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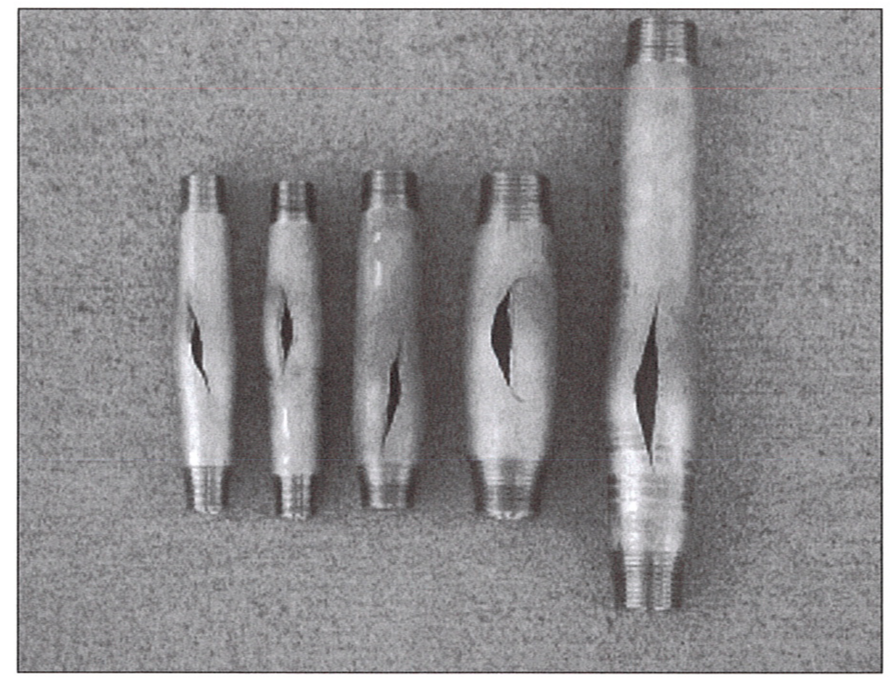
Pipe Threads -What Is The Limit?

By: D. Wright, J. Wolgamott, G. Zink

StoneAge, Inc., Durango, Colorado, U.S.A.



304L schedule 160 seamless stainless steel pipe samples (1/2, 3/4, and 1 NPT tested to burst)

ABSTRACT

At present there is no established guideline in the waterblast industry regarding the maximum operating pressure of tapered pipe thread connections. This paper presents the results of tests to determine the failure point of tapered pipe threads when internally pressurized.

Male pipe threads machined on short sections of pipe with various inside diameters were tested to burst or thread failure in three stainless steel materials. Female pipe couplings in two stainless steel materials and with various outside diameters were also tested to failure. Pipe thread sizes from 1/8 to 1-1/4 NPT were studied. Variables such as the number of threads engaged and the effect of repeated assembly of pipe thread connections were also tested.

Comparisons between actual failure points and the predictions of common equations were made, in an effort to determine the best fit for making calculations. Hopefully, based on these tests and others, a consensus can be reached regarding the use of pipe threads in the waterblast industry.

1. INTRODUCTION

The purpose of this research was to find through testing at what pressures pipe thread connections fail, and to compare the actual values to predicted values to

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On the inside

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Table 1. Thread depth

1/8 NPT	.635 mm (.025 in.)
1/4 NPT	.973 mm (.038 in.)
1/2 NPT	1.288 mm (.0507 in.)
3/4 NPT	1.288 mm (.0507 in.)
1 NPT	1.590 mm (.0626 in.)
1 NPT	1.590 mm (.0626 in.)

determine the best equations for calculating burst pressures. These values in combination with a factor of safety can then be used to determine safe operating pressures for these components.

A factor of safety is used to allow for uncertainty in material properties, geometry and the operating environment. Safety factors can be as high as 20 for structures such as dams, to as low as 1.5 for a commercial aircraft, which would not get off the ground if built like a dam, but must be inspected and maintained regularly. The Waterjet Technology Association has specified a safety factor of 2.5 for components used in a system chosen primarily with weight considerations in mind. This means that once the burst pressure of a component is determined by testing or calculation, this value is divided by 2.5 to determine the operating pressure for that component.

The two equations commonly used for calculating the burst pressure of a cylinder are known as Barlow (equation 1) and Lamé (equation 2).

The Barlow equation is used when the cylinder is considered to be thin walled, because it assumes the stress across the wall is constant. Thin walled is defined by the ratio of the inside diameter/wall being greater than ten. For cylinders with this ratio being less than ten, the Lamé equation should be used, as it allows for decreasing stress values through the wall. All test samples used in these tests had a ratio less than ten.

$$P = 2\,S\,t\,/\,D \qquad (1)$$

$$P = S\,(w^2-1)\,/\,(w^2+1) \qquad (2)$$

Where
P = pressure (burst)
S = tensile strength of material
t = wall thickness
D = outer diameter
w = wall ratio (outer diameter/inner diameter)

The working pressure for the component then becomes P / 2.5 to account for the factor of safety. Variations to these equations account for the reduction of the wall thickness when threads are cut. The thread depth values are shown in Table 1 for each thread size tested. For externally threaded components two times the thread depth is subtracted from the outer diameter, while for internally threaded components two times the

(continued on page 4)

Table 2. Material properties

Material	Yield Strength	Tensile Strength
303 SS	245 MPa (35,000 psi)	630 MPa (90,000 psi)
304L SS pipe	238 MPa (34,000 psi)	595 MPa (85,000 psi)
304A SS bar	277 MPa (39,600 psi)	640 MPa (91,500 psi)
17-4 H900 SS	1190 MPa (170,000 psi)	1330 MPa (190,000 psi)

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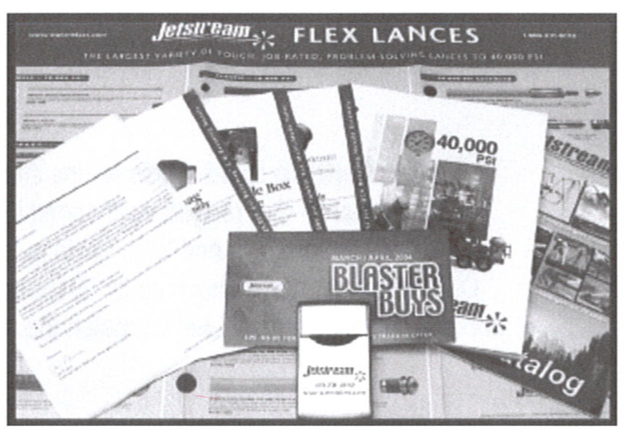

"One of our primary goals is to ensure each new customer is aware of our selection of parts and accessories for Jetstream waterblasters," said Joe Varca, national sales manager. "We feel this packet accomplishes that, and the discount expresses our commitment to their continued business."

Jetstream manufactures industrial high-pressure waterblasting equipment operated at pressures up to 40,000 psi for a wide range of industrial cleaning and surface prep applications. Product offerings include a complete line of skid- and trailer-mounted units, pumps, control guns, valves, hoses, replacement parts and nozzles.

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thread depth is added to the inner diameter.

2.0 TEST PROCEDURE

Two methods of pressurizing the test samples were used; a single stroke intensifier capable of pressures up to 560 MPa (80,000 psi) and a triplex plunger pump capable of pressures up to 280 MPa (40,000 psi). The intensifier was used where possible, except in cases where the test fittings leaked and the intensifier could not produce enough volume to maintain pressure. Some samples did not fail up to 560 MPa (80,000 psi); actual failure points for these are not known.

The male pipe samples were installed in 17-4 stainless steel test fittings with a calculated wall thickness to allow 560 MPa (80,000 psi) without yield. The female pipe couplings were tested with 17-4 stainless steel male threads. All fittings were assembled with Parker Thread Mate and Teflon tape and tightened to five turns of engagement.

Samples made from 303, 304A bar, 304L seamless schedule 160 pipe and 17-4 H900 stainless steel were tested. The properties of these materials are shown in Table 2; these are the values used for all calculations. All threads were machined, with a standard root radius of .15 mm (.006 in.).

