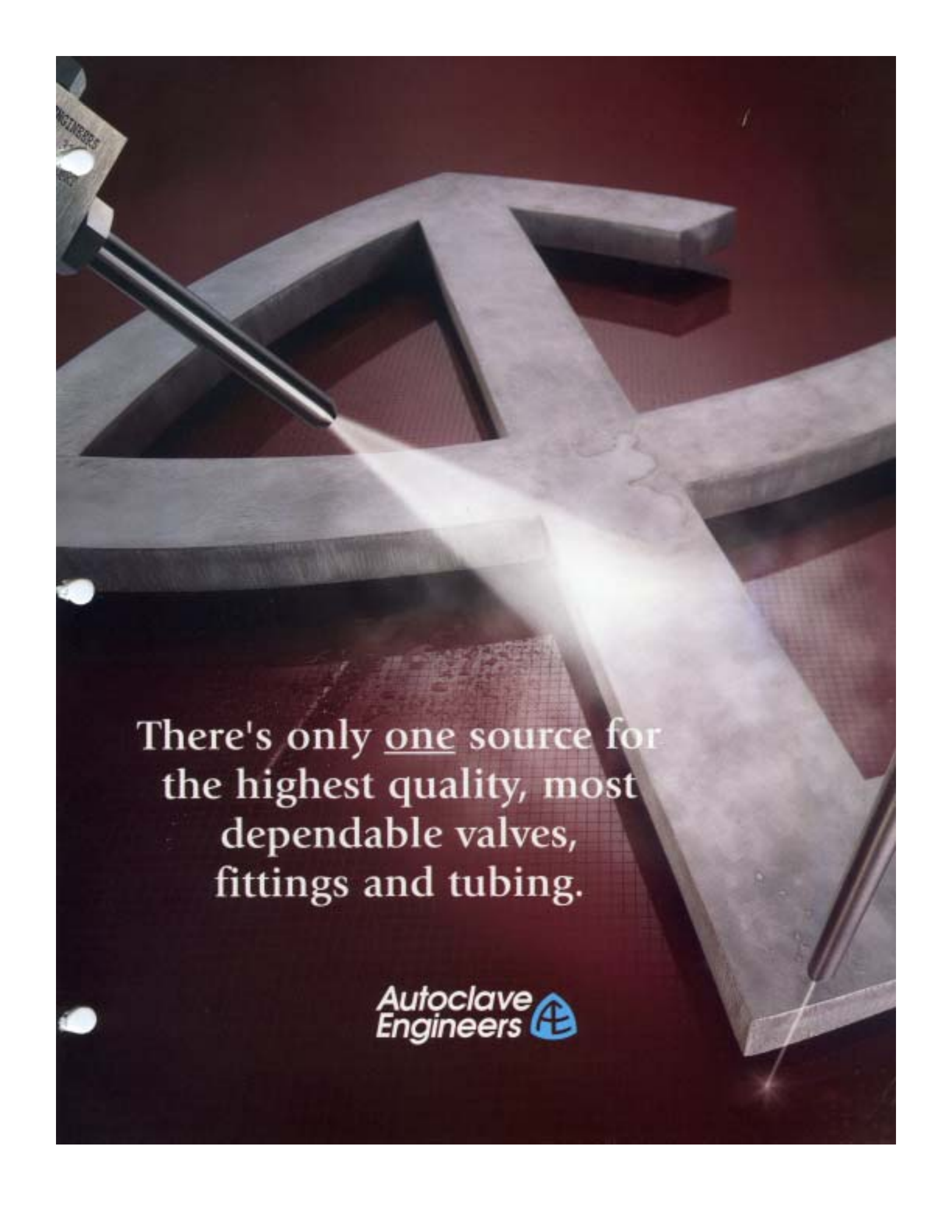
Houston, Texas

### Cleaner Times Magazine

Little Rock, Arkansas

## Waterjets Open Clogged Blood Vessels, from pg. 14



A large, complex metal valve or fitting is shown in the background, with a bright light emanating from a welding torch as it works on the metal. The scene is set against a dark, textured background.

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