

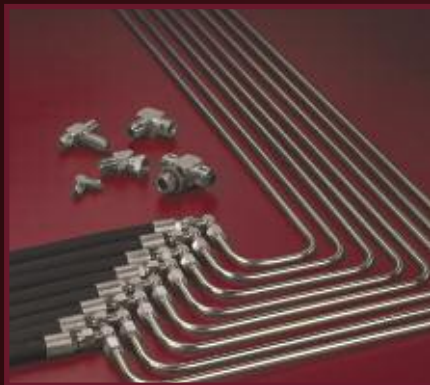
# MID-STATE

*"Performance Under Pressure"*



## *Tube Assemblies Catalog*

*Catalog TAW215b  
Dated June 2009  
Supersedes all previous catalogs*



(800) 421-7051 • (614) 864-1811  
[www.mshose.com](http://www.mshose.com)

*Performance  
Under  
Pressure*

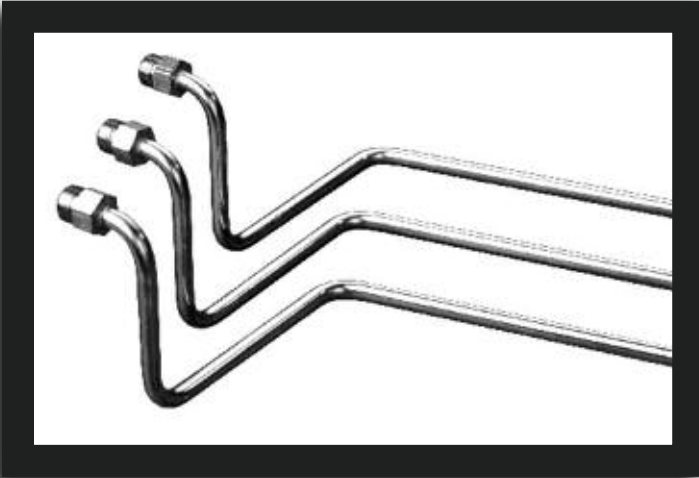


## TERMS AND CONDITIONS

- Payment Terms:** Net 30 days from invoice date. Please pay from invoice. Statement will be sent only upon request.
- Credit:** Orders will be shipped on an open account basis after credit approval.
- Freight:** All items are F.O.B. shipping point unless otherwise noted. Freight prepaid on shipments of \$3000 to \$5000 depending upon location.
- Returns:** Defective items may be returned with prior approval within 14 days of original shipment. ALL RETURNS MUST BE ACCOMPANIED BY OUR WRITTEN AUTHORIZATION. Hose assemblies and tube assemblies are made to special order and MAY NOT BE RETURNED unless defective.
- Cancellations:** Cancellations will be accepted subject to charges for costs incurred to date of cancellation.
- Warranty:** For a period of one year after date of purchase Mid-State warrants it's products to be free from defects in materials and workmanship when properly installed and maintained. Defective products will be replaced or credit given. LIABILITY IS LIMITED TO THE INVOICE VALUE OF THE MERCHANDISE RETURNED. IN NO EVENT SHALL MID-STATE BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES WHATSOEVER. This is our entire warranty. No other warranty either implied or expressed, is given.

## TUBE ASSEMBLIES

### INTRODUCTION



Industry leading OEM's (Original Equipment Manufacturers) have chosen Mid-State because we provide a wide range of tube processing services including engineering support, stocking a large inventory of bulk tubing, and prototype to production runs.

We manufacture hydraulic tube assemblies for a variety of applications and industries using standard SAE hydraulic tubing to create made to order assemblies.

Our tube assemblies are used in hydraulic, fuel, oil, lubrication, fleet, automotive and military applications. In fact, Mid-State production

standards are qualified to **MIL-I-45208A** by the Defense Contract Management Agency, which provides contract management services to the U.S. Department of Defense, other federal agencies and foreign governments.

We can simplify your engineering, specification, and purchasing duties by taking single source responsibility for all of the flow control systems on your machinery from prototype to production.