3.0 TEST RESULTS

3.1 Male Pipe

Pipe sizes of 1/8, 1/4, 1/2, 3/4, 1, and 1-1/4 NPT were tested. Table 3 lists each test sample by size, material, type of failure and failure pressure.

Solid plugs of each size were made from 304A hot finished bar and tested to determine where thread failure occurred. The 1/8, 1/4 and 1/2 NPT plugs went to 560 MPa (80,000 psi)

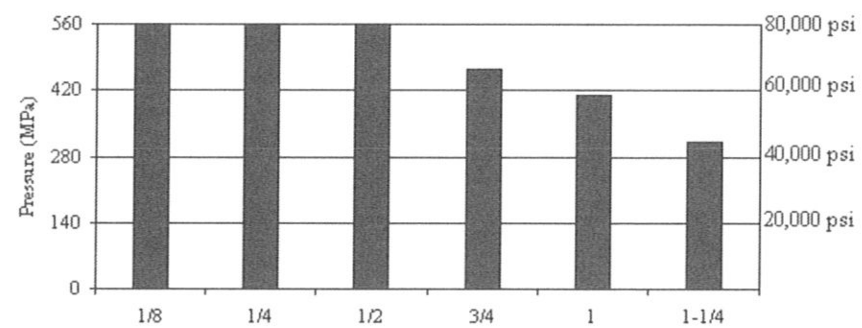

Figure 1. Pipe plug failure pressures, 304 male in 17-4 female

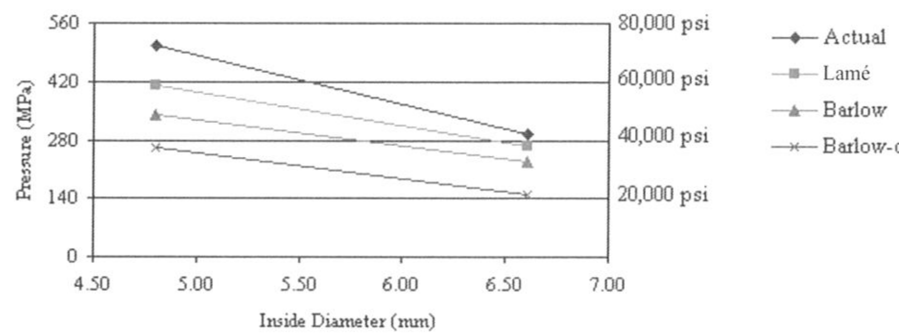

Figure 2. Results of 1/8 NPT 304 samples compared to calculated burst

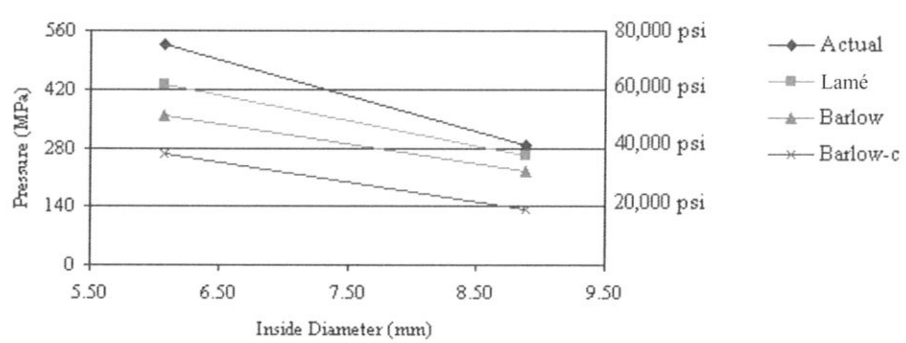

Figure 3. Results of 1/4 NPT 304 samples compared to calculated burst

without failure, the limit of these tests. The 3/4, 1 and 1-1/4 NPT samples failed by shearing of the threads. The results of the plug tests are shown in Figure 1.

Figures 2 and 3 show the results of 1/8 and 1/4 NPT samples, machined from 304A bar, with two different inside diameters. These results are compared to values calculated with the Lamé, Barlow and Barlow with the thread depth allowance (Barlow-c) equations, using the nominal outer and inner diameters, as well as the calculated results with the thread depth removed from the outer diameter. Both 1/8 NPT samples failed by burst in the wall with the threaded end remaining intact; the

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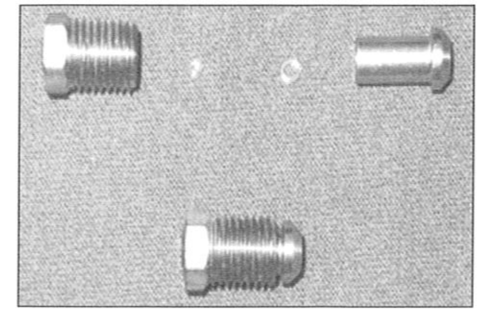
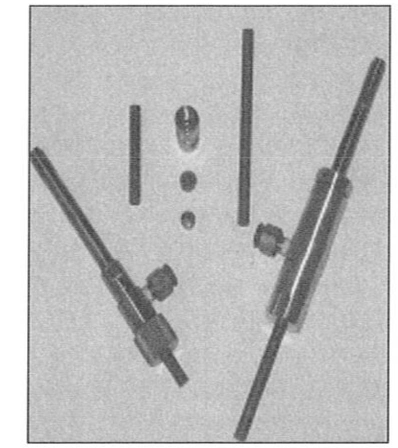


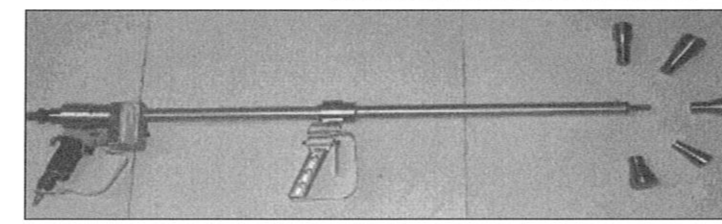
again attributes this to the patent pending inner geometry of the retaining bushing. To the naked eye, it appears the same; yet the same it is not. The advanced technology has increased jet velocity in addition to a tighter stream at the exit of the orifice jewel. The result is more cleaning, cutting, and shredding potential for the user.

Terydon Inc. is adept in field cutting and hence, incorporates the Amuloid technology in two abrasive cutting head styles. Although adaptable to any system, the company recommends attaching them to their modular Jack Track system, which includes a circle cutter, mini radius cutter, and a multi-flexible linear rail that promotes ease of set up even for the novice for precision cuts.

The Amuloid also excels at pressures up to 50K, tested in Terydon Inc.'s new 50K Rotary Gun. Based on the rugged gorilla proof design of its 40K predecessor, the SG 50 with the Amuloid, offers quality durability and performance in the advances of the 50K frontier.

The same rotary 40K and 50K technology are offered in crawlers, duct and stack cleaning, tube lancing and special applications…most and foremost emphasizing the needs and requests of the customer. For more information call Terry Gromes or Gary Manack at (330)879-2448.





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MPa (35,400 psi), with 5.75 threads engaged, 5 percent less than the value predicted from the thread engagement tests.

4.0 CONCLUSIONS

Figure 25 shows the average difference between the actual failures and the values predicted by the equations used for each material. The testing of the male pipe samples machined from 304A bar resulted in burst failures equal to or greater than values predicted by the Lamé equation for thick walled cylinders. Failures due to thread shear occurred in the 1 and 1-1/4 NPT heavy walled samples, where the burst pressure exceeded the thread strength. All samples of 304L pipe failed in the pipe wall, at values predicted by the Lamé equation, with no failures related to the pipe threads.

The 17-4 stainless steel male pipe samples showed some failures occurring at less than the predicted values of the Lamé equation; it is possible that the actual strength of these pieces was less than used in the calculations. Materials such as 13-8 and 15-5 are known to have better transverse toughness properties than 17-4 and would be recommended in cases where size or weight constraints require designs at the 2.5 times burst limit. Otherwise, with very strong materials such as 17-4, parts can be designed with much higher burst values without much sacrifice in weight.

