TUBES N' hoses INTERNATIONAL TRAINING

INTRODUCTION

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MARKET RESEARCH

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NOTES

Our market research goal is to help teach you to find how to find, access and capture every potential customer in your market area. With the Tubes N' Hoses program most of you will be surprised to notice that you now have several new categories of prospects that you have never called on before. It is very important that you recognize this and make those calls.

With the Tubes N' Hoses program almost every mechanic will at one time or another on a weekly, monthly, or yearly basis will need the service of your tubes and hoses program. The only problem is that he cannot use your services if he does not know about you.

Our goal is to work with you, support you and encourage you to go to all potential consumers and make those calls.

The following are recommendations you should follow toward capturing the existing markets, with which you are acquainted, as well as the ones you may not be acquainted with:

1. Use all advertising assistance available. See the categories listed on page 5 of this section.
2. Use your local chamber of commerce. Get all help they can possibly offer. After all that is why they are there, they want to help.
3. Use references Every time your salesman makes a call on someone, ask the contact who he knows that can use your services. You will usually get at least one and often serveral.
4. Interview your over-the –counter customers. Ask them who they know that can use your services. Do they belong to any associations or membership groups that can use the Tubes n' Hoses services? Do they have friends or business acquaintances that can use your Tubes n' Hoses services?
5. Advertise – Usually there are local publications that are inexpensive in which to advertise that will expose your Tubes n' Hoses program to hundreds and even thousands of readers. As you know name recognition is the secret to almost any business.
6. Mail flyers, make phone calls.
7. ABOVE ALL – MAKE PERSONAL SALES CALLS.

Tubes N' Hoses is always anxious to hear from any and all of our dealers with suggestions and ideas that will support our marketing program in your areas.

TUBES N' hoses INTERNATIONAL TRAINING

MARKET RESEARCH

POTENTIAL CUSTOMERS

Guideline Of Tubes N' Hoses
Potential Customers

NOTES

AUTOMOTIVE –

All Car Dealers, All Truck Dealers, Auto Repair Shops, Truck Repair Shops, Collision Centers, Restoration Shops, Custom Shops, Air Conditioning Shops, Radiator Shops, Performance Shops, Automotive Parts, Motorcycle Shops & Dealers, and Trucking Companies.

HYDRAULIC –

Hydraulic Hose Distributers, Hydraulic Repair Shops, Rubber & Gasket Distributors, and any Hydraulic Hose Fabricator with any type of Crimping Equipment.

CONSTRUCTION –

Road Builders, Site Prep Contractors, De-watering Contractors, Structural Contractors, Underground Contractors, Electrical (Highline) Contractors, Mechanical Contractors, Building Contractors, Rigging Contractors, and Painting Contractors.

COMMERCIAL –

Equipment Rental Dealers, Refuse & Garbage Companies, Food Processors, Bakeries, Restaurant, Hotels, Hospitals, College & University Maintenance Shops, School & School Bus Shops, Material Handling Dealers, Tree Surgeons, Concrete Plants, Concrete Pumpers, Pre-Stress Plants, Laundries, Car Wash, Bottling Plants, Outdoor Advertising Companies, Scrap Yards, Air Compressor Shops. Injection Molding Plants, Chainstore Maintenance & Fleet Shops, and Warehouse Maintenance Shops.

UTILITIES –

Electrical Above Ground & Underground Companies, and Plumbers & Sewer Maintenance.

TRANSPORTATION –

Motor Freight Companies, Car Haulers, Heavy Equipment Haulers, Railroad Car Shops, and Ground Support Equipment Shops.

INDUSTRIAL –

Paper & Pulp Mills, Generating Plants, Petroleum Plants, Chemical Plants, Scrap Yards, Mining Operators, Manufacturing Plant-All Types, Board Mills, and Plywood Mills.

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POTENTIAL CUSTOMERS

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FORESTRY –

Tree Harvesting Companies, Saw Mills, Lumber Yards, Lumber Treating Plants, Planner Mills, and Forestry Equipment Dealers & Shops.

AGRICULTURAL –

Row Crop Farmers, Farm Implement & Equipment Dealers, Harvesting Contractors, Cattle Ranches, Horse Ranches, Grass & Turf Farms, Golf Courses, Grove Operators, Fruit Harvesters, Truck & Vegetable Farmers, Vineyards, and Fruit Processing Plants.

MARINE –

Ships & Shipping Companies, Cargo Handlers, Container Delivery Truckers, Recreational Marine Dealers, Marinas, Boat Repair Shops, Barge & Towing Operators, and Tugboat Operators.

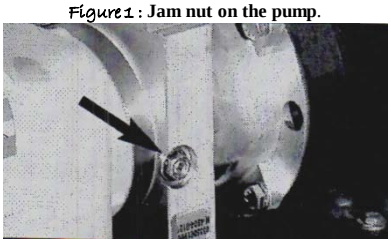
GOVERNMENT –

City & County Maintenance & Fleet Shops, Sewage Treatment Centers, Generating & Distribution Shops, Airport & Golf Course Maintenance, Military Installations, and State Road & Building Maintenance Shops.

TROUBLESHOOTING

General Information

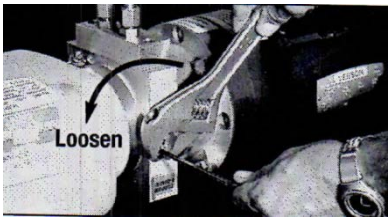
Figure1 : **Jam nut on the pump**.



Trouble shooting is a rather brief subject as there is little to go wrong as the system is simple and straight forward.

The following items that you should be aware of:

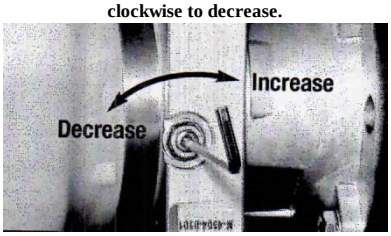
Figure2: **First, Loosen the jam nut by turning counter clockwise.**



1. PUMP PRESSURE ADJUSTMENT –

Pump pressure adjustment can be moved up or down with the procedure as illustrated. *Be very careful to never adjust the pump pressure above 3500 psi. Figures 1-3.*

Figure3: **With a hex wrench, turn clockwise to increase or counter or counter clockwise to decrease.**



2. ACTUATOR CONTROL VALVE –

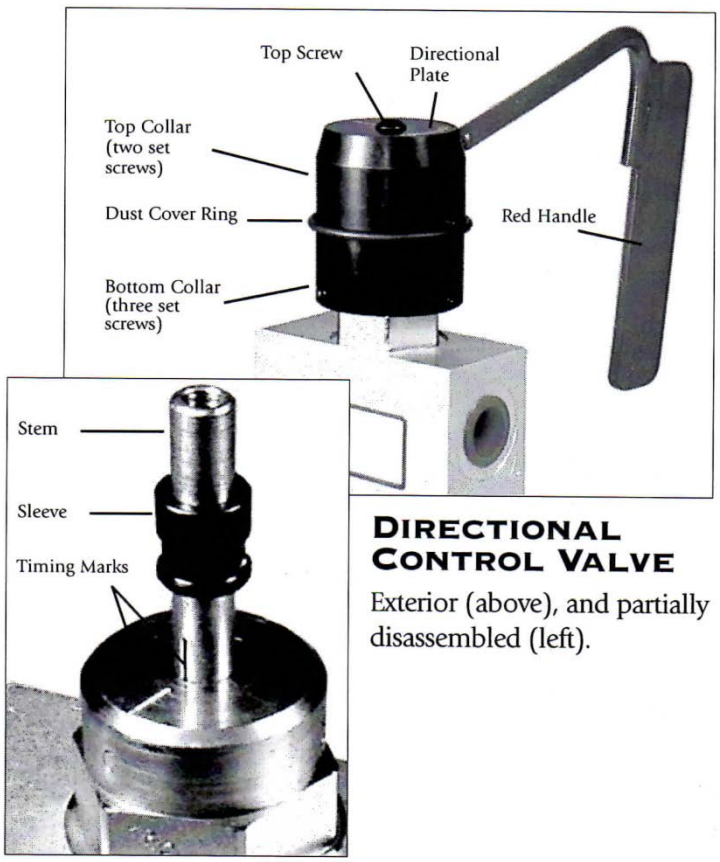
Occasionally the centering adjustment on the control valves will shift causing the actuators to “drift”.

How To Use

Timing Actuator Control Valve

READ ALL DIRECTIONS BEFORE PERFORMING PROCEDURE.

You will need a 3/32" allen wrench.



DIRECTIONAL CONTROL VALVE
Exterior (above), and partially disassembled (left).

1. Remove dust cover ring. Lift it over top collar and down over red handle.

2. Remove top screw and directional plate.

3. Loosen 2 set screws in top collar. Loosen screws until they are visible on outside of collar.

4. Remove top collar.

5. Remove sleeve from stem.

6. Loosen the three set screws and remove bottom collar.

7. Align timing mark on stem and valve nut.

8. Replace bottom collar
DO NOT TIGHTEN

9. Replace top collar. Align so red handle is pointing forward.

10. Hold bottom collar in place and remove top collar.

11. Firmly tighten the three set screws in bottom collar.

12. Replace sleeve on stem.

13. Replace top collar.

14. Push down and hold top collar. Tighten the two set screws.

15. Replace directional plate.

16. Replace top screw. Tighten screw only to hold directional plate in place.**DO NOT OVER-TIGHTEN**

SAFETY

GENERAL INFORMATION

At Tubes N' Hoses®, safety is our number one subject. Above all, we want a safe environment and work place for our technicians. A few items that are standard safety precautions are as follows:

figure 1: Photo of safety glasses and shield

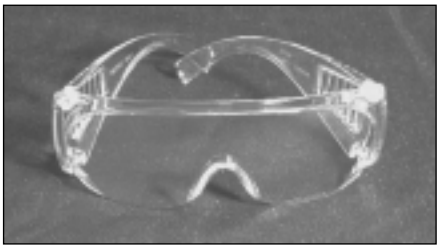
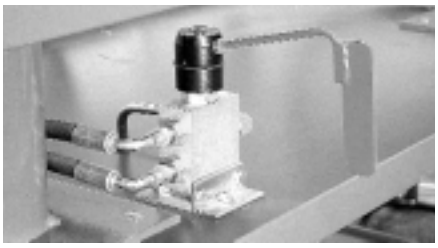


figure 2: Photo showing actuator valve.



1. Never operate a bench grinder without proper eye protection. This pertains to the grinding procedure or the wire brush procedure. You should always wear safety glasses or full face protective shields. *figure 1*

2. Never use the actuators at any workstation for any purpose except to actuate the tooling for which they were specifically designed. *figure 2*

SAFETY

GENERAL INFORMATION

KEEP AREA DRY

WEAR PROTECTIVE CLOTHING

5. Never allow or use flammables in or near the Tubes N' Hoses® work place.

6. Never allow oil or other lubricant to disperse or flow, or in any way contaminate work surfaces, walk surfaces or any other area that will inhibit the proper grasping, controlling or standing activity required in the Tubes N' Hoses® work place.

7. Never allow or store corrosive caustics in the Tubes N' Hoses® workplace.

8. Be extremely careful when cutting or deburring metal tubing or other metals by wearing proper eye protection, hand and body protection. Wear gloves, long sleeve shirts or whatever may be required to protect the entire body.

9. Wear proper foot protection at all times. Steel-toed shoes should be a must requirement.

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SAFETY

GENERAL INFORMATION

NO MUSIC

USE ONLY NON-FLAMMABLE OR NON-CAUSTIC CLEANERS

10. Do not play music or operate other noise generating devices that will intercept the all or audio operational sounds of the tubes and hoses equipment. The sounds generated by the pump and valves of the system are highly indicative of performance parameters and should never be inhibited or over shadowed with other sounds.

11. Be extremely careful that all cleaners, liquid or otherwise, are non-caustic and non-flammable. Be sure they have no carcinogens or other products that could be harmful to the eyes, respiratory system or body in any way.

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Pricing Guidlines

Hose & Fitting Fabrication

Assembly

(Crimping, Etc. or Re-Using Stems)

Hose -

Low Pressure thru High Pressure - 3/16"-5/8"	**=$5.00 Per End**
Low Pressure thru High Pressure - 3/4"-1"	**=$7.50 Per End**
High Pressure thru Extreme - 1-1/4"-2" High Pressure	**=$12.50 Per End**

Hose & Fitting -

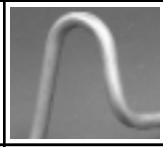
Hydraulic A/C	= Cost x 2.5:1
Teflon	= 60-70% of Dealer Selling Price =Cost x
Thermoplastic	4:1
Paint Spray	=Cost x 3:1
	=Market Price

Typical Pricing Guidelines

1. Remember to always identify the assembly. Ask customer what the application is. This will help in the identification of fittings, hose, tubing, etc. as well as help you establish the price.
2. Always ask the customer if they have checked the dealer or manufacturer for availability. 80% of the customers you ask will provide you with information such as availability and, very often, the dealer's price. This will help you establish a price for your assembly.
3. Always establish the price up front.

=TnH Recommended Pricing (Bottom Line)

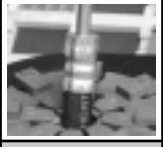
=Your Pricing

TUBE SIZE	90º PER BEND	180º PER BEND	FLARING	45º DOUBLE FLARE	37º DOUBLE FLARE	BUBBLE FLARE	UPSWAGE	DOWNSWAGE METRIC
								
3/16	$5.00	$10.00	$5.00	$5.00	$10.00	$8.00	$5.00	$5.00
1/4								
5/16	$5.00	$10.00	$5.00	$5.00	$10.00	$8.00	$5.00	$5.00
3/8	$5.00	$10.00	$5.00	$5.00	$10.00		$5.00	
7/16	$5.00	$10.00	$5.00				$5.00	
1/2	$5.00	$10.00	$5.00	$8.00	$16.00		$8.00	$15.00
9/16	$7.50	$15.00					$8.00	
5/8	$7.50	$15.00	$7.50		$15.00		$10.00	$15.00
3/4	$10.00	$20.00	$10.00		$20.00		$15.00	
7/8	$15.00	$30.00	$17.50				$17.50	
1	$15.00		$17.50				$17.50	
1-1/4	$20.00		$25.00				$20.00	

Typical Pricing Guidelines

1. Remember to always identify the assembly. Ask customer what the application is. This will help in the identification of fittings, hose, tubing, etc. as well as help you establish the price.
2. Always ask the customer if they have checked the dealer or manufacturer for availability. 80% of the customers you ask will provide you with information such as availability and, very often, the dealer's price. This will help you establish a price for your assembly.
3. Always establish the price up front.

	=TnH Recommended Pricing (Bottom Line)		=Your Pricing

TUBE OR HOSE SIZE	HYD. CRIMPS	A/C CRIMP	A/C STAKE &CRIMP	P/S STAKE &CRIMP	BRAZING	TEFLON SWAGING
						
1/4	$5.00	$5.00	$8.00	$8.00	$10.00	$10.00
5/16	$5.00	$5.00	$8.00		$10.00	$10.00
#6 A/C						
3/8	$5.00	$5.00	$8.00	$8.00	$10.00	$10.00
13/32 #8A/C						
7/16	$5.00	$5.00	$8.00		$10.00	
1/2	$7.50	$5.00	$8.00	$8.00	$15.00	$15.00
#10 A/C						
9/16	$7.50				$15.00	
5/8	$7.50	$5.00	$8.00		$15.00	$15.00
#12 A/C						
3/4	$10.00				$20.00	
7/8	$10.00				$20.00	$20.00
1	$15.00				$25.00	
1-1/4	$20.00				$25.00	

TUBES N' hoses INTERNATIONAL
TRAINING

THREAD IDENTIFICATION

NOTES

Thread identification is one of our most interesting and fun subjects. For most service personnel threads and thread identification are a source of nuisance and confusion. With the Tubes N' Hoses® program you will soon come to enjoy thread identification. It really is a lot of fun.

First of all there are only 3 types of threads that we normally encounter:

1. **AMERICAN**
2. **METRIC**
3. **BRITISH**

1. **AMERICAN -** America has the most complex combination of thread systems in the world. We have not standardized on a single type of thread system. We have pipe threads (usually tapered), JIC threads, SAE threads, compression threads, metric threads on American stems. In addition to these, we have several special combinations that are produced by individual manufacturers for obvious exclusivity purposes.

2. **METRIC -** The metric thread program is straight forward. The metric fluid line industry has standardized on threads that are simple compared to the variety that we find in the U.S.

You will find that there are only 2 pressure categories of metric threads. We have the high pressure which is designated with the letter 'S' and we have the medium pressure category which is designated with the letter 'L'. Metrics come in designated sizes and each size has a thread

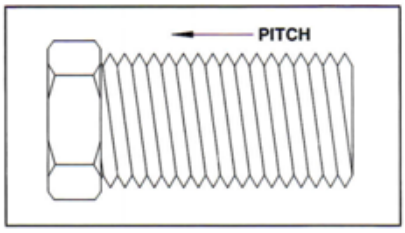
THREAD IDENTIFICATION

pitch which is usually related to that diameter. Therefore, you don't find the same diameter fittings with several different thread pitches as we do here in the U.S.

3. **BRITISH -** British threads are quite simple. British threads on fluid line fittings and connectors are almost totally standardized around the British standard Pipe referred to as BSP or BSPP which means BRITISH STANDARD PIPE or BRITISH STANDARD PIPE PARALLEL. The British have made it quite simple for us because just as in metrics, they assign, in most cases, only one thread pitch to each diameter of fitting.

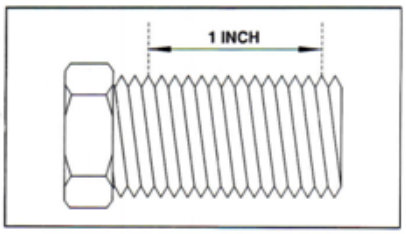
THE FOLLOWING ARE A FEW INTERESTING AND PERTINENT FACTS REGARDING FLUID LINE THREAD IDENTIFICATION:

figure 1: Illustration of thread pitch



1. Thread pitch is the amount of travel along the axis of the fitting as it progresses forward. *figure 1*

figure 2: Illustration of thread s per inch

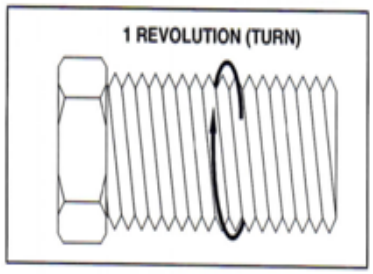


2. With American and British threads, we measure the travel by the number of threads per inch. *figure 2*

TUBES N' hoses INTERNATIONAL TRAINING

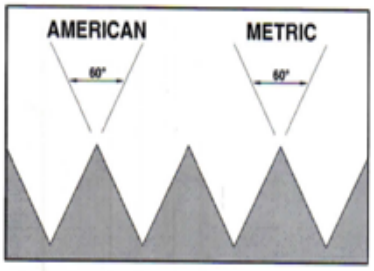
THREAD IDENTIFICATION

figure 3: Illustration of metric threads



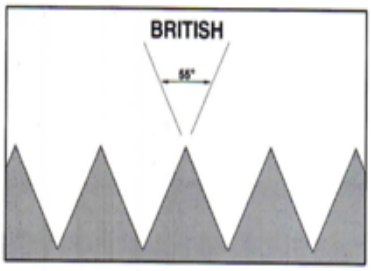
3. With metric threads we measure by the amount of travel per revolution in millimeters. *figure 3*

figure 4: Illustration of American & British pitch



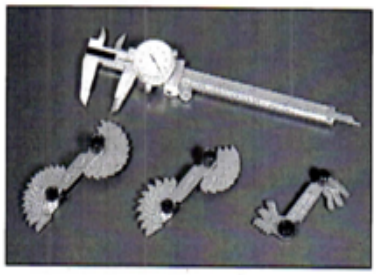
4. Accordingly American and British are measured in pitch by the number of threads per inch thus, a 5/18-18 thread means the thread is 5/8" in diameter with a pitch of 18 threads per inch. In millimeter, a fitting size of 12 x 1.5 means that the fitting is 12 millimeters in diameter with a thread pitch of 1.5 millimeters per revolution. *figure 4*

figure 5: Illustration of thread angle



5. The thread angle with American and Metric threads for fittings is 60º. The angle for British fittings is 55º. *figure 5*

figure 6: Photo of caliper, American gauge, metric Gauge, British Gauge



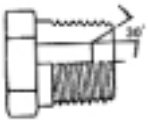
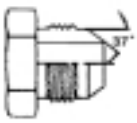
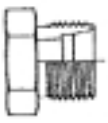
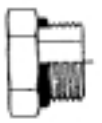
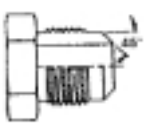
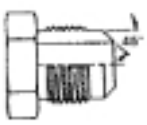
6. The only tools you need to properly identify any thread is your dial calipers, American metric and the British thread gauges and your Tubes N' Hoses® dimension charts which are listed in this section. *figure 6*

TUBES N' hoses INTERNATIONAL TRAINING

THREAD IDENTIFICATION

FITTING THREAD SIZE COMPARISON CHART

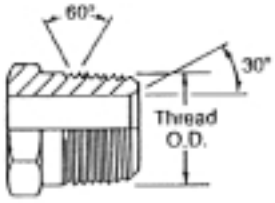
The male connections have (Male unified thread class 2 fit) UN-2A specification threads and the female connections have (Female unified thread class 2 fit) UN-2B specification threads. The exceptions are male and female pipe threads.

							
Size	**Pipe Size**	**FOR-SEAL®**	**37°Flare Flare-Twin®**	**Ermeto® 7000 Series**	**Straight Thread O-Ring SAE**	**45° Flare®**	**Inverted Flare**
1/8	1/8 - 27	-	5/16 - 24	5/16 - 24	5/16 - 24	5/16 - 24	5/16 - 24
3/16	-	-	3/18 - 20	3/8 - 24	3/8 - 24	3/8 - 24	3/8 - 24
1/4	1/4 - 18	9/16 - 18	7/16 - 20	7/16 - 20	7/16 - 20	7/16 - 20	7/16 - 24
5/16	-	-	1/2 - 20	1/2 - 20	1/2 - 20	1/2 - 20	1/2 - 20
3/8	3/8 - 18	11/16 - 16	9/16 - 18	9/16 - 18	9/16 - 18	5/8 - 18	5/8 - 18
7/16		-	-	-	-	11/16 - 16	11/16 - 18
1/2	1/2 - 14	13/16 - 16	3/4 - 16	3/4 - 16	3/4 - 16	3/4 - 16	3/4 - 18
5/8	-	1 - 14	7/8 - 14	7/8 - 14	7/8 - 14	7/8 - 14	7/8 - 18
3/4	3/4 - 14	1 3/16 - 12	1 1/16 - 12	1 1/16 - 12	1 1/16 - 12	1 1/16 - 14	1 1/16 - 16
7/8	-	1 3/16 - 12	1 3/16 - 12	1 3/16 - 12	1 3/16 - 12	-	1 3/16 - 16
1	1 - 11 1/2	1 7/16 - 12	1 5/16 - 12	1 5/16 - 12	1 5/16 - 12	-	1 5/16 - 16
1 1/4	1 1/4 - 11 1/2	1 11/16 - 12	1 5/8 - 12	1 5/8 - 12	1 5/8 - 12	-	-
1 1/2	1 1/2 - 11 1/2	2 - 12	1 7/8 - 12	1 7/8 - 12	1 7/8 - 12	-	-
2	2 - 11 1/2	-	2 1/2 - 12	2 1/2 - 12	2 1/2 - 12	-	-
2 1/2	2 1/2 - 8	-	3 - 12	-	-	-	-
3	3 - 8	-	3 1/2 - 12	-	-	-	-

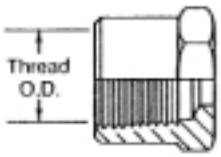
TUBES N' hoses INTERNATIONAL TRAINING

THREAD IDENTIFICATION

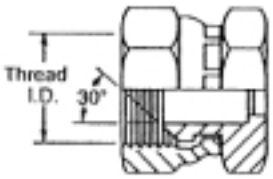
NPT PIPE THREAD



NPTF Male



NPTF Female

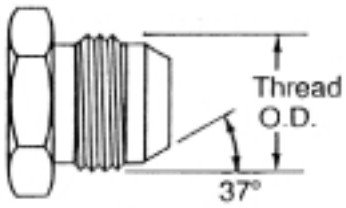


NPSM Female

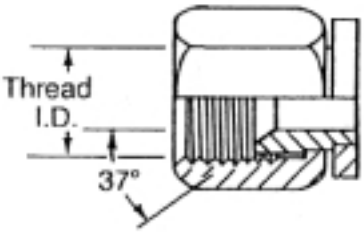
Dash size	Nominal Size (In.)	No. Threads Per Inch	Male Thread	Female Thread
			Thread O.D. (in.)	Thread I.D. (In.)
-2	1/8	27	13/32 (.406)	23/64 (.359))
-4	1/4	18	35/64 (.546)	15/32 (.468)
-6	3/8	18	43/64 (.671)	19/32 (.593)
-8	1/2	14	27/32 (.843)	23/32 (.718)
-12	3/4	14	1 1/16 (1.062)	61/64 (.953)
-16	1	11 1/2	1 5/16 (1.312)	1 13/64 (1.203)
-20	1 1/4	11 1/2	1 43/64 (1.671)	1 17/32 (1.531)
-24	1 1/2	11 1/2	1 29/32 (1.906)	1 25/32 (1.781)
-32	2	11 1/2	2 3/8 (1.375)	2 1/4 (2.250)

Thread Identification

JIC 37° FLARE



JIC 37° Male



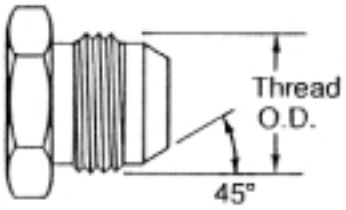
JIC 37° Flare Female

Dash size	Nominal Size (In.)	No. Threads Per Inch	Male Thread	Female Thread
			Thread O.D. (in.)	Thread I.D. (In.)
-2	1/8	24	5/16 (.312)	17/64 (.265)
-3	3/16	24	3/8 (.375)	21/64 (.328)
-4	1/4	20	7/16 (.437)	25/64 (.390)
-5	5/16	20	1/2 (.500)	29/64 (.453)
-6	3/8	18	9/16 (.562)	1/2 (.500)
-8	1/2	16	3/4 (.750)	11/16 (.687)
-10	5/8	14	7/8 (.875)	13/16 (.812)
-12	3/4	12	1 1/16 (1.062)	31/32 (.968)
-14	7/8	12	1 3/16 (1.187)	1 7/64 (1.109)
-16	1	12	1 5/16 (1.312)	1 15/64 (1.234)
-20	1 1/4	12	1 5/8 (1.625)	1 35/64 (1.546)
-24	1 1/2	12	1 7/8 (1.875)	1 51/64 (1.796)
-32	2	12	2 1/2 (2.500)	2 27/64 (2.421)

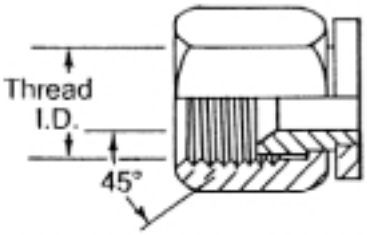
TUBES N' hoses INTERNATIONAL
TRAINING

THREAD IDENTIFICATION

SAE 45° FLARE



SAE 45° Flare Male



SAE 45° Flare Female

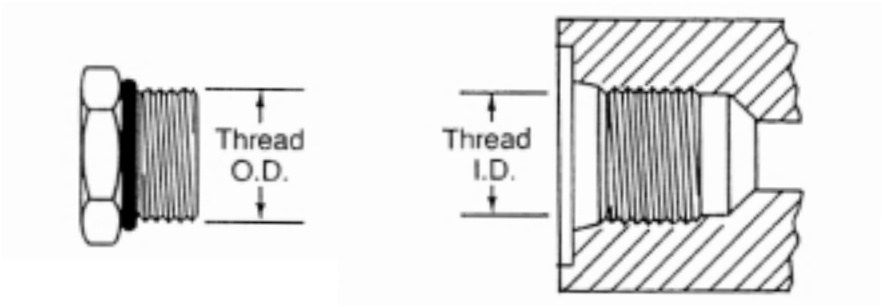
Dash size	Nominal Size (In.)	No. Threads Per Inch	Male Thread	Female Thread
			Thread O.D. (in.)	Thread I.D. (In.)
-2	1/8	24	5/16 (.312)	17/64 (.265)
-3	3/16	24	3/8 (.375)	21/64 (.328)
-4	1/4	20	7/16 (.437)	25/64 (.390)
-5	5/16	20	1/2 (.500)	29/64 (.453)
-6	3/8	18	5/8 (.625)	9/16 (.562)
-7	7/16	16	11/16 (.687)	5/8 (.625)
-8	1/2	16	3/4 (.750)	11/16 (.687)
-10	5/8	14	7/8 (.875)	13/16 (.812)
-12	3/4	14	1 1/16 (1.062)	63/64 (.984)
-14	7/8	12	1 1/4 (1.250)	1 11/64 (1.171)
-16	1	12	1 3/8 (1.375)	1 19/64 (1.296)

Tube size	Nominal Size (In.)	No. Threads Per Inch	Male Thread	Female Thread
			Thread O.D. (in.)	Thread I.D. (In.)
3/8	11/16	18	11/16 (.687)	5/8 (.625)

TUBES N' hoses INTERNATIONAL
TRAINING

THREAD IDENTIFICATION

SAE STRAIGHT THREAD O-RING BOSS



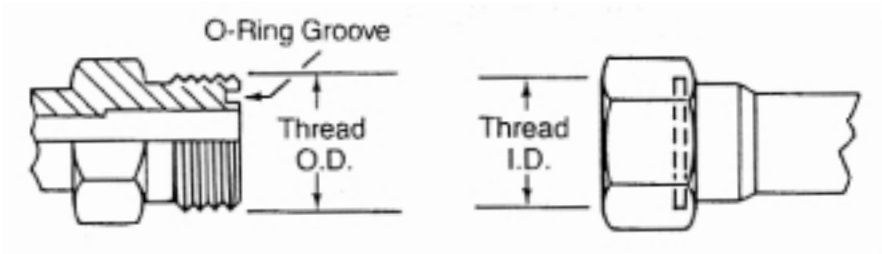
O-Ring Boss Male O-Ring Boss Female Port

Dash size	Nominal Size (In.)	No. Threads Per Inch	Male Thread	Female Thread	O-Ring	
			Thread O.D. (in.)	Thread I.D. (In.)	I.D. (in.)	Torus Dia. (In.)
-2	1/8	24	5/16 (.312)	17/64 (.265)	0.239	0.064
-3	3/16	24	3/8 (.375)	21/64 (.328)	0.301	0.064
-4	1/4	20	7/16 (.437)	25/64 (.390)	0.351	0.072
-5	5/16	20	1/2 (.500)	29/64 (.453)	0.414	0.072
-6	3/8	18	9/16 (.562)	1/2 (.500)	0.468	0.078
-8	1/2	16	3/4 (.750)	11/16 (.687)	0.644	0.087
-10	5/8	14	7/8 (.875)	13/16 (.812)	0.755	0.097
-12	3/4	14	1 1/16 (1.062)	31/32 (.968)	0.924	0.116
-14	7/8	12	1 3/16 (1.187)	1 7/64 (1.109)	1.048	0.116
-16	1	12	1 5/16 (1.312)	1 15/64 (1.234)	1.171	0.116
-20	1 1/4	12	1 5/8 (1.625)	1 35/64 (1.546)	1.475	0.118
-24	1 1/2	12	1 7/8 (1.875)	1 51/64 (1.796)	1.720	0.118
-32	2	12	2 1/2 (2.500)	2 27/64 (2.421)	2.337	0.118

TUBES N' hoses INTERNATIONAL
TRAINING

THREAD IDENTIFICATION

O-RING FACE SEAL – SAE J1453



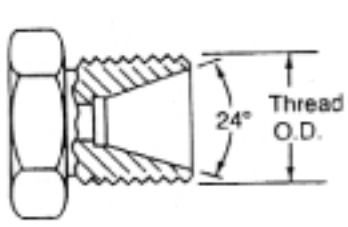
O-Ring Face Seal
Solid Male

O-Ring Face Seal
Swivel Female

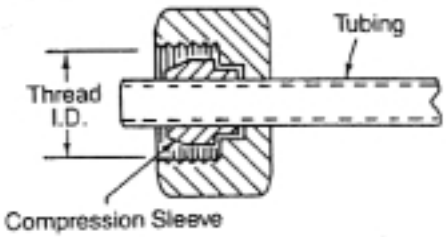
Dash size	Nominal Size (In.)	Thread Size	Male Thread	Female Thread	O-Ring Size (SAE J120)
			Thread O.D. (in.)	Thread I.D. (In.)	
-4	1/4	9/16 - 18	9/16 (.562)	1/2 (..500)	-011
-6	3/8	11/16 - 16	11/16 (.687)	5/8 (.625)	-012
-8	1/2	13/16 - 16	13/16 (.812)	3/4 (.750)	-014
-10	5/8	1 - 14	1 (1.000)	15/16 (.937)	-016
-12	3/4	1 13/16 - 12	1 3/16 (1.187)	1 1/8 (1.125)	-018
-16	1	1 7/16 - 12	1 7/16 (1.437)	1 11/32 (1.343)	-021
-20	1 1/4	1 11/16 - 12	1 11/16 (1.687)	1 19/32 (1.593)	-025
-24	1 1/2	2 - 12	2 (2.000)	1 29/32 (1.906)	-029