Below is a chart that outlines our capabilities and manufacturing

Tube Assembly Specifications	Processes
Type — Hydraulic, fuel line, oil lines, lubrication, fleet and automotive	• Bending
Size — 1/8" O.D. to 1-1/2" O.D.	• Flaring
Materials — Steel, stainless steel, copper, Bundy	• Double Flaring
Ends — Flared, double flared, pipe, O-Ring, flat face O-Ring, specials	• Beading
Quantities — 1 piece to 50,000 pieces	• Brazing
	• Welding (TIG)
	• Machining



## TUBE ASSEMBLIES

### PROCESSING SERVICES

One of our primary goals is to maximize our ability to provide the highest quality products and services that meet or exceed industry standards. Mid-State comes highly recommended not only because our tube processing services are supported by skilled professionals; but also because we are responsive, innovative, reliable and committed to providing exceptional service.

**Services** – Standard Tube Product – beading, bending, brazing, flaring, double flaring, machining and welding (TIG and Orbital).

For orders and information, call your Mid-State representative at **800-421-7051**.

As your hydraulic tubing expert, Mid-State provides all the essential production processing services. By the time our two teams have finished collaborating, your project will be completed to the most exacting specifications. For more information on processing services, see the chart below. Whatever your hydraulic tubing needs, Mid-State delivers on time, every time.

### TUBE PROCESSING CHART

Service/Process	Metal	Thickness/Diameter	Specifications
Beading	CS, SS, Cu, Al	3/8" - 1 1/2" O.D. / 0.065 max	SAE J1231
Bending	CS, SS, Cu, Al	1/8" - 1 1/2" O.D.	To Print
Brazing	CS, SS, Al, Br	All	AWS
Flaring	CS, SS, Cu, AL	3/8" - 1 1/2" O.D. / 0.120 max	SAE J533
Machining	CS, SS, Al, Br	Up to 4" O.D.	SAE
Welding	CS, SS, Al	All	AWS / ASME

*CS - Carbon Steel, SS - Stainless Steel, Cu - Copper, Al - Aluminum, Br - Brass.*

*Beading, Bending & Flaring can be done up to 4" with tooling upon request.*

**SPECIAL NOTES:** *Our welders are certified to AWS D.1-90 and ASME Section IX.*

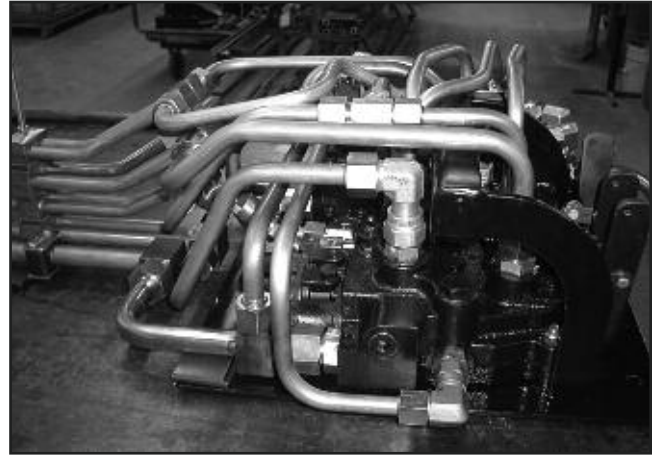


## TUBE ASSEMBLIES

### SUPPORT AND ASSISTANCE

Mid-State works carefully to ensure that every order is delivered to the customer's specification; that's why each of our processing services is managed to MIL-I-45208A standards. Additionally, Mid-State offers customers an array of value-added services including engineering assistance, technical counseling, field expertise and special packaging, just pick up the phone and call us at **800-421-7051**.

**Engineering Support** - Our CAD capabilities allow us to work from finished engineering drawings, samples, or even rough sketches. Combined with our product knowledge of hydraulic tube and fitting processes, we are able to conduct a value analysis and recommend the best installation and routing methods for your application. Have a question? We have the answer. Our staff provides expert product recommendations on appropriate sizes and grades, machining, and fabrication. We can counsel you and your engineers over the phone, or at your plant.



**Field Application Assistance** – Our Field Application Specialists are specially trained to provide accurate, in-depth evaluations of your current hydraulic systems. Our tried and tested methods of hydraulic tube routing and installation prove that the earlier we get involved with your product engineering team, the more effective we are.

Our Step-by-Step process to proper tube routing and installation include:

1. Meeting with your engineering team to identify the problem, issue, challenge or obstacle.
2. Gather all available engineering data.
3. Analyze the engineering data.
4. Make an initial recommendation.
5. Test the recommendation.
6. Evaluate the test.
7. Provide a final solution.

During the testing phase, we like to physically route an ideal port-to-port hydraulic system. Our goal is to assist your team to design a finished product to test and evaluate before production begins. We want to help you design the most efficient fluid power product for your customers.