The testing of the couplings of 303 and 17-4 showed a failure mode of thread shear to be much more likely than failure due to burst. The thread shear failures were caused by yield of the coupling. Actual failures due to yield and thread shear typically occurred above the calculated yield, but below the calculated burst.

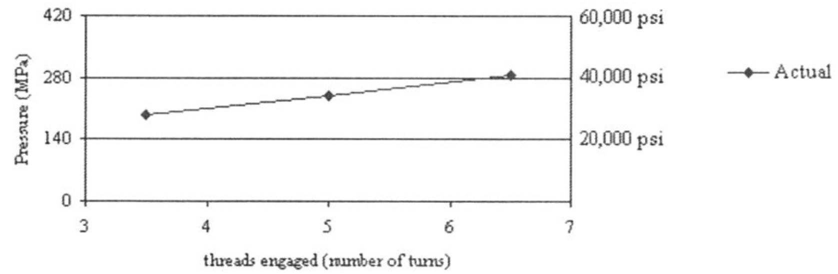


Figure 24. 3/4 NPT couplings, 303, effect of threads engaged

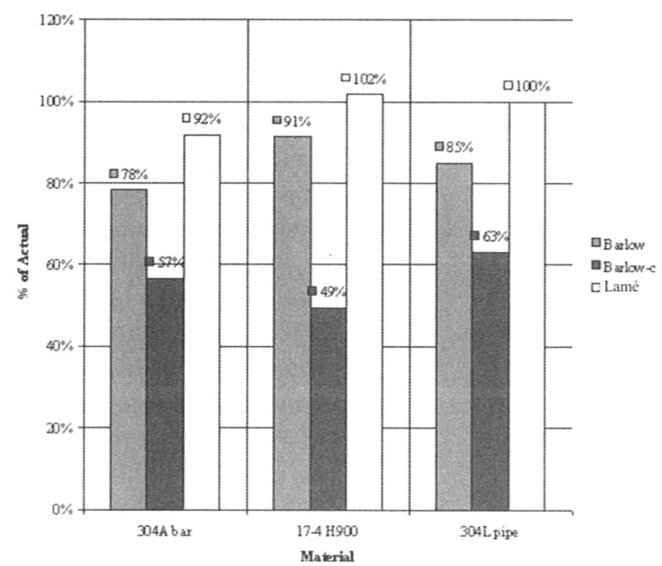


Figure 25. Average of calculated values to actual failures, by material type

Table 4. List of pipe coupling samples and test results

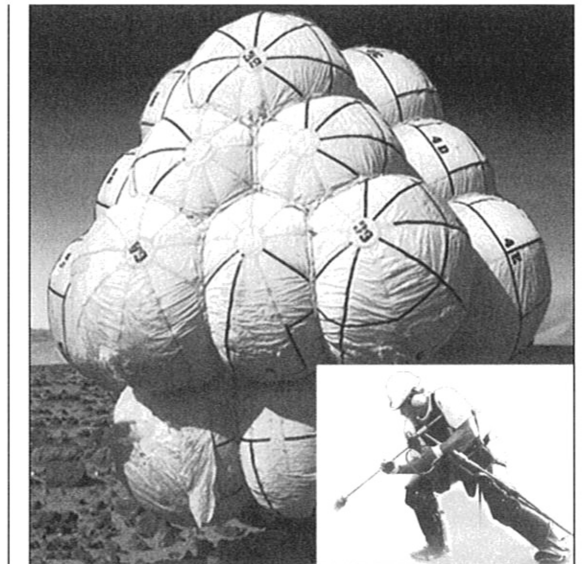
Size	Material	O.D.	I.D.	Failure pressure	Failure type
1/4	303	21.3 mm (.840 in.)	11.1 mm (.438 in.)	340 MPa (48,600 psi)	Yield, leak
1/4	303	28.6 mm (1.125 in.)	11.1 mm (.438 in.)	441 MPa (63,000 psi)	Yield, leak
1/4	17-4 H900	16.8 mm (.661 in.)	11.1 mm (.438 in.)	418 MPa (59,700 psi)	Yield, leak
1/4	17-4 H900	18.8 mm (.741 in.)	11.1 mm (.438 in.)	526 MPa (75,100 psi)	Yield, leak
1/2	303	28.4 mm (1.120 in.)	18.3 mm (.719 in.)	232 MPa (33,100 psi)	Yield, leak
1/2	303	31.8 mm (1.250 in.)	18.3 mm (.719 in.)	317 MPa (45,300 psi)	Yield, leak
1/2	17-4 H900	26.1 mm (1.029 in.)	18.3 mm (.719 in.)	541 MPa (77,300 psi)	Burst
1/2	17-4 H900	28.9 mm (1.137 in.)	18.3 mm (.719 in.)	560 MPa (80,000 psi)	No failure
3/4	303	36.8 mm (1.450 in.)	23.4 mm (.922 in.)	178 MPa (25,400 psi)	Thread shear
3/4	303	44.4 mm (1.750 in.)	23.4 mm (.922 in.)	240 MPa (34,300 psi)	Thread shear
3/4	17-4 H900	32.5 mm (1.280 in.)	23.4 mm (.922 in.)	332 MPa (47,500 psi)	Burst
3/4	17-4 H900	36.3 mm (1.430 in.)	23.4 mm (.922 in.)	464 MPa (66,300 psi)	Thread shear
1	303	52.8 mm (2.080 in.)	29.4 mm (1.156 in.)	201 MPa (28,700 psi)	Thread shear
1	303	63.5 mm (2.500 in.)	29.4 mm (1.156 in.)	245 MPa (35,000 psi)	Thread shear
1	17-4 H900	40.7 mm (1.603 in.)	29.4 mm (1.156 in.)	441 MPa (63,000 psi)	Yield, leak
1	17-4 H900	45.4 mm (1.789 in.)	29.4 mm (1.156 in.)	456 MPa (65,200 psi)	Thread shear

Waterjet Application Of NASA Spinoff

The TurtleSkin material technology used in the crash bags for NASA's Spirit and Opportunity Rovers is now being used in Turtleskin's line of WaterArmor protective suits for high pressure waterjet operators. The TurtleSkin WaterArmor provides protection against accidental swipes of up to 40,000 psi.

The patented technology used in the WaterArmor was first developed for the crash bags used in the Mars landings. As the world leader in puncture resistance, the TurtleSkin team was asked by NASA to develop a lightweight material that was rugged enough to withstand the sharp and rocky Mars terrain. The TurtleSkin material system successfully protected the Spirit and Opportunity Rovers which landed this past January.

Now this rocket science technology is available a little closer to home. For more information on how this innovative technology is helping to prevent serious waterjetting injuries, visit www.turtleskin.com or contact: Warwick Mills, 301 Turnpike Road, New Ipswich, NH 03071, phone: (603)878-1565, extension 235, or fax: (603)878-4306.



TurtleSkin materials technology used by NASA's Mars landings now used in waterjet safety suits

Pipe Threads, from page 4

burst failure in the thin walled 1/4 NPT sample started at the last thread root. The thick walled 1/4 NPT sample failed by burst in the wall and the threads remained intact. These four pieces are shown in Figure 4.

Three samples of 1/2 NPT 304A bar were machined, with three different inside diameters. The middle size inner diameter matched that of standard 1/2 schedule 160 pipe. In addition, a sample of 304L schedule 160 1/2 pipe was tested. These results are shown in Figure 5, again compared to calculated values. The thin walled sample burst failure started at the last thread root; burst failure occurred in the wall in the other two samples as well as in the pipe sample. Figure 6 shows these pieces.

Similar samples were prepared for 3/4 NPT, machined from bar as well as from 3/4 schedule 160 pipe. The results are shown in Figure 7, and Figure 8 shows these samples. All samples failed by burst, which began in the wall on all of these.

The same series of tests were performed on 1 NPT samples. However, only the thin walled piece machined from bar and the sample of 1 schedule 160 pipe failed by burst. The other two machined pieces failed by thread shear. The results of these tests are shown in Figure 9, and the pieces are shown in Figure 10. Figure 11 shows all the pieces made from schedule 160 304 L pipe as a group; note that every failure occurred in the pipe wall, independent of the pipe threads.