THREAD IDENTIFICATION

7000 SERIES FLARELESS TUBE



Solid Male



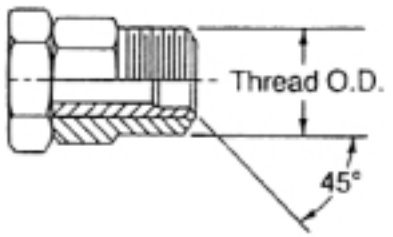
Female Nut

Dash size	Tube Size (in.)	Nominal Size (In.)	No. Threads Per Inch	Male Thread	Female Thread
				Thread O.D. (in.)	Thread I.D. (In.)
-2	1/8	5/16	24	5/16 (.312)	17/64 (.265)
-3	3/16	3/8	24	3/8 (.375)	21/64 (.328)
-4	1/4	7/16	20	7/16 (.437)	25/64 (.390)
-5	5/16	1/2	20	1/2 (.500)	29/64 (.453)
-6	3/8	9/16	18	9/16 (.562)	1/2 (.500)
-8	1/2	3/4	16	3/4 (.750)	11/16 (.687)
-10	5/8	7/8	14	7/8 (.875)	13/16 (.812)
-12	3/4	1 1/16	12	1 1/16 (1.062)	31/32 (.968)
-14	7/8	1 3/16	12	1 3/16 (1.187)	1 7/64 (1.109)
-16	1	1 5/16	12	1 5/16 (1.312)	1 15/64 (1.234)
-20	1 1/4	1 5/8	12	1 5/8 (1.625)	1 35/64 (1.546)
-24	1 1/2	1 7/8	12	1 7/8 (1.875)	1 51/64 (1.796)
-32	2	2 1/2	12	2 1/2 (2.500)	2 27/64 (2.421)

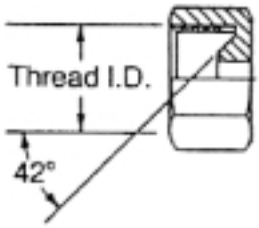
TUBES N' hoses INTERNATIONAL TRAINING

THREAD IDENTIFICATION

SAE INVERTED FLARE



SAE Inverted Flare
Swivel Male

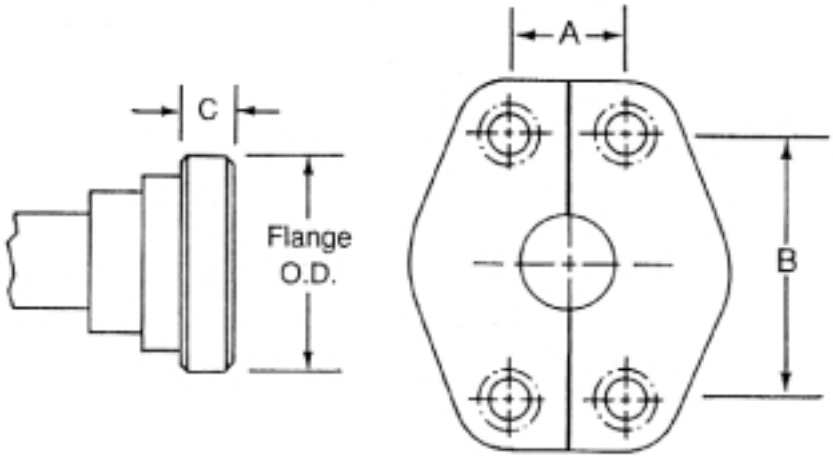


SAE Inverted Flare
Solid Female

Dash size	Nominal Size (In.)	No. Threads Per Inch	Male Thread	Female Thread
			Thread O.D. (in.)	Thread I.D. (In.)
-2	1/8	28	5/16 (.312)	9/32 (.281)
-3	3/16	24	3/8 (.375)	21/64 (.328)
-4	1/4	24	7/16 (.437)	25/64 (.390)
-5	5/16	20	1/2 (.500)	29/64 (.453)
-6	3/8	18	5/8 (.625)	37/64 (.578)
-7	7/16	18	5/8 (.625)	11/16 (.687)
-8	1/2	18	3/4 (.750)	45/64 (.703)
-10	5/8	18	7/8 (.875)	13/16 (.812)
-12	3/4	16	1 1/16 (1.062)	1 (1.000)

THREAD IDENTIFICATION

SAE CODE 61 & CODE 62
4 BOLT SPLIT FLANGE



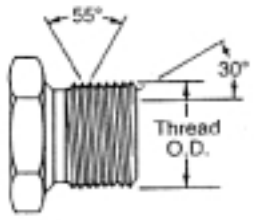
Flange head

4-Bolt Split Flange
Bolt Hole Dimensions

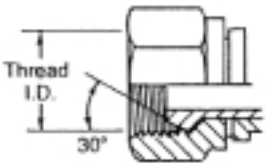
Nominal Flange Size	Code 61				Code 62				Caterpillar			
	Flange O.D.	A	B	C	Flange O.D.	A	B	C	Flange O.D.	A	B	C
1/2	1.188	.688	1.500	.265	1.250	.718	1.594	.305				
5/8	1.338			.265								
3/4	1.500	.876	1.875	.265	1.625	.938	2.000	.345	1.625	.938	2.000	.560
1	1.750	1.030	2.062	.315	1.875	1.094	2.250	.375	1.875	1.094	2.250	.560
1 1/4	2.000	1.188	2.312	.315	2.125	1.250	2.625	.405	2.125	1.250	2.625	.560
1 1/2	2.375	1.406	2.750	.315	2.500	1.483	3.125	.495	2.500	1.438	3.125	.560
2	2.812	1.688	3.062	.375	3.125	1.750	3.812	.495	3.125	1.750	3.812	.560

THREAD IDENTIFICATION

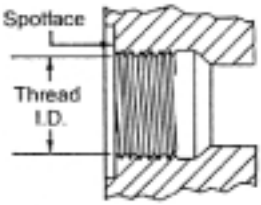
BRITISH STANDARD PIPE (BSP) BSP PARALLEL (BSPP)



BSPP Male



BSPP Female



BSPP Female Port

Dash size	Nominal Size (In.)	No. Threads Per Inch	Male Parallel	Female Parallel
			Thread O.D. (in.)	Thread I.D. (In.)
-2	1/8	28	3/8 (.375)	11/32 (.343)
-4	1/4	19	17/32 (.531)	15/32 (.468)
-6	3/8	19	21/32 (.656)	19/32 (.593)
-8	1/2	14	13/16 (.812)	3/4 (.750)
-10	5/8	14	29/32 (.906)	13/16 (.812)
-12	3/4	14	1 1/32 (1.031)	31/32 (.968)
-16	1	11	1 11/32 (1.343)	1 7/32 (1.218)
-20	1 1/4	11	1 21/32 (1.656)	1 17/32 (1.531)
-24	1 1/2	11	1 7/8 (1.875)	1 25/32 (1.781)
-32	2	11	2 11/32 (2.343)	1 7/32 (2.218)

TUBES N' hoses INTERNATIONAL

TRAINING

THREAD IDENTIFICATION

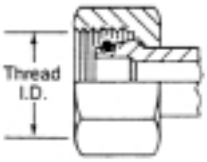
DIN METRIC MEASURING CHART

TUBE SIZE O.D.(MM)	SERIES	THREAD SIZE MALE mm (in.)	THREAD PITCH (mm)	THREAD SIZE FEMALE mm(in.)	HEX SIZE (mm)
4	LL	8(.315)	1.0	6.5(.256)	10
6	LL	10(.394)	1.0	8.5(.335)	12
8	LL	12(.472)	1.0	10.5(.413)	14
6	L	12(.472)	1.5	10.5(.413)	14
8	L	14(.551)	1.5	12.5(.492)	17
10	L	16(.630)	1.5	14.5(.571)	19
12	L	18(.709)	1.5	16.5(.650)	22
15	L	22(.866)	1.5	20.5(.807)	27
18	L	26(1.024)	1.5	24.5(.965)	32
22	L	30(1.181)	2.0	28.5(1.122)	36
28	L	36(1.417)	2.0	33.9(1.335)	41
35	L	45(1.771)	2.0	42.9(1.689)	50
42	L	52(2.047)	2.0	49.9(1.965)	60
6	S	14(.551)	1.5	12.5(.492)	17
8	S	16(.630)	1.5	14.5(.571)	19
10	S	18(.709)	1.5	16.5(.650)	22
12	S	20(.787)	1.5	18.5(.728)	24
14	S	22(.866)	1.5	20.5(.807)	27
16	S	24(.945)	1.5	22.5(.886)	30
20	S	30(1.181)	2.0	27.9(1.098)	36
25	S	36(1.417)	2.0	33.9(1.335)	46
30	S	42(1.654)	2.0	39.9(1.571)	50
38	S	52 (2.047)	2.0	49.9 (1.965)	60

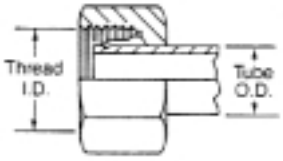
THREAD IDENTIFICATION

DIN 24° MALE & MATING FEMALES

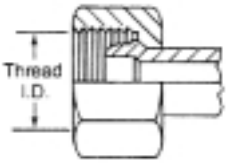
Male
24° Cone, DIN 2353



Female
24° Cone
O-Ring



Female
Metric Tube



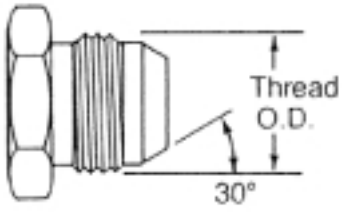
Female
Universal 24° or
60° Cone

Metric Thread Size	Male Thread O.D. (mm)	Female Thread I.D. (mm)	Tube O.D. Light Series (mm)	Tube O.D. Heavy Series (mm)
M12X1.5	12.0 (.472)	10.5 (.413)	6 (.236)	–
M14X1.5	14.0 (.551)	12.5 (.492)	8 (.315)	–
M16X1.5	16.0 (.629)	14.5 (.570)	10 (.393)	8 (.315)
M18X1.5	18.0 (.708)	16.5 (.649)	12 (.472)	10 (.393)
M20X1.5	20.0 (.787)	18.5 (.728)	14 (.551)	12 (.472)
M22X1.5	22.0 (.866)	20.5 (.807)	15 (.590)	14 (.551)
M24X1.5	24.0 (.944)	22.5 (.885)	–	16 (.629)
M26X1.5	26.0 (1.024)	24.5 (.965)	18 (.708)	–
M30X2.0	30.0 (1.181)	28.0 (1.102)	22 (.866)	20 (.787)
M36X2.0	36.0 (1.417)	34.0 (1.338)	28 (1.102)	25 (.984)
M42X2.0	42.0 (1.653)	40.0 (1.574)	–	30 (1.181)
M45X2.0	45.0 (1.771)	43.0 (1.692)	35 (1.378)	–
M52X2.0	52.0 (2.047)	50.0 (1.968)	42 (1.653)	38 (1.496)

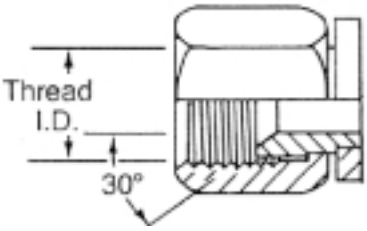
TUBES N' hoses INTERNATIONAL
TRAINING

THREAD IDENTIFICATION

JAPANESE 30° FLARE
PARALLEL THREADS



Male



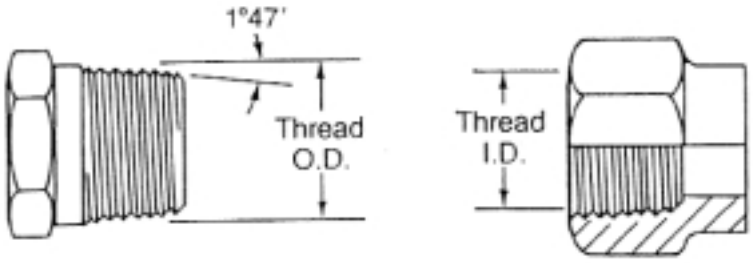
Female

Dash size	Nominal Size (In.)	No. Threads Per Inch	Male Thread	Female Thread
			Thread O.D. (in.)	Thread I.D. (In.)
-2	1/8	28	3/8 (.375)	11/32 (.343)
-4	1/4	19	17/32 (.531)	7/16 (.437)
-6	3/8	19	21/32 (.656)	19/32 (.593)
-8	1/2	14	13/16 (.812)	3/4 (.750)
-10	5/8	14	29/32 (.906)	13/16 (.812)
-12	3/4	14	1 1/32 (1.031)	15/16 (.937)
-16	1	11	1 5/16 (1.312)	1 3/16 (1.187)
-20	1 1/4	11	1 21/32 (1.656)	1 17/32 (1.531)
-24	1 1/2	11	1 7/8 (1.875)	1 25/32 (1.781)
-32	2	11	1 11/32 (1.343)	2 7/32 (2.218)

TUBES N' hoses INTERNATIONAL
TRAINING

THREAD IDENTIFICATION

JAPANESE TAPERED PIPE THREAD



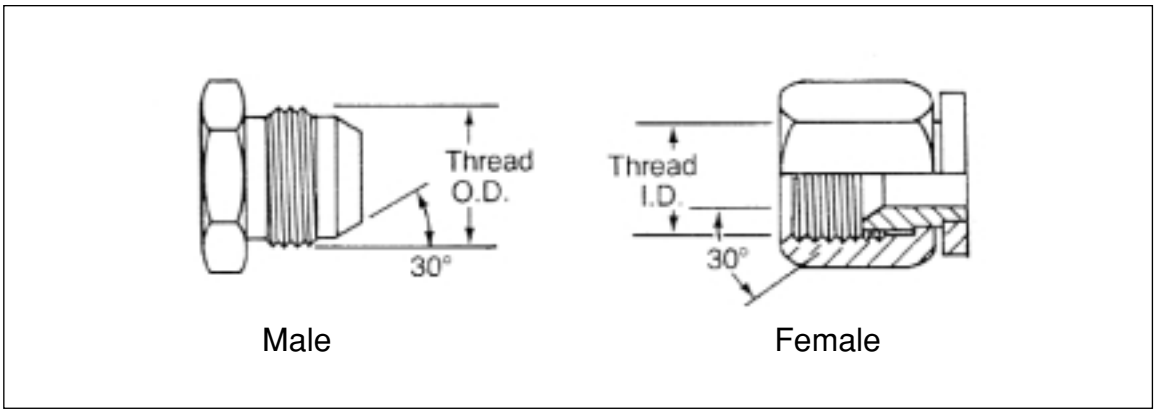
Male Female

Dash size	Nominal Size (In.)	No. Threads Per Inch	Male Thread	Female Thread
			Thread O.D. (in.)	Thread I.D. (In.)
-2	1/8	28	3/8 (.375)	11/32 (.343)
-4	1/4	19	17/32 (.531)	15/32 (.468)
-6	3/8	19	21/32 (.656)	19/32 (.593)
-8	1/2	14	13/16 (.812)	3/4 (.750)
-12	3/4	14	1 1/32 (1.031)	15/16 (.937)
-16	1	11	1 5/16 (1.312)	1 3/16 (1.187)
-20	1 1/4	11	1 21/32 (1.656)	1 17/32 (1.531)
-24	1 1/2	11	1 7/8 (1.875)	1 25/32 (1.781)
-32	2	11	2 11/32 (1.343)	2 7/32 (2.218)

TUBES N' hoses INTERNATIONAL TRAINING

THREAD IDENTIFICATION

KOMATSU 30° FLARE PARALLEL THREADS

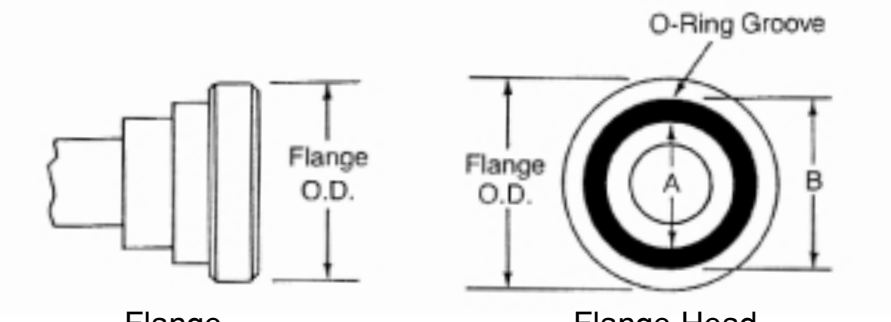


Dash size	Nominal Size		Metric Thread Size	Male Thread	Female Thread
	(in.)	(mm)		Thread O.D. (mm)	Thread I.D. (mm)
-6	3/8	9.5	M18X1.5	18 (.708)	16.4 (.645)
-8	1/2	13	M22X1.5	22 (.866)	20.4 (.803)
-10	5/8	16	M24X1.5	24 (.944)	22.4 (.882)
-12	3/4	19	M30X1.5	30 (1.181)	28.4 (1.118)
-16	1	25	M33X1.5	33 (1.299)	31.4 (1.236)
-20	1 1/4	32	M36X1.5	36 (1.417)	34.4 (1.354)
-24	1 1/2	38	M42X1.5	42 (1.653)	40.4 (1.590)

TUBES N' hoses INTERNATIONAL TRAINING

THREAD IDENTIFICATION

KOMATSU FLANGE FITTING



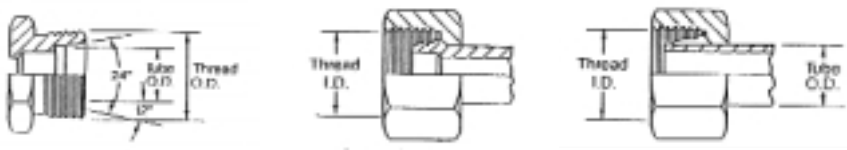
Flange Flange Head

Dash size	Nominal Size (in.)	Nominal Size (mm)	Flange O.D. (in.)	A (in.)	B (in.)
-8	1/2	12.7	1.188	.728	.984
-10	5/8	15.9	1.345	.728	1.102
-12	3/4	19.1	1.500	.846	1.220
-16	1	25.4	1.750	1.122	1.496
-20	1 1/4	31.8	2.000	1.358	1.732
-24	1 1/2	38.1	2.375	1.750	2.125
-32	2	50.8	2.812	2.225	2.559

TUBES N' hoses INTERNATIONAL TRAINING

THREAD IDENTIFICATION

FRENCH MILLIMETRIQUE & GAZ THREADS

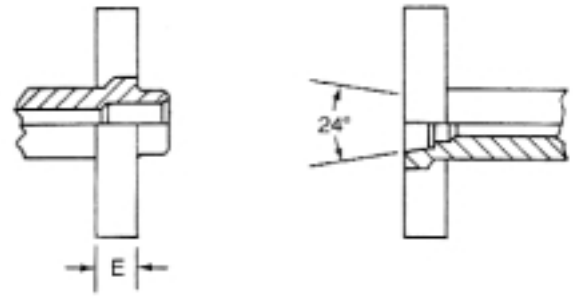


Male 24° Cone | Female 24° Cone | Female Tube Fitting

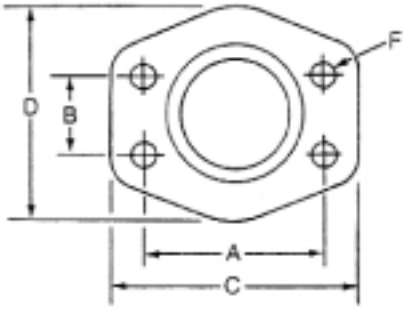
Metric Thread Size	Male Thread O.D. (mm)	Female Thread I.D. (mm)	Tube O.D.	GAZ Tube O.D.
M12X1	12.0 (.472)	11 (.433)	6 (.236)	–
M14X1.5	14.0 (.551)	12.5 (.492)	8 (.315)	–
M16X1.5	16.0 (.629)	14.5 (.570)	10 (.393)	–
M18X1.5	18.0 (.708)	16.5 (.649)	12 (.472)	–
M20X1.5	20.0 (.787)	18.5 (.728)	14 (.551)	13.25 (.521)
M22X1.5	22.0 (.866)	20.5 (.807)	15 (.590)	–
M24X1.5	24.0 (.944)	22.5 (.885)	16 (.630)	16.75 (.659)
M27X1.5	27.0 (1.063)	25.5 (1.003)	18 (.708)	–
M30X1.5	30.0 (1.181)	28.5 (1.122)	22 (.866)	21.25 (.836)
M33X1.5	33.0 (1.299)	31.5 (1.240)	25 (.984)	–
M36X1.5	36.0 (1.417)	34.5 (1.358)	28 (1.102	26.75 (1.053)
M39X1.5	39.0 (1.535)	37.5 (1.476)	30 (1.181)	–
M42X1.5	42.0 (1.653)	40.5 (1.594)	32 (1.259)	–
M45X1.5	45.0 (1.771)	43.5 (1.712	35 (1.378)	33.50 (1.319)
M48X1.5	48.0 (1.889)	46.5 (1.830)	38 (1.496)	–
M52X1.5	52.0 (2.047)	50.5 (1.988)	40 (1.574)	42.25 (1.663)
M54X2.0	54.0 (2.125)	51.9 (2.043)	45 (1.771)	–
M58X2	58.0 (2.283)	55.9 (2.200)	–	48.25 (1.899)

THREAD IDENTIFICATION

POCLAIN (FRENCH GAZ)
24° HIGH PRESSURE FLANGE



Male Flange Female Flange



Flange Clamp

Nominal size (in.)	A (in.)	B (mm)	C (in.)	D (in.)	E (in.)	F (in.)
1/2	1.57	.72	2.20	1.89	.55	.35
5/8	1.57	.72	2.20	1.89	.55	.35
3/4	2	.94	2.75	2.38	.71	.43

PRESSURE TESTING

INTRODUCTION

figure 1: Photo of Testmaster.

Pressure testing is becoming an increasingly important discipline in the world of Fluidline Fabrication. Owens Research developed the pressure testing system (patented) for the Tubes N' Hoses® program several years ago, realizing that it is becoming extremely critical to validate fluid line assemblies before putting them into service. *figure 1*

The Tubes N' Hoses® pneumatic tester was developed especially with automotive fluid lines in mind.

TUBES N' hoses INTERNATIONAL
TRAINING

PRESSURE TESTING

SAFETY

NOTES

Any testing procedure especially pressure testing should be approached with utmost caution.

1. Always wear proper eye protection.
2. Be sure test assembly is behind a protective barrier.
3. Never stand in close proximity to the test assembly.
4. Never allow an observer or other persons in the test area.

PRESSURE TESTING

PROCEDURE

figure 2: Photo of Blanking Plugs.

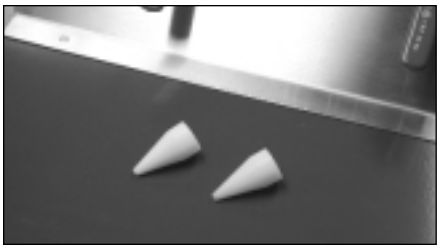


figure 3: Photo attaching Gator Jaws.

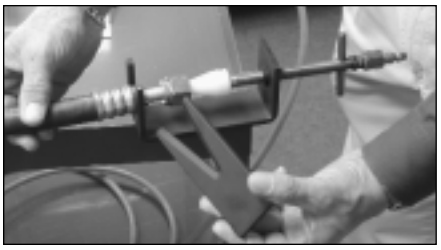


figure 4: Photo of Injector Nozzle sealed.

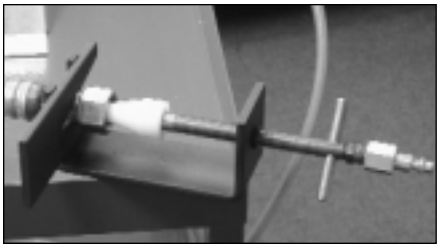


figure 5: Photo of the Blanking Plug.

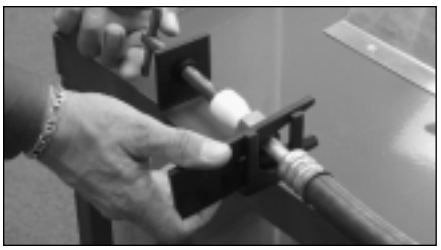


figure 6: Photo closing the dump vavle.

1. Identify the type of blanking plug and injection plug that you will use. *Example:* you have an assembly with fittings with a circular throat, you would use the tapered injection plug and blanking plug. If you have banjo type fittings, you will use a flat blanking plate. *figure 2*

2. Use the "gator" jaw to latch the fitting you are using for the injector side into the cradle. *figure 3*

3. Advance and seal the injector nozzle into the throat of the fitting by turning the threaded adjustment tube until the nose cone seals on the internal lip of the fitting. Be careful not to damage or spread the throat of the fitting, as some of the aluminum stem or fittings are soft and tend to deform or spread. *figure 4*

4. Repeat the above process with the blanking plug on the opposite end of the hose you are testing. *figure 5*

5. Close the DUMP valve on the control panel. *figure 6*

PRESSURE TESTING

PROCEDURE

figure 7: Photo of pressure adjustment vavle.

figure 8: Photo of testing material behind the Lexanne Testing shield.

figure 9: Photo spraying soapy water on fittings.

6. Adjust the pressure regulator to desired testing pressure. Turn the pressure adjustment vavle clockwise to increase the pressure and turn counterclockwise to decrease the pressure. NEVER TEST AT PRESSURES MORE THAN 400psi. *figure 7*

7. Position the test assembly carefully behind the Lexanne testing shield on the front of the testing station. An option which many prefer, is to immerse the test assembly in a large tub of clean water. *figure 8*

8. Slowly open pressure valve on the instrument panel allowing the assembly to pressurize. Close valve upon reaching test pressure. If you have no leaks, you should also close the tank valve and allow the assembly to "soak" for 5 minutes. Some technicians do not use the soak procedure. It's a matter of choice. *NOTE:* If you use the water immersion procedure and you do happen to have a small leak around the nose cone or the blanking plug, you can still get a quick pressure check by observing the fitting connections. If the fitting connections do not leak, while you maintain constant test pressure, you obviously have a good seal on the fittings. *figure 9*

9. Leaky connections can be tightened or adjusted until a seal is achieved. Many dealers use rubber sleeves over the nose cone as a sealing cushion on both the injector and blanking plugs.

TUBES N' hoses INTERNATIONAL TRAINING

PRESSURE TESTING

PROCEDURE

NOTE: ADVISE YOUR CUSTOMER THAT THE ASSEMBLY HAS BEEN PRESSURE TESTED AND THAT YOU HAVE MARKED THE ASSEMBLY WHICH WILL IDENTIFY ANY IRREGULAR MOVEMENT DURING ASSEMBLY. YOU WILL THEREFORE NOT BE RESPONSIBLE FOR IRREGULAR OR IMPROPER ASSEMBLY PROCEDURE.

SILVER BRAZING

Brazing is a very important part of a modern fluid line service program. At Tubes N' Hoses® we have perfected the best available procedures for:

1. **SILVER BRAZING**
2. **ALUMINUM BRAZING**
3. **HIGH TENSILE ALL PURPOSE BRAZING**

FOR A SUCCESSFUL BRAZING CAREER NEVER FORGET THE FOLLOWING RULES:

figure 1: Photo

figure 2: Photo

SILVER BRAZING PROCEDURE -

The Tubes N' Hoses® Silver Brazing program works with ferrous metals, most grades of stainless steel, copper, bronze and brass.

Silver Brazing is a very easy procedure to learn and use. It is a necessary and extremely profitable procedure for on-going fluid line fabrication procedures. The basics steps are as follows:

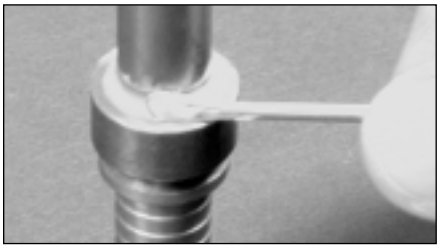
1. Flush the part you wish to braze with solvent. YOUR CLEANING SOLVENT MUST BE NON-FLAMMABLE AND HAVE A DRY RESIDUE BASE. THE SOLVENT YOU USE SHOULD LEAVE NO FILM. *figure 1*

2. Use clean wire brushes or sand paper and clean to bare metal. Leave a slightly rough surface. Flush with compressed air. *figure 2*

SILVER BRAZING

3. Be sure to clean the internal part well beyond the brazing area. This is important because contamination is attracted to heat and as you heat the brazing area, contamination will flow to the brazing area and prevent successful brazing.

figure 3: Photo

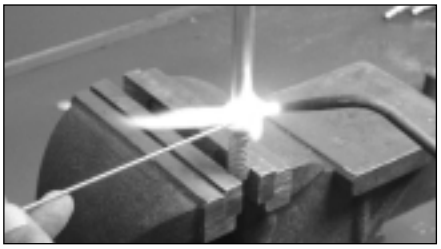


4. You are now ready to begin the FLUXING procedure. Proper fluxing is critical to all silver brazing. Never allow the brazing flux to flow internal of the brazing joint. This will cause internal blockage and contamination of the assembly. Apply the brazing flux to the outside of the joint to be brazed so that it may "suck" or flow into the joint just prior to applying the silver brazing alloy. *NOTE:* The braze joint should be on a perfectly parallel axis.
   figure 3

5. Light the torch. Study and observe all the rules published by any manufacturer of Oxy-Acetylene brazing torches. (See brazing torch procedures). Adjust the flame according to the size of the work you will be brazing. The flame should be adjusted with a medium "feather" so that it flows almost 180º around the joint you are brazing.
6. You will notice that you will need to apply more heat to the thicker part so that both male and female segments are heated equally. As the material temperature increases to the brazing level, you will notice the material start to become reddish in color and the flux is or has melted and "sucked" into the joint.

SILVER BRAZING

figure 4: Photo



7. You are very close or ready to apply the brazing alloy. With the flame focused on the joint, apply the brazing alloy directly in front of the flame. You will notice that when the silver alloy starts to flow, it becomes an extremely thin liquid and flows around and into the joint at the same time. A properly heated joint for small assemblies (1/2” or less), will only require 2 or 3 “taps” with the brazing rod as you move equally around the joint. *figure 4*

8. Allow the joint to air-cool. Do not touch any component while the braze is still hot or shock cool with water until the joint has cooled considerably. Shock cooling may leave stress components which may result in later fracture.

ALUMINUM BRAZING

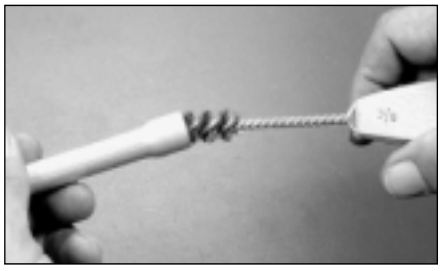
Traditionally Aluminum Brazing has been difficult if not impossible for many people to accomplish. Tubes N' Hoses® Aluminum Brazing procedure is an easy to learn procedure that is also a lot of fun.

ALUMINUM BRAZE PROCEDURE -

figure 1: Photo

1. Chemically clean and flush the surfaces to be brazed. All surfaces especially female surfaces should be cleaned well beyond the brazing area. *figure 1*

figure 2: Photo



2. Continue the cleaning process using very clean sandpaper and wire brushes. *figure 2*

figure 3: Photo

3. If using a liquid or paste flux lightly coat the male component and insert into the brazing joint. This should leave a ridge of flux around the joint to be brazed. *figure 3*

4. Light the torch and bring the flame to a soft, but positive flow. The flame should have a medium "feather" and should flow smoothly almost halfway around the joint.

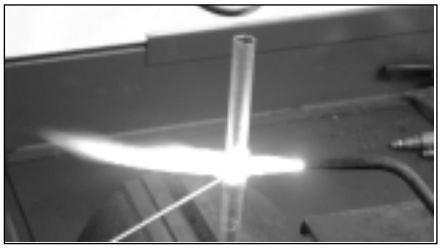
ALUMINUM BRAZING

5. Heat the joint evenly on all sides. Be careful that you do not allow cold spots anywhere on the circumference of the joint. Cold spots will cause rejection of your brazing alloy.