**Customer Service** - We understand the difficulties in the quoting and ordering process; therefore, we simplify the buying process by providing kitting and quotation services. An example of kitting would be individually packaging a group of tube assemblies into separate boxes so that the assembly line only has to pick up one box for each manufactured unit.

For more information, call your Mid-State representative at **800-421-7051**.

## TUBE ASSEMBLIES

### MATERIAL

Mid-State can be your primary source for hydraulic & structural tubing. We stock every possible size of SAE J525 carbon steel hydraulic tubing from 1/8" - 1 1/2" O.D. We also carry SAE J524 (carbon seamless), SAE J527 Bundy weld, 304 SS SAE A269, 304 SS SAE A213, ASTM A- 513 DOM, C4130 (Aircraft quality) and Metric (CS & SS) sizes in that range. Aluminum and Copper are available upon request.

To select tubing for a particular installation, two factors must be determined:

1. **Tubing type** – material and construction and
2. **Size** – inside diameter (I.D.) and wall thickness. Information listed below will help with your tubing selection.

### TUBING TYPES

Commercial tubing is available in a wide variety of materials, types of construction and quality. Each is best suited for certain specific applications.

**STEEL TUBING** – Seamless SAE 1010 fully annealed and SAE welded types suitable for bending and flaring. This is the only tubing material approved without restrictions by SAE standards.

**STAINLESS STEEL TUBING** – Both seamless \*18-8 fully annealed and welded types suitable for bending and flaring, although seamless tubing is best suited for JIC single flares. Stainless steel tubing is recommended for use with very high pressures and where large diameter tubing is required. It is also suited for many applications where corrosion is a problem.  
\* (302, 303 and/or 304)

**ALUMINUM TUBING** – Seamless annealed is approved by SAE for low-pressure applications.

**COPPER TUBING** – Seamless fully annealed coils and fully annealed or quarter-hard straight lengths can be used for systems that do not use petroleum-based fluids (copper acts as an oil-oxidation catalyst, causing sludge). Copper also tends to work harden when flared or bent and has poor resistance to vibration. Therefore, the use of copper tubing is limited to low-pressure stationary applications and air circuits.

**SPECIAL ALLOY TUBING** – May be required for specific corrosion problems. For more information on these applications, please contact our Tube & Weld Division.

### STANDARD SIZE HYDRAULIC TUBING

Tube O.D.	Tube I.D.	Wall
1/8	.055	.035
	.069	.028
3/16	.117	.035
1/4	.120	.065
	.152	.049
	.180	.035
	.194	.028
5/16	.182	.065
	.214	.049
	.242	.035
	.256	.028
3/8	.245	.065
	.277	.049
	.305	.035

Tube O.D.	Tube I.D.	Wall
1/2	.310	.095
	.344	.083
	.370	.065
	.402	.049
	.430	.035
5/8	.435	.095
	.459	.083
	.495	.065
	.527	.049
	.555	.035
3/4	.510	.120
	.532	.109
	.560	.095
	.584	.083
	.620	.065
	.652	.049
	.680	.035

Tube O.D.	Tube I.D.	Wall
7/8	.657	.109
	.685	.095
	.709	.083
	.745	.065
1	.760	.120
	.782	.109
	.810	.095
	.834	.083
	.870	.065
	.902	.049
1 1/4	.982	.134
	1.010	.120
	1.032	.109
	1.060	.095
	1.084	.083
	1.120	.065
1 1/2	1.232	.134
	1.260	.120
	1.282	.109
	1.310	.095
	1.334	.083
	1.370	.065