Two samples of 1-1/4 NPT were machined from 304A bar, with two different inside diameters. The thin walled sample failed by burst, beginning at the last thread root. The thick walled sample failed by thread shear. These results and samples are shown in Figures 12 and 13.

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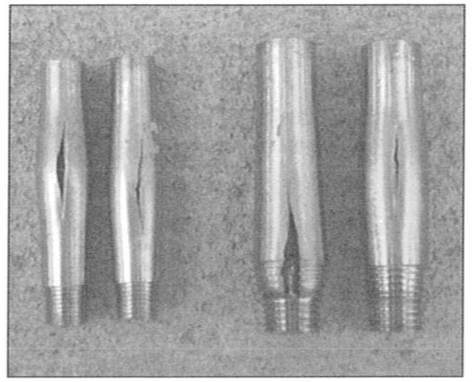


Figure 4. 1/8 and 1/4 NPT 304 test samples

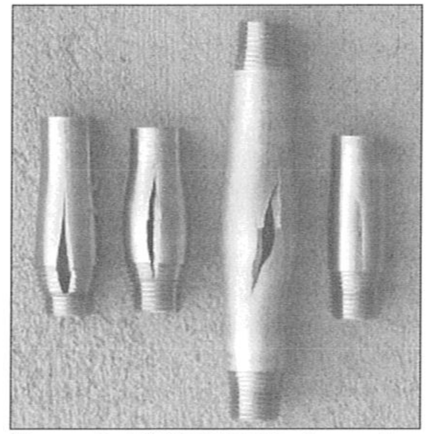


Figure 6. 1/2 NPT 304 test samples

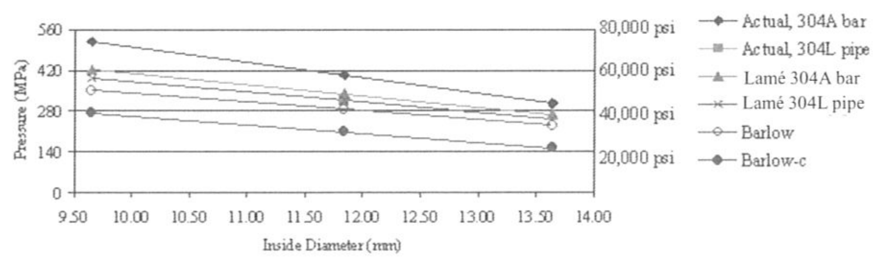


Figure 5. Results of 1/2 NPT 304 samples compared to calculated burst

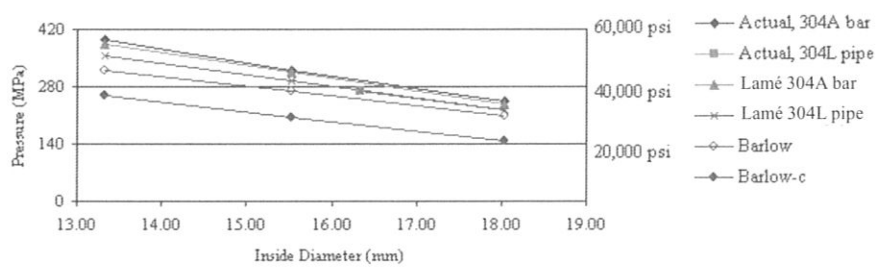
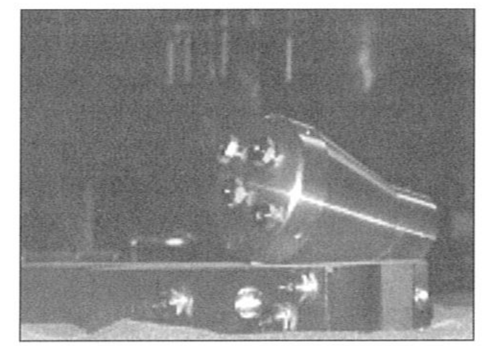


Figure 7. Results of 3/4 NPT 304 samples compared to calculated burst

An Advancement In Orifice Technology

Terydon Inc., a manufacturer of specialty UHP tooling and accessories, has recently unveiled to the competitive market, the Amuloid, an advancement in high velocity, high cohesive orifice technology. Inspired by customer requests, the Amuloid is cost effective, convenient and can potentially increase productivity up to two times that of currently available orifice assemblies. Encompassing a sapphire jewel, the two piece hex head embodiment conveniently threads into most nozzle manifolds or spray bars that utilize a 3/8-24 RH thread and cone seat.



The company has always based its designs on customer needs and wants, keeping a constant open ear to the consumer. Thus, customer input influenced the pursuit of the Amuloid. Initially, attention was not performance oriented. User concerns have been that, through rigorous field use, the hex heads of current assemblies wear away from blow-back or abrasion resulting in the replacement of the whole assembly. Even socket head types, as they wear, become difficult to remove. When performance declines, whether as a result of deposit accumulation on the jewel exiting edge, jewel fracturing, or simply jewel wear, the practice is to discard and replace. Therefore, the request was for a high cohesive jet that could be easily reset and last longer.

The patent pending, two piece Amuloid design (shown in photo at left) allows simple replacement of the threaded hex head body. In addition, it employs a common sapphire orifice that is easily replaced with no special tools. As well, the inner retaining bushing and seal can be replaced with ease when necessary. The new conveniences are obvious at a fraction of the cost of total replacement, and all components are interchangeable regardless of orifice size.

Going one step further, Terydon Inc. took the opportunity to incorporate company theory on orifice performance. Based on inner geometric experimentation and two and a half years of feedback from selected contractors, the potential capabilities of the Amuloid have proven to be excellent. The company chose the arena of its tests to be the service field industry: UHP cleaning and cutting. All contractors know (yet may not admit) that when in the field, expect the unexpected and don't predict the unpredictable. Real life scenarios...real life tests...real life results. Of course, the tests required "apples to apples" conditions; pump to pump, hose to hose, tool to tool... connectors... orifice sizes...and arrangements. The intended tests were directed to the inconstant constant...the gunner. (Even the speeds and feed of field "robotics" are at the discretion of the operator.) Results were enticing. The experienced gunner recorded performance increases of up to 2:1, compared to the most competitive assembly; the inexperienced, as low as an increase of 30% in productivity.

The Amuloid performed best in attacking applications where materials need to be cut, shredded, and pulverized (typical high cohesive stream applications). The company

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3.3 Thread Engagement and Multiple Assembly

A series of tests to determine the effect of number of threads engaged was performed using the 3/4 NPT 303 stainless steel couplings with a 44 mm (1.75 in.) outer diameter, which were known to fail by thread shear. These results are shown in Figure 24. The coupling with 6.5 threads of engagement did not fail, but yielded and leaked; this point was used on the plot. Over the range tested, each thread of engagement resulted in a 12 percent difference.

Testing of multiple assemblies took place on a sample of 1/2 NPT 304L pipe and a 3/4 NPT 303 coupling with a 44 mm (1.75 in.) outer diameter. Each sample was assembled and disassembled 100 times. The 1/2 NPT pipe sample failed in the pipe wall, not in the thread. The 3/4 NPT sample failed by thread shear at 248

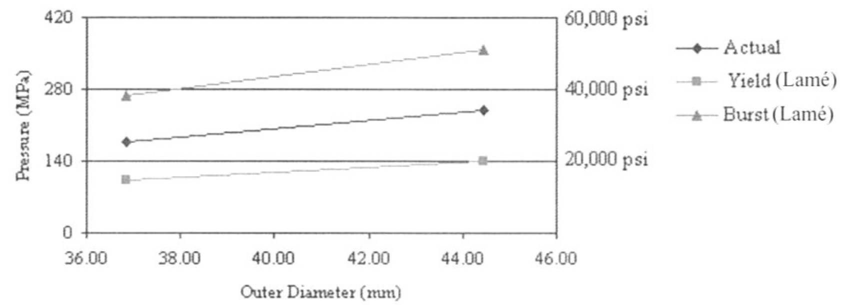


Figure 22. 3/4 NPT couplings, 303, failures compared to calculated yield and burst