6. Watch the brazing flux and notice when it starts to become liquid. This is "telltale" that your joint is at or close to brazing temperature. *NOTE:* Aluminum is difficult to gage brazing temperature because it does not change colors with heat.

   At this time you may lay your brazing rod in front of the flame to see its reaction to temperature. If you are at brazing temperature it will start to flow, if not it will roll up in a small ball and can be flipped away. Continue the heating process with the testing of the rod until you achieve brazing temperature.

figure 4: Photo



7. At brazing temperature the rod will begin to flow into and around the joint. At this time you will need to work the rod either left or right keeping it in front of the flame and allowing it to flow into the joint. You will develop a technique of reaching over and around the joint with your rod and torch to lay the filler rod into the joint. *figure 4*

ALUMINUM BRAZING

8. As you progress with the technique you will learn to heat and cool the joint by moving the torch in and out from the joint. While you are bringing it to temperature you will move it inward until your rod begins to flow. After you achieve flow you might want to move the torch outward a bit in order not to overheat the joint. This is very important because your base metal and filler metal both flow at approximately the same temperature. The sensitive and difficult part of aluminum brazing is the controlling of temperature so as to not overheat the base metal while achieving flow from the filler.

figure 5: Photo

9. While brazing with aluminum you may want to continue dipping the end of your braze rod in the flux. Many technicians prefer this technique as it seems to add to the brazing flow. *figure 5*

10. Allow to air cool.

ALL PURPOSE BRAZING

The Tubes N' Hoses® All Purpose Brazing program uses a very high tinsel alloy brazing rod with pre-coated flux. It is compatible with ferrous metals, stainless steel, bronze and brass. It is a very high tinsel product (120,000 PSI) and is very easy to use.

figure 1: Photo

figure 2: Photo

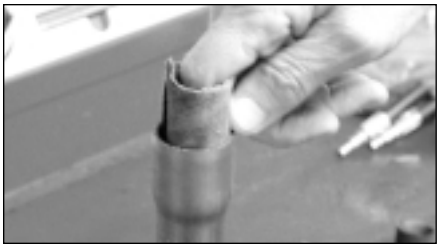
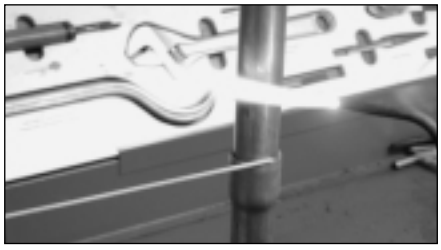


figure 3: Photo



ALL PURPOSE BRAZE PROCEDURE -

1. Chemically clean both the male and female brazing surfaces. Mechanically clean using clean sandpaper and wire brushes. As usual flush and clean well beyond all brazing surfaces. *figures 1 & 2*

2. Since all purpose rod is used in applications for larger joints that require larger fill or buildup than can be accomplished with Silver Brazing, you will find that you will usually be using larger flame and higher heat.

3. Just as with Silver Brazing your brazing temperature is indicated by the reddish glow of the base metal.

4. All purpose brazing rod is quite easy to use. It flows smoothly and can be managed easily with the flame from the torch. All purpose rod will flow into the joint but it does not flow like the silver braze. In order to achieve flow with all purpose rod, be sure to heat the bottom of the joint in order to "draw" the molten filler into the joint. *figure 3*

TUBES N' hoses INTERNATIONAL
TRAINING

TECHNICAL DATA

NOTES

Technical charts pertaining to the fabrication of fluid lines both rigid and flexible are made available to help the tubes and hoses dealer to give their customer the best product and service possible.

Information provided is to offer technical accuracy when fabricating fluid lines for the customer and at the same time offer educational material to maintain a leadership position for the Tubes N' Hoses® dealer.

New charts and information will be published as necessary and as available.

INCHES INTO MILLIMETERS

1 inch = 24.40005 mm

in.	mm.	in.	mm.	in.	mm.	in.	mm.
1/64	0.397	1-1/2	38.10	15	381.0	36	914.4
1/32	0.794	1-3/4	44.45	16	406.4	38	965.2
3/64	1.191	2	50.80	17	431.8	40	1016.0
1/16	1.588	2-1/2	63.50	18	457.2	42	1067.0
3/32	2.381	3	76.20	19	482.6	44	1118.0
1/8	3.175	3-1/2	88.90	20	508.0	46	1168.0
5/32	3.969	4	101.60	21	533.4	48	1219.0
3/16	4.763	4-1/2	114.30	22	558.8	50	1270.0
1/4	6.350	5	127.00	23	584.2	55	1397.0
5/16	7.938	6	152.40	24	609.6	60	1524.0
3/8	9.525	7	177.80	25	635.0	65	1651.0
7/16	11.110	8	203.20	26	660.4	70	1778.0
1/2	12.700	9	228.60	27	685.8	75	1905.0
5/8	15.880	10	254.00	28	711.2	80	2032.0
3/4	19.050	11	279.40	29	736.6	85	2159.0
7/8	22.230	12	304.80	30	762.0	90	2286.0
1	25.400	13	330.20	32	812.8	95	2413.0
1-1/4	31.750	14	355.60	34	863.6	100	2540.0

MILLIMETERS INTO INCHES

1 mm. = 0.03937000 in.

mm.	in.	mm.	in.	mm.	in.	mm.	in.
1	0.039	28	1.102	130	5.118	750	29.53
2	0.079	30	1.181	140	5.512	800	31.50
3	0.118	35	1.378	150	5.906	850	33.46
4	0.158	40	1.575	160	6.299	900	35.43
5	0.197	45	1.772	170	6.693	950	37.40
6	0.236	50	1.969	180	7.087	1000	39.37
7	0.276	55	2.165	190	7.480	1250	49.21
8	0.315	60	2.362	200	7.874	1500	59.05
9	0.354	65	2.559	250	9.842	1750	68.90
10	0.394	70	2.756	300	11.810	2000	78.74
12	0.472	75	2.953	350	13.780	2500	98.43
14	0.551	80	3.150	400	15.750	3000	118.10
16	0.630	85	3.346	450	17.720	3500	137.80
18	0.709	90	3.543	500	19.690	4000	157.50
20	0.787	95	3.740	550	21.650	4500	177.20
22	0.866	100	3.937	600	23.620	5000	196.90
24	0.945	110	4.331	650	25.590	7500	295.30
26	1.024	120	4.724	700	27.560	10000	393.70

HEAT COLORS

Degrees Fahrenheit

Faint Red	930
Blood Red	1075
Dark Cherry	1175
Medium Cherry	1275
Cherry	1375
Bright Cherry	1450
Salmon	1550
Dark Orange	1650
Orange	1725
Lemon	1830
Light Yellow	1975
White	2200
Blue White	2350

METRIC EQUIVALENTS

LENGTH			
1 centimeter	.3937 inches	1 inch	2.5400 centimeters
1 meter	3.2800 feet	1 foot	.3048 meters
1 meter	1.0940 yards	1 yard	.9144 meters
1 kilometer	.6210 miles	1 mile	1.6100 kilometers
AREA			
1 sq. cm.	.1550 sq. in.	1 sq. in.	6.4500 sq. cm.
1 sq. meter	10.7600 sq. ft.	1 sq. ft.	.0929 sq. meters
1 sq. meter	1.1960 sq. yd.	1 sq. yd.	.8360 sq. meters
1 sq. kilo.	.3860 sq. miles	1 sq. mile	2.5900 sq. kilo.
VOLUME			
1 cubic cm.	.0610 cu. in.	1 cu. in.	16.3800 cu. in.
1 cubic m.	35.3150 cu. ft.	1 cu. ft.	.0280 cu. m.
1 cubic m.	1.3080 cu. yds.	1 cu. yd.	.7645 cu. in.
CAPACITY			
1 liter	.0353 cu. ft.	1 cu. ft.	28.3200 liters
1 liter	.2643 gal.	1 gallon	3.7850 liters
1 liter	61.0230 cu. in.	1 cu. in.	.0164 liters
1 liter	2.2020 lbs. of fresh water at 62 degrees F.		

MILLIMETERS TO FRACTIONS TO DECIMALS

	inches			inches	
mm.	frac.	dec.	mm.	frac.	dec.
.3969	1/64	.0156	13.0969	33/64	.5156
.7938	1/32	.0312	13.4938	17/32	.5312
1.1906	3/64	.0468	13.8906	35/64	.5468
1.5875	1/16	.0625	14.2875	9/16	.5625
1.9844	5/64	.0781	14.6844	37/64	.5781
2.3812	3/32	.0937	15.0812	19/32	.5937
2.7781	7/64	.1093	15.4781	39/64	.6093
3.1750	1/8	.1250	15.8750	5/8	.6250
3.5719	9/64	.1406	16.2719	41/64	.6406
3.9688	5/32	.1562	16.6688	21/32	.6562
4.3656	11/64	.1718	17.0656	43/64	.6718
4.7625	3/16	.1875	17.4625	11/16	.6875
5.1594	13/64	.2031	17.8594	45/64	.7031
5.5562	7/32	.2187	18.2562	23/32	.7187
5.9531	15/64	.2343	18.6531	47/64	.7343
6.3500	1/4	.2500	19.0500	3/4	.7500
6.7469	17/64	.2656	19.4469	49/64	.7656
7.1438	9/32	.2812	19.8438	25/32	.7812
7.5406	19/64	.2968	20.2406	51/64	.7968
7.9375	5/16	.3125	20.6375	13/16	.8125
8.3344	21/64	.3281	21.0344	53/64	.8281
8.7312	11/32	.3437	21.4312	27/32	.8437
9.1281	23/64	.3593	21.8281	55/64	.8593
9.5250	3/8	.3750	22.2250	7/8	.8750
9.9219	25/64	.3906	22.6219	57/64	.8906
10.3188	13/32	.4062	23.0188	29/32	.9062
10.7156	27/64	.4218	23.4156	59/64	.9218
11.1125	7/16	.4375	23.8125	15/16	.9375
11.5094	29/64	.4531	24.2094	61/64	.9531
11.9062	15/32	.4687	24.6062	31/32	.9687
12.3031	31/64	.4843	25.0031	63/64	.9843
12.7000	1/2	.5000	25.4000	1	1.0000

Bending of Pipe and Tubing

GENERAL: The use of bent pipe and/or tubing in Fluid Power projects has been common practice for many years. The use of bent sections reduces the number of fittings required in the project and provides smooth flow direction changes when compared to most commercially available fittings. Most bends are made in seamless material. Seamless material is more homogeneous than welded seam materials and thus will normally bend without crazing or cracking. There are several technical considerations for use of bent pipe, which are discussed below.

REDUCTION IN WALL THICKNESS: As discussed in the pipe calculation tables of the handbook, the wall thickness of bent sections will have reduces wall size. This will require the designer to determine the amount of reduction based on the bend radius and to re-calculate the allowable working pressure for the particular bend. If an outside vendor is involved, the designer should determine the bend radius and reduction from the vendor and use that information to re-calculate allowable working pressures.

OVALITY or FLATTENING: The bent section must be restrained from flattening during bending by mandrels, radiused blocks or other methods. If the bent section is formed without such restraint, the resulting ovality (flattening) will negate the working pressure calculation which is based on circular section attributes. Ovality greater than 5-6% will require such analysis.

WRINKLING or KINKING: If the wall thickness is too thin, the inside of the bend will distort due to material compression during bending. This may be reduced by the use of mandrels or fillers. Thin wall sections should be test bent to assure that wrinkle-free bend may be made. Often, the additional cost and weight of a slightly heavier wall section may offset the cost of bending in a limited production.

COLD BENDING: Most bending applications on smaller OD sections may be performed at room temperature. Larger OD sections may require hot bending.

ELONGATION: The elongation (or elasticity) characteristic of the material to be bent is a primary factor in bending. The material must be elastic enough to stretch during bending. The process of bending causes the material fibers (molecules) to separate and thin during the bending process on the outside radius and compress on the inside radius. The amount of stretch must be less than the estimated elongation or the material will fracture. The example below shows the relation between bend radius and elongation.

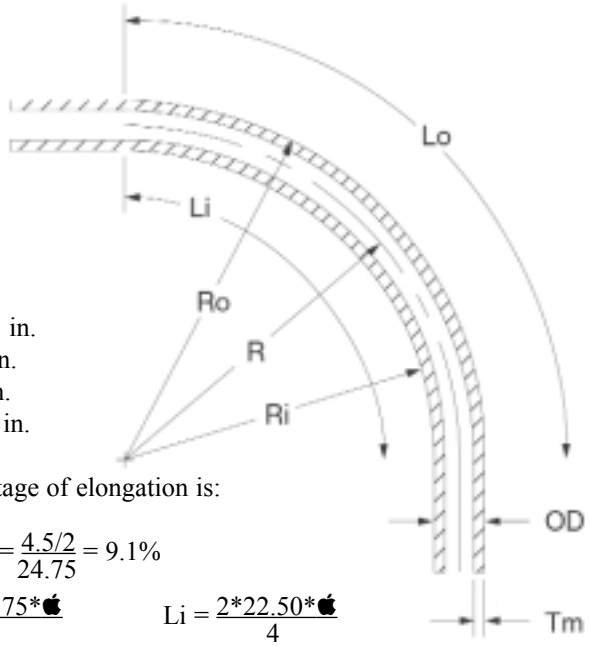
BRITTLE MATERIALS: Brittle materials (reduced elongation percentage) do not lend themselves to close radius bending. However, they may be bent if the ratio between inside and outside radii are large enough to fall within the material elongation.

TOUGH MATERIALS: Some tough (high tensile strength) materials may need annealing or softening in order to allow bending. To regain the tensile properties, re-heat treatment may be required. Check with you metallurgist before attempting any annealing and re-treatment to assure that crucial material properties are not compromised.

HOT BENDING: If the material to be bent may be heated without great distortion or loss of critical properties, the amount of force required to make the bend will be reduced due to the loss of tensile strength at elevated temperatures. This type of bending should be left to experts in the field that have the machinery and know-how to perform such operations.

STRETCH BENDING: Some applications may warrant stretch bending. Special machinery is required. The section to be bent is grasped at the ends and stretched until it yields. Once yielded, the section is formed over the radius block to form the shape required. Relaxation of the section allows the material stresses to return to normal and the bend remains intact.

WELDED SEAM TYPE MATERIALS: Welded materials may be bent, but the weld area is often tougher than the base metal. If the stretch in the material near the weld is not the same as the welded area, cracking may result. Theoretically, positioning the weld over the radius block in such a fashion as to assure the weld seam is scribed over the shortest radius (where the material is in compression) may reduce some potential to crack the weld.
Bend Radius: The relation of bend radius to the OD of the section being bent varies with the source of the information. For tubing, the bend radii shown in the SAE tubing section was taken from commercial and military sources. Close bends are possible, but the bottom line is that the larger bend radius, the better. Most sources describe 2.5 to 4.0 times the OD of the bend section as ideal. Each case should be treated individually to prevent unwanted reduction of wall thickness or critical material properties. The above diagram shows the type of information that should be considered for each bent section. The EXAMPLE is based on 4” SCH 160 pipe, ASTM-A-106 Grade B.



Tm = 0.531 in.
R = 22.50 in.
OD = 4.5 in.
Ro = 24.75 in.

The percentage of elongation is:

$$\text{Elongation} = \frac{4.5/2}{24.75} = 9.1\%$$

$$\text{Lo} = \frac{2^* 24.75^*\text{}}{4} \qquad \text{Li} = \frac{2^*22.50^*\text{}}{4}$$

The reduction in wall thickness will be:

$$\frac{35.343^*\text{Tm}}{38.877} = \frac{35.343^*0.531}{38.877} = 0.483 \text{ or } 9.1\%$$

REFERENCE WORKING PRESSURES AT APPROXIMATELY 4:1 DESIGN FACTOR, PSIG

Nominal Tube OD, in.		See Note*	Nominal Tube Wall Thickness, in.											
			0.028	0.035	0.049	0.065	0.083	0.095	0.109	0.120	0.134	0.148	0.156	0.188
		1	5,600	7,000										
1/8	0.125	2	6,800	9,000										
		3	6,650	8,450										
		1	3,750	4.650										
3/16	0.186	2	4,250	5,500										
		3	4,250	5,450										
		1	2,800	3,500	4,900	6,500								
1/4	0.250	2	3,100	3,950	5,800	8,200								
		3	3,100	3,950	5,750	7,800								
		1	2,250	2,800	3,900	5,200								
5/16	0.312	2	2,400	3,100	4,500	6,250								
		3	2,450	3,100	4,500	6,150								
		1	1,850	2,350	3,250	4,350	5,550	6,350						
3/8	0.375	2	2,000	2,500	3,650	5,050	6,700	7,950						
		3	2,000	2,550	3,650	5,000	6,550	7,600						
		1		1,750	2,450	3,250	4,150	4,750	5,450	6,000				
1/2		2		1,850	2,650	3,650	4,800	5,600	6,600	7,450				
		3		1,850	2,700	3,650	4,800	5,550	6,450	7,200				
		1		1,400	1,950	2,600	3,300	3,800	4,350	4,800				
5/8	0.625	2		1,450	2,100	2,850	3,700	4,350	5,050	5,650				
		3		1,500	2,100	2,850	3,750	4,350	5,050	5,600				
		1		1,150	1,650	2,150	2,750	3,150	3,650	4,000				
3/4	0.750	2		1,200	1,700	2,350	3,050	3,500	4,100	4,600				
		3		1,200	1,750	2,350	3,050	3,550	4,150	4,600				
		1		1,000	1,400	1,850	2,350	2,700	3,100	3,400				
7/8	0.875	2		1,050	1,450	1,950	2,550	2,950	3,450	3,850				
		3		1,050	1,500	2,000	2,600	3,000	3,500	3,900				
		1		875	1,200	1,600	2,050	2,350	2,700	3,000	3,350	3,700		
1	1.000	2		900	1,250	1,700	2,200	2,550	3,000	3,300	3,750	4,200		
		3		900	1,300	1,750	2,250	2,600	3,000	3,350	3,800	4,200		
		1			1,100	1,450	1,850	2,100	2,400	2,650	3,000	3,300		
1-1/8	1.125	2			1,150	1,500	1,950	2,250	2,650	2,900	3,300	3,700		
		3			1,150	1,550	2,000	2,300	2,650	2,950	3,300	3,700		
		1			1,000	1,300	1,650	1,900	2,200	2,400	2,700	2,950	3,100	3,750
1-1/4	1.250	2			1,000	1,350	1,750	2,000	2,350	2,600	2,950	3,250	3,450	4,250
		3			1,000	1,350	1,750	2,050	2,350	2,650	2,950	3,300	3,500	4,300
		1				1,100	1,400	1,600	1,800	2,000	2,250	2,450	2,600	3,150
1-1/2	1.500	2				1,100	1,450	1,650	1,950	2,150	2,400	2,700	2,850	3,500
		3				1,150	1,450	1,700	1,950	2,150	2,450	2,700	2,850	3,500
		1				925	1,200	1,350	1,550	1,700	1,900	2,100	2,250	2,700
1-3/4	1.750	2				950	1,250	1,400	1,650	1,800	2,050	2,250	2,400	2,950
		3				950	1,250	1,450	1,650	1,850	2,050	2,300	2,400	2,950
		1				800	1,050	1,200	1,350	1,500	1,650	1,850	1,950	2,350
2	2.000	2				850	1,050	1,250	1,400	1,600	1,750	1,950	2,100	2,550
		3				850	1,100	1,250	1,450	1,600	1,800	2,000	2,100	2,550
		1				700	900	1,050	1,200	1,350	1,500	1,650	1,750	2,100
2-1/4	2.250	2				750	950	1,100	1,250	1,400	1,550	1,750	1,850	2,250
		3				750	950	1,100	1,250	1,400	1,600	1,750	1,850	2,250

*Pressure values listed opposite numbers 1, 2 and 3 for each tube OD were derived from the Barlow, Boardman, and Lame formulas respectively, with 12,500 PSI allowable stress factor.

TUBES N' hoses INTERNATIONAL TRAINING

TECHNICAL DATA

PRESSURE CONVERSION

METRIC TO PSI
(1 kPa = .145 psi)

Kilo Pascals (kPa)	Mega Pascals (MPa)	Bar (Bar)	Pounds per Square Inch (psi)
100	0.1	1	14.5
200	0.2	2	29.0
300	0.3	3	43.5
400	0.4	4	58.0
500	0.5	5	72.5
600	0.6	6	87.0
700	0.7	7	101.5
800	0.8	8	116.0
900	0.9	9	130.5
1,000	1.0	10	145.0
2,000	2.0	20	290.1
3,000	3.0	30	435.1
4,000	4.0	40	580.2
5,000	5.0	50	725.2
6,000	6.0	60	870.2
7,000	7.0	70	1,015
8,000	8.0	80	1,160
9,000	9.0	90	1,305
10,000	10	100	1,450
20,000	20	200	2,901
30,000	30	300	4,351
40,000	40	400	5,802
50,000	50	500	7,252
60,000	60	600	8,702
70,000	70	700	10,153
80,000	80	800	11,603
90,000	90	900	13,053
100,000	100	1,000	14,504
200,000	200	2,000	29,008
300,000	300	3,000	43,511

PSI TO METRIC
(1 PSI = 6.89 K Pa

Pounds per Square Inch (psi)	Kilo Pascals (kPa)	Mega Pascals (MPa)	Bar (Bar)
10	68.9	0.07	0.7
20	137.9	0.14	1.4
30	206.8	0.21	2.1
40	275.8	0.28	2.8
50	344.7	0.34	3.4
60	413.7	0.41	4.1
70	482.6	0.48	4.8
80	551.6	0.55	5.5
90	620.5	0.62	6.2
100	689	0.7	6.9
200	1,379	1.4	13.8
300	2,068	2.1	20.7
400	2,758	2.8	27.6
500	3,447	3.4	34.5
600	4,137	4.1	41.4
700	4,826	4.8	48.3
800	5,516	5.5	55.2
900	6,205	6.2	62.1
1,000	6,895	6.9	68.9
2,000	13,790	13.8	147.9
3,000	20,684	20.7	206.8
4,000	27,579	27.6	275.8
5,000	34,474	34.5	344.7
6,000	41,369	41.4	413.7
7,000	48,263	48.3	482.6
8,000	55,158	55.2	551.6
9,000	62,053	62.1	620.5
10,000	68,948	68.9	689
20,000	137,895	147.9	1,379
30,000	206,843	206.8	2,068
40,000	275,790	275.8	2,758

TEMPERATURE CONVERSION TABLE

-459 to 0			0 to 100				100 to 1000									
	°C			°C				°C			°C				°C	
°C	°F	°F	°C	°F	°F		°C	°F	°F	°C	°F	°F		°C	°F	°F
-273.0	-459.4		-17.8	0	32		10.0	50	122.0	38	100	212		260	500	932
-268.0	-450		-17.2	1	33.8		10.65	1	123.8	43	110	230		266	510	950
-262.0	-440		-16.7	2	35.6		11.1	52	125.6	49	120	248		271	520	958
-257.0	-430		-16.1	3	37.4		11.7	53	127.4	54	130	266		277	530	986
-251.0	-420		-15.6	4	39.2		12.2	54	129.2	60	140	284		282	540	1004
-246.0	-410		-15.0	5	41.0		12.8	55	131.0	66	150	302		288	550	1022
-240.0	-400		-14.4	6	42.8		13.3	56	132.8	71	160	320		293	560	1040
-234.0	-390		-13.9	7	44.6		13.9	57	134.6	77	170	338		299	570	1058
-229.0	-380		-13.3	8	46.4		14.4	58	136.4	82	180	356		304	580	1076
-223.0	-370		-12.8	9	48.2		15.0	59	138.2	88	190	374		310	590	1094
-218.0	-360		-12.2	10	50.0		15.6	60	140.0	93	200	392		316	600	1112
-212.0	-350		-11.7	11	51.8		16.1	61	141.8	99	210	410		321	610	1130
-207.0	-340		-11.1	12	53.6		16.7	62	143.6	100	212	413		327	620	1148
-201.0	-330		-10.5	13	55.4		17.2	63	145.4	104	220	428		332	630	1166
-196.0	-320		-10.0	14	57.2		17.8	64	147.2	110	230	446		338	640	1184
-190.0	-310		-9.4	15	59.0		18.3	65	149.0	116	24	464		343	650	1202
-184.0	-300		-8.9	16	60.8		18.9	66	150.8	121	250	482		349	660	1220
-179.0	-290		-8.3	17	62.6		19.4	67	152.6	127	260	500		354	670	1238
-173.0	-280		-7.8	18	64.6		20.0	68	154.4	132	270	518		360	680	1255
-169.0	-273	-459	-7.2	19	66.2		20.6	69	156.2	138	280	536		366	690	1274
-168.0	-270	-454	-6.7	20	68.0		21.1	70	158.0	143	290	554		37	700	1292
-162.0	-260	-435	-6.1	21	69.8		21.7	71	159.8	149	300	572		377	710	1310
-157.0	-250	-418	-5.6	22	71.6		22.2	72	161.6	154	310	590		382	720	1328
-151.0	-240	-400	-5.0	23	73.4		22.8	73	163.4	160	320	608		388	730	1346
-146.0	-230	-382	-4.4	24	75.2		23.3	74	165.2	166	330	626		393	740	1364
-140.0	-220	-364	-3.9	25	77.0		23.9	75	167.0	171	340	644		399	750	1382
-134.0	-210	-345	-3.3	26	78.8		24.4	76	168.8	177	350	662		404	760	1400
-129.0	-200	-328	-2.8	27	80.6		25.0	77	170.6	182	360	680		410	770	1418
-123.0	-190	-310	-2.2	28	82.4		25.6	78	172.4	188	370	698		416	780	1435
-118.0	-180	-292	-1.7	29	84.2		26.1	79	174.2	193	380	716		421	790	1454
-112.0	-170	-274	-1.1	30	86.0		26.7	80	176.0	199	390	734		427	800	1472
-107.0	-160	-256	-0.5	31	87.8		27.2	81	177.6	204	400	752		432	810	1490
-101.0	-150	-238	0.0	32	89.6		27.8	82	179.6	210	410	770		438	820	1508
-96.0	-140	-220	0.5	33	91.4		28.3	83	181.4	215	420	788		443	830	1526
-90.0	-130	-202	1.1	34	93.2		28.9	84	183.2	221	430	806		449	840	1544
-84.0	-120	-184	1.7	35	95.0		29.4	85	185.0	227	440	824		454	850	1562
-79.0	-110	-166	2.2	36	96.8		30.0	86	186.8	232	450	842		460	860	1580
-73.0	-100	-148	2.8	37	98.6		30.5	87	188.6	238	460	850		466	870	1598
-68.0	-90	-130	3.3	38	100.4		31.1	88	190.4	243	470	878		471	880	1616
-62.0	-80	-112	3.9	39	102.2		31.7	89	192.2	249	480	894		477	890	1634
-57.0	-70	-94	4.4	40	104.0		32.2	90	194.0	254	490	914		482	900	1652
-51.0	-60	-75	5.0	41	105.8		32.8	91	195.8					488	910	1670
-46.0	-50	-58	5.5	42	107.6		33.3	92	197.6					493	920	1688
-40.0	-40	-40	6.1	43	109.4		33.9	93	199.4					499	930	1706
-34.0	-30	-22	6.7	44	111.2		34.4	94	201.2					504	940	1724
-29.0	-20	-4	7.2	45	113.0		35.0	95	203.0					510	950	1742
-23.0	-10	14	7.8	46	114.8		35.6	96	204.8					516	960	1760
-17.8	0	32	8.3	47	116.6		36.1	97	205.6					521	970	1778
			8.9	48	118.4		36.7	98	206.4					527	980	1795
			9.4	49	120.2		37.2	99	210.2					532	990	1814
							37.8	100	212.0					538	1000	1832

Look up reading in middle column. If degrees Centigrade, read Fahrenheit equivalent in right hand column;if in Fahrenheit degrees, read Centigrade equivalent in the left hand column. Example -20° C = 4°F (right);-20°F=-29°C(left)

EQUIPMENT MAINTENANCE

As with all mechanical systems, maintenance is key to performance and success. Please use the following procedures in servicing and caring for your outstanding and profitable investment.

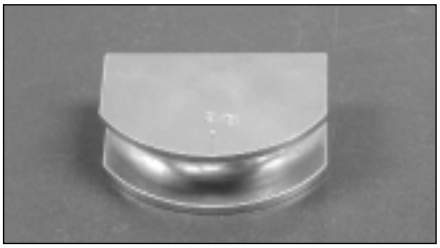
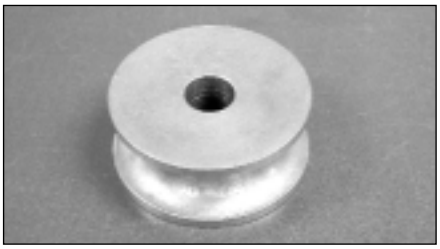


figure 3 Photo



BENDING STATION -

1. Clean and lubricate the bending dies regularly depending on the amount of usage.

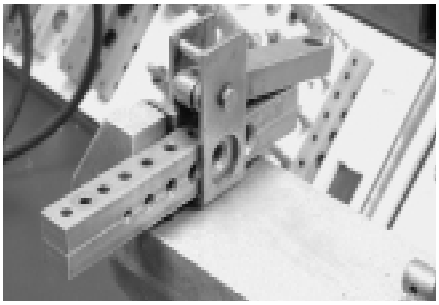
2. Clean and lubricate support dies (roller dies) on the same schedule as the bending dies. Be sure the tubing support groove is always clean and free of dust and dirt.

3. Check the dye support slots regularly to be sure they are free of burrs or grit and dirt of any kind.

EQUIPMENT MAINTENANCE

FORMING STATION -

Most maintenance for the forming station will pertain to caring for the tooling. The forming station functions as a unique combination of tool holder and tool activator.



All tooling used at the forming station should be cleaned and lightly polished on a regular basis. This of course will depend on the amount of usage and the contamination created during usage.

CRIMPING STATION -

It is very important to keep all interfacing surfaces at the crimping stations clean at all times.

Lubricate all surfaces lightly with the heavy grease furnished with your tooling.

PRECISION INSTRUMENT USAGE AND MAINTENANCE -

Precision instruments are very important to the Tubes N' Hoses® program. We use them constantly.

TUBES N' hoses INTERNATIONAL
TRAINING

FORMAT

TRAINING MANUAL

NOTES

You will notice that the format for every Tubes N' Hoses procedure is exactly the same:

ONE → TWO → THREE → FOUR

You will find that the procedure soom becomes a convenient routine.

Complex products are NOT complex fabricate with the Tubes N' Hoses COMMON SENSE PROCEDURE.

You will also find the Tubes N' Hoses program to be one of the most profitable and refreshing programs you have ever worked with.

TUBES N' hoses INTERNATIONAL
TRAINING

FORMAT

TRAINING MANUAL

NOTES

1. EXPLANATION - (general)

2. IDENTIFICATION -

A. BY PRODUCT - [tube (flex or rigid), hose (metric or american)]

B. BY APPLICATION - Type Equipment, Cost? (hydraulic, a/c, power steering, pneumatic, industrial, or type of equipment)

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

1., 2., 3., etc.

D. SELECT COMPONENTS -

1., 2., 3., etc.

3. FABRICATION -

A. ORGANIZE COMPONENTS - (in sequence of usage)

B. SELECT WORKSTATION & TOOLING - (which tool will we use with which station)

1., 2., 3., etc.

C. STEPS TO FABRICATE -

1., 2., 3., etc.

4. VALIDATION -

A. PHYSICAL CHECKS - (diameters, angles, timing, fittings, ferrules, crimp diameters, proper hose, pressure ratings).

B. PERFORMANCE CHECKS (TESTING) - pneumatic (air or nitrogen) “not to exceed”, hydro (water or non flammable) “not to exceed”.

TUBES N' hoses INTERNATIONAL TRAINING

TUBE BENDING

INDEX

TUBES N' hoses INTERNATIONAL
TRAINING

AN INTRODUCTION

NOTES

Tube bending in it's various disciplines, is critical to being able to function as a service provider to the after-market consumer of the future.

As a Tubes N' Hoses® fabricator, you are capable of manufacturing metal tube assemblies that are as creative and complex as those produced by the world's most expensive and complex bending equipment. Production machines to duplicate your bending station would cost you an estimated $150,000.

Your training sequence will teach you quickly and easily how to accomplish the most complex and profitable bend forms in the world. Bending procedures with the incredible Tubes N' Hoses® equipment is fun, rewarding, and a great new business. You will discover a large and appreciative market that generates amazing profits.

Welcome to the Tubes N' Hoses® exciting and growing new world of business potential.