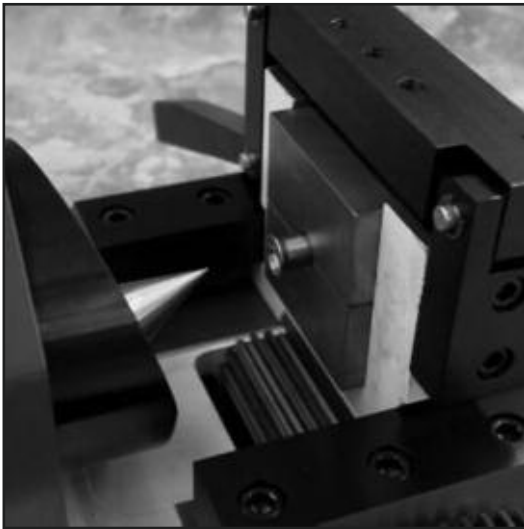
## TUBE ASSEMBLIES

### END FORMATION AND CONNECTIONS

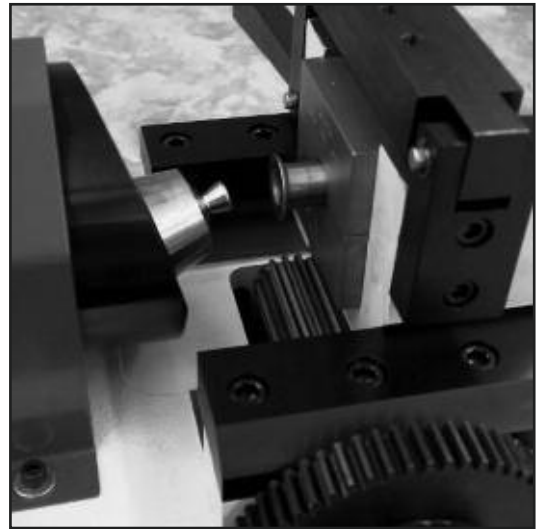
#### AUTOMATED FLARING AND FLANGING

Mid-State is committed to providing exceptional service and continually examining new methods of delivering superior products. We are pleased to announce the implementation of a mistake-proof tube flaring and flanging process known as VERSAtool™. Using the latest technology to improve your product delivery, VERSAtool™ is a Semi-Automatic Tube Flaring and Flanging Machine that provides ultimate versatility in a tube preparation tool. VERSAtool™ is a "three-in-one" operation center. It flares 1/4" to 1 1/2" (6mm to 38mm) tubing AND flanges 1/4" to 1" (6mm to 25mm) tubing. The forming operation automatically burnishes the tube-sealing surface. The machine is tested and approved for use with stainless steel, carbon steel, and copper tubing.

VERSAtool™ flares and flanges various sizes of tubing using a separate Nose-tool and SINGLE Set of Dies that allow VERSAtool™ to form a 37° or 45° Flare, or a SAE J1453 O-Ring Face Seal.



37° or 45° Flare Nose-tool



90° Flange Nose-tool



## TUBE ASSEMBLIES

Mid-State stocks one of the largest inventories of hydraulic fittings in the U.S. Our huge inventory enables us to build almost any type of prototype or standard assembly for your specific application quickly. We stock the standard SAE brazed, welded, flared and compression fittings for tube from 1/8" to 1-1/2" O.D.

In addition, we pride ourselves on our unique ability to modify standard fittings to create "special" connections as well as incorporate the finished component into your production assembly.

We have coined this process "P2P" Performance (port-to-port) and we are unmatched by our competition. Our P2P process gives you, the customer, an unlimited variety of styles to choose from when in the design phase.

### TUBE ASSEMBLY END CONNECTIONS

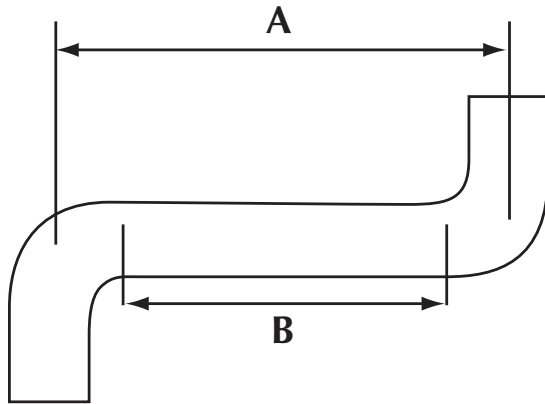
 <b>318 - Nut</b> (1) Tube O.D.	 <b>319 - Sleeve</b> (1) Tube O.D.	 <b>403</b> (1) Tube O.D. (2) Male 37° Flare	 <b>404</b> (1) Tube O.D. (2) Male Pipe	 <b>500</b> (1) Male 37° Flare (2) Tube O.D.	 <b>FF318 - Nut</b> (1) ORFS Tube Nut	 <b>FF319 - Sleeve</b> (1) ORFS Braze On Sleeve
 <b>FF403</b> (1) Tube O.D. (2) Male ORFS	 <b>FF500</b> (1) Male ORFS (2) Tube O.D.					