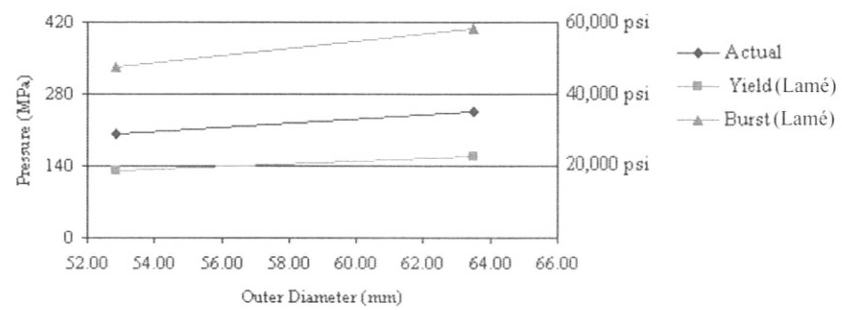


Figure 23. 1 NPT couplings, 303, failures compared to calculated yield and burst

(continued on page 20)

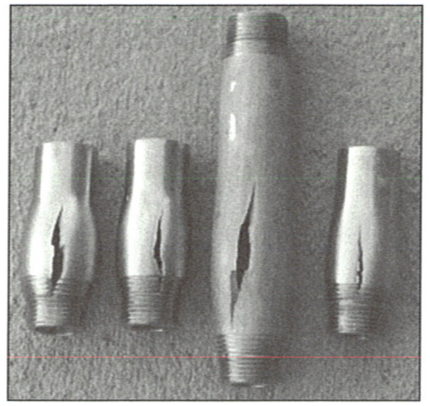


Figure 8. 3/4 NPT 304 test samples

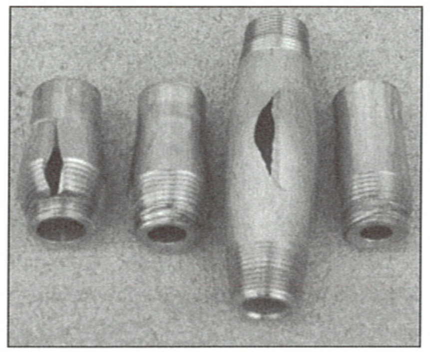


Figure 10. 1 NPT 304 test samples

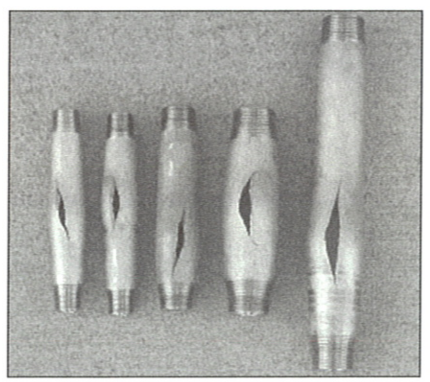


Figure 11. 304L schedule 160 seamless pipe samples (1/2, 3/4, and 1 NPT) (Also pictured on the cover)

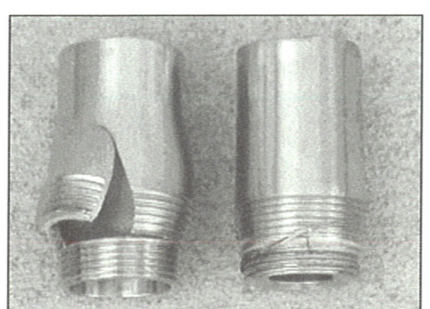


Figure 13. 1-1/4 NPT 304 test samples

Table 3. List of male pipe samples and test results

Size	Material	O.D.	I.D.	Failure Pressure	Failure Type
1/8	304A bar	10.3 mm (.405 in.)	Plug	560 MPa (80,000 psi)	No failure
1/8	304A bar	10.3 mm (.405 in.)	4.8 mm (.189 in.)	507 MPa (72,400 psi)	Burst
1/8	304A bar	10.3 mm (.405 in.)	6.6 mm (.260 in.)	294 MPa (42,000 psi)	Burst
1/8	17-4 H900	10.3 mm (.405 in.)	7.4 mm (.290 in.)	444 MPa (63,500 psi)	Burst
1/4	304A bar	13.7 mm (.540 in.)	Plug	560 MPa (80,000 psi)	No failure
1/4	304A bar	13.7 mm (.540 in.)	6.1 mm (.239 in.)	526 MPa (75,100 psi)	Burst
1/4	304A bar	13.7 mm (.540 in.)	8.9 mm (.350 in.)	286 MPa (40,900 psi)	Burst
1/4	17-4 H900	13.7 mm (.540 in.)	9.9 mm (.390 in.)	356 MPa (50,800 psi)	Burst
1/2	304A bar	21.3 mm (.840 in.)	Plug	560 MPa (80,000 psi)	No failure
1/2	304A bar	21.3 mm (.840 in.)	9.7 mm (.380 in.)	518 MPa (74,000 psi)	Burst
1/2	304A bar	21.3 mm (.840 in.)	11.8 mm (.466 in.)	403 MPa (57,500 psi)	Burst
1/2	304L pipe	21.3 mm (.840 in.)	11.8 mm (.466 in.)	313 MPa (44,700 psi)	Burst
1/2	304A bar	21.3 mm (.840 in.)	13.6 mm (.537 in.)	305 MPa (43,600 psi)	Burst
1/2	17-4 H900	21.3 mm (.840 in.)	15.7 mm (.618 in.)	403 MPa (57,500 psi)	Burst
3/4	304A bar	26.7 mm (1.050 in.)	Plug	464 MPa (66,300 psi)	Thread shear
3/4	304A bar	26.7 mm (1.050 in.)	13.3 mm (.525 in.)	394 MPa (56,300 psi)	Burst
3/4	304A bar	26.7 mm (1.050 in.)	15.5 mm (.611 in.)	321 MPa (45,800 psi)	Burst
3/4	304L pipe	26.7 mm (1.050 in.)	16.3 mm (.643 in.)	271 MPa (38,700 psi)	Burst
3/4	304A bar	26.7 mm (1.050 in.)	18.0 mm (.710 in.)	244 MPa (34,800 psi)	Burst
3/4	17-4 H900	26.7 mm (1.050 in.)	21.3 mm (.838 in.)	286 MPa (40,900 psi)	Burst
1	304A bar	33.4 mm (1.325 in.)	Plug	410 MPa (58,500 psi)	Thread shear
1	304A bar	33.4 mm (1.325 in.)	17.4 mm (.688 in.)	360 MPa (51,400 psi)	Thread shear
1	304A bar	33.4 mm (1.325 in.)	20.7 mm (.815 in.)	294 MPa (42,000 psi)	Thread shear
1	304L pipe	33.4 mm (1.325 in.)	20.7 mm (.815 in.)	266 MPa (38,000 psi)	Burst
1	304A bar	33.4 mm (1.325 in.)	24.6 mm (.970 in.)	196 MPa (28,000 psi)	Burst
1	17-4 H900	33.4 mm (1.325 in.)	26.6 mm (1.048 in.)	292 MPa (41,700 psi)	Burst
1-1/4	304A bar	42.2 mm (1.660 in.)	Plug	309 MPa (44,200 psi)	Thread shear
1-1/4	304A bar	42.2 mm (1.660 in.)	24.3 mm (.958 in.)	305 MPa (43,600 psi)	Thread shear
1-1/4	304A bar	42.2 mm (1.660 in.)	33.7 mm (1.328 in.)	170 MPa (24,300 psi)	Burst
1-1/4	17-4 H900	42.2 mm (1.660 in.)	34.0 mm (1.338 in.)	302 MPa (43,100 psi)	Burst