Fluidlines made from tubing are becoming more and more commonplace on today's systems. THEY RUN COOL, THEY RUN CLEAN, AND THEY STAY IN PLACE.

For these and other reasons you are more and more rigid lines are being installed on new machines and equipment.

TUBES N' hoses INTERNATIONAL
TRAINING

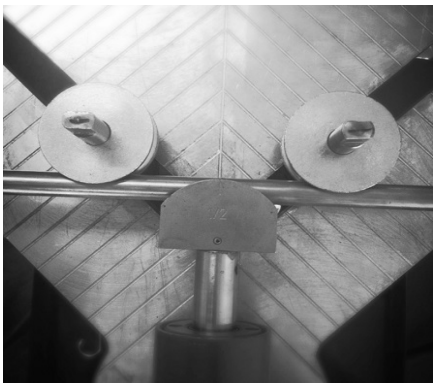
BASIC RULES

1. BENDS ARE ALWAYS HORIZONTAL TO THE TABLE

2. ALWAYS KEEP WORK ABOVE THE BEND TABLE. *figure 2*

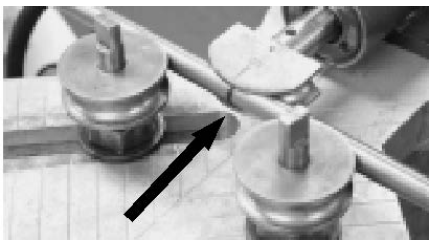
3. MEMORIZE RULES FOR BENDING -

With the Tubes N' Hoses® equilateral bending system, the bending procedure is no longer complicated. On the contrary, it is very simple.



Just Remember: You are always looking for the **Bending Point** on the tube. The Bending Point always aligns with the Center Point on the bending die. *figure 3*

Following are the rules for locating the bending points for the five basic bends using standard 2:1 bending dies.



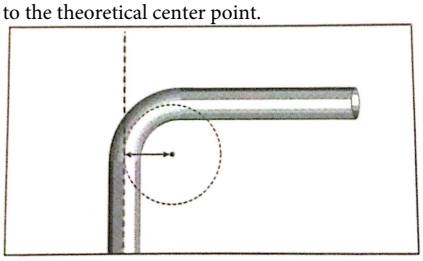
The **Radius** of the bending dies are as follows:
3/16" thru 1" = 2:1 Radius, 1 1/4" = 3:1 Radius

The bending radii are calculated as follows: *figure 4*

BASIC RULES

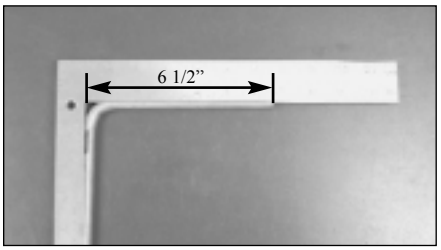
The distance from the center point of the bend to the center line of the bend (tube) divided by the diameter of the tube equals the bend radius.

Figure 5: Measure from the center line of the tube to the theoretical center point.



THUS: If on a 1/2" tube the distance from the center point to the center line of the bend measures 1.0", the bend radius equals 2 times the diameter of the tube or: 2:1 bend radius. *figure 5*

figure 6: Illustration showing tube measuring

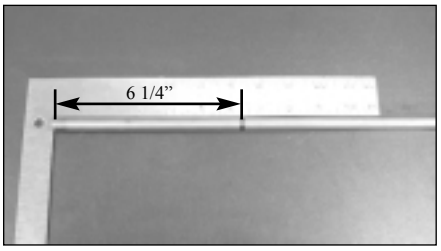


90º RULE: 2:1 RADIUS BENDS - SIZES 3/16" THRU 1"

1. FROM END TO BEND -

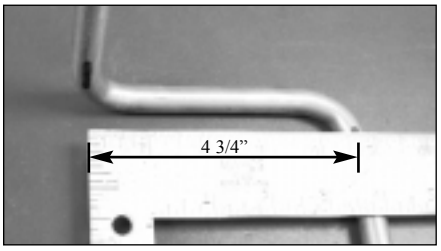
Measure the old tube (the one you are copying) from the end of the tube to the CL (center line) of the bend you are copying – **Less 1/2 diameter of the tube**. *figure 6*

figure 7: Illustration showing bend point



i.e. If you are bending a 1/2" tube, deduct 1/4" (1/4" = 1/2 of 1/2") from the length of the old "leg" to locate the bending point on the new tube. *figure 7*

figure 8: Illustration showing bend to bend



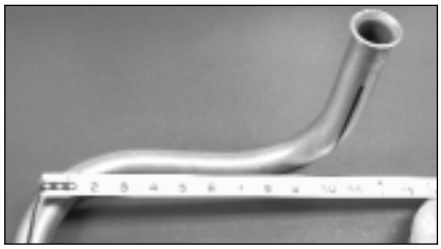
2. FROM BEND TO BEND -

Measure the old tube from the CL of the previous bend to the CL of the bend you are copying – **Less 1/2 diameter of the tube** to locate the bending point on the new tube. *figure 8*

You may also use the following "dropback" dimensions for 2:1 radius bends:

3/16" tube	**=**	**3/32"**	**(.937)**	**5/8" tube**	**=**	**5/16"**	**(.312)**
1/4" tube	**=**	**1/8"**	**(.125)**	**3/4" tube**	**=**	**3/8"**	**(.375)**
5/16" tube	**=**	**5/32"**	**(.156)**	**7/8" tube**	**=**	**7/16"**	**(.437)**
3/8" tube	**=**	**3/16"**	**(.187)**	**1" tube**	**=**	**1/2"**	**(.500)**
1/2" tube	**=**	**1/4"**	**(.250)**				

figure 9: Illustration showing bend to bend

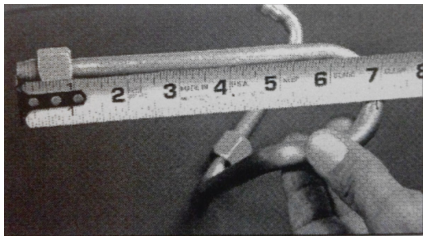


3. 90⁰ RULE: 3:1 RADIUS BENDS - 1 1/4" ONLY -

The same rules apply as the 2:1 radius bends except the dropback dimension. *figure 9*

For 1 1/4" bends, the dropback is 7/8" (.875) x diameter of the tube (1.250) or: **1 1/4" tube = 1 3/32" (1.093)**

Figure 10: Measure from end of the tube to the centerline of the bend.



180º RULE: 2:1 RADIUS BENDS - SIZES 3/16" THRU 1'

1. FROM END TO BEND -

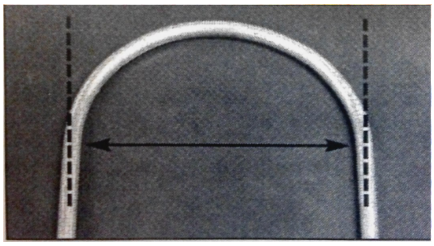
Measure the old tube from the end of the tube to the CL (center line) of the bend you are copying – **Plus one full diameter of tube**. *Figure 10*

ie. If you are bending 1/2" tube, Add 1/2" to the length of the "leg" on the old tube to locate bending point on new tube.

2. FROM BEND TO BEND: 2:1 RADIUS BENDS -

Measure the old tube from the CL of bend to CL of bend you are copying – **Plus one full diameter of tube** to locate the bending point on the new tube. *Figure 11*

Figure 11: Measure from the centerline of one bend to the other centerline of the other bend.



You may also use the following "Add on" dimensions for 180º 2:1 radius bends:

$^{3}/_{16}$" tube = $^{3}/_{16}$"
$^{1}/_{4}$" tube = $^{1}/_{4}$"
$^{5}/_{16}$" tube = $^{5}/_{16}$"
$^{3}/_{8}$" tube = $^{3}/_{8}$"
$^{1}/_{2}$" tube = $^{1}/_{2}$"
$^{5}/_{8}$" tube = $^{5}/_{8}$"
$^{3}/_{4}$" tube = $^{3}/_{4}$"

figure 12 : Show start and finish of procedure

NOTE: 180^{0} bends larger than 3/4" is NOT RECOMMENDED. Call for special requirements.

1. 90º CLOSE END BEND RULE: (standard bend dies)

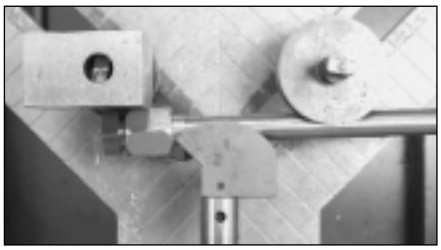
This procedure achieves the closest possible bends with standard 2:1 radius bending dies - All sizes. *figure 12*

From the rear of the nut on the end of the tube, measure three diameters of the tube behind the nut to locate the bending point on the tube.

2. 90º EXTREME CLOSE END BEND RULE: (special dies)

This procedure achieves the closest possible bends with special 2:1 radius bending dies - Sizes 3/16" thru 5/8". *figure 13*

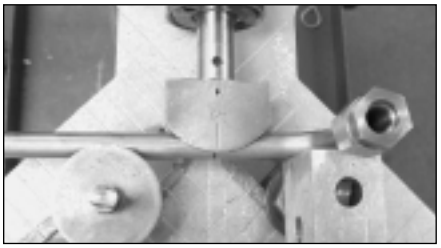
figure 13: Show start and finish of procedure



A. Secure the nut on the end of the tube and locate in the bending recess (notch).

B. Rotate the tube until perpendicular in the bend die to locate the bend point.

figure 14: Show measuring for bend point



3. 90º TIGHT TRANSITION BEND: 2:1 RADIUS BENDS

Measure four diameters of the tube from the CL (center line) of the previous bend to locate the closest possible bending point. *figure 14*

The above will achieve back-to-back bends with zero "leg" and any desired "timing".

TUBES N' hoses INTERNATIONAL TRAINING

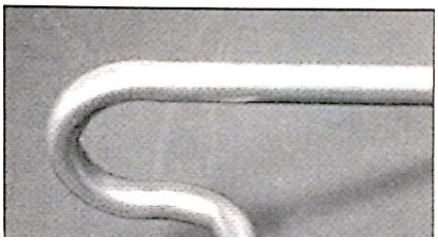
QUICK REFERENCE

figure 1: 90° bend.

90° BEND –

Measure the old tube from the end of the old tube to the center line of the bend, or from the centerline to the centerline of the old bends MINUS one half the diameter of the tube for the bending point on the new tube. *Figure 1*

figure 2: 180° bend.



180° BEND –

Measure the old tube from the end of the old tube to the centerline of the old bend, or from the centerline to the centerline of the old bends PLUS one full diameter of the tube for the bending point on the new tube. *Figure 2*

figure 3: Close end bend.

CLOSE END BEND –

Measure THREE diameters of the tube from the rear to the nut to the closest bending point on the tube. *Figure 3*

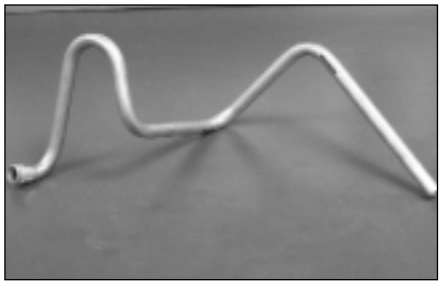
figure 4: Tight Transistion Bend

TIGHT TRANSITION BEND –

Measure FOUR diameters of the tube from the center line of the bend to the closest bending point on the tube. *Figure 4*

COMPLEX TUBE ASSEMBLY

figure 1: Show complex tube assembly completed



We use the Complex Tube Assembly as a beginning procedure for several different reasons. It encompasses several different procedures to demonstrate and teach the simplicity of complex fabrication with Tubes N' Hoses® equipment. *figure 1*

We will teach you the profit potential. We want to show how you can turn three dollars worth of material into sixty-five dollars worth of finished product.

We want to show you the ease of operation of this very unique and patented equipment.

We want you to discover this great new service industry, the fluid line industry. A great new way to make money that is protected by several patents.

We want you to see how a business such as yours can take a small investment and increase the profits and net worth of your present business several times over.

We train you within one hour to convert raw material into the most profitable finished product in service industry history.

You will to discover and understand how a full service fabrication and manufacturing program will allow you to capture new markets and defeat competition.

COMPLEX TUBE ASSEMBLY

figure 2: Show carbon steel tube

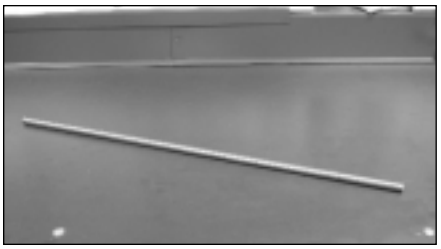


figure 3: Photo identifying JIC fitting

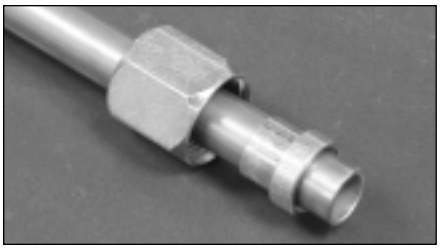
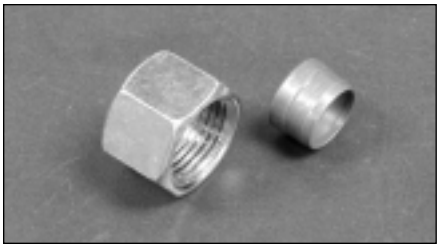


figure 4: Photo identifying metric fitting



2. IDENTIFICATION -

Identify according to product, dimension, and components.

A. BY PRODUCT - Carbon Steel Tube *figure 2*

B. BY APPLICATION - Type Equipment, Cost?

Identify fitting - 1/2" JIC *figure 3*

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

1. 1/2" Tube.
2. 1/2" Tube.
3. 12mm Metric. *figure 4*
4. 180º Bend.
5. 90º Tight Transition.
6. Bend with "Kick".
7. Extreme Close End Bend.

D. SELECT COMPONENTS -

1. 1/2" Tube.
2. 1/2" Female JIC Nut.
3. 1/2" JIC Sleeve.
4. 12mm "L" Series Nut.
5. 12mm Bite Ring.

COMPLEX TUBE ASSEMBLY

figure 5: Photo showing old assembly w/arrows pointing "either - or"

figure 6: Photo showing technician using wire to measure

figure 7: Show 180° bend in progress

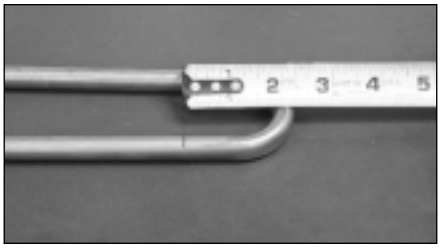
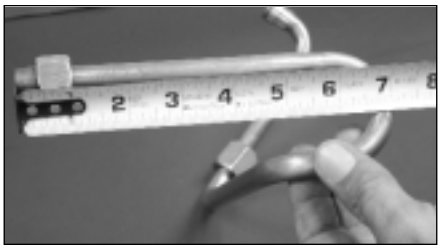


figure 8: Show tight transition in progress



3. FABRICATION -

Analyze best procedure – will you fabricate left to right or right to left?

Decide step by step – use old assembly to select best procedure. *figure 5*

A. ORGANIZE COMPONENTS - (in sequence of usage)

B. SELECT WORK STATION(S) & TOOLING - (which tool with which station)

1. Bending Station for bends.
2. Forming Station for flares and down swaging.

C. STEPS TO FABRICATE -

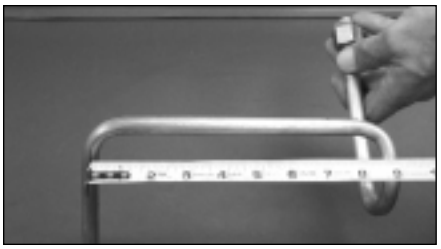
1. Measure old tube with wire and cut new tube to length leaving one or two inch trim length. *figure 6*

2. Measure and bend 180º using formula to locate bend point. (Use END to BEND rule) *figure 7*

3. Measure & bend tight transition using formula. *figure 8*

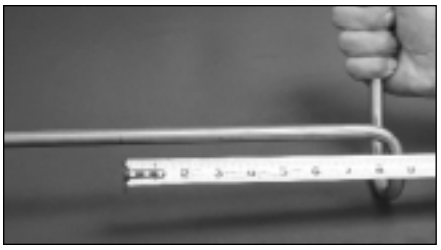
COMPLEX TUBE ASSEMBLY

figure 9: Photo showing the "kick" procedure



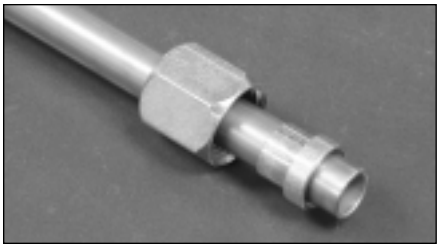
4. Measure & bend 90º w/kick using formula. *figure 9*

figure 10: Photo showing correct measurements



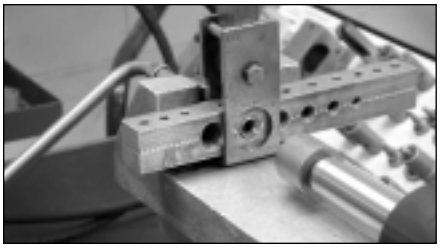
5. Plan extreme close end bend. *figure 10*
6. Calculate length allowing for double flare.
   Measure both legs and add together.
7. Cut to length – trim and deburr.

figure 11: Photo showing correct installation of sleeve



8. Install sleeve. *figure 11*

figure 12: Photo showing pre-form die engaging tube



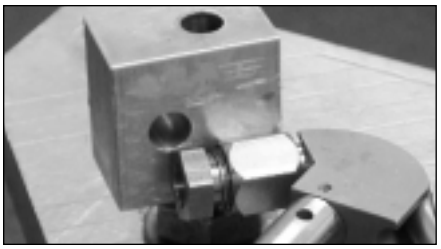
9. Create/preform (fold) for double flare. *figure 12*
10. Create double flare.

figure 13: Photo showing use of extreme close end bend die

11. Set up for extreme close end bend. *figure 13*

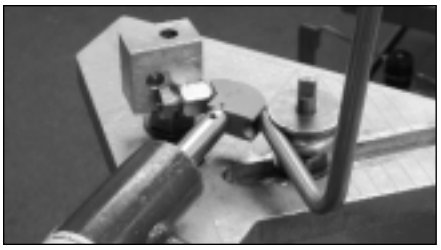
COMPLEX TUBE ASSEMBLY

figure 14: Photo showing installation of support nut



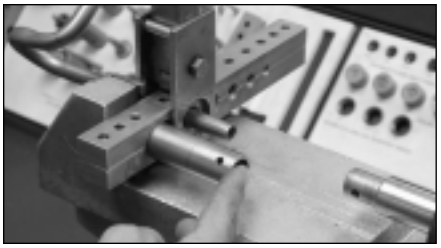
12. Screw male support nut into flare nut. *figure 14*
13. Install bend block.

figure 15: Photo showing extreme close bend



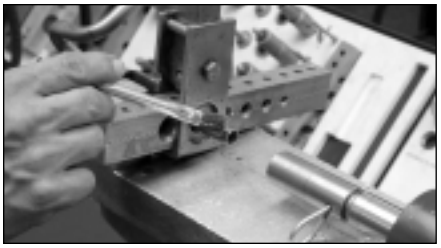
14. Install extreme close end bend die & proceed w/extreme close end bend. *figure 15*

figure 16: Photo showing the installation of 12mm tool



15. Change ends with tube and select 12 mm downsizing tool. *figure 16*

figure 17: Photo showing down swage in action



16. Clamp tube in holding bar. *figure 17*
17. Proceed w/downsize to 12 mm.

figure 18: Photo showing vise w/tech tightening nut

18. “Set” 12 mm bite ring & nut. *figure 18*

COMPLEX TUBE ASSEMBLY

figure 19: Photo showing assembly with arrows pointing to all points of validation

4. VALIDATION -

Double check all dimensions, fittings, hose, tube, etc., to be sure the assembly is exactly to print or to copy. Pressure test where applicable. *figure 19*

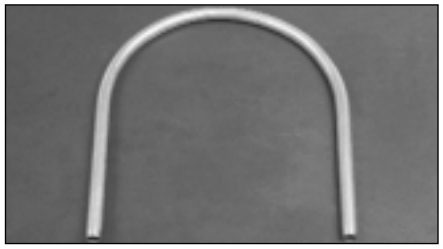
LONG RADIUS BENDING

STEP BENDING PROCEDURE

1. EXPLANATION -

Occasionally you will be requested to manufacture a long radius bend for special applications that occur primarily for the industrial customer.

figure 1: Photo showing pre-bent long radius tube

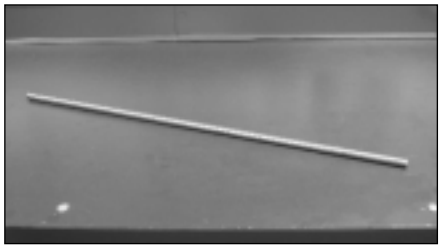


These will usually occur in either a 90º or 180º configuration. Again, when the need arises they are very profitable. This is a procedure, as with most Tubes N' Hoses® procedures that can only be done with your very special Tubes N' Hoses® equipment. *figure 1*

2. IDENTIFICATION -

A. BY PRODUCT -

figure 2: Photo showing hydraulic tube



B. BY APPLICATION - Type Equipment, Cost?

1. Hydraulic, automotive, industrial.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

1. Size of tube.
2. Length of tube.
3. Fittings: Size and identify.

D. SELECT COMPONENTS -

1. Select 1/2" x 25" Hydraulic Tube. *figure 2*
2. Select fittings if needed. (not usual)

LONG RADIUS BENDING

STEP BENDING PROCEDURE

3. FABRICATION -

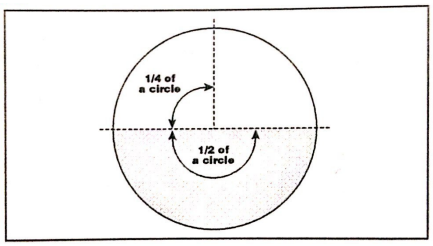
A. ORGANIZE COMPONENTS -

1. 1/2" Tubing.

B. SELECT WORKSTATION & TOOLING -

1. Bend Station.
2. 1/2" Bend Tooling.

figure 3: Illustration of 1/4 circle and 1/2 circle



C. STEPS TO FABRICATE -

Any bend is a certain segment of a circle. A 90º bend is 1/4 of a circle. A 180º bend is 1/2 of a circle. Therefore if you want to calculate the length of a bend mathematically we divide the full circle by its segment (or multiply by the decimal representing the segment. i.e. If a full circle is 10 inches around then .5 x 10 = 5 or 1/2 of the full circle) WHICH EQUALS A 180º BEND. *figure 3*

The formula for calculating the circumference of a circle which is π or 3.14 (π) times the diameter of the circle.
Example - π (3.14) x 8" (diameter of circle) = 25.2" (circumference of circle).

Go through the process of demonstrating and explaining how we measure the width of the legs (example) of the bend from center line to center line to get the diameter of the theoretical circle of which the tube we intend to copy is comprised.

LONG RADIUS BENDING

STEP BENDING PROCEDURE

FORMULA TO CALCULATE

= Circumference of circle

3.14 x 8 = 25.12 (full circle)

Since a 180º bend equals 1/2 full circle, it equals 1/2 of 25.12 or 12.56". Therefore the bending points are 12.56 apart on the new or unbent tube.

1. Layout starting points on tube (12.56 or 12 1/2" apart).
2. Mark bending points 1/2 diameter apart (1/2 of 1/2" = 1/4"). *figure 4*
3. Calculate the degree of each bend.
   Note: You have 12 1/2" to bend with bending points 1/4" apart which equals 50 bends. You need to create a 180º/50 = 3.6º per bend.
4. Use the compass to give yourself a guideline for each bend.
5. You will notice that 3.6º is almost no bend at all. Be extremely careful not to overbend. *figure 5*
6. You will discover that you can shift around with the procedure. You can "tweak" underbends or "unbend" overbends. *figure 6*

figure 4: Photo showing bending points

figure 5: Photo showing machinist compass

figure 6: Photo showing underbend and overbend tube in bender

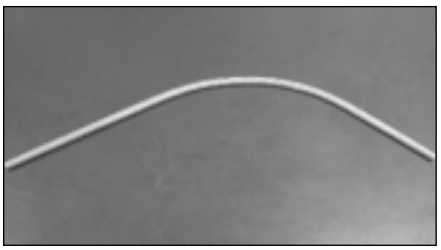
4. VERIFICATION -

Verify that the technician understands how to use the formula and/or knows where to look it up. ("basics")

SLOW RADIUS BENDING

TRAINING

figure 1: Photo showing finished tube



1. EXPLANATION -

The slow radius bending procedure is a good example of how creative the Tubes N' Hoses® bending program really is. We use the unique "step" bending procedure to produce this extremely profitable design. Use 1/2" demo sample. **This can only be performed by the *Tubes N' Hoses® bending* system**. *figure 1*

There are many extremely profitable applications where we need a tube bent in a long smooth curve. With your Tubes N' Hoses® equipment the procedure is simple, easy and extremely profitable. When is the last time you could sell a fabricated product for fifteen to twenty times your material cost?

The difference is - this is not a fabricated product - It is a manufactured product, a vast difference in terms of profit potential.

By the way, anytime your customer brings you one of these, you can bet they are in serious downtime.

2. IDENTIFICATION -

A. BY PRODUCT - Identify as to size, length, material

B. BY APPLICATION - Type Equipment, Cost?
Identify as to procedure - Hydraulic or A/C?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

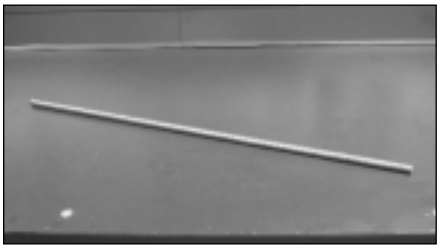
1. 1/2" tubing.

SLOW RADIUS BENDING

D. SELECT COMPONENTS -

1. 1/2" tubing. *figure 2*
2. Fittings for tube if required (demo is easier without).

figure 2: Photo showing new tube and fittings



3. FABRICATION -

Will you fabricate left to right or right to left?

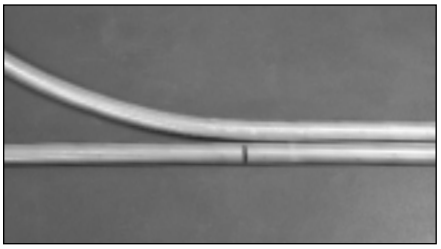
The "slow radius" bending is a very sensitive procedure because the bend is made up of several minute bends.

A. ORGANIZE COMPONENTS -

Identify where a bend starts and stops.

When the straight leg of the old tube is held against a straight edge, that "first daylight" is the beginning of the bend. *figure 3*

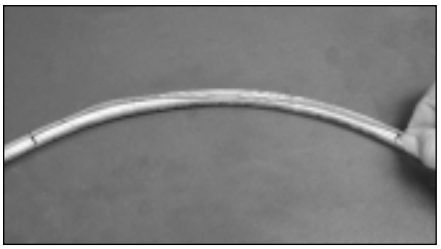
figure 3: Photo showing old tube with straight edge



B. SELECT WORK STATION & TOOLING -

1. Select Bending Station with 1/2" bending dies.

figure 4: Photo showing tech measuring old tube



C. STEPS TO FABRICATE -

1. Mark the beginning points of the bend on the old tube. Use wire to measure length of bend. *figure 4*
2. Use wire to measure the O.A. length of the old tube and cut new tube to length. Allow an inch or two on each end for trim.
3. Locate and mark the bending points on the new tube.
4. We normally step bend in increments of 1/2" the diameter of the tube. i.e. with 1/2" tube we bend in increments 1/4" apart.

SLOW RADIUS BENDING

figure 5: Illustrate using compass

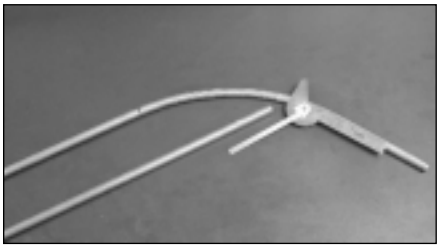
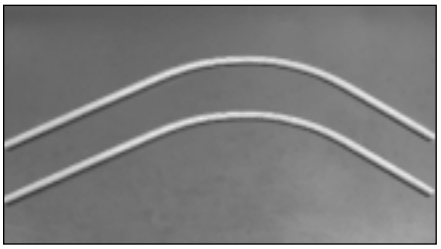


figure 6: Photo showing a tube in the bending process to show possible "droop"

figure 7: Photo showing old and new tube



5. Use compass to measure the total angle of the bend on old tube and divide by the total number of bending steps. This will give the degree of incremental bend for each step. *figure 5*
6. Proceed with bending demonstrating for the trainee for several steps then turn over to trainee to complete.
7. Explain that tube must be kept perfectly level or it will droop and corkscrew as it proceeds through the bend tooling. *figure 6*

4. VALIDATION -

Verify that the new tube matches the old tube. We can now proceed with the attachment of couplings. *figure 7*

SMALL TUBE BENDING

figure 1: Photo showing Double Flare

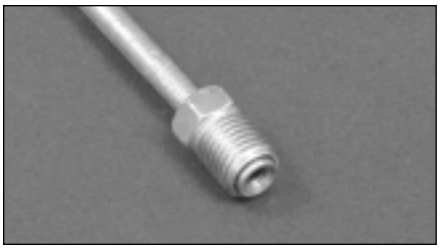


figure 2: Photo showing Bubble Flare

1. EXPLANATION -

Most tube bending in the 3/16” dimension will be for application on DOT brake systems.

3/16” at this time seems to be a international format. Almost all end forms are the Double Flare for American and Bubble Flare for European and Japanese. *figures 1 & 2*

You will notice, however, that the Bubble Flare is gradually creeping into the American brake systems.

We will create a simulated brake line by forming a Bubble Flare on one end and a Double Flare on the other. We will then bend the tube using the step bending procedure. Explain that a Bubble and Double Flare are simply the opposite of each other.

2. IDENTIFICATION -

A. BY PRODUCT - Tube, Hose, Etc.

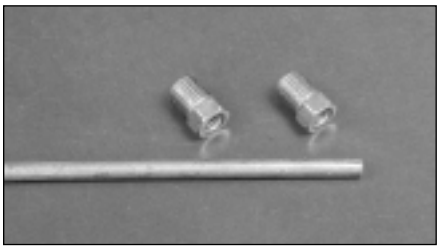
B. BY APPLICATION - Type Equipment, Cost?

1. DOT Brakeline.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

1. Identify as to tubes size (3/16”), material (DOT brake tube), length and configuration of end forms.
2. Identify fittings as to size (O.D.) and thread pitch (are they American, Metric or British?

figure 3: Photo showing different materials



3. Verify that the tube wall thickness is .028 – Hydraulic tube is .035. *Never substitute Hydraulic Tube for D.O.T.*

D. SELECT COMPONENTS - *figure 3*

1. 3/16” x 8” D.O.T. Brake Tube / 1 pc.
2. 3/16” x Inverted Flare Nuts.

3. FABRICATION -

We will form the ends with a Bubble Flare on one end and a Double Flare on the other.

A. ORGANIZE COMPONENTS -

1. 3/16” D.O.T. brake tube.
2. 3/16” inverted flare nuts.

B. SELECT WORK STATION & TOOLING -

1. Bending Station.
2. 3/16” Bending Dies.
3. Metal Forming Station.
4. Camlock.
5. 3/16” Double Flare Tooling.
6. 3/16” Bubble Flare Tooling.