### FITTING THREAD SIZE COMPARISON CHART

Tube O.D.	NPT/ NPSM	O-Ring Face Seal	JIC	SAE O-Ring	SAE45°	Inverted Flare	Compression	BSPT/ BSPP	Dash #
1/8	1/8 - 27	—	5/16 - 24	5/16 - 24	5/16 - 24	5/16 - 28	5/16 - 24	1/8 - 28	02
3/16	—	—	3/8 - 24	3/8 - 24	3/8 - 24	3/8 - 24	3/8 - 24	—	03
1/4	1/4 - 18	9/16 - 18	7/16 - 20	7/16 - 20	7/16 - 20	7/16 - 24	7/16 - 24	1/4 - 19	04
5/16	—	—	1/2 - 20	1/2 - 20	1/2 - 20	1/2 - 20	1/2 - 24	—	05
3/8	3/8 - 18	1 1/16 - 16	9/16 - 18	9/16 - 18	5/8 - 18	5/8 - 18	9/16 - 24	3/8 - 19	06
7/16	—	—	—	—	1 1/16 - 16	1 1/16 - 18	5/8 - 24	—	07
1/2	1/2 - 14	1 3/16 - 16	3/4 - 16	3/4 - 16	3/4 - 16	3/4 - 18	1 1/16 - 20	1/2 - 14	08
5/8	—	1 - 14	7/8 - 14	7/8 - 14	7/8 - 14	7/8 - 18	1 3/16 - 18	—	10
3/4	3/4 - 14	1 3/16 - 12	1 1/16 - 12	1 1/16 - 12	1 1/16 - 14	1 1/16 - 16	1 - 18	3/4 - 14	12
7/8	—	1 3/16 - 12	1 3/16 - 12	1 3/16 - 12	—	1 3/16 - 16	—	—	16
1	1 - 11 1/2	1 7/16 - 12	1 5/16 - 12	1 5/16 - 12	—	1 5/16 - 16	1 1/4 - 18	1 - 11	20
1 1/4	1 1/4 - 11 1/2	1 1 1/16 - 12	1 5/8 - 12	1 5/8 - 12	—	—	—	1 1/4 - 11	24
1 1/2	1 1/2 - 11 1/2	2 - 12	1 7/8 - 12	1 7/8 - 12	—	—	—	1 1/2 - 11	32

## TUBE ASSEMBLIES

### TUBE ASSEMBLY DESIGN GUIDE



**A = Overall Length**

**B = Minimum Straight Length Between Bends**

This Chart is designed to be used as a guide for obtaining the most economic combination of bend radius, overall length and minimum straight length between two bends. Many other bend radii and design characteristics are available for specific application requirements.

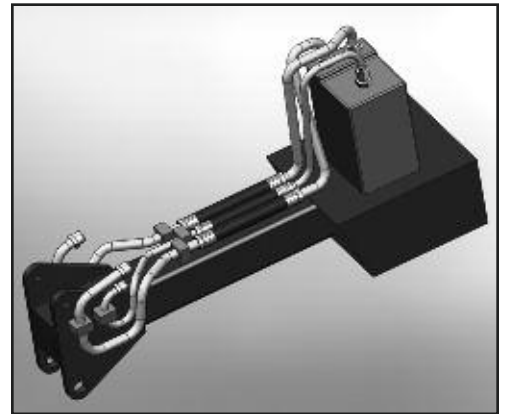
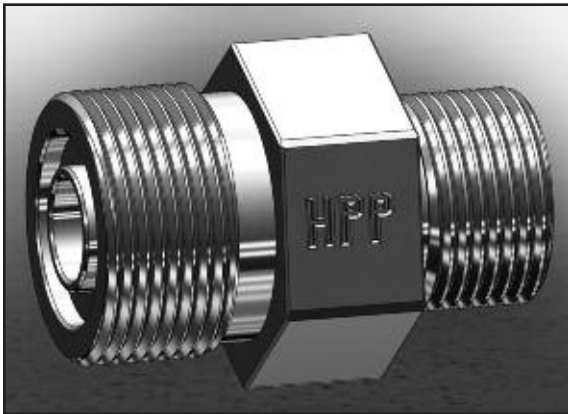
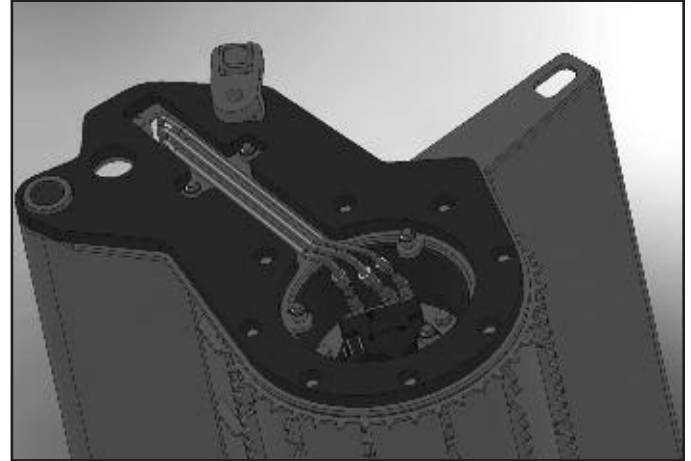
Tube O.D.	Desired Bend Radius	'A' Minimum	'B' Minimum
1/4"	.50	2.75"	1.25"
5/16"	.75	2.75"	1.25"
3/8"	.75	2.75"	1.25"
1/2"	.75	2.75"	1.25"
5/8"	1.12	2.75"	1.25"
3/4"	1.25	2.75"	1.25"
1"	1.50	2.75"	1.25"
1 1/4"	2.50	5.50"	3.00"
1 1/2"	4.50	12.00"	3.00"
2"	8.00	19.00"	4.00"