Figure 9. Results of 1 NPT 304 samples compared to calculated burst

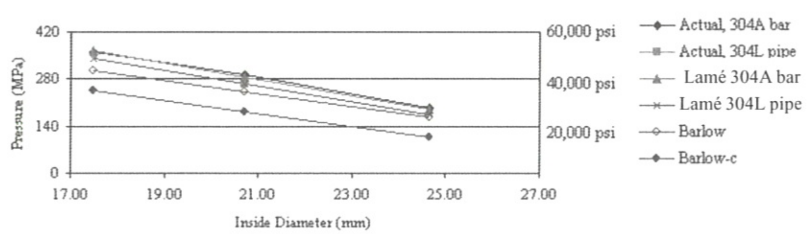
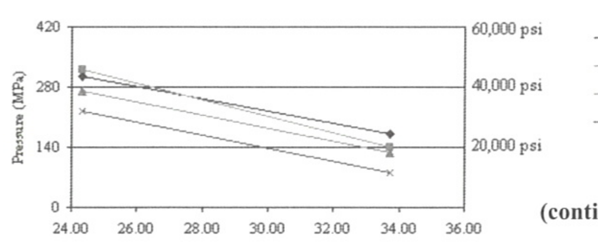


Figure 12. Results of 1-1/4 NPT 304 samples compared to calculated burst



(continued on page 13)

All of the failures in the 303 stainless steel were caused by thread shear as yield progressed. Both of the 1/4 NPT samples yielded and leaked, without our being able to make them fail. Actual values shown in Figure 20 are the points at which this occurred, compared to calculated values using the Lamé equation for burst and yield. The same results occurred with the 1/2 NPT 303 couplings; these values are shown in Figure 21. The failures in the 1/4 and 1/2 NPT samples occurred close to the calcu-lated burst; well above the calculated yield. Both of the 3/4 NPT couplings failed by thread shear; Figure 22 shows these results versus the calculated values. The 1 NPT samples also failed by thread shear; these results are plotted in Figure 23. The failures in the 3/4 and 1 NPT samples occurred about midway between the calculated yield and burst values.

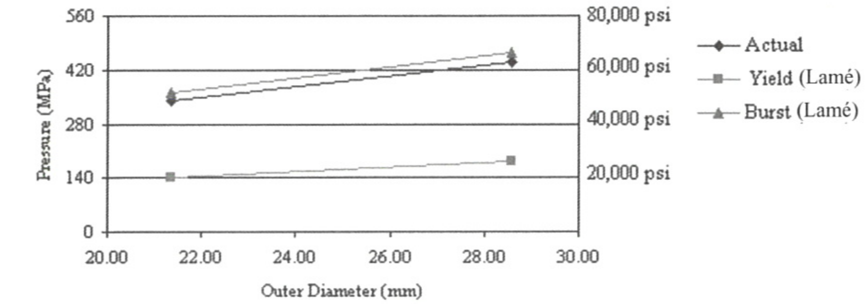


Figure 20. 1/4 NPT couplings, 303, failures compared to calculated yield and burst

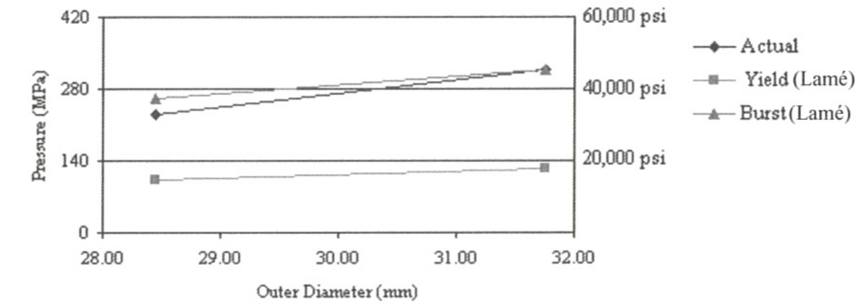


Figure 21. 1/2 NPT couplings, 303, failures compared to calculated yield and burst

(continued on page 18)

New Turbo Nozzles

WOMA has further developed and improved their turbo nozzle program. The nozzles are available in pressure ranges of 1000 bar (14,500 psi), 2000 bar (29,000 psi), and 3000 bar (43,500 psi) (compatible with all hand-operated high-pressure guns currently on the market).

Technical advantages include:

- Light Weight 1,600 g, (3.5 lbs), the lightest available turbo nozzle on the market.
- Leakage Free Sealing System: No water is used to cool or lubricate the shaft or seals meaning 100% of the power of your pump goes to production.
- Excellent starting characteristics: Starts instantly even after prolonged storage time.
- Excellent resistance to contamination: Sealed bearing and braking system, meaning the complete system is encapsulated.
- Appropriate for field use: Simple field maintenance seal reducing field expenses.
- Connection: 9/16" UNF or M14x1 left hand threads.
- Handling: Very easy due to WOMA's pre-selected nozzle assembly (form 21-LL).

For more information, contact: WOMA Corporation, P.O. Box 6793, Edison, NJ 08837, phone: 800-258-5530, fax: 732-417-0015, e-mail: womacorp@bellatlantic.net

Upcoming Events

July 16, 2004

Surface Preparation – The Latest Developments: Waterjetting, Waterblasting, Web Abrasive Blasting, Surface Preparation Workshop, Clarion Hotel & Conference Center, Louisville, Kentucky, visit www.advisorycouncil.org or contact the Advisory Council by phone: 512-392-2210 or fax: 512-754-9454.

September 2004

17th International Conference on Waterjetting, Advances and Future Needs, Mainz, Germany, visit www.bhrgroup.com/confsite/jt04home.htm, or contact: BHR Group Limited, The Fluid Engineering Centre, Cranfield, Bedford MK43 0AJ, UK, phone: 44(0)1234 750422, fax: 44(0)1234 750074, email: crolfe@bhrgroup.com

September 8-15, 2004

International Manufacturing Technology Show (IMTS) 2004 – The New Manufacturing Age, McCormick Place, Chicago, IL, visit www.imts.com, or contact IMTS, 7901 Westpark Drive, McLean, VA 22102-4206, phone: 800-828-7469

October 26-28, 2004

FABTECH International, International Exposition (I-X) Center, Cleveland, Ohio, visit: www.sme.org/fabtech, call toll free 800-733-4763, or contact: Society of Manufacturing Engineers, One SME Drive, PO Box 930, Dearborn, MI 48121, phone: 313-271-1500; fax: 313-425-3400.

October 31-November 2, 2004

CETA PowerClean 2004, Hyatt Regency and Albuquerque Convention Center, Albuquerque, NM, visit www.ceta.org, call toll free 800-441-0111, or contact the Cleaning Equipment Trade Association, 7691 Central Avenue NE, Suite 201, Fridley, MN 55432-3541, phone: 763-786-9200, fax: 763-786-7775.

John Dedic, Malcolm MacQuarrie Join KMT Waterjet Systems

Duane Johnson, president of KMT Waterjet Systems, has announced that John Dedic and Malcolm MacQuarrie have joined KMT Waterjet Systems. KMT Waterjet Systems was formerly named Ingersoll-Rand Waterjet.

Mr. Dedic was appointed North American marketing manager, and he will be responsible for all marketing and marketing communications activities associated with KMT Waterjet Systems' products and services. A graduate of DePaul University with a Bachelors Degree in business administration and distribution management, Mr. Dedic was formerly employed at Danley Die Set where for the past fourteen years he has held a number of management positions covering marketing, product development, market research, sales and marketing communications.

Mr. MacQuarrie was appointed vice president of sales and marketing, and he will be responsible for all sales and marketing activities for waterjet pumps and aftermarket parts in the US, Mexico and Canadian markets. Mr. MacQuarrie has a broad range of industrial products and capital equipment experience. He has held a variety of positions in sales and marketing management, as well as product management and operations. Mr. MacQuarrie holds a Masters Degree in business administration from the University of Rochester and he is a graduate of Drexel University with a Bachelors Degree in chemical engineering.

KMT Waterjet Systems, based in Baxter Springs, Kansas, is a global source for high-pressure waterjet pumps, nozzles and ancillary equipment, services and spare parts. For more information, visit www.kmtwaterjet.com, or contact: KMT Waterjet Systems, 635 West 12th Street, Baxter Springs, KS 66713, phone: 620-856-2151, fax: 620-856-5050.