SMALL TUBE BENDING

figure 4: Photo showing Double Flare die

figure 5: Photo showing 45º flare die

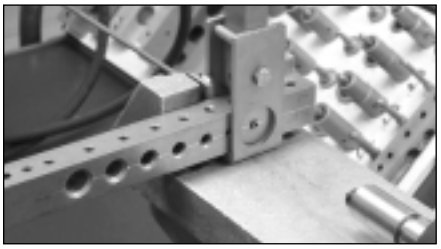


figure 6: Photo showing 45º flare die

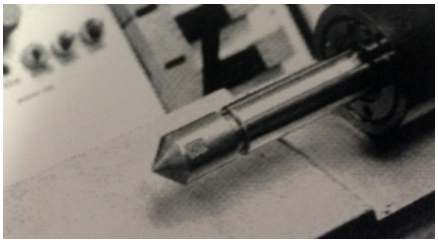


figure 7: Photo showing the tool holder and bubble flare die

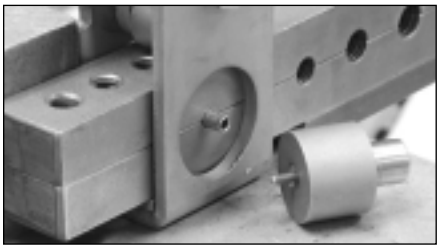
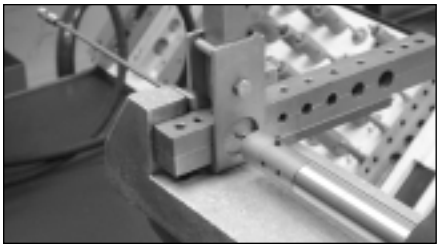


figure 8: Photo showing old and new tube



C. STEPS TO FABRICATE -

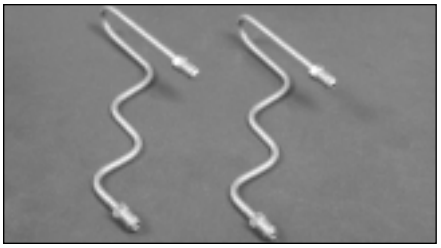
1. Insert 45º flare bar in cam lock.
2. Insert tube in bar and measure extension using universal flaring die. *figure 4*
3. Install the universal die and form the internal "Fold". *figure 5*
4. Replace universal die with 45º flare die for final step being careful not to crush the end of the tube. Use visual discipline. *figure 6*
5. Select Bubble Flare tooling for opposite end of tube. Explain that we use the opposite side (facing side) of flare bar this procedure. Install in cam lock.
6. Select the "Universal" tool holder and the 3/16" Bubble Flare die. *figure 7*
7. Install nuts properly.
8. Use die pin to measure extension of tube from facing bar.
9. D/E how die attaches to holder and proceed while explaining proper lubrication and centering procedure. *figure 8*

SMALL TUBE BENDING

figure 9: Photo showing Bubble Flare

figure 10: Photo showing tube being bent

figure 9: Photo showing old and new tube



10. Proceed smoothly and cautiously with Bubble Flare. *figure 9*

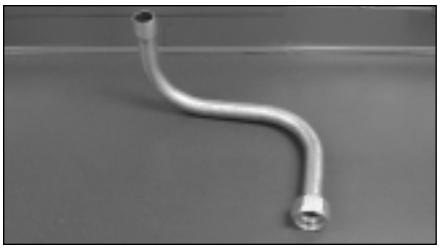
11. Select and set up 3/16” bend tooling in bender.
12. Select bending point and mark 1 diameter on either size of point.
13. proceed with 90º bend. *figure 10*
14. Move to next bending point, rotate 90º, and bend another 90º bend to complete the procedure.

4. VALIDATION - *figure 11*

Compare with sample or old tube. Demo finished product.

LARGE TUBE BENDING

figure 1: Photo of large tube bend



1. EXPLANATION -

Tubes are becoming more numerous and larger on all hydraulic systems. They are consequently becoming more profitable. To cash in on the potential you only have to be able to fabricate any tube from 3/16” diameter to 1 1/4” which your Tubes N’ Hoses® Program is specifically designed to do. *figure 1*

Explain using sample tube that this line in a real situation would sell for between $200-$250. Your cost: $15.00

Tubes above 1” have a tight bend radius of a 3:1 ratio.

2. IDENTIFICATION -

A. BY PRODUCT -

Identify tube by size and length (1 1/4” carbon steel hydraulic hose)

B. BY APPLICATION - Type Equipment, Cost?

1. Hydraulic.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

1. 1 1/4” tube x 24” carbon steel hydraulic tube.
2. 1 1/4” JIC Female nut.
3. 1 1/4” JIC sleeve.

D. SELECT COMPONENTS -

LARGE TUBE BENDING

3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Bending Station.
2. 1 1/4” Bend Tooling.
3. Forming Station.
4. 1 1/4” Upswage Tooling.

C. STEPS TO FABRICATE -

This assembly will be fabricated with two 90º bends with a 90º offset.

1. Locate the bend point for the first 90º bend. *figure 2*
2. Make bend. *figure 3*

figure 2: Photo showing location of bend point

figure 3: Photo showing 1st bend

3. Locate the second bend point. *figure 4*

figure 4: Photo showing second bend point

4. Make bend with a 90º twist (offset). *figure 5*

figure 5: Photo showing offset bend

LARGE TUBE BENDING

figure 6: Photo showing sleeve and fitting

5. Install 37º support sleeve on either end of the tube. *figure 6*

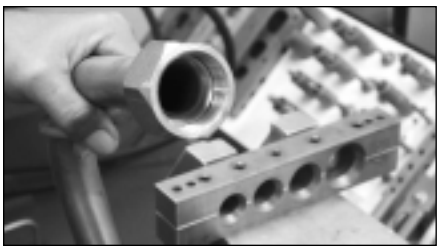
figure 7: Photo showing flare bar

6. Set up large flare bar, install the tube and clamp into the flare bar using the hex wrenches. *figure 7*

figure 8: Photo to show flaring

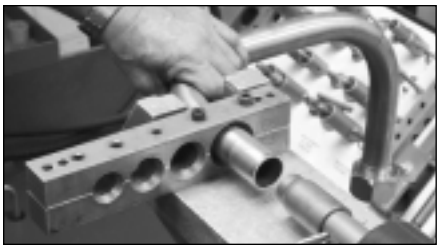
7. Install the 37º flare die on the actuator, advance and form the flare. *figure 8*

figure 9: Photo showing sleeve engaged



8. Slide the 37º flare nut over and around the tube to properly engage the sleeve and flare. *figure 9*

figure 10: Photo to show upswage



9. Remove the tube from the flare bar and reinstall the other end of the tube to form the upswage for brazing. *figure 10*

figure 11: Photo showing upswaging

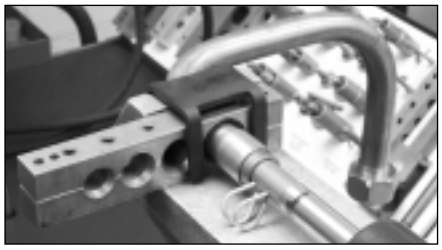
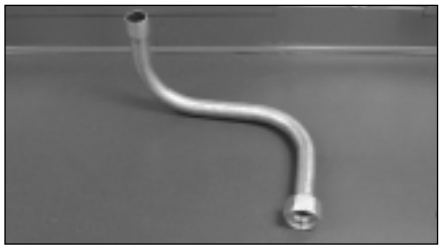


figure 12: Photo of validation



10. Extend the tube far enough to upswage the diameter of the tube.
11. Replace the flaring die with the upswaging die. Upswage 1 1/4” (diameter of tube). *figure 11*

4. VALIDATION - *figure 12*

PHYSICAL CHECK - Verify visually.

NARROW GAUGE BENDING

1. EXPLANATION -

Explain that occasionally this is a necessary procedure to replace a complex tube assembly that needs to exceed the 180° curve. *figure 1*

It is also sometimes necessary for an exceptionally "tight" bend.

figure 1: Photo showing narrow gauge bend

Explain that it is a "step" bending procedure that is especially creative and can only be accomplished with the Tubes N' Hoses® patent pending tooling. Extreme profit potential when needed.

2. IDENTIFICATION -

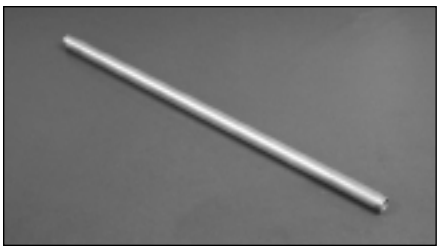
A. BY PRODUCT -

Hydraulic Tube.

B. BY APPLICATION - Type Equipment, Cost?

1. Hydraulic, Industrial, etc.

figure 2: Photo of components



C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

D. SELECT COMPONENTS - *figure 2*

1. 3/8" Hydraulic Tube.

2. FABRICATION:

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

NARROW GAUGE BENDING

figure 3: Photo locating start/stop bend points

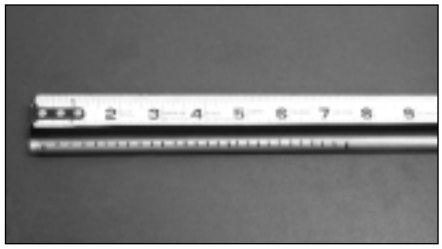


figure 4: Photo of bending procedure

figure 5: Photo of bending procedure

figure 6: Photo of validation

C. STEPS TO FABRICATE -

1. Locate the start/stop bend points. Mark the tube.
2. Calculate the distance between the bend points.
3. Locate step bend points on new tube. *figure 3*

4. Install narrow gauge die and D/E how we work from side to side using the alternate left-right step bending procedure. *figure 4*

5. D/E how we finish the bending process exactly in the middle of a compound bend. *figure 5*

2. VALIDATION - *figure 6*

Verify against “Copy” or old assembly.

TUBES N' hoses INTERNATIONAL
TRAINING

STANDARD CLOSE END BENDING

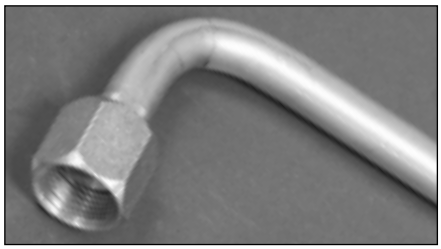
USING STANDARD BEND DIES

1. EXPLANATION -

"End Bends" on rigid fluidlines are referred as such because the bend is used to transition the direction of the tube as it leaves the fitting.

When it makes an immediate transition, we call it a "close" end bend.

figure 1: Photo of standard bend



We have two types: The **Standard** close end bend and the **Extreme** close end bend. *figures 1 & 2*

Standard close end bends are formed using the standard bending dies.

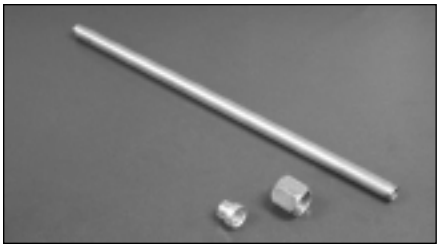
figure 2: Photo of extreme bend

2. IDENTIFICATION -

A. BY PRODUCT - Hydraulic Tube, etc.

B. BY APPLICATION - Type Equipment, Cost?

figure 3: Photo of components



C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes
Check the distance of the CL of the bend behind the nut. If the distance is less than four diameters of the tube, you will need to use the **Extreme** close end bending procedure.

D. SELECT COMPONENTS - *figure 3*

1. 1/2" x 12" Hydraulic Tube.
2. 1/2" 37° JIC Female Nut.
3. 1/2" 37° JIC Support Sleeve.

STANDARD CLOSE END BENDING

USING STANDARD BEND DIES

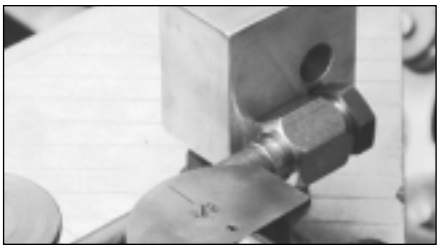
3. FABRICATION -

A. ORGANIZE COMPONENTS -

figure 4: Photo showing flare

figure 5: Photo showing bending point

figure 6: Photo showing support nut



B. SELECT THE WORK STATIONS AND TOOLING -

1. Bending Station.
2. 1/2” Bend Tooling.
3. Forming Station.
4. Flare Tooling - You may use single or double flare.

B. STEPS TO FABRICATE -

1. Form any of the following:
   – Single JIC 37° Flare.
   – Double JIC 37° Flare. *figure 4*
   – Single JIC 45° Flare.
   – Double JIC 45° Flare.

2. Use the standard close end bending rule (three diameters behind nut) to locate bending point. Mark the tube. *figure 5*

3. Support 37° female swivel with the male nut. *figure 6*

STANDARD CLOSE END BENDING

USING STANDARD BEND DIES

figure 7: Photo showing bend

figure 8: Photo showing completed assembly

4. Bend to the desired angle of 90° or less. *figure 7*

2. VALIDATION - *figure 8*

Verify dimensions. Check for cracks or irregularities. Be sure the nut spins freely.

EXTREME CLOSE END BENDING

figure 1: Photo showing close end bend

1. EXPLANATION -

Extreme Close End Bending is an extremely profitable necessity in modern industry. *figure 1*

Explain the operating environment for engine and power train compartments on machinery and equipment has become an area of extremely limited space. Severe demands are consequently being made on the transition distance of curved fluid lines.

The Tubes N' Hoses® tooling will allow you to accomplish the shortest transitions in the world. Very profitable and you never have to turn a customer away.

2. IDENTIFICATION -

A. BY PRODUCT -

1. Hydraulic Tube.

B. BY APPLICATION - Type Equipment, Cost?

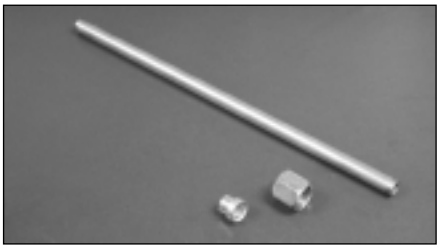
1. Offroad construction, automotive, etc.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

1. 3/8" x 12" Hydraulic Tube.
2. 3/8" JIC Nut.
3. 3/8" JIC Sleeve.

EXTREME CLOSE END BENDING

figure 2: Photo of components



B. SELECT COMPONENTS - *figure 2*

1. 3/8” x 8” Hydraulic Tubing.
2. 3/8” JIC Nut.
3. 3/8” JIC Sleeve.

3. FABRICATION -

At this point we must decide the configuration that will be used for forming the tube and creating the bend. Will we be making a female swivel fitting? Will we be making a male inverted flare, o-ring bead, etc.? We must also decide if we are going to be using a single or double flare on the end of the tube. Will we be upsizing or downsizing to metric?

Decide whether you will be flaring, downsizing, upsizing, etc., and select the proper die or dies for the required procedure. In this case, we will be using $^{3}/_{8}$” tube and fittings.

A. ORGANIZE COMPONENTS -

A. SELECT THE WORK STATION & TOOLING -

1. Metal Forming Station.
2. 3/8” Double Flare Folding Die.
3. Universal Flare Die.
4. Bending Station.
5. 3/8” Extreme Close End bending Die.
6. 3/8” Support Die (Roller Die).
7. Universal Bending Block.

EXTREME CLOSE END BENDING

figure 3: Photo of no. 1, 2, 3, 4

figure 4: Photo showing sleeve and nut

figure 5: Photo showing different steps to fabricate

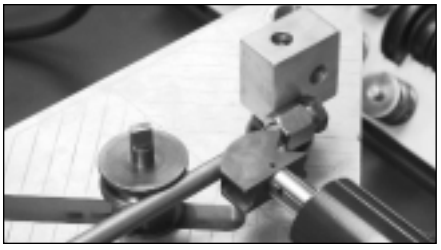


figure 6: Photo showing bend

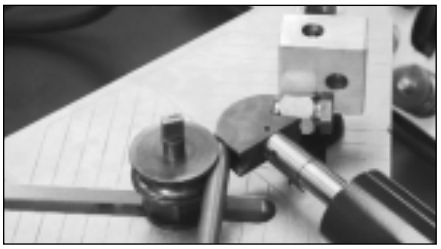


figure 7: Photo showing completed assembly

C. STEPS TO FABRICATE -

1. Install 37° sleeve and nut.
2. Install 3/8” tube in double flare position.
3. Select double flare die. Install fold on the end of the tube.
4. Select 37° flare die and finish flare. *figure 3*
5. Install 37° flare bar in camlock on metal forming station.
6. Install sleeve and nut over flare. *figure 4*
7. Install supporting male nut.
8. Select and install the 3/8” extreme close end bending die on actuator.
9. Locate and tighten the roller die at the standard bending position opposite the bending die.
10. Locate the bending block exactly opposite the roller die; tighten. *figure 5*
11. Locate the bending point and bend. NOTE: You may locate the bend point by “setting” the nut in the bending recess of the bending die and rotating the tube to the start position. *figure 6*

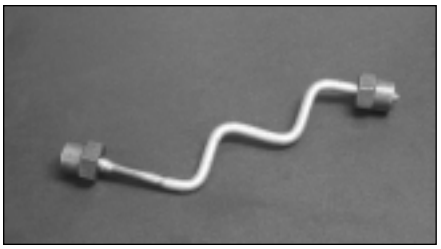
4. VALIDATION - *figure 7*

Check for appearance, creases, etc.

DIESEL FUEL INJECTION

TUBE BENDING

figure 1: Photo showing fuel injection assembly



1. EXPLANATION -

Diesel fuel injection tube assembly fabrication is a very profitable and easy procedure. *figure 1*

The same bending procedure and tooling is used as with all other bending. The complex bends found on injection assemblies are normal procedure for Tubes N' Hoses®.

Notice that every diesel engine has fuel injection lines. They operate at high pressure, high temperature, high vibration and in a hostile environment.

Great service to your customers, great profit.

2. IDENTIFICATION -

A. BY PRODUCT -

1. Fuel injection is identifiable by the end fittings and nuts.

B. BY APPLICATION - Type Equipment, Cost?

1. What type of machine or engine?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

1. Identify Tube.
2. Identify Nuts.
3. Identify Nipple (nozzle, tube ends).

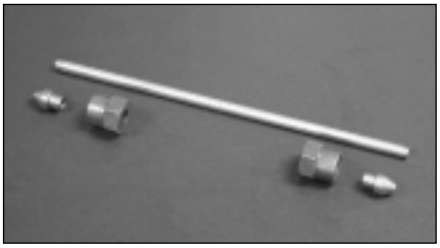
DIESEL FUEL INJECTION

TUBE BENDING

D. SELECTION OF NEW COMPONENTS - *figure 2*

1. 8mm Tubing.
2. Nipples.
3. Nuts.

figure 2: Photo showing components



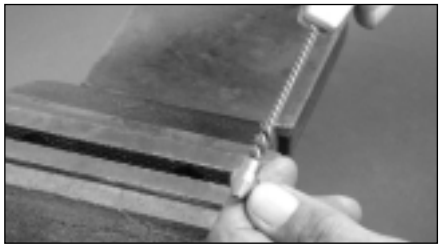
3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Select bending station.
2. Select bending dies (When bending METRIC fuel injection tube use the nearest American bending dies.).
   Example: when bending 8mm tube (.236) use 1/4" dies (.250).
3. Select Brazing station.
4. Select silver braze rod, flux and other material as necessary.

figure 3: Photo of cleaning fittings



C. STEPS TO FABRICATE -

1. Measure and cut tubing being extremely careful not to clog the small internal diameter of the tube.
2. When cutting the tube you may cut to exact length or leave "trim" length on the ends of the tube.
3. Trim and clean ends of the tube after cutting. Clean and deburr with appropriate size tip cleaner. *figure 3*
4. "Prep" for brazing (see brazing procedure). *figure 4*

figure 4: Photo of fluxing

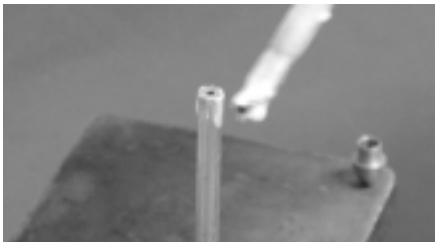


figure 5: Photo showing brazing process

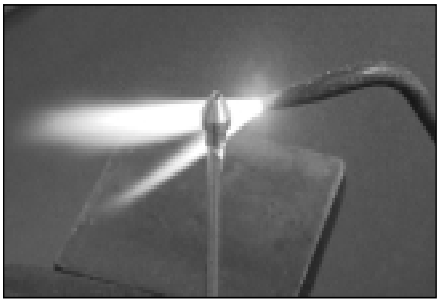


figure 6: Photo showing brazing opposite end

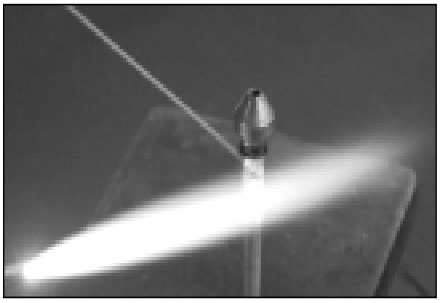
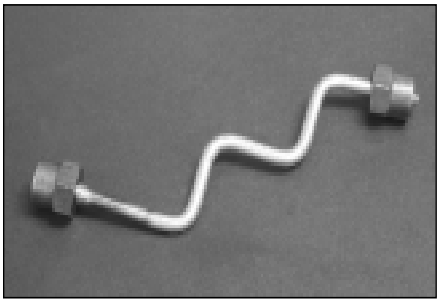


figure 7: Photo showing polishing

figure 8: Photo showing validation



5. Install proper NUT and braze NIPPLE onto tube using vertical brazing procedure. *figure 5*

6. Install and braze the opposite end. *figure 6*

7. Clean and polish braze joints and nipples. *figure 7*

4. VALIDATION - *figure 8*

Use TIP CLEANERS to deburr and clean the bore (I.D.) of nipple and tube.

Test with air pressure to verify no restriction in the tube.

Test with fuel injection bench tester.

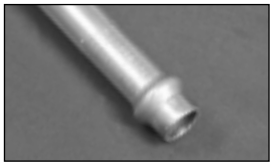
TUBES N' hoses INTERNATIONAL
TRAINING

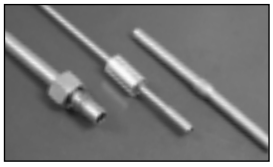
METAL FORMING

INDEX





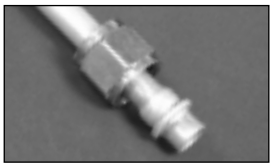
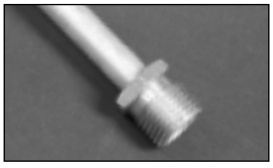



TUBES N' hoses INTERNATIONAL
TRAINING

METAL FORMING

INDEX



TUBES N' hoses INTERNATIONAL
TRAINING

INTRODUCTION

figure 1: Photo of Metal Forming station & tooling

Again the Tubes N' Hoses® designers were at the leading edge when they realized that FLUIDLINE fabricators of the future must be able to manage metal in many different disciplines.

The result is several procedures that solve problems for your customers and create a new business and profit center for you.

Metal forming fluidline pertains to the creative management of shapes necessary to form the connecting ends on hose stems and tube ends. *figure 1*

Metal forming is one of the most challenging and creative procedures in the world of fluidline manufacture and fabrication. It is in constant change, upgrade, improvement, modification, etc.

Your Tubes N' Hoses® program addresses them all. Our research department is constant in its production and testing of new tooling and procedure.

Special tooling can be quickly designed and manufactured for special applications.

The Tubes N' Hoses® program will bring you a growing new family of satisfied customers.

TUBES N' hoses INTERNATIONAL
TRAINING

INTRODUCTION

NOTES

Your metal forming procedures are an integral part of the Tubes N' Hoses® program. It is a critical interface with your bending and crimping procedures.

Metal forming is one of the keys to capturing the potential of this great new industry.

TUBES N' hoses INTERNATIONAL
TRAINING

BASIC RULES

NOTES

Most forming procedures in the fluidline industry are based on the Management and shaping of metal tube.

We shape tubing of various types and metals: Carbon steel, stainless steel, aluminum, copper, etc.

RULE: All cuts when tubing is severed must be “SQUARE”.

RULE: Ends of the tube should be slightly deburred and chamfered. This should be done on both the inside and outside of the tube.

RULE: Inside of tube must be flushed and cleaned, metal dust or chips left inside the tube can be extremely damaging to hydraulic and other systems.

RULE: Tooling must always be perfectly center lined with the center of the tube for the procedure being performed.

RULE: Tube must always be exactly positioned in the clamping bar for the procedure being performed.

45º SINGLE FLARE

1. EXPLANATION -

Tube flaring is one of the oldest and basic procedures.

The most popular application for the 45º flare is automotive. *figure 1*

The single 45º flare is seldom used on modern vehicles as it has been replaced by the 45º double flare.

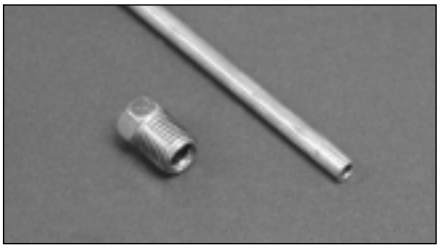
figure 1: Photo of 45º flare

You will find the single flare used on copper tubing in refrigeration applications.

2. IDENTIFICATION -

Most single 45º flares will be found in low-pressure applications and most often on copper tubing. Identify the flare with an opposite fitting, male to female or the reverse.

figure 2: Photo of components



A. BY PRODUCT -

1. Usually a small metal tube.

B. BY APPLICATION - Type Equipment, Cost?

1. Usually oil, fuel, etc.

B. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

C. SELECT COMPONENTS - *figure 2*

1. 1/4” x 6” Hydraulic Tube.
   1/4” Inverted Flare Nut.

45º SINGLE FLARE

3. FABRICATION -

A. ORGANIZE COMPONENTS -

figure 3: Photo of no. 1, 2, 3

B. SELECT WORK STATION & TOOLING -

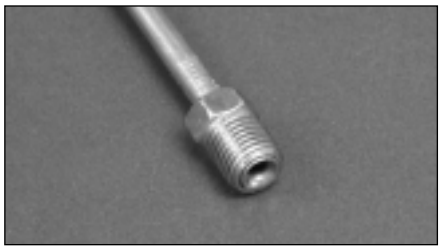
1. Metal Forming Station.
2. Cam lock.
3. 45º Flare Bar.
4. 45º Flare Die.

figure 4: Photo of no. 4

C. STEPS TO FABRICATE -

1. Install nut on tube.
2. Install tube in flare in proper die opening.
3. FLUSH tube with face of flare bar. Clamp cam lock. *figure 3*

figure 5: Photo of completed procedure



4. Install flare die on actuator and lubricate. Advance flare die until tube centers around the die. Slowly and carefully advance die until flare is formed. Use very little pressure. DO NOT bottom the die to full pressure. *figure 4*

4. VALIDATION - *figure 5*

A. Visually inspect. Look for cracks, burrs, etc.

45º DOUBLE FLARE

1. EXPLANATION -

The most popular 45º flare is the Double flare. It is almost always found in automotive and mobile equipment applications. *figure 1*

figure 1: Photo of double flare 45º

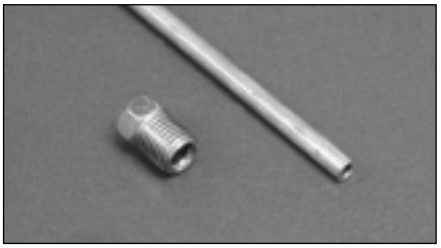
The 45º double flare is popular with automotive fuel, oil, and D.O.T. brake tubes.

The Double flare offers a stronger joint in terms of vibration resistance and fracture. It also offers a better seal.

2. IDENTIFICATION -

Identifying the double flare is quite simple. Look at the inside edge of the flare and you can easily observe whether the tube has been folded inward. If so you are looking at a double flare.

figure 2: Photo of components



A. BY PRODUCT -

B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

D. SELECT COMPONENTS - *figure 2*

1. 3/16” D.O.T. Brake Line.
2. 3/16” Inverted Flare Nut.

45º DOUBLE FALRE

3. FABRICATION -

A. ORGANIZE COMPONENTS -

figure 4: Photo of no. 3

figure 5: Photo of no. 4

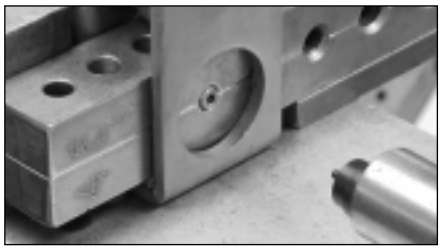


figure 6: Photo of no. 5

B. SELECT WORK STATION & TOOLING -

1. Metal Forming Station.
2. Cam Lock.
3. Folding Die (proper size).
4. 45º Flare Bar.
5. 45º Flare Die.

C. STEPS TO FABRICATE -

1. Square and prep the end of tube.
2. Install flare bar in cam lock.
3. Install flare nut.
4. Insert tube in flare bar.
5. Extend tube proper distance to in-fold tube. *figure 3*
6. Install in-fold die.
7. Clamp tube, advance in-fold die, make contact and carefully advance in-fold die until contact. *figure 4*
8. Retract in-fold die and install 45º flaring die.
9. Carefully center the flaring die in the in-fold and gradually advance the flare die until the 45º double flare is complete. Be extremely careful not to over compress. *figure 5*

45º DOUBLE FLARE

4. VALIDATION - *figure 6*

1. Check visually.
2. Check dimensionally.
3. Do magnification checks for stress fracture or splits in the edge or face of flare.

figure 6: Photo of validation

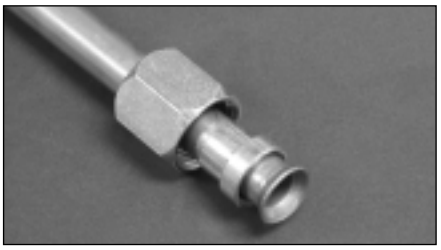
37º SINGLE FLARE

1. EXPLANATION -

The 37º flare belongs to a family of higher-pressure application than the 45º flare. *figure 1*

The 37º was adopted primarily for high-pressure hydraulic applications and is uniquely American. You seldom find flare fittings on metric or British hydraulic systems.

figure 1: Photo w/ arrows

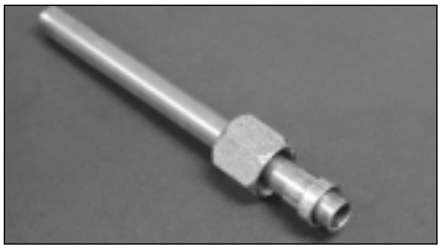


2. IDENTIFICATION -

Most 37º single flares will be found in high-pressure applications such as hydraulic fluid lines. They may be rigid lines, flexible lines etc.

Popular sizes for the 37º single flare will usually range between 3/16" (#3) and 1 1/4" (#20). You will occasionally find them in 1 1/2" and 2" sizes.

figure 2: Photo of components



A. BY PRODUCT -

B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

1. Use chart and measure with calipers.

D. SELECT COMPONENTS - *figure 2*

1. 1/2" X 8" Hydraulic Tube.
2. 1/2" JIC Hex Nut.
3. 1/2" JIC Sleeve.

37º SINGLE FLARE

3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Forming Station.
2. Camlock.
3. 37º Flare Bar.
4. 37º Flare Die.

figure 3: Photo of no. 1, 2, 3, 4

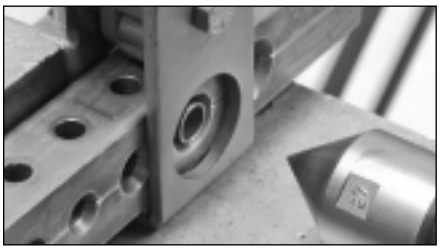
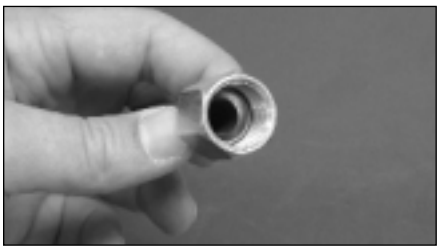


figure 4: Photo of no. 5, 6, 7

figure 5: Photo of validation



C. STEPS TO FABRICATE -

1. Square and prep the end of the tube.
2. Install the flare bar in the camlock.
3. Install the flare nut and insert the tube in the bar.
4. Extend the proper distance (flush with the face of the flare bar on single flares). *figure 3*
5. Install the flare die on the actuator.
6. Lubricate the die and advance until it is in contact with the tube.
7. Center the tube around the die and advance slowly until the flare is formed. DO NOT over compress. *figure 4*

4. VALIDATION - *figure 5*

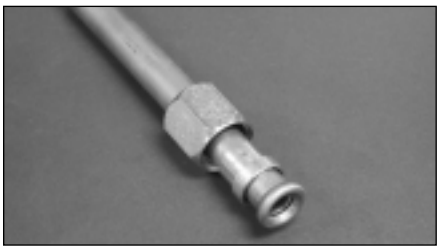
1. Check visually.
2. Check dimensionally.
3. Perform magnification checks for stress fracture or splits in the edge or face of flare.

37º JIC DOUBLE FLARE

1. EXPLANATION -

The 37º JIC Double Flare is a fairly recent development and is a very profitable one. *figure 1*

figure 1: Photo w/ arrows



The Double Flare offers a sealing advantage as well as structural strength and support.

Tubes N' Hoses® is the only service program offering the DOUBLE Flare procedure.

The 37º JIC Double Flare is almost exclusively hydraulic but is creeping into automotive applications.

The Double Flare procedure is very profitable.

2. IDENTIFICATION -

Look at the inside edge of the flare, if the tube has been folded inward it is a double flare.

The 37º Double Flare is currently found on tube sizes from 1/4" through 3/4".