## TUBE ASSEMBLIES

### SOLIDWORKS

Mid-State utilizes SolidWorks engineering software. We are capable of assisting our customers in the design and routing of hydraulic tubes, hoses and fittings. We can help develop a complete hydraulic system while still in the concept design phase. All too many times, the hose and fittings are left as the final step in the product design with little thought of where it will fit or how much it will cost. Tube assemblies are usually completely overlooked and once in production are never considered. We can detect clearance issues by providing a 3D image of the "complete" hydraulic system. We can import other 3D formats and save the results in an "IGES" format for easy interaction. We can also guide our customers towards cost saving solutions before it's too late! Contact our engineering department and ask how 3D imaging can help in your hydraulic system design.



## TUBE ASSEMBLIES

### BULK TUBING



SAE J525 Electric resistant welded low carbon steel tubing meets ANS B93.4 and NFPA-STD-T3.15.66. Excellent bending and flaring characteristics. Sold in 20 foot random lengths.

Tubing O.D.	Wall Thickness	Gauge	PSI Burst Pressure	Part Number
3/16	.035	20	16,000	3-035 HWST
1/4	.035	20	12,600	4-035 HWST
1/4	.049	18	17,640	4-049 HWST
1/4	.065	16	22,000	4-065 HWST
5/16	.035	20	10,080	5-035 HWST
5/16	.049	18	14,112	5-049 HWST
3/8	.035	20	8,400	6-035 HWST
3/8	.049	18	11,760	6-049 HWST
3/8	.065	16	15,600	6-065 HWST
1/2	.035	20	6,300	8-035 HWST
1/2	.049	18	8,820	8-049 HWST
1/2	.065	16	11,700	8-065 HWST
1/2	.083	14	14,940	8-083 HWST
1/4	.095	13	17,100	8-095 HWST
5/8	.049	18	7,055	10-049 HWST
5/8	.065	16	9,360	10-065 HWST
5/8	.083	14	11,950	10-083 HWST
5/8	.095	13	13,680	10-095 HWST
3/4	.035	20	4,200	12-035 HWST
3/4	.049	18	5,880	12-049 HWST
3/4	.065	16	7,800	12-065 HWST
3/4	.083	14	9,960	12-083 HWST
3/4	.095	13	11,400	12-095 HWST
3/4	.120	11	13,080	12-120 HWST
7/8	.065	16	6,685	14-065 HWST
7/8	.083	14	8,537	14-083 HWST
7/8	.095	13	9,771	14-095 HWST
1	.065	16	5,850	16-065 HWST
1	.083	14	7,470	16-083 HWST
1	.095	13	8,550	16-095 HWST
1	.109	12	9,810	16-109 HWST
1	.120	11	10,800	16-120 HWST
1 1/4	.065	16	4,860	20-065 HWST
1 1/4	.095	13	6,840	20-095 HWST
1 1/4	.120	11	8,640	20-120 HWST
1 1/4	.134	10	11,000	20-134 HWST
1 1/2	.095	13	5,700	24-095 HWST
1 1/2	.120	11	7,200	24-120 HWST



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— Customer Service Hotline —

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**(614) 864-1811**

(For fast quotes, EZ order placement and technical assistance)  
24 Hour Order Fax Line (614) 864-0435

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