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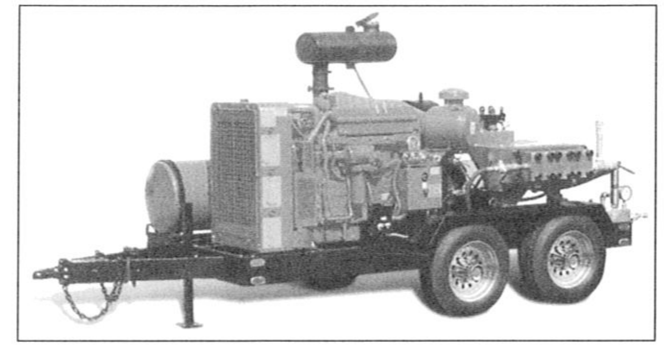
The Proceedings are a compilation of papers and abstracts, including photographs and illustrations, presented at each American Waterjet Conference. Valuable scientific and technical information contained in these Proceedings is excellent reference and study material.

Contact the WJTA office for shipping information and rates. Email: wjta@wjta.org, phone: 314-241-1445, fax: 314-241-1449, WJTA, 917 Locust Street, Suite 1100, Saint, Louis, MO 63101-1419.

NLB Pump Unit Offers Choice Of Six Pressures At 425 HP

The NLB 350D Series convertible waterjet pump units combine maximum power (350 or 425 hp) with maximum flexibility. A simple kit lets users convert to any of six pressures to suit a job: 8,000, 10,000, 13,000, 15,000, 17,000 or 20,000 psi (550 to 1,400 bar). These diesel-driven units are trailer-mounted for portability.



NLB 350D Series Convertible Waterjet Pump Unit

The NLB 350D Series is designed for long life and low operating costs as well as fast conversions. Wear-reducing features include NLB's slow-running triplex plunger pump and hard-coated valves and plungers. Corrosion-resistant stainless steel is used throughout the pump, instead of carbon steel. Flows range from 27-74 gpm (102 to 279 lpm).

Changing the pressure requires fewer parts than other convertible pump units, reducing cost and downtime. Other important features include a heavy-duty poly-chain belt drive system with belt guard and water pressure-actuated throttle control to adjust output to operator demand.

A series of skid-mounted electric-driven units, the 350E Series, is also available.

For more information, visit www.nlbcorp.com or contact: NLB Corp., 29830 Beck Road, Wixom, MI 48393-2824, phone: 248-624-5555, fax: 248-624-0908.

NLB Videos Available At Website

NLB Corp. has completed a major update of its website that lets people quickly find answers to waterjetting questions, match pumps to their needs, and request quotations.

The website, www.nlbcorp.com, features video clips of waterjets performing a variety of applications and an FAQ section filled with helpful charts and tables. Visitors interested in waterjet pumps can scroll through diesel, electric or convertible units (also bareshaft pumps), or enter their desired specifications to see which unit best suits their needs. Data sheets are available for downloading.

An extensive "Applications" section describes the most common uses of waterjetting, offering relevant product and application literature for downloading. Another section presents features and detailed specifications for hundreds of NLB accessories and offers the opportunity to request a quotation by completing a user-friendly, on-line form.

Answers to questions about renting NLB waterjet equipment and a credit application can also be found on the website. Visit www.nlbcorp.com

— Classified —

Florida-based individual with 33 years of industry experience seeks a position to utilize supervisory, managerial and operational skills in waterjet cleaning, coating and paint removal, hydrodemolition, and ultra high pressure abrasive cutting. Holds a Class A CDL and is also skilled in carpentry, plumbing, welding, electric, and heavy equipment operation. Willing to travel. Resume available upon request. Contact William G. Smith at (772)336-9907.

Pipe Threads, from page 13

The biggest difficulty of testing the couplings was due to yield causing a leak. If this occurred above the 280 MPa (40,000 psi) limit of the triplex pump, the only way to continue with the intensifier was to reassemble and retighten the fittings, which effectively results in more threads engaged, and allows reaching a burst failure if this process is repeated. However, it was found that failure due to thread shear occurred at much lower pressures than burst, as the coupling yielded and reduced the thread contact area. Therefore, when possible, the couplings were taken to failure by yield and thread shear, but in cases where they yielded and leaked suddenly without shear or rupture, this point was taken as the failure pressure.

In the case of 17-4, which has a yield strength very close to the tensile strength, it was possible to reach burst failure without a large leak in some of the couplings. The 1/4 NPT couplings of 17-4 stainless steel yielded and leaked without failing; these values are plotted in Figure 16, and are less than the calculated yield and burst values using the Lamé equation. The thin walled 1/2 NPT made from 17-4 failed by burst, breaking into several pieces, while the thick walled coupling did not fail at 560 MPa (80,000 psi); Figure 17 shows these values compared to the calculated values. The 3/4 NPT 17-4 thin walled coupling failed by burst, a single split down the side, but the thick walled coupling failed by thread shear. Both failures were greater than that predicted by calculated burst; these values are shown in Figure 18. The thin walled 1 NPT 17-4 yielded and leaked between the calculated values for yield and burst. The thick walled coupling failed by thread shear above that calculated for burst; Figure 19 compares the actual values to the calculated values for burst and yield.

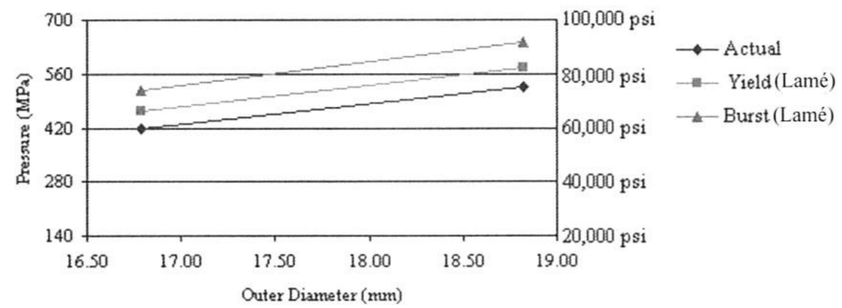


Figure 16. 1/4 NPT couplings, 17-4, failures compared to calculated yield and burst

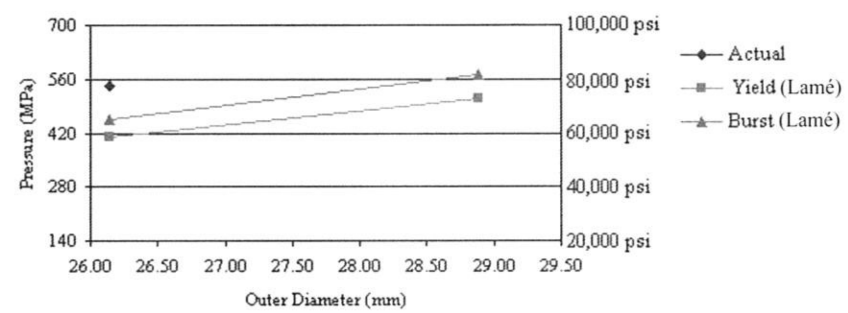


Figure 17. 1/2 NPT couplings, 17-4, failures compared to calculated yield and burst

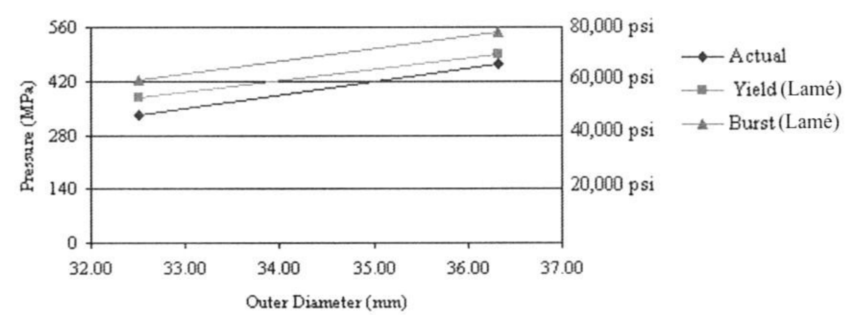


Figure 18. 3/4 NPT couplings, 17-4, failures compared to calculated yield and burst