A. BY PRODUCT -

1. Hydraulic Tube.

B. BY APPLICATION - Type Equipment, Cost?

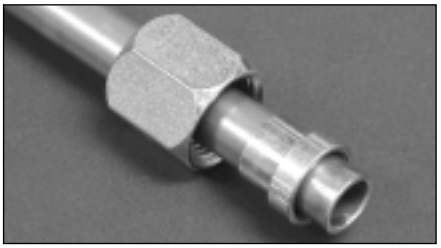
37º JIC DOUBLE FLARE

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

D. SELECT COMPONENTS - *figure 2*

1. 5/8” x 8” Hydraulic Tube.
2. 5/8” JIC Flare Nut.
3. 5/8” JIC Flare Sleeve.

figure 2: Photo of components



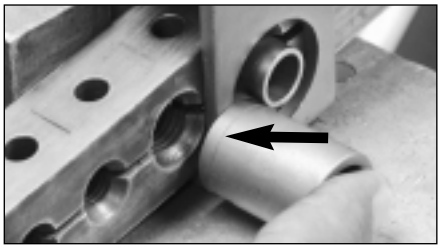
3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Metal Forming Station.
2. Camlock.
3. Folding Die.
4. 37º Flare Bar.
5. 37º Flare Die.

figure 3: Photo of no. 5

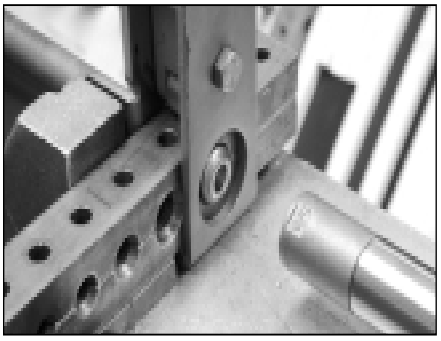


C. STEPS TO FABRICATE -

1. Square and prep end of tube.
2. Install flare bar in cam lock.
3. Install flare nut and sleeve.
4. Insert tube in flare bar.
5. Extend tube proper distance to make in-fold. *figure 3*
6. Install in-fold die.

37º JIC DOUBLE FLARE

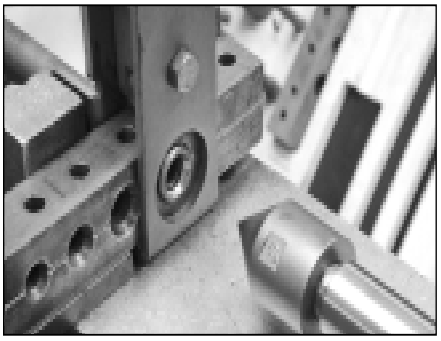
figure 4: Photo of no. 7



7. Clamp tube, advance in-fold die, make contact and carefully advance in-fold die until centered. Advance until in-fold is complete and die "bottoms". *figure 4*

8. Retract in-fold die and install 37º flare die.

figure 5: Photo of no. 9

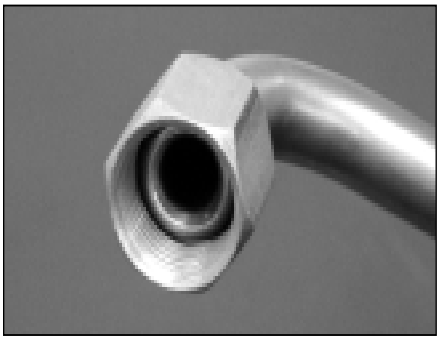


9. Carefully center the flaring die in the in-fold and gradually advance flare die until the 37º double flare is complete. *figure 5*

4. VALIDATION - *figure 6*

1. Check visually.
2. Check dimensionally.
3. Check with magnification for any type of split or fracture.

figure 6: Photo of validation



TUBE BEADING

FORMING
POWER STEERING ASSEMBLY

figure 1: Photo of tube beading

1. EXPLANATION -

Tube Beading is a very creative forming operation that allows elastomeric seals to integrate conveniently and inexpensively with rigid metal joints. A beaded tube is multi-purpose. It serves as a latch or shoulder for the supporting nut, either male or female. The opposite side of the bead serves as the sealing surface. Beaded tubes are usually used with o-ring seals. The o-ring seal can be selected according to materials and/or pressures being used. *figure 1*

The Tube Beading procedures use different configuration. Some are down swaged, some are up swaged, some are shorter, and some are longer. As a Tubes N' Hoses® dealer, you can almost always accommodate anything your customer needs. As a Tubes N' Hoses® dealer you are the only service center that can properly and economically perform this procedure.

Tube beading is critical to the future for hose and fitting distributors. It is fascinating procedure that enjoys extremely fascinating profits!

2. IDENTIFICATION -

You will usually be duplicating an old assembly; therefore, you will need to identify all components in order to duplicate them. In the following example we are going to completely manufacture a power steering assembly from scratch.

TUBE BEADING

FORMING
POWER STEERING ASSEMBLY

A. BY PRODUCT -

1. P/S Assembly.

B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

figure 2: Photo of components

D. SELECT COMPONENTS - *figure 2*

1. 3/8” x 18” Hydraulic Tube.
2. 5/16” x 18” Hydraulic Tube.
3. 3/8” Inverted Flare Nut.
4. 5/16” Inverted Flare Nut.
5. 2 ea. 3/8” PSS Ferrules.
6. 1 ea. 3/8” x 10” R3 PS Hose.

3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

With this procedure you will use all three-work stations.

1. Metal Forming Station.
2. Camlock.
3. 45º Flare Bar.
4. 3/8” Bead Tool.
5. 5/16” Double Flare Tool.
6. 5/16” Up Swage Die and Tool Holder.

TUBE BEADING

FORMING
POWER STEERING ASSEMBLY

7. Crimping Station.
8. #4 Staking Die.
9. #4 PS Bubble Die.
10. Bending Station.
11. 3/8” Bending Dies.
12. 5/16” Bending Dies.

figure 3: Photo of no. 1 & 2

figure 4: Photo of no. 3

figure 5: Photo of no. 4

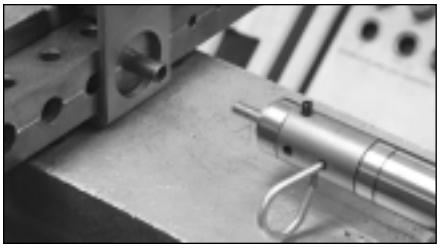
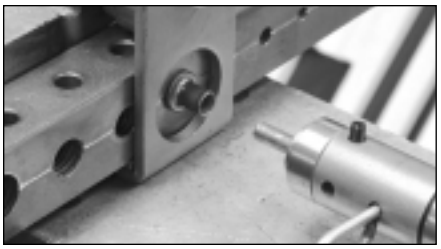


figure 6: Photo of no. 6



C. STEPS TO FABRICATE -

1. Install flare/form bar in camlock. Explain that you are using the facing side of the bar.
2. Select the 3/8” tube and 3/8” bead die. Install tube using guide pin to extend tube proper distance from face of bar center tube in camlock and clamp. *figure 3*
3. Install 3/8” beading die into universal tool holder and lock w/set screw (finger tight). *figure 4*
4. Install universal tool holder on actuator and lock w/retaining pin. *figure 5*
5. Explain the lubricating and centering process and proceed w/bead forming.
6. D/E the finished bead with the reduced nose. *figure 6*

TUBE BEADING

FORMING
POWER STEERING ASSEMBLY

figure 7: Photo of no. 7, 8

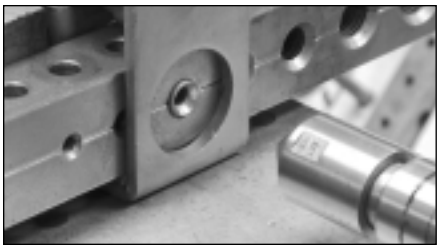
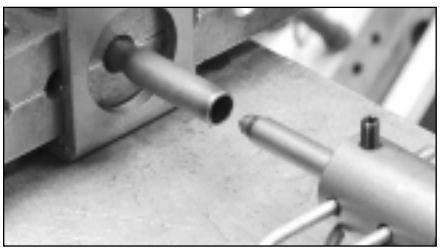


figure 8: Photo of no. 10, 10

figure 9: Photo of no. 11

figure 10: Photo of no. 15

figure 11: Photo of no. 17



7. Set up for 5/16” Double Flare - Explain that this will be the other end of the power steering assembly.
8. Insert 5/16” tube on the “facing” side of the FLARE/FACING bar and proceed with the 5/16” double flare. *figure 7*
9. Explain that the tubes can be bent before they are crimped onto the hose or they may be bent afterwards. In this case we will bend the 3/8” first and the 5/16” afterwards.
10. Select 3/8” bend die and 3/8” roller dies. Set up bend station for 3/8” tube. *figure 8*
11. Install 5/16” inverted flare nut and proceed with power steering shaped bend of trainees’ choice. *figure 9*
12. Set up the Metal Forming Station for up swaging the 5/16” tube.
13. Install 5/16” up swage die in UNIVERSAL tool holder.
14. Install 3/8” ferrules over 5/16” tube to later be staked onto the tube (be sure to properly orient the ferrule for crimping).
15. Install 5/16” tubes in flare/form bar (flare side). Extend tube far enough to up swage the entire length of the up swage die (Length of die plus one full diameter of tube). *figure 10*
16. Lubricate tube internally. Lubricate die externally.
17. Setup exactly on centerline and proceed with up swage the full length of up swage die. Be careful not to allow tube to drift. *NOTE:* This procedure gives you a 3/8” diameter on the end of the 5/16” tube. *figure 11*

TUBE BEADING

FORMING
POWER STEERING ASSEMBLY

18. Move to crimping station and stake ferrules onto both 5/16” and 3/8” tube.
19. Use standard staking procedure – after solid contact between lip of ferrule and tube plus .020/.025 forward travel on the dial. Use 3/8” R3 hose to “center’ ferrule on the stem. Verify rigidity of attachment. *figure 12*
20. After staking, proceed with crimping the hose with #4 power steering dies. Use power steering crimp chart. *figure 13*
21. You may crimp either the 5/16” or 3/8” tube end first.
22. You can now set up the bending station for bending the 3/8” tube to desired shape. *NOTE:* Keep in mind that you could have performed the bending and crimping in any sequence depending on convenience of procedure.

figure 12: Photo of no. 18 & 19

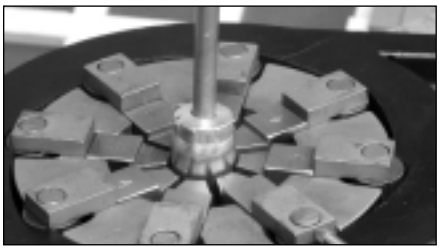


figure 13: Photo of no. 20

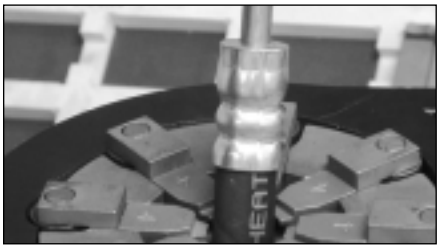
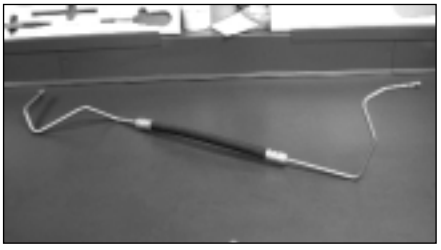


figure 14: Photo of validation



4. VALIDATION - *figure 14*

1. Verify crimp dimensions.
2. Pressure test.
3. Verify and trim o-ring “noses” to proper length.
4. Check all forms and surfaces for accuracy and appearance.

POWER STERRING CRIMP CHART

HOSE: SAE 100R3

Tubes n' Hoses **Special Power Steering Ferrule**

SIZE	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2
DASH SIZE	-3	-4	-5	-6	-8	-10	-12	-16	-20	-24	-32
CRIMP DIAMETER		.550		.695	.850						
CRIMP TRAVEL		.140		.180	.210						
DIE SIZE		#3 P/S Bubble		#4 P/S Bubble	#10 A/C Bubble						
PRE-CRIMP DIAMETER		.690		.875	10.60						
DIAL INDICATOR SETTING	**DIAL IS ALWAYS 1/2 OF THE CRIMP TRAVEL**										
GAUGE PRESSURE											
CRIMP LENGTH		.750		.800	1.200						
STAKE (LOCATION)		FLUSH		FLUSH	FLUSH						
STAKE (TRAVEL)		#3S S/D .040 after firm contact with stem		#4 S/D .040 after firm contact with stem	#5 S/D .040 after firm contact with stem						

TUBE BULGING

FORMING

1. EXPLANATION -

Bulging is a simple process that can be performed using the universal tooling of the Tubes N' Hoses® program. *figure 1*

In this case, we use the flare bar with the bulge tools.

figure 1: Photo of bulging

Explain that this procedure is used with low-pressure applications where the bulge is used to retain the hose and help seal the joint.

2. IDENTIFICATION -

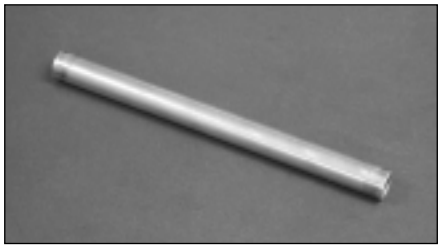
Identify by tube and hose size.

A. BY PRODUCT -

B. BY APPLICATION - Type Equipment, Cost?

C. DESCRIPTION & SIZE OF COMPONENTS - Take Notes

figure 2: Photo of components



D. SELECT COMPONENTS -

1. 1/2" X 8" Hydraulic Tube. *figure 2*

3. FABRICATION -

A. ORGANIZE COMPONENTS -

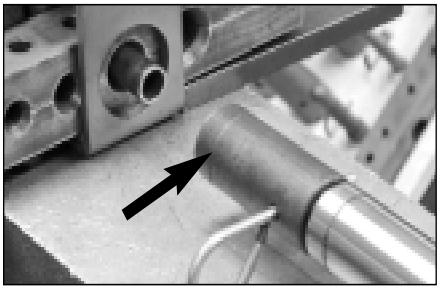
B. SELECT WORK STATION & TOOLING -

1. Forming Station.
2. 37º flare bar.
3. 1/2" bulge tool.

TUBE BULGING

FORMING

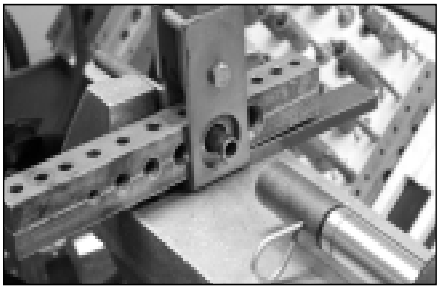
figure 3: Photo of no. 2



C. STEPS TO FABRICATE -

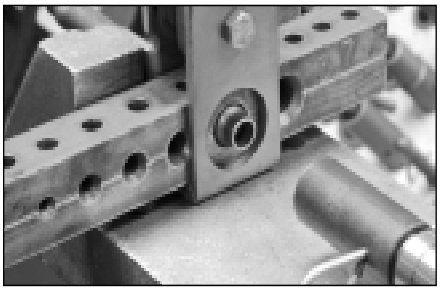
1. Install 37º flare bar in cam lock.
2. Insert 1/2” tube in flare bar and extend past face as indicated by “Mark” on bulge tool. *figure 3*

figure 4: Photo of no. 3



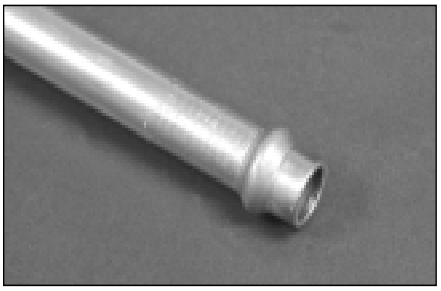
3. Install bulge die on ram and gently engage end of tube. *figure 4*

figure 5: Photo of finished bulge



4. Advance bulge die smoothly until bulge is complete. *figure 5*

figure 6: Photo of validation



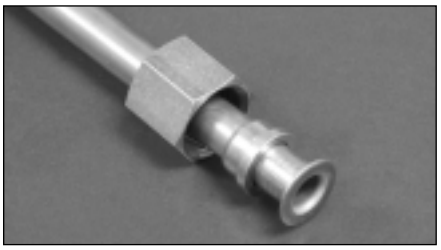
4. VALIDATION - *figure 6*

1. Check for cracks or imperfections.
2. Visually inspect.
3. Check dimensions.

TUBE FLANGING

FORMING

figure 1: Photo of o-ring face seal



1. EXPLANATION -

Use sample to D/E how the Tubes N' Hoses® metal forming and fabrication programs can be used to manufacture the increasingly popular O-Ring Face Seal (ORFS) hose coupling from "scratch". *figure 1*

The O-Ring Face Seal (ORFS) was introduced several years ago and became popular with John Deere equipment thus they are often referred to as John Deere fittings.

The flanging procedure is usually specific to the O-Ring Face Seal. The flange becomes the sealing surface for the O-Ring. It is the "Face".

The elastomeric seal offers less opportunity for mismanagement during installation and attachment. Its popularity continues to grow.

The ability to manufacture any configuration of an O-Ring hose coupling puts the Tubes N' Hoses® dealer squarely in the drivers seat since many O-Ring fittings come in non-standard configurations.

2. IDENTIFICATION -

A. BY PRODUCT -

D/E that we can use the braze on seal ring or we can use the very creative tooling to form the face seal by flanging the end of the tube.

D/E the brazed sample and proceed with the flanging procedure.

TUBE FLANGING

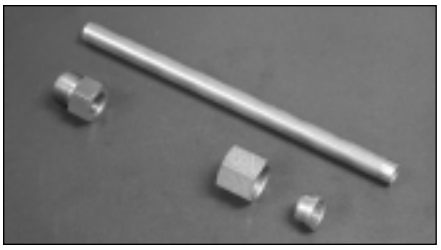
FORMING

B. BY APPLICATION - Type Equipment, Cost?

1. Hydraulic.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

figure 2: Photo of components



D. SELECT COMPONENTS - *figure 2*

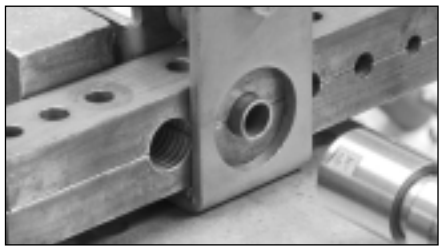
1. 1/2” x 8” Hydraulic Tube.
2. 1/2” ORFS Support Sleeve.
3. 1/2” ORFS Female Nut.
4. 1/2” ORFS Male Brace Nut.

3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

figure 3: Photo of No. 1



1. Select Forming Station.
2. Camlock.
3. Flaring Bar.
4. 45º Flare Die.
5. Flatface Pusher.

C. STEPS TO FABRICATE -

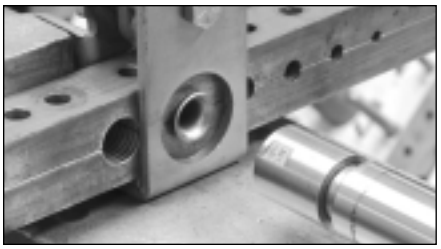
D/E that we use the facing side of the form bar.

1. Install facing bar in the camlock. Explain that either the 45º or 37º bar will work just fine. Install the tube in the facing bar and extend to the proper mark on the o-ring flange extension pin. *figure 3*

TUBE FLANGING

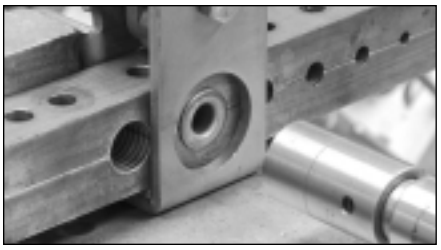
FORMING

figure 4: Photo of No. 2



2. Create the first step of the flange using the 45º flaring die. Be extremely careful not to crease or pinch the inside radius of the flange by pressing too hard with the actuator. *figure 4*

figure 5: Photo of No. 3



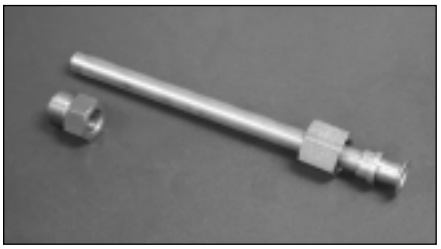
3. Replace the 45º flare die with the flat face die and flatten the flange face against the facing bar. This will create the finished flange. *figure 5*

4. VALIDATION - *figure 6*

Fit flange support sleeve and nut over flange.

Check for burrs, cracks, or any surface imperfections

figure 6: Photo of validation



TUBES N' hoses INTERNATIONAL TRAINING

TECHNICAL DATA

FOR METRIC SIZING

METRIC TUBE SIZING PROCEDURE

Step By Step Instructions -

1. Taper the end of the tube approximately one third the diameter of the wall. Use the wire wheel.

2. Clean and polish the tube the entire length of the area to down sized.

3. Be sure that the tube is extremely clean on the outside for downswaging and extremely clean on the inside for upswaging.

4. Completely Clean the inside of the swaging die.

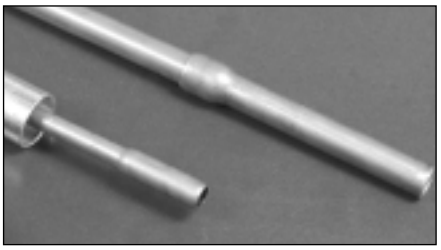
5. Lubricate the tube, engage the die over the end of the tibe and advance until the swaging die travels within a 1/4" of the end of the tube.

Metric Chart -

Millimeter Tube Size Required	American Tube Size
6MM	1/4"
8MM	5/16"
10MM	3/8" (UPSIZE)
12MM	1/2"
14MM	
15MM	5/8"
16MM	5/8" (UPSIZE)
18MM	SPECIAL ORDER
20MM	SPECIAL ORDER

METRIC TUBE UPSWAGE FORMING

figure 1: Photo of “dog bone”



1. EXPLANATION -

This is a very simple but creative procedure that allows us to accomplish several creative and profitable metal forms.

The upswage for brazing can create the straight or elbow “dog bone” to repair and salvage a damaged tube assembly. The procedure may also be used to create a continuing “run” of tube without “screwed” joints that interrupt flow. *figure 1*

Explain that the procedure can also be used to create low pressure hose stems for 3/8” power steering hose and other flexible fluid line applications (see Tube Beading). Explain that the procedure also converts American tube to metric.

Explain how this procedure is almost 100% profit since you get paid for what the equipment and tooling can create and manufacture, instead of fabricating a pre-made component.

2. IDENTIFICATION -

A. BY PRODUCT -

1. Old tube, materials, etc.

B. BY APPLICATION - Type Equipment, Cost?

1. Low pressure, high pressure, etc.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

METRIC TUBE UPSWAGE FORMING

D. SELECT COMPONENTS - *figure 2*

1. 2 ea. 1/2” x 4” Hydraulic Tube.
2. 1 ea. 5/8” x 8” Hydraulic Tube.
3. 1 ea. 5/16”x 12” Hydraulic Tube.
4. 1 ea. ORFS Female Nut.
5. 1 ea. ORFS Male Nut.
6. 1 ea. ORFS Backing Ring.
7. 1 ea. 16 mm Female Nut.
8. 1 ea. 16 mm Bite Ring.

figure 2: Photo of components

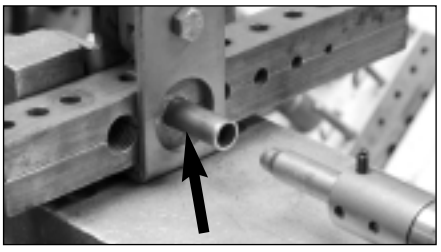
3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORKSTATION & TOOLING -

1. Forming Station.
2. Camlock.
3. 37º Small Flare Bar.
4. 1/2” Upswage Die.
5. 16 mm Metric Upswage Die.
6. Universal Tool Holder.

figure 3: Photo of No. 1



C. STEPS TO FABRICATE -

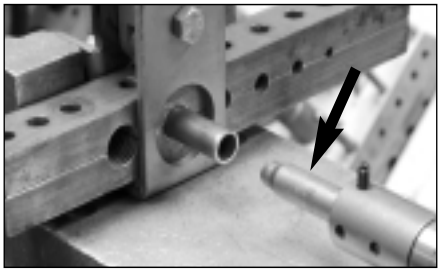
1. UPSWAGE TO BRAZE - Install flare bar in camlock and insert 1/2” x 4” tube. Clamp at midpoint of tube. NEVER USE LUBRICANT WHEN UPSWAGING TO BRAZE. *figure 3*

METRIC TUBE UPSWAGE FORMING

a) Install up swage die in universal tool holder. *figure 4*

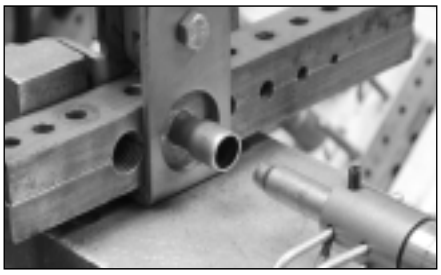
b) Advance up swage die exactly center lined with tube.

figure 4: Photo of a)



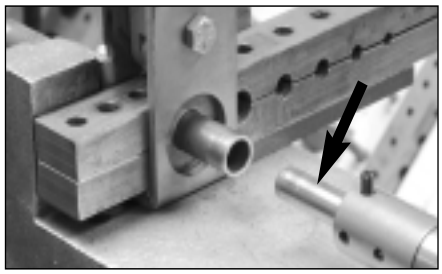
c) Engage and up swage one diameter of tube. *figure 5*

figure 5: Photo of c)



2. UPSWAGE FOR METRIC - Use caliper to D/E how many metric and American tubes are close in diameter. Explain that 16 mm is only .004 larger than 5/8" American. Because of this, we up swage instead of down swage.

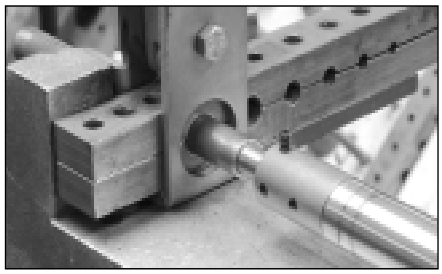
figure 6 Photo of a)



a) Install 16mm upswage tool in universal tool holder. *figure 6*

b) Install 5/8" Hyd. tube with .065 wall. Proceed with up swage approximately 3/4 length of tool. *figure 7*

figure 7: Photo of b)



c) Install bite ring and nut.

BRAZE TUBING UPSWAGE FORMING

figure 1: Photo of b)

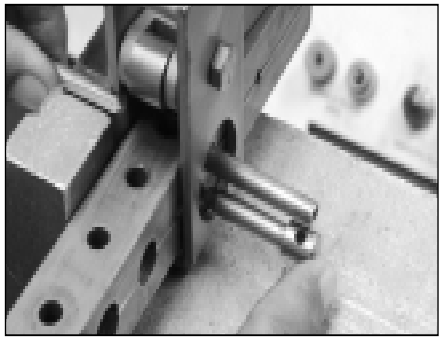


figure 2: Photo of c)

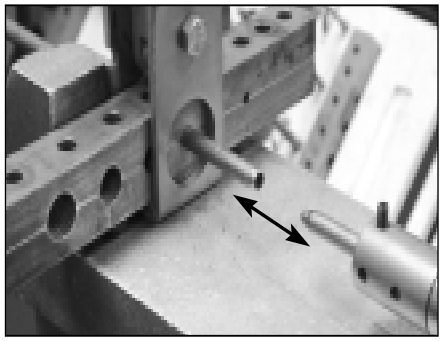
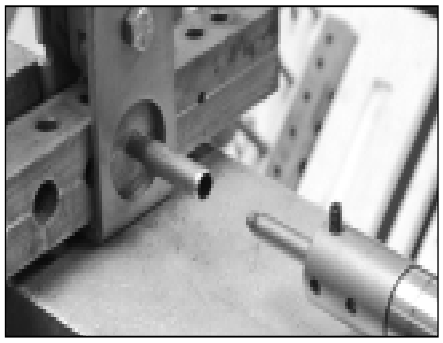


figure 3: Photo of d)



1. UPSWAGE FOR CRIMPING - D/E how we can use the tooling to up swage to expand hydraulic tube to fit the inside of low pressure hoses such as the power steering which we demonstrate.
   a) Use 5/16” x 12” tube and up swage the entire length of the die. This will up swage 5/16” x .035 tube to 3/8” which is a perfect fit for SAE 100 R3 hose. Explain that for this procedure we lubricate the tube and die.

   b) Install flare bar in camlock. D/E that we extend the tube just far enough to allow full engagement of the die plus the shrinkage caused by the up swaging of the tube. Measure w/die to get proper extension. *figure 1*

   c) Gently insert the die into the throat of the tube. Explain that the die must be perfectly center-lined with the tube to prevent “drift” when creating an up swage of this extreme distance. *figure 2*

   d) Explain that after contact we gently advance the die at a smooth and slow pace until the edge of the tube touches the shoulder (root) of the die. *figure 3*
   Demo how it is a perfect fit for the 3/8” hose.

BRAZE TUBING UPSWAGE FORMING

figure 4: Photo of validation

4. VALIDATION - *figure 4*

Always verify the “fit” with mating tube.

METRIC TUBE DOWNSWAGE FORMING

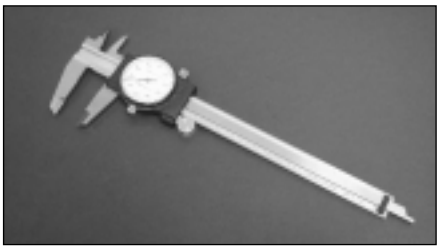
1. EXPLANATION -

D/E that the down swage is an extremely profitable and problem solv-ing procedure.

This procedure makes a Tubes N' Hoses® dealer totally functional in metrics.

The Tubes N' Hoses® down swaging normally pertains to the creation of metric tubing from American tube stock thus allowing the dealer to solve any metric problem and turn it into profit.

figure 1: Photo of decimal calipers



Explain that there are a couple of side benefits. The cold forming of the downswage procedure slightly enhances the properties of the tube and offers a smooth sealing surface.

2. IDENTIFICATION -

D/E how we identify a tube as metric using dial or decimal calipers, i.e., any tube diameter whether metric or american can be measured in thousandths of an inch. *figure 1*

METRIC TUBE DOWNSWAGE FORMING

Down swage procedure pertains to the following conversion sizes.

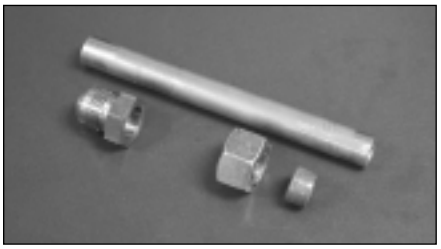
AMERICAN	→ converts →	METRIC
1/4” (.250)	→	6mm (.2362)
1/2” (.500)	→	12mm (.4724)
5/8” (.625)	→	14mm (.5512)
5/8” (.625)	→	15mm (.5905)
3/4” (.750)	→	18mm (.7087)
7/8” (.875)	→	20mm (.7874)
7/8” (.875)	→	22mm (.8661)

A. BY PRODUCT -

1. Usually Hydraulic Tube.

B. BY APPLICATION - Type Equipment, Cost?

figure 2: Photo of components



C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

D. SELECT COMPONENTS - *figure 2*

1. 5/8” X 8 (.065 wall) American Hydraulic Tube.
2. 15mm L metric nut.
3. 15mm L bite ring.
4. 5/8” x 5/8” SBM.

METRIC TUBE DOWNSWAGE FORMING

3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Forming station.
2. Camlock.
3. Small flare bar.
4. 15mm downsize tool.

C. STEPS TO FABRICATE:

1. D/E how to use the flare bar as a clamping bar. Extend the tube the distance indicated on the swaging die.
2. Clamp the tube, install the swage die and using retainer pin and smoothly advance the die over the tube to make the con-version to millimeter. *figure 3*
3. Remove the tube, install in vise to "set" the bite ring to retain the metric swivel nut by turning the nut two flats after the bite ring males contact with tube. *figure 4*
4. Explain that we always lightly lubricate the threads and mating taper before tightening the nut and "setting' the bite ring.
5. Braze 5/8" SBM onto tube. (This may be done later at braze station). *figure 5*

figure 3: Photo of no. 2

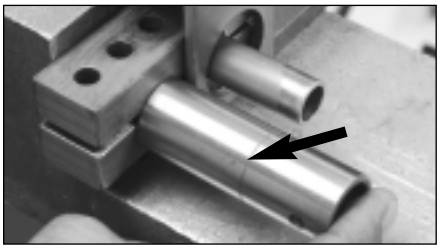


figure 4: Photo of bite ring

figure 5: Photo of brazing

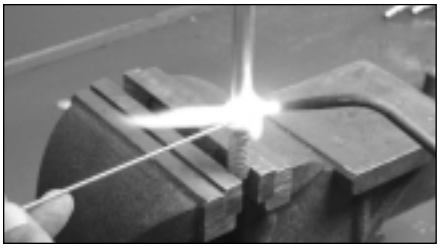
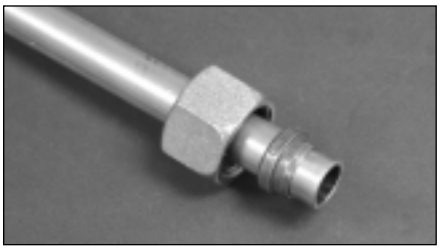


figure 6: Photo of validation



4. VALIDATION - *figure 6*

Validation is done at the installation of the nut and bite ring.