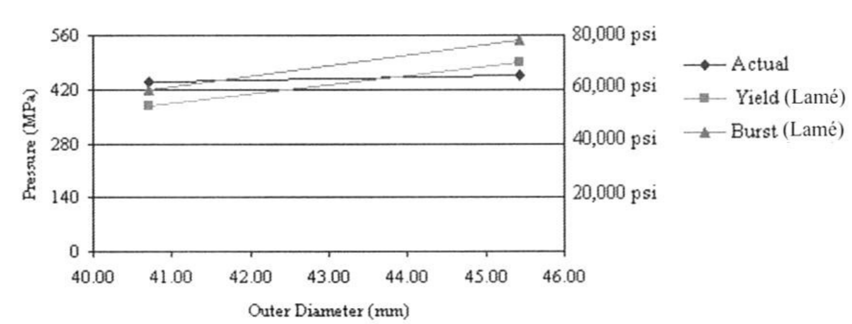


Figure 19. 1 NPT couplings, 17-4, failures compared to calculated yield and burst

(continued on page 17)

Welcome WJTA New Members

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Correction To Spanish Version Of Recommended Practices

Practicas Recomendadas Errata Sheet

There is an error in the title of the publication, ***Practicas Recomendadas Para El Uso Manual De Hidrolavadores A Alta Presion***, Spanish Edition, as follows:

The letter U in the world HIDROLAUADORES is incorrect. The letter should be a V and the word corrected to read: HIDROLAVADORES.

Therefore, the title should read:

Practicas Recomendadas Para El Uso Manual De Hidrolavadores A Alta Presion

Please note this correction on the following pages of the Spanish Practicas Recomendadas:

Front cover:
third line from the top

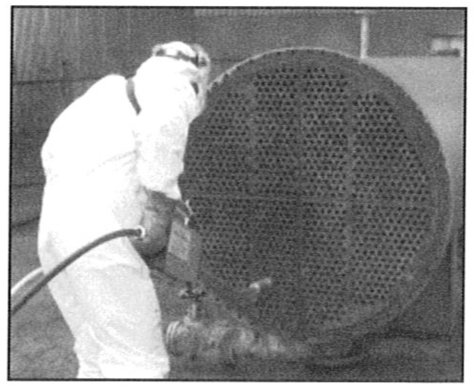
Page 1:
third line from the top

Page 2:
first line in the boxed text at the bottom of the page

Contact the WJTA office if you have any questions.

A Hand-Held Tube Bundle Cleaner

The new 1 LTC (Lance Tube Cleaner), an air-powered, hand-held, tube bundle-cleaning unit designed to increase productivity and operator safety is available from Peinemann Equipment B.V. The 1 LTC can be used for both horizontal and vertical applications at pressures to 40,000 psi. It is ideal for tight spaces and offers consistent controllable cleaning speeds.



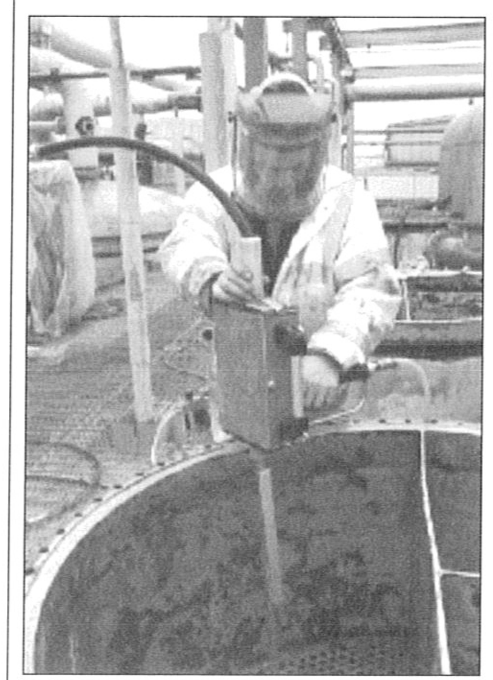
Lightweight and compact, the unit weighs only 19 pounds. It contains and handles the high pressure hose for the operator at a consistent controlled speed and prevents operator exposure to both hose and waterjets, thereby increasing safety and reducing potential damage to expensive high pressure flexible hoses.

Set up time takes a matter of minutes. The unit is operated by positioning the nozzle end against the tube to be cleaned. By using the simple hand control, the operator extends and retracts the hose and nozzle through the tube at an appropriate speed while applying water pressure. The hose is moved through the unit by means of polyurethane friction blocks, and the hose is stopped by means of two mechanical stops.

The controlled speed of the cleaning nozzle delivers excellent cleaning results in the shortest possible time. The unit is competitively priced to enable even the smallest contractor to provide a safer more efficient tube bundle cleaning service.

The 1 LTC has been used to clean tube bundles at a British sugar factory since November 2003. In the photo below, a worker is removing hard scale and clearing blocked tubes in a vertical tube bundle 10 meters long. The tube diameter is approximately 25mm. The machine has been in continuous operation for the last seven months without any problems. The sugar factory has drastically reduced the number of non-planned shutdowns due to blocked exchangers, thereby increasing production.

For further information and a video CD visit www.peinemannequipment.com or contact Peinemann Equipment B.V. by email at: pein@peinemann.nl, by phone: +31102955000 or fax: +31102955049.



Pipe Threads, from page 8

Samples of each of the pipe sizes were also made from 17-4, in the H900 condition. These pieces had inside diameters at least as large as standard schedule 40 pipe sizes, as it was desired to have them fail below 560 MPa (80,000 psi). The results of these tests are shown in Figure 14, compared to the calculated values. The 1/8, 1/4 and 1/2 NPT samples failed by burst, shattering into multiple pieces. The 3/4 and 1 NPT samples broke cleanly off at the last exposed thread, while the 1-1/4 NPT sample burst out one side. These pieces are shown in Figure 15.

3.2 Pipe Couplings

Sample pipe couplings were made in both 303 and 17-4 H900 stainless steels, in sizes of 1/4, 1/2, 3/4 and 1 NPT, with two different outside diameters. Table 4 on page 20 lists each test sample by size, material, type of failure and failure pressure.

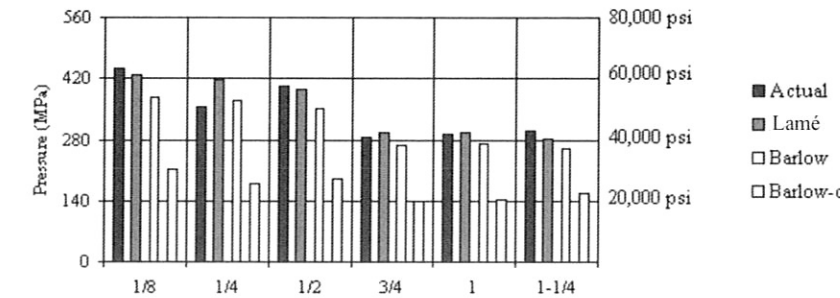


Figure 14. Results of 17-4 samples compared to calculated burst

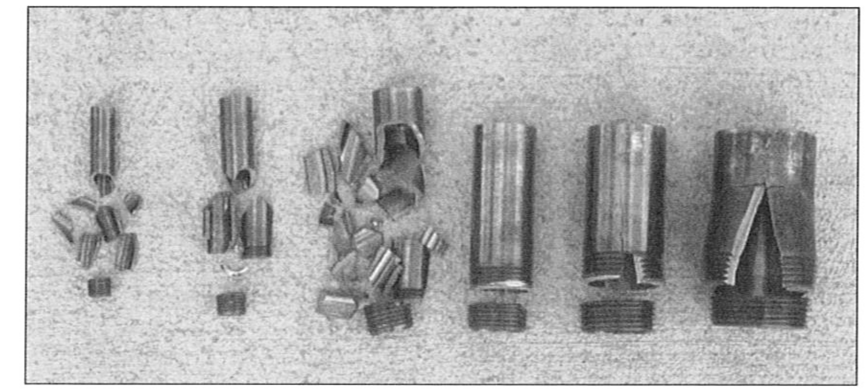


Figure 15. 17-4 test samples

(continued on page 14)