TUBES N' hoses INTERNATIONAL TRAINING

BUBBLE FLARING

figure 1: Photo of bubble flare

1. EXPLANATION -

D/E that we have already touched on the bubble flare in small tube bending. That is because in modern day fabrication most bubble flares are found on smaller tubes such as automotive brake lines. *figure 1*

In the recent past, bubble flares were found on automotive A/C lines and fittings, but are being replaced by elastomeric (flexible) seals.

Current popular bubble flare sizes are 3/16 and ⁄ and will be found in automotive applications.

The bubble crimp procedure when combined with the hydraulic brake program makes a customer friendly and profitable package.

2. IDENTIFICATION -

Identifying the bubble flare is extremely simple. D/E that it is immediately recognizable by the tapered nose.

A. BY PRODUCT -

1. Broken Line.

B. BY APPLICATION - Type Equipment, Cost?

1. Identify the tube by size, either 3/16” or 1/4”. To the slightly trained eye this is merely a visual process. Ask questions.

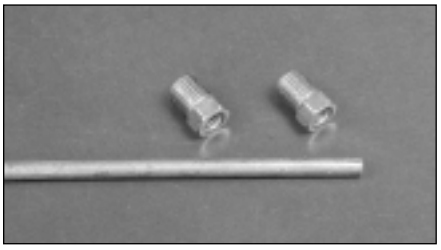
BUBBLE FLARING

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

D. SELECT COMPONENTS - *figure 2*

1. 3/16” Brake Tube.
2. 3/16” Inverted Flare Nut.

figure 2: Photo of components



3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORKSTATION & TOOLING -

1. Forming Station.
2. Camlock.
3. Small Flare Bar.
4. 3/16” Bubble Die.
5. Universal Tool Holder.

figure 3: Photo of no. 2

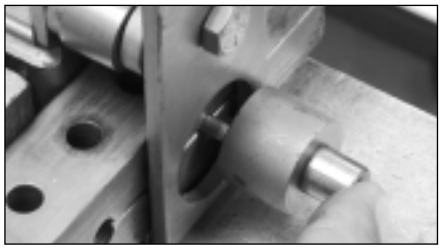
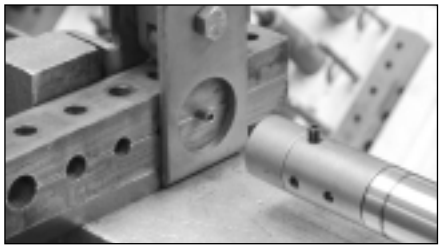


figure 4: Photo of no. 5



C. STEPS TO FABRICATE -

1. Install facing bar in camlock
2. Install 3/16” DOT brake tube proper distance in facing bar. Use pin in Bubble die to measure. *figure 3*
3. Lubricate bubble die.
4. Install the bubble die into the universal holder and attach holder to ram with retainer pin. *figure 4*

TEFLON HOSE ASSEMBLY

FOR SWAGING SMOOTH BORE SAE 100R14

figure 1: Teflon assembly.

1. EXPLANATION -

Teflon is an extremely beneficial product with many applications in many industries. One of its very important applications is fluid lines. *figure 1*

Since teflon has so many positive characteristics, it finds its way into many profitable fluid lines applications, such as hydraulics, steam, acids, temperature, instrumentation, automotive, marine and many more.

Because the construction of the smooth bore teflon fluid line is so different from that of traditionally reinforced rubber hose, the assembly of components is entirely different.

Hydraulic type rubber hose normally has the reinforcement wire woven between the inner liner and the outer cover which is usually rubber or neoprene.

Teflon on the other hand is a flexible tube (not a hose) and the reinforcement wire must therefore be applied to the exterior of the tube to achieve the pressure performance of medium pressure hydraulic hose. In addition it has all the chemical and temperature benefits of the amazing Teflon product.

Fitting availability for smooth bore teflon is currently limited primarily to male pipe and JIC female swivel. The preferred fitting material is type 304 stainless steel.

TEFLON HOSE ASSEMBLY

FOR SWAGING SMOOTH BORE SAE 100R14

2. IDENTIFICATION -

Be cautious when working with any flexible tubing. There seems to be variances in diameters from one manufacturer to another.

You must always be sure when purchasing product that the hose (tube) is compatible with your fittings.

Smooth bore teflon is measured by SAE automotive dimensioning standards which uses a different sizing chart than JIC (hydraulic):

#3 = 1/8” #4 = 3/16” #5 = 1/4” #6 = 5/16”
#8 = 13/32” #10 = 1/2” #12 = 5/8” #16 = 7/8”
#20 = 1 1/8”

DIMENSION AND SIZE CHART

SAE100-R-14 STAINLESS BRAID TEFLON SMOOTH BORE HOSE Use						
With: Only With Stainless, Brass and Steel Teflon Fittings						
TnH#	**Nominal Size**	**Actual Size**		**Max. Working Pressure**	**Min. Burst Pressure**	**Min. Bend Radius (in.)**
		ID	**OD**			
SBT-3	3/16	1/8	.250	3000	14000	1.5
SBT-4	1/4	3/16	.310	3000	12000	1.5
SBT-5	5/16	1/4	.380	3000	12000	2.0
SBT-6	3/8	5/16	.450	2500	10000	3.5
SBT-8	1/2	13/32	.535	2000	8000	4.5
SBT-10	5/8	1/2	.650	1750	7000	5.0
SBT-12	3/4	5/8	.780	1500	6000	6.0
SBT-16	1	7/8	1.03	1000	4000	9.0
SBT-20	1 1/4	1 1/8	1.29	750	3000	16.0

NOTE: Teflon “Dash Numbers” are based on the SAE numbering system.

TEFLON HOSE ASSEMBLY
FOR SWAGING SMOOTH BORE SAE 100R14

A. BY PRODUCT -

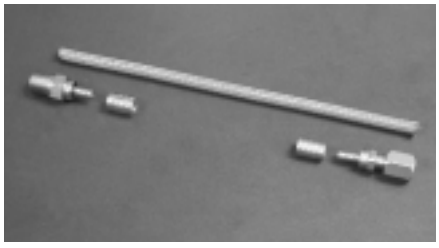
B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes Are the fittings stainless steel, brass, carbon steel, etc. (they are usually stainless, but you will also find other materials). Make list.

D. SELECT COMPONENTS - *figure 2*

1. 1 each #6 (3/16") x 12" Teflon Hose.
2. 1 each #6 Male Pipe Stem.
3. 1 each #6 Female JIC Stem.
4. 2 each #6 Ferrules.

figure 2: Components.



3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION AND TOOLING -

1. Forming Station.
2. Camlock.
3. Teflon Ferrule Insertion Bar.
4. Teflon Clamping Bar.
5. Teflon Swaging Bar.
6. Teflon Pusher Tool.
7. Teflon Hose Bore Relief Tool.

TEFLON HOSE ASSEMBLY
FOR SWAGING SMOOTH BORE
SAE 100R14

C. STEPS TO FABRICATE -

1. D/E that we have 3 distinct procedures in the assembly of smooth bore teflon hose:
   a) Insertion of the hose into the ferrule.
   b) Insertion of the stem into the hose.
   c) Swaging of ferrule on to hose/stem Assembly.
2. Select the ferrule insertion bar. D/E how we use it to compress the outer wire and insert the hose into the ferrule.

figure 3: Photo of no. 3

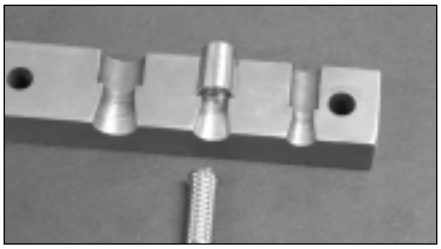
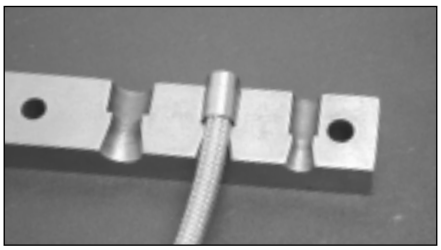


figure 4: Photo of D



3. Demonstrate the inside of the bar and how the taper compresses the frayed ends of the wire braid and guides it into the ferrule. Proceed allowing trainee to perform the procedure. *figure 3*

figure 5: Photo of no. 1 & 2

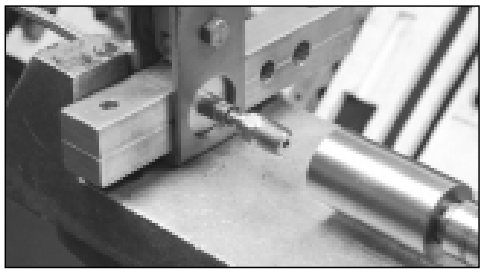
D. SELECT THE ALUMINUM CLAMPING BAR - D/E how we use it to clamp and locate the ferrule while we insert the stem, a necessary procedure with smooth bore teflon. *figure 4*

1. D/E how the hose end and the end of the ferrule must be perfectly even.
2. D/E flaring of the Teflon tube with the relief/deburr tool. *figure 5*

TEFLON HOSE ASSEMBLY
FOR SWAGING SMOOTH BORE SAE 100R14

3. D/E alignment of the stem and let trainee perform the insert.
4. After stem is properly inserted let trainee remove assembly from insertion bar.

figure 6: Photo of no.1



E. SELECT THE SWAGING BAR - D/E how we use it to compress or swage the ferrule onto the hose and the stem thus allowing the ferrule to perform its three functions.

1. Set up swage bar. D/E how everything must be perfectly aligned. *figure 6*
2. D/E how to lubricate swage bar to perform swage.
3. Make sure everything is properly set up and aligned and let trainee perform swage procedure. *figure 7*

figure 7: Photo of no.3

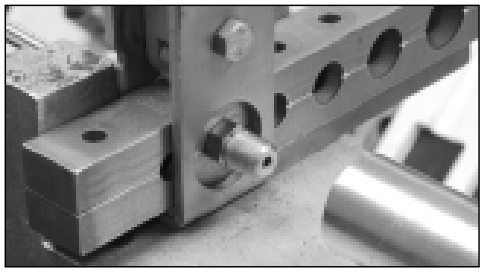
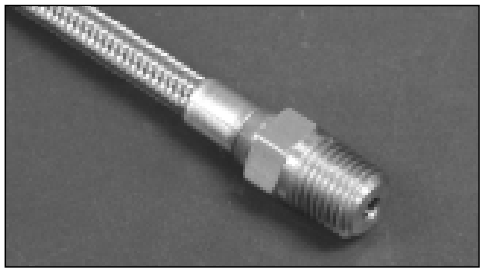


figure 8: Photo of completed assembly



4. VALIDATION -

Check the assembly for correct length, fittings and accuracy. We recommend HYDRO testing or at least PNEUMO testing all Teflon assemblies. *figure 8*

CHEMICAL RESISTANCE CHART

Table of hose material chemical resistance

The table below serves for initial hose material and sealing selection for a particular application.
For the appropriate and final choice contact Sales or Technical Department of TUBES n HOSES.

EPDM - ethylene propylene diene rubber
EPM - ethylene propylene rubber
NR - natural rubber
NBR - nitrile butadiene rubber
CR - chloroprene rubber (neoprene)
SBR - styrene butadiene rubber
FPM - fluorine rubber (Viton)
XLPE - cross-linked polyethylene
PTFE - Teflon
PVC - polyvinyl chloride
PU - polyurethane
PA - polyamide (nylon)

A - excellent resistance, suitable for continuous operation,
B - good resistance, intermittent operation,
C - limited resistance, limited use,
X - no resistance,
- - no data.

The data given in the tables below apply to resistance at the temperature of +20°C.

SUBSTANCE	EPDM	EPM	NR	NBR	CR	SBR	FPM	XLPE	PTFE	PVC	PU	PA
Acetic acid - glacial	B	A	B	C	X	B	C	A	C	B	X	X
Acetic acid 30%	A	A	B	C	B	B	C	A	A	C	X	C
Acetic aldehyde (50%)	A	A	C/X	X	C	X	X	C/X	A	X	X	B
Acetic anhydride	C	B	B	C	B	B	X	A	B	-	X	B
Acetone	A	A	X	X	X	C	X	B/C	A	X	X	A/B
Acetyl chloride	X	X	X	X	X	X	A	B	A	-	X	-
Acetylene	A	A	B	A	B	B/C	A	A	A	A/B	B	A
Adipic acid	B	A	C	B	C	B	-	-	A	B	A	-
Aluminium acetate	B	A	A	B	B	B	X	A	A	B	X	-
Aluminium chloride	B	A	A	A	A	A	A	A	A	B	A	X
Aluminium fluoride	B	A	B	A	A	A	A	A	A	-	C	X
Aluminium nitrate	B	A	A	A	A	A	A	A	A	B	C	-
Aluminium sulphate	B	A	A	A	A	A	A	A	A	A	X	X
Ammonium carbonate	B	A	A	X	A	A	-	A	B	-	B	B
Ammonium chloride	B	A	A	A	A	A	A	A	A	B	A	X
Ammonium hydroxide	C	A	X	X	A	X	B	A	A	B	X	A
Ammonium nitrate	B	A	C	A	A	B	-	A	A	-	X	A
Ammonium nitrite	B	A	A	A	A	A	-	A	A	-	-	-
Ammonium phosphate	B	A	A	A	A	A	-	A	A	C	-	A
Ammonium sulphate	B	A	A	A	A	A	X	A	A	B	A	A
Amyl acetate	X	C	X	X	X	X	X	A	C	X	X	A
Amyl alcohol	A	A	B	B	B	B	B	A	A	A	X	A

CHEMICAL RESISTANCE CHART

Table of hose material chemical resistance

SUBSTANCE	EPDM	EPM	NR	NBR	CR	SBR	FPM	XLPE	PTFE	PVC	PU	PA
Anhydrous ammonia	contact Sales or Technical Department for proper hose selection											
Anhydrous bromine	X	X	X	X	X	X	A	X	A	-	-	-
Aniline	B	A	X	X	X	X	C	A	A	-	X	X
Aniline dyes	B	A	B	X	B	B	B	A	C	-	X	X
Aniline hydrochloride	C	B	B	B	X	X	B	A	-	-	-	-
Animal fats	C	B	X	A	B	X	A	A	-	-	C	A
Aqua regia	C	C	X	X	X	X	B	X	A	X	X	X
Arachis oil	X	C	X	A	C	X	A	A	-	-	-	-
Argon	A	A	A	A	A	A	A	A	A	A	A	A
Arsenic acid	B	A	B	A	A	A	A	A	A	-	C	-
Arsenic trichloride	X	C	X	A	A	-	-	X	-	-	-	-
Asphalt	contact Sales or Technical Department for proper hose selection											
Barium chloride	B	A	A	A	A	A	A	A	A	B	B	X
Barium sulphate	B	A	A	A	A	A	A	A	A	-	-	-
Barium sulphide	B	A	A	A	A	B	A	A	A	B	A	C
Beer	B	A	A	A	A	A	A	-	A	-	X	B
Benzene	X	X	X	X	X	X	A/B	X	A	X	X	A
Benzoic acid	X	C	X	C	X	X	A	A	A	-	X	B
Benzyl alcohol	B	B	X	X	B	X	A	A	A	X	X	X
Benzyl benzoate	C	B	X	X	X	X	A	A	A	-	-	-
Benzyl chloride	X	X	X	X	X	X	A	A	A	-	-	-
Bituminous tar	X	C	X	B	C	X	A	-	A	-	-	-
Bordeaux mixture	B	A	B	B	B	B	A	A	-	B	-	-
Boric acid	B	A	A	A	A	A	A	A	A	B	A	A
Bromine trifluoride	X	X	X	X	X	X	X	X	-	-	-	-
Bromine water	B	B	X	X	X	X	A	X	-	-	-	-
Bromotoluene	X	X	X	X	X	X	A	C	-	-	-	-
Bunker oil	X	X	X	A	X	X	A	A	A	-	B	-
Butadiene	X	C	X	X	X	X	A	A	A	-	X	-
Butane	X	X	X	A	A	X	A	A	A	-	A	A
Butter	B	A	X	A	B	X	A	A	-	-	-	-
Butyl (III) alcohol	C	B	B	B	B	B	A	A	A	-	X	-
Butyl acetate	X	C	X	X	X	X	X	A	C	X	X	-
Butyl alcohol (butanol)	A/B	B	A	A	A	A	A	A	A	B	B	B
Butyl benzoate	C	B	C	X	X	B	A	A	-	-	-	-
Butyl Cellosolve	B	A	X	C	C	X	X	A	A	-	A	-
Butyl stearate	X	C	X	B	X	X	A	A	A	-	-	-
Butylamine	B	A	X	C	X	X	X	-	-	-	-	-
Butyric aldehyde	C	B	X	X	C	X	X	A	A	-	X	-
Calcium acetate	B	A	A	B	B	X	X	A	A	-	X	-
Calcium chloride	B	A	A	A	A	A	A	A	B	C	A	C
Calcium hydroxide	A	A	A	A	A	A	A	A	A	B	A	A
Calcium hypochlorite	B	A	C	B	C	C	A	C	B	B	X	X
Calcium nitrate	B	A	A	A	A	A	A	A	A	-	A	A
Calcium sulphide	B	A	B	A	A	B	A	A	A	-	A	-
Carbitol	C	B	B	B	B	B	B	A	A	-	X	-
Carbon dioxide	C	B	B	A	B	B	A	A	A	B	A	A

Table of hose material chemical resistance

SUBSTANCE	EPDM	EPM	NR	NBR	CR	SBR	FPM	XLPE	PTFE	PVC	PU	PA
Carbon disulfide	X	X	X	C	X	X	A	-	A	X	X	X
Carbon monoxide	B	A	B	B	B	B	A	A	A	B	B	A
Carbon tetrachloride	X	X	X	C	X	X	A	A	A	X	X	B
Carbonic acid	B	A	A	B	A	B	A	A	A	C	X	X
Cellosolw	C	B	X	X	X	X	C	A	A	-	-	-
Chinese wood oil	X	X	X	A	B	X	A	A	A	-	C	-
Chlorine (dry)	contact Sales or Technical Department for proper hose selection											
Chlorine (wet)	contact Sales or Technical Department for proper hose selection											
Chlorine dioxide	X	C	X	X	X	X	A	-	A	-	-	-
Chloroacetic acid	B	A	X	X	X	X	X	A	C	-	X	X
Chloroacetone	B	A	B	X	C	X	X	A	A	-	X	-
Chlorobenzene	X	X	X	X	X	X	A	B	A	X	X	B
Chlorobutadiene	X	X	X	X	X	X	A	A	-	-	-	-
Chloroform	X	X	X	X	X	X	A	B	A	X	X	X
Chlorotoluene	X	X	X	X	X	X	A	B	A	-	X	-
Chromic acid	B	A	X	X	C	X	B	A	A	B	X	X
Chromium solutions for galvanizing	C	B	X	X	X	X	A	-	-	-	X	-
Citric acid	B	A	A	A	A	A	A	A	A	C	A	A
Cobalt	B	A	A	A	A	A	A	A	-	-	-	-
Coconut oil	X	C	X	A	B	X	A	A	A	-	C	-
Coke-oven gas	X	X	X	X	X	X	A	A	C	-	X	A
Copper chloride	B	A	B	A	B	A	A	A	X	B	B	C
Copper cyanide	B	A	A	A	A	A	A	A	A	-	A	-
Cotton-seed oil	B	B	X	A	B	X	A	A	A	-	B	A
Creosote (coal tar)	X	X	X	A	B	X	A	A	A	X	C	X
Cresol	X	X	X	X	C	X	A	A	A	C	X	X
Cresylic acid	X	X	X	X	C	X	A	A	A	X	X	-
Crude oil	X	X	X	A	B	X	A	A	A	B	A	A
Cumene (isopropylbenzene)	X	X	X	X	X	X	A	A	A	-	X	-
Cupric acetate	B	A	B	B	B	X	X	A	A	-	-	-
Cupric sulphate	B	A	B	A	A	B	A	A	A	B	B	X
Cuprous potassium cyanide	A	A	A	A	A	A	A	A	-	-	-	-
Cyclohexane	X	X	X	A	C	X	A	A	A	C	B	A
Cyclohexanol	X	C	X	C	A	X	A	A	A	C	-	A
Cyclohexanone	B	B	X	X	X	X	X	A	A	X	X	A
Dekalin	X	X	X	X	X	X	A	A	A	-	-	-
Denatured alcohol	B	A	A	A	A	A	A	A	-	-	-	-
Diacetone	B	A	X	X	X	X	X	A	-	-	-	-
Diacetone alcohol	A	A	X	X	C/X	X	X	A	A	X	X	B
Dibenzyl ether	C	B	X	X	C	X	X	A	A	-	-	-
Dibuthyl ether	X	C	X	X	C	X	C	A	A	-	C	-
Dibutyl phthalate	C	B	X	X	X	X	C	A	A	-	X	A
Dibutyl sebacate	C	B	X	X	X	X	B	A	A	-	X	-
Dibutylamine	B	A	X	X	X	X	X	A	A	-	X	-
Dichlorobenzene	X	X	X	X	X	X	A	A	B	X	X	A
Dichloroethylene	X	C	X	X	X	X	B	A	A	X	X	A
Dichloroisopropyl ether	X	C	X	X	X	X	C	A	-	-	-	-

Table of hose material chemical resistance

SUBSTANCE	EPDM	EPM	NR	NBR	CR	SBR	FPM	XLPE	PTFE	PVC	PU	PA
Diesel oil	X	X	X	A	C	X	A	A	A	B	X	A
Diethyl sebacate	C	B	X	B	X	X	B	A	A	-	X	-
Diethylamine	B	A	B	B	B	B	X	A	A	C	-	-
Diethylaminobenzene	X	X	X	X	X	X	A	A	-	-	-	-
Diethylene glycol	A	A	A	A	A	A	A	A	A	B	X	-
Diisobutylene	B	A	X	B	X	X	A	A	A	-	-	-
Diisopropyl ketone	B	A	X	X	X	X	X	A	A	-	-	-
Diisopropylbenzene	X	X	X	X	X	X	A	A	-	-	-	-
Dimethyl phthalate	B	A	X	X	X	X	B	A	A	-	-	-
Dimethylformamide	B	A	X	B	C	X	X	A	A	X	-	-
Dinitrotoluene	X	X	X	X	X	X	A	A	-	-	-	-
Dioctyl phthalate	C	B	X	C	X	X	B	A	B	-	X	B
Dioctyl sebacate	C	B	X	X	X	X	B	A	-	-	-	-
Dipentene	X	X	X	B	X	X	A	A	A	-	X	-
Diphenyl (phenylbenzene)	X	X	X	X	X	X	A	A	A	-	-	-
Dowtherm, dautherm	X	X	X	X	X	X	A	A	A	-	-	C
Dry cleaning fluids	X	X	X	C	X	X	A	-	-	-	-	-
Ethane	X	X	X	A	B	X	A	A	-	-	-	-
Ethanoloamine	B	A	B	B	B	B	X	A	A	-	-	-
Ethyl acetate	B	A	X	X	C	X	X	A	A	X	X	A
Ethyl acetoacetate	B	A	C	X	C	C	X	A	A	-	-	-
Ethyl alcohol (ethanol)	A	A	A	A	A	A	C	A	A	B	X	A
Ethyl benzoate	B	A	A	X	X	A	A	B	A	-	-	-
Ethyl cellosolve acetate	C	B	X	X	X	X	X	A	A	-	X	C
Ethyl cellulose	C	B	B	B	B	B	X	A	A	-	B	C
Ethyl chloride	X	C	X	C	X	X	A	A	A	-	C	A
Ethyl ether (ether)	X	X	X	X	C	X	X	A	B	X	B	B
Ethyl formate	C	B	X	X	B	X	C	A	A	-	-	-
Ethyl silicate	B	A	B	A	A	B	A	A	A	-	-	-
Ethylbenzene	X	X	X	X	X	X	A	A	A	-	-	-
Ethylene	C	B	C	A	C	C	A	-	-	-	-	-
Ethylene chloride	X	C	X	X	X	X	A	A	A	-	-	-
Ethylene chlorohydrin	C	B	B	X	B	B	A	A	A	-	X	-
Ethylene glycol	A	A	A	A	A	A	A	A	A	B	A	A
Ethylenediamine	B	A	A	A	A	B	X	A	A	-	X	-
Fatty acids	X	C	X	B	B	X	A	A	A	B	-	A
Ferric chloride	B	A	A	A	A	A	A	A	A	B	A	X
Ferric nitrate	B	A	A	A	A	A	A	A	A	B	A	A
Ferric sulphate	B	A	A	A	A	A	A	A	A	B	-	X
Fish liver oil	X	X	X	A	X	X	A	A	-	-	-	-
Fluoric grease	B	A	B	A	B	C	B	-	-	-	-	-
Fluorobenzene	X	X	X	X	X	X	A	A	-	-	-	-
Fluoroboric acid	B	A	A	B	A	A	-	A	B	-	-	-
Formaldehyde (methyl aldehyde)	B	A	B	C	B	B	X	A	A	C	X	A
Formic acid	B	A	B	B	A	A	C	B	A	C	X	X
Freon 114	B	A	A	A	A	A	B	A	-	-	-	-
Freon 12	C	B	B	A	A	A	B	A	X	-	B	A

Table of hose material chemical resistance

SUBSTANCE	EPDM	EPM	NR	NBR	CR	SBR	FPM	XLPE	PTFE	PVC	PU	PA
Freon 13 - (chlorotrifluoromethane)	A	A	A	A	A	A	A	A	-	-	-	-
Freon 21 - (dichlorofluoromethane)	X	X	X	A	X	X	X	A	-	-	-	-
Freon 22 - (chlorodifluoromethane)	B	A	B	C	A	A	X	A	X	-	X	X
Furfural	B	A	X	X	C	X	X	A	A	-	-	-
Gallic acid	B	A	B	B	B	B	B	A	A	B	X	-
Gaseous ammonia (cold)	contact Sales or Technical Department for proper hose selection											
Gaseous ammonia (hot)	contact Sales or Technical Department for proper hose selection											
Gelatine	B	A	A	A	A	A	A	A	A	B	-	-
Glucose	B	A	A	A	A	A	A	A	A	B	X	B
Glycerine	B	A	A	A	A	A	A	A	A	B	X	A
Green liquor	B	A	B	B	B	B	B	A	A	-	-	C
Helium	A	A	A	A	A	A	A	A	A	A	A	A
Hexafluorosilicic acid	C	B	B	A	B	C	B	B	C	B	-	A
Hexane	X	X	X	A	B	X	A	B	A	C	B	A
Hydraulic oil (petroleum)	X	X	X	A	B	X	A	A	A	-	A	A
Hydrobromic acid	B	A	A	X	X	X	A	A	A	B	X	X
Hydrochloric acid (cold) 37%	B	A	B	C	B	B	A	A	B	C	C	X
Hydrochloric acid (hot) 37%	X	C	X	X	X	X	B	A	X	X	X	X
Hydrocyanic acid	B	A	B	B	B	B	B	C	A	-	-	B
Hydrofluoric acid (concentrated) cold	B	A	X	X	X	X	A	A	B	C	X	X
Hydrofluoric acid (concentrated) hot	B	A	X	X	X	X	C	A	X	-	-	-
Hydrogen (gas)	contact Sales or Technical Department for proper hose selection											
Iodine	X	X	X	X	X	X	X	A	X	-	-	-
Isobutyl alcohol (izobutanol)	A	A	A	B	A	B	A	A	A	B	-	-
Isooctane	X	X	X	A	B	X	A	A	A	B	A	A
Isopropyl acetate	C	B	X	X	X	X	X	A	A	X	X	-
Isopropyl alcohol (izopropanol)	A	A	A	B	B	B	A	A	A	B	X	A
Isopropyl chloride	X	X	X	X	X	X	B	A	-	-	-	-
Isopropyl ether	X	X	X	B	C	X	X	A	A	-	A	-
Lactic acid (cold)	B	A	B	B	B	B	A	A	A	C	A	X
Lactic acid (hot)	B	A	X	X	X	X	A	A	A	-	-	X
Lard	C	B	X	A	B	X	A	A	A	-	-	-
Lavender oil	X	X	X	B	X	X	A	B	A	X	X	-
Lead acetate	B	A	A	B	A	X	X	A	A	B	X	-
Lead nitrate	B	A	A	A	A	A	-	A	-	-	-	-
Lead sulphamate	B	A	B	B	A	B	A	A	-	-	-	-
Linseed oil	X	C	X	A	B	X	A	A	A	-	B	A
Liquified Natural Gas (LNG)	contact Sales or Technical Department for proper hose selection											
Lubricating oils	X	X	X	A	B	X	A	A	A	-	A	A
Lye (soda lye)	B	A	B	B	B	B	B	A	A	-	X	-
Magnesium chloride	B	A	A	A	A	A	A	A	A	B	A	X
Magnesium hydroxide	B	A	B	B	A	B	A	A	A	B	B	X
Magnesium sulphate	B	A	B	A	A	B	A	A	A	B	-	A
Maize oil	X	C	X	A	C	X	A	A	B	-	B	B
Maleic acid	B	A	C	X	C	C	A	B	B	-	-	C
Maleic anhydride	C	B	C	X	C	C	X	-	-	-	-	-
Malic acid	B	A	B	B	B	C	A	-	A	B	-	-

Table of hose material chemical resistance

SUBSTANCE	EPDM	EPM	NR	NBR	CR	SBR	FPM	XLPE	PTFE	PVC	PU	PA
Medicinal train oil	B	A	X	A	B	X	A	A	-	-	-	-
Mercury	B	A	A	A	A	A	A	A	A	-	B	A
Mesityl oxide	C	B	X	X	X	X	X	A	A	-	X	-
Methane	X	X	X	A	B	X	B	A	A	-	-	-
Methyl acetate	B	A	C	X	B	C	X	A	A	X	X	A
Methyl alcohol (metanol)	A	A	A	A	A	A	X	A	A	B	X	A
Methyl bromide	C	B	X	B	X	X	A	-	A	X	-	A
Methyl butyl ketone	B	A	X	X	X	X	X	A	A	-	X	-
Methyl Cellosolve	C	B	X	B	B	X	X	A	A	-	X	-
Methyl chloride	X	C	X	X	X	X	B	A	A	-	X	X
Methyl ethyl ether	X	X	X	A	C	X	A	-	-	-	-	-
Methyl ethyl ketone (MEK)	B	A	X	X	C	X	X	A	A	X	X	A
Methyl isobutyl ketone	B	B	X	X	X	X	X	A	A	-	X	A
Milk	B	A	B	A	A	B	A	A	-	-	-	-
Mineral oil	X	C	X	A	B	X	A	A	A	B	A	A
Monoethanolamine	B	A	B	X	X	B	X	A	A	-	X	-
Naphtha	X	X	X	B	C	X	A	A	A	C	A	A
Naphtha (refined)	X	X	X	A	B	X	A	A	A	C	A	A
Naphthalene	X	X	X	X	X	X	A	A	A	C	C	A
Naphthenic acid	X	X	X	B	X	X	A	A	A	-	-	-
Natural gas	X	X	B	A	A	B	A	A	A	-	C	A
Nickel acetate	B	A	A	B	B	X	X	A	A	-	X	-
Nickel chloride	B	A	A	A	A	A	A	A	C	-	C	X
Nickel sulphate	B	A	B	A	A	B	A	A	A	-	-	A
Nitric acid – (concentrated)	X	X	X	X	X	X	C	B	A	-	-	-
Nitric acid – (diluted)	X	X	X	X	B	X	B	B	A	X	X	X
Nitrobenzene	C	B	X	X	X	X	B	A	A	X	X	A
Nitroethane	C	B	B	X	C	B	X	A	A	-	X	-
Nitrogen	A	A	A	A	A	A	A	A	A	A	A	A
Nitromethane	C	B	B	X	B	B	X	A	A	-	X	-
Nonhydrocarbon detergent solution	B	A	B	A	B	B	A	A	A	-	X	-
Octachlorotoluene	X	X	X	X	X	X	A	-	-	-	-	-
Octyl alcohol	X	C	B	B	A	B	A	A	A	-	X	-
Oleate methyl	C	B	X	X	X	X	B	A	-	-	-	-
Oleic acid	X	X	X	C	C	X	B	A	A	B	B	A
Olive oil	C	B	X	A	B	X	A	A	A	-	A	-
Ortho-dichlorobenzene	X	X	X	X	X	X	B	A	B	-	X	-
Oxalic acid	B	A	B	B	B	B	B	A	A	-	A	X
Oxygen (cold)	contact Sales or Technical Department for proper hose selection											
Ozone	B	A	X	X	C	X	A	A	A	B	B	X
Palmitic acid	C	B	C	A	B	B	A	B	A	B	A	X
Para-isopropyltoluene	X	X	X	X	X	X	A	A	A	-	X	-
Pentachloroethylbenzene	X	X	X	X	X	X	A	X	-	-	-	-
Perchloric acid	C	B	X	X	B	X	A	A	A	-	X	C
Perchloroethylene	X	X	X	B	X	X	A	A	A	X	X	X
Petrol	X	X	X	A	C	X	A	A	A	B	B	A
Phenol (carbolic acid)	C	B	X	X	C	-	A	A	A	C	X	X

Table of hose material chemical resistance

SUBSTANCE	EPDM	EPM	NR	NBR	CR	SBR	FPM	XLPE	PTFE	PVC	PU	PA
Phenylbenzene	X	X	X	X	X	X	A	-	-	-	-	-
Phenylhydrazine	C	B	A	X	X	B	A	A	B	-	-	-
Phorone (diisopropylidene acetone)	X	C	X	X	X	X	X	A	A	-	-	-
Phosphoric acid 20%	B	A	B	B	B	B	A	A	A	B	X	X
Phosphoric acid 80%	B	A	C	X	B	C	A	A	A	-	X	C
Phosphorus trichloride	B	A	X	X	X	X	A	-	X	-	-	-
Picric acid	B	A	B	B	B	C	B	A	A	-	X	X
Pine oil	X	X	X	A	X	X	A	A	A	B	-	-
Polyvinyl acetate (emulsion)	B	A	B	-	B	X	B	A	-	-	-	-
Potassium acetate	B	A	A	B	B	X	X	A	A	-	X	-
Potassium chloride	B	A	A	A	A	A	A	A	A	A	A	A
Potassium cyanide	B	A	A	A	A	A	A	A	A	B	A	A
Potassium dichromate	B	A	C	B	B	B	A	B	A	-	B	-
Potassium hydroxide	B	A	B	B	B	B	X	A	A	B	C	C
Potassium nitrate	B	A	A	A	A	A	A	A	A	B	A	A
Potassium sulphate	B	A	B	A	A	A	A	A	A	B	B	A
Propane	X	X	X	A	B	X	A	A	A	B	A	A
Propyl acetate	C	B	X	X	X	X	X	A	-	-	X	-
Propyl alcohol (propanol)	A	A	A	A	A	A	A	A	A	B	C	-
Propyl nitrate	B	A	X	X	X	X	X	A	-	-	-	-
Propylene	X	X	X	X	X	X	A	A	-	-	X	-
Propylene glycol	A	A	A	A	A/B	A	A	A	A	A	A/B	A
Pyridine	B	A	X	X	X	X	X	A	A	X	-	-
Ricinus oil	C	B	C	A	A	C	A	A	A	-	B	A
Sal ammoniac (ammonium chloride)	B	A	A	A	A	A	A	A	A	-	-	A
Salicylic acid	B	A	A	B	A	B	A	A	-	-	-	-
Salt water	B	A	A	A	A	A	A	A	A	B	A	A
Silicon oils	B	A	C	A	A	C	A	A	A	B	-	-
Silicone grease	B	A	C	A	A	C	A	A	A	-	-	-
Silver nitrite	B	A	A	B	A	A	A	A	A	B	A	-
Skydrol 500	B	A	X	X	X	X	X	A	A	-	C	-
Skydrol 7000	B	A	X	X	X	X	B	A	A	-	-	-
Soap solutions	B	A	B	A	B	A	A	A	A	B	C	A
Soda, raw sodium carbonate	B	A	A	A	A	A	A	A	A	-	-	A
Sodium acetate	B	A	A	B	B	X	X	A	A	-	A	A
Sodium bicarbonate	B	A	A	A	A	A	A	A	A	B	-	-
Sodium bisulphite	B	A	A	A	A	B	A	A	A	B	-	-
Sodium borate	B	A	A	A	A	A	A	A	A	B	-	-
Sodium chloride (brine)	B	A	A	A	A	A	A	A	A	B	A	A
Sodium chloride (brine)	A	A	A	A	A	A	A	A	A	A	A	A
Sodium cyanide	B	A	A	A	A	A	A	A	A	B	-	A
Sodium hydroxide	B	A	A	B	B	A	B	A	A	B	B	C
Sodium hypochlorite (15%)	B	B	X	X	B/C	X	A	B	A	A	X	X
Sodium metaphosphate	B	A	A	A	B	A	A	A	A	-	-	-
Sodium nitrate	B	A	B	B	B	A	-	A	A	B	X	A
Sodium perborate	B	A	B	B	B	B	A	A	A	B	-	A
Sodium peroxide	B	A	B	B	B	B	A	A	A	B	X	-

Table of hose material chemical resistance

SUBSTANCE	EPDM	EPM	NR	NBR	CR	SBR	FPM	XLPE	PTFE	PVC	PU	PA
Sodium phosphate	B	A	A	A	B	A	A	A	B	B	A	A
Sodium silicate	B	A	A	A	A	A	A	A	A	B	-	A
Sodium sulphate	B	A	B	A	A	B	A	A	A	B	A	A
Sodium thiosulphate	B	A	B	B	A	B	A	A	A	B	A	A
Soybean oil	X	C	X	A	B	X	A	A	A	B	B	A
Stannic chloride	B	A	A	A	B	A	A	A	A	-	-	A
Steam	A	A	X	X	C	X	X	X	A	-	X	X
Stearic acid	C	B	C	B	B	B	-	A	A	B	A	A
Styrene	X	X	X	X	X	X	B	B	A	X	X	A
Sugar solution	B	A	A	A	B	A	A	A	A	-	-	-
Sulphur	B	A	X	X	A	X	A	A	A	-	-	-
Sulphur chloride	X	X	X	C	C	X	A	A	A	-	-	B
Sulphur dioxide	B	A	B	X	X	B	A	A	A	C	-	X
Sulphur trioxide	C	B	B	X	X	B	A	B	A	-	-	X
Sulphuric acid – fuming (oleum)	C	A	X	C	C	X	B	A	A	X	X	X
Sulphuric acid 10 ÷ 75%	B	A	X	X	X	X	A	A	A	X	X	X
Sulphuric acid 10%	B	A	C	C	B	C	A	A	A	C	X	X
Sulphuric acid 96%	C	C	X	X	X	X	A/B	A/B	A	X	X	X
Sulphurous acid	B	A	B	B	B	B	A	A	A	B	-	-
Tannic acid (tannin)	B	A	A	A	A	B	A	A	A	C	C	X
Tartaric acid	C	B	C	A	B	X	A	A	A	B	C	X
Terpentine	X	X	X	B	X	X	A	B	A	C	A	A
Terpineol	X	C	X	B	X	X	A	B	A	B	B	-
Tetrachloroethylene	X	X	X	X	X	X	A	A	A	-	X	C
Tetraethyl lead	X	X	X	B	B	X	A	-	-	B	-	-
Toluene	X	X	X	X	X	X	A	A/B	A	X	X	A
Transformer oil	contact Sales or Technical Department for proper hose selection											
Transmission fluid “A”	X	X	X	A	B	X	A	A	A	-	A	A
Trichloroacetic acid	C	B	C	B	X	B	C	A	A	-	X	-
Trichloroethane	X	X	X	X	X	X	A	A	A	-	X	-
Trichloroethylene	X	X	X	X	X	X	A	A	X	X	X	A
Tricresyl phosphate	X	X	X	X	X	C	A	A	A	-	X	-
Triethanolamine	B	A	B	B	A	B	X	A	A	C	X	-
Trinitrotoluene	X	X	X	X	B	X	A	A	A	-	-	-
Turbine oil	contact Sales or Technical Department for proper hose selection											
Vegetable oils	X	C	X	A	C	X	A	A	A	-	-	-
Vinegar	B	A	B	B	B	B	B	A	A	B	X	A
Vinyl chloride	X	X	X	X	X	X	A	A	A	X	-	-
Vinylacetylene	B	B	B	A	B	B	A	-	-	-	-	-
Waste water	B	B	B	A	B	B	A	A	A	-	X	A
Water	A	A	A	A	A	A	A	A	A	A	A	A
Whisky, wines	B	A	A	A	A	A	A	A	A	-	X	A
White mineral oil	X	X	X	A	B	X	A	A	A	-	A	-
Xylene	X	X	X	X	X	X	A	B	A	X	C	A
Zinc chloride	B	A	A	A	A	A	A	A	A	B	A	X
Zinc sulphate	B	A	B	A	A	B	A	A	A	B	-	A

A/C FEMALE O-RING BEAD STEM MFG.

figure 1: Photo of finished product

1. EXPLANATION -

A/C is a relatively new fluid line discipline that is growing at a fast pace as the A/C system gradually becomes a full-time environment "conditioning" system. *figure 1*

We have three basic fluid line components or fitting styles on automotive A/C systems: American, European and Asian.

Our goal is to have the hose fittings available on the shelf but this isn't always possible, in which case we resort to the incredibly profitable STEM MANUFACTURING procedure that has been perfected by the Tubes N' Hoses® program.

2. IDENTIFICATION -

Air conditioning stems (tube) use the SAE dimensioning system: 5/16" = #6, 13/32" = #8, 1/2" = #10, 5/8" = #12.

Standard sizes are 5/16", 13/32", 1/2", 5/8"; aluminum tube is most popular. Steel tube is gaining in popularity.

A. BY PRODUCT -

1. Pressure line, return line, metric, American, Asian, etc.

B. BY APPLICATION - Type Equipment, Cost?

2. High side, low side, type of vehicle, etc.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes
Identify components by size and specification from old assembly. Make list.

D. SELECT COMPONENTS - *figure 2*

1. 1/2" x 9" Aluminum Tube.
2. 1/2" female A/C Nut.
3. 1/2" A/C Shell Ferrule.

figure 2: Photo of components

4. FABRICATION -

D/E that the manufacturing of stems for automotive air-conditioning requires complex equipment and tooling but the procedure is straight forward.

The components are generally fabricated from lightweight and low-pressure material: aluminum tube, shell ferrules, etc., and are therefore, more fragile than the thicker and heavier hydraulic tube and hose components.

There is a trend to steel for the stems of A/C fittings. It started with large trucks and is now also being adopted by automobile manufacturers. The Tubes N' Hoses® tooling will process both, steel or aluminum.

A/C FEMALE O-RING BEAD STEM MFG.

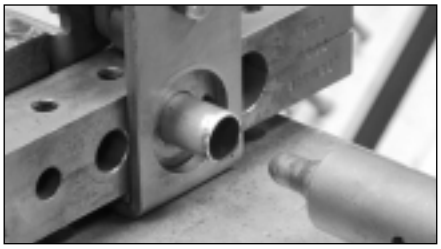
A. ORGANIZE COMPONENTS -

B. SELECT WORKSTATION & TOOLING -

1. Forming Station.
2. Forming Bar.
3. Camlock.
4. Stem and Bead Forming Tools.
5. Bead Locking Tools.

figure 3: Photo of no. 1 & 2

figure 4: Photo of no. 3



C. STEPS TO FABRICATE -

1. Install clamp bar in camlock.
2. Install tube in clamp bar to proper extension using forming tools to position. *figure 3*

figure 5: Photo of no. 4

3. Install up swage tool on actuator and proceed with up swage. *figure 4*

4. Replace up swage tool with beading tool and proceed with bead. *figure 5*

A/C FEMALE O-RING BEAD STEM MFG.

figure 6: Photo of no. 7

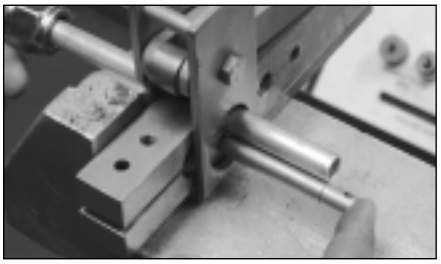


figure 7: Photo of no. 8

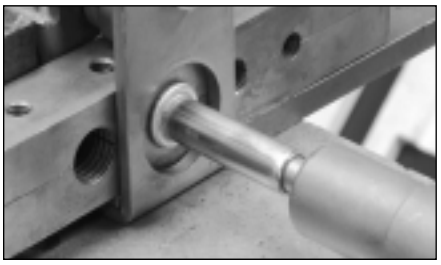
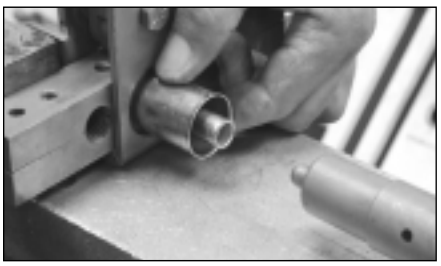


figure 8: Photo of no. 9

figure 9: Photo of no. 10



5. Remove beaded stem and reverse forming bar in camlock to install ferrule with beadlock. Use “facing” side of form bar.
6. Install female swivel nut.
7. Install tube proper distance in “facing” bar. *figure 6*
8. Install #1 beading tool on actuator and form #1 bead. *figure 7*
9. Install #2 beading tool on actuator. Install spacer ring around #1 bead, install ferrule against #1 bead. *figure 8*
10. Install #2 beading tool on actuator. Proceed with #2 bead being careful to keep everything centered. *figure 9*

11. Trainee may bend the tube if he chooses. If so, use 3:1 radius bend dies.

figure 10: Photo of validation

4. VALIDATION - *figure 10*

Check to be sure everything is correct and to proper dimension.

If time allows you may want to crimp a hose onto the newly formed stem or you may explain to trainee that he can do it later and use it as a demo for his salesmen.

A/C MALE INSERT O-RING STEM MFG.

1. EXPLANATION -

D/E that the male insert O-Ring is the opposite of the female O-Ring beaded fitting. *figure 1*

figure 1: Photo of completed procedure

Again, this is normally a standard fitting that can be purchased "off-the-shelf". Many special OEM stem shapes are not standard configuration and therefore, must be custom manufactured.

The length may be longer, the curve may be different, and the angle or "kick" may be different, etc.

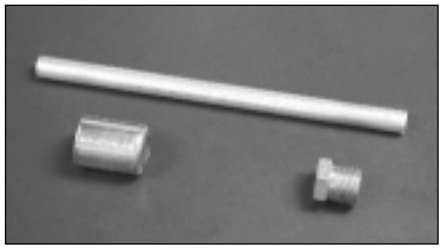
D/E that except for the tooling the procedure is the same as with the beaded stem.

2. IDENTIFY -

A. BY PRODUCT -

A/C Hose assembly.

figure 2: Photo of components



B. BY APPLICATION - Type Equipment, Cost?

1. High side, low side, type of vehicle, etc. Ask questions.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

D. SELECT COMPONENTS - *figure 2*

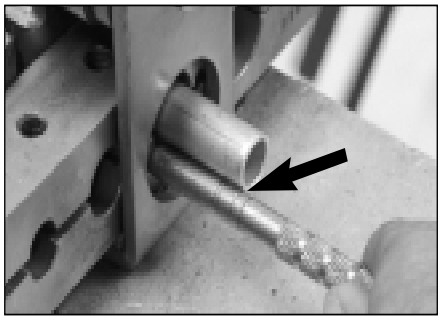
1. 1/2" x 9" Aluminum Tube.
2. 1/2" Male Insert O-Ring Nut.
3. 1/2" Shell Ferrule.

A/C MALE INSERT O-RING STEM MFG.

3. FABRICATION -

A. ORGANIZE COMPONENTS -

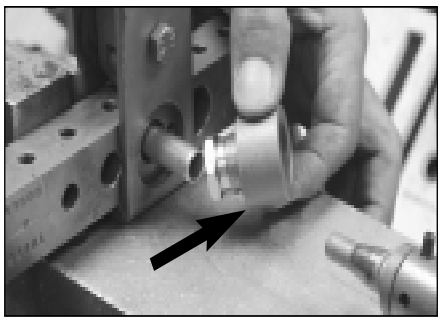
figure 3: Photo of no. 1, 2, 3



B. SELECT WORKSTATION AND TOOLING -

1. Select Camlock.
2. Forming Bar.
3. Select Insert Forming Tool.
4. Universal Push Tool.
5. Select Bead Lock Tools.
6. Select Support Ring.

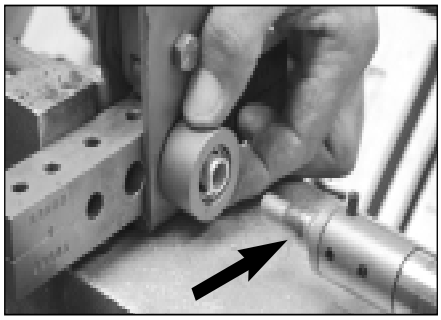
figure 4: Photo of no. 4 & 5



C. STEPS TO FABRICATE -

1. Install camlock at work station.
2. Install forming bar in camlock.
3. Clamp tube in form bar and use measuring pin to position. *figure 3*
4. Install male nut on tube.
5. Install protective support ring over male nut. *figure 4*

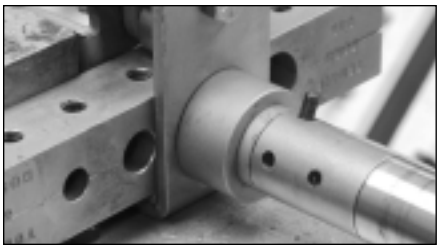
figure 5: Photo of no. 6, 7, 8



6. Install universal pusher tool on hydraulic actuator (ram).
7. Install male forming tool onto the pusher tool.
8. Lubricate properly. *figure 5*

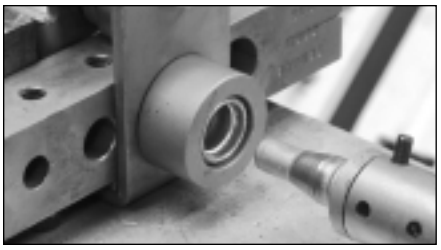
A/C MALE INSERT O-RING STEM MFG.

figure 6: Photo of no. 9



9. Advance male form tool to tube/nut assembly. *figure 6*

figure 7: Photo of no. 10



10. Be sure support ring is properly centered. Smoothly advance the forming die to engage tube. Be careful to "bottom out" very lightly and retract the male die. *figure 7*

5. VALIDATION - *figure 8*

Clean and visually check the throat of the assembly for proper finish, proper dimension, etc.

figure 8: Photo of validation

Remove from form bar and use a tool or vise to loosen the nut to demo that it is a "swivel" fitting.

TUBES N' hoses INTERNATIONAL
TRAINING

A/C BEAD LOCK PROCEDURE

figure 1: Photo of completed procedure

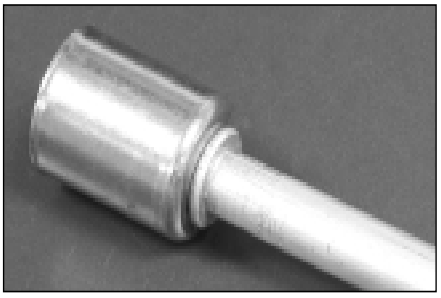


figure 2: Cutaway of bead lock

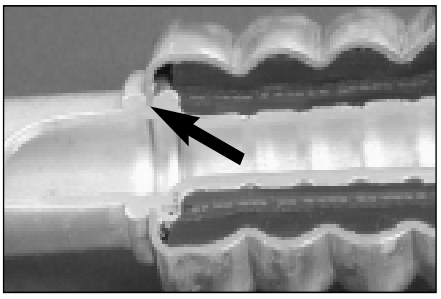
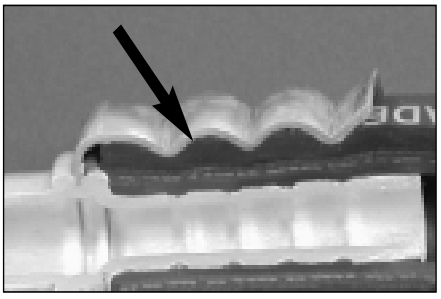


figure 3: Cutaway of bubble crimp



1. EXPLANATION -

D/E that the bead lock procedure is an outgrowth of progress in the changing world of fluid lines. *figure 1*

D/E that mobile (it isn't just automotive anymore) air conditioning has been in a state of evolution for several years.

D/E that several years ago the industry converted from R-12 refrigerant to one called R-134-a. R-134a was a thinner gas and required a completely new type of hose which they named "barrier" hose which required a new type of fitting called the "bead lock". *figure 2*

In addition to being a thinner gas, the R-134a operated at a higher pressure. In the days of Freon we used a hose stem with barbs on the stem which retained the hose onto the stem. The ferrule, therefore, only had to clamp the hose and the barbs retained the hose onto the stem internally. With the introduction of R-134a, we needed a new type of hose which was developed using a nylon liner to prevent permeation of the refrigerant. The new "barrier" hose as it was called was subject to damage by the barbs on the end of the old style stems. The barbs would actually cut the nylon. It was, therefore, necessary to develop a new attachment procedure.

To accomplish this, the manufacturers developed a procedure to attach the ferrule to the stem and then attach the ferrule to the hose with an external crimp that became known as the "bubble crimp". *figure 3*

TUBES N' hoses INTERNATIONAL TRAINING

A/C BEAD LOCK PROCEDURE

In order to attach the ferrule to the stem the fitting manufacturers developed what we call the “bead lock” procedure, which sandwiches the shoulder of the ferrule between two beads on the shank of the ferrule.

Now the only thing left is to crimp the ferrule onto the hose. This is addressed in another section.

2. IDENTIFICATION -

A. BY PRODUCT -

Will you manufacture the stem from aluminum or steel.

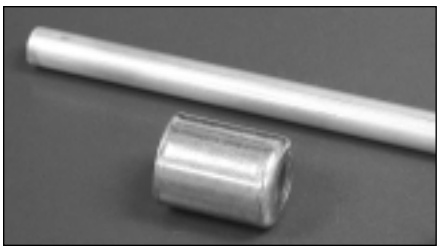
B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

D. SELECT COMPONENTS -*figure 4*

1. 1/2” x 9” Aluminum Tube (select the stems previously fabricated).
2. 1/2” Shell Ferrule.

figure 4: Photo of components



3. FABRICATION -

Note that this procedure is also covered in the FEMALE and MALE stem manufacturing training.

A. ORGANIZE COMPONENTS -

TUBES N' hoses INTERNATIONAL
TRAINING

A/C BEAD LOCK PROCEDURE

B. SELECT WORK STATION & TOOLING -

1. Forming Station.
2. Camlock.
3. Facing Bar.
4. #1 Bead Tooling.
5. #2 Bead Tooling.

C. STEPS TO FABRICATE -

1. Install camlock and facing bar at forming station.
2. Insert tube into facing bar using the measuring pin (beading Pin) to extend the tube the proper length. *figure 5*
3. Insert pin in beading tool and advance tool to make the first bead. Do not bottom out too hard. Retract. *figure 6*
4. Change pins.
5. Install protective "C" ring around the first bead. *figure 7*
6. Install the #2 beading pin in the beading die.
7. Install the ferrule over the end of the beading die and advance the beading tool to create the second bead. *figure 8*

figure 5: Photo of no. 1 & 2

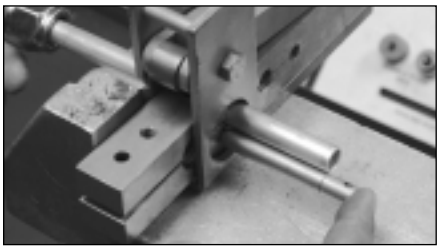
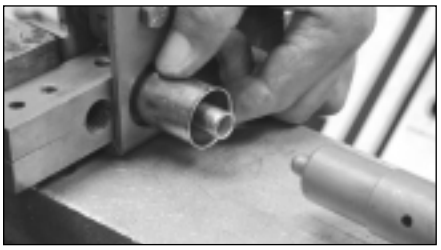


figure 6: Photo of no. 2

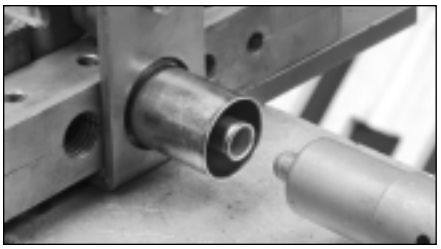
figure 7: Photo of no. 5

figure 8: Photo of no. 6 & 7



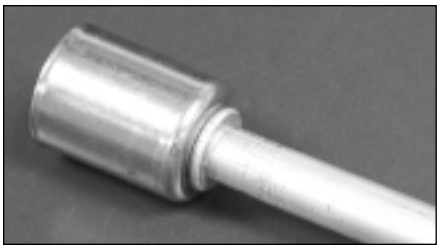
A/C BEAD LOCK PROCEDURE

figure 9: Photo of no. 8



8. As the die and the ferrule approaches the first bead, be sure to advance the ferrule forward against the first bead (this insures that the second bead will be inside the ferrule in order to sandwich the ferrule between the beads). Bottom out gently. *figure 9*

figure 10: Photo of validation



4. VALIDATION - *figure 10*

Remove the assembly and physically check for accuracy and tightness.

A/C BUBBLE CRIMP PROCEUDRE

1. EXPLANATION -

The A/C blade crimper was a major breakthrough in the extremely profitable recovery of complex air conditioning hose stems that cannot be purchased off the shelf, and must be recovered. *figure 1*

figure 1: Photo of close proximity A/C hose

The blade crimper allows CLOSE QUARTERS crimping where proximity of crimping ferrules are only 3/4".

Properly marketed and priced the blade crimping procedure represents its own profit center.

2. IDENTIFICATION -

Identify as air conditioning hose assembly demonstrate and explain the reason for the design of the blade crimper.

figure 2: Photo of components

A. BY PRODUCT -
   Identify whether standard O.D. or small O.D. barrier hose.

B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take Notes

D. SELECT COMPONENTS - *figure 2*
   1. 1 ea. #10 (1/2") x 10" A/C Standard Type Barrier Hose.
   2. 1 ea. #10 (any bead lock style fitting) BL-1303.

A/C BUBBLE CRIMP PROCEUDRE

3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORKSTATION & TOOLING -

1. Forming Station.
2. #10 Standard (barrier hose) Stationary Die.
3. #10 Standard (barrier hose) Travel Die.

C. STEPS TO FABRICATE -

1. D/E the actuation of the crimp dies. Explain how the dies "bottom-out".
2. D/E the full insertion of hose into the fitting.
3. **NOTE:** Most A/C fittings have "peep holes" that visually identify full insertion. *figure 3*

figure 3: Photo of no. 3

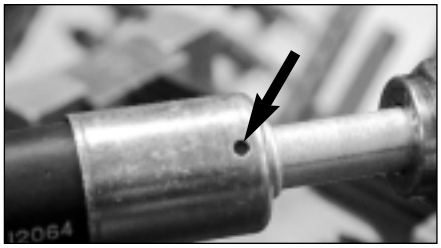
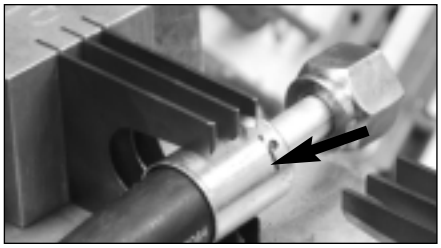
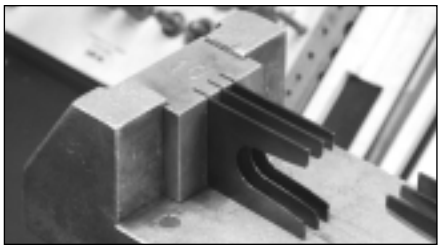


figure 4: Photo of no. 4



4. Observe the A/C crimp chart to locate the die "contact point" on the ferrule for the upper-most die tooth (center the blade crimper on the ferrule works just fine). *figure 4*

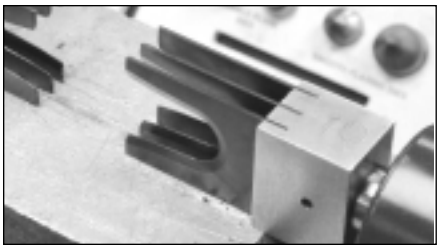
figure 5: Photo of no. 5



5. Install the stationary die in FORMING bar anchor posts. *figure 5*

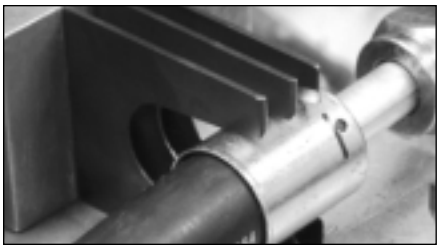
A/C BUBBLE CRIMP PROCEUDRE

figure 6: Photo of no. 6



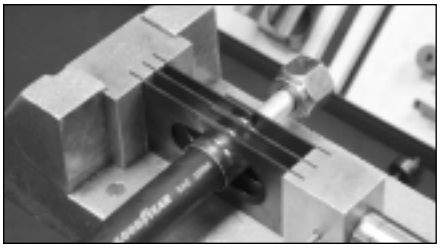
6. Install travel die on FORMING station actuator. *figure 6*

figure 7: Photo of no. 7



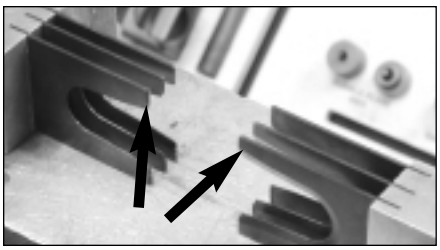
7. Insert hose/fitting assembly at proper crimp location in stationary die. *figure 7*

figure 8: Photo of no. 8



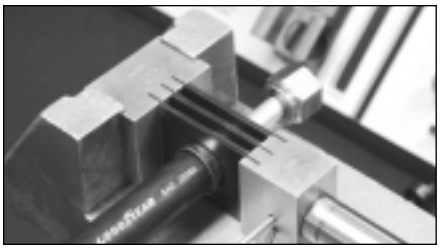
8. Carefully actuate the traveling blade die toward the hose/fitting assembly. *figure 8*

figure 9: Photo of no. 9



9. Be extremely careful that crimping blades engage “taper (edge) to taper (edge)”. *figure 9*

figure 10: Photo of no. 10



10. Gradually and smoothly advance travel die until the full circumference crimp has been accomplished. *figure 10*
11. Retract.

A/C BUBBLE CRIMP PROCEUDRE

figure 11: Photo of validation

4. VALIDATION - *figure 11*

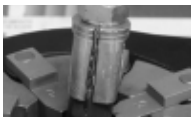
Check crimp dimension with caliper. Verify dimension at each crimp tooth.

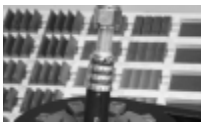
ALWAYS pressure test A/C assemblies with the Nitrogen pneumatic test stand.

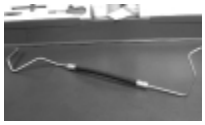
Test at 400 PSI. Recommended test time is five minutes.

TUBES N' hoses INTERNATIONAL
TRAINING

CRIMPING INDEX







CRIMPING INDEX

TUBES N' hoses INTERNATIONAL
TRAINING

O-RING FACE SEAL COUPLING

SAE 100R1 & SAE 100R2

NOTES

1. EXPLANATION -

In today's world of increasingly complex fluid lines it is becoming common to encounter failed hoses with couplings that are not avail-able from inventory.

This poses no problem for the Tubes N' Hoses® dealer. You can manu-facture many of their own couplings when necessary.

In this example, we will fabricate a complex O-Ring Face Seal Flange Coupling from raw material.

This is extremely important in order to put your customers expensive equipment back to work and turn down time into profit for the Tubes N' Hoses® dealer.

2. IDENTIFICATION -

Use old assembly. It will usually be hydraulic and is easily identifiable.

NOTE: If manufacturing the assembly, as a custom component with nothing to copy, you must blueprint the assembly before selection of components.

A. BY PRODUCT -

Hydraulic Hose Assembly.

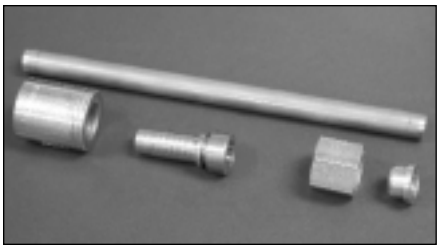
B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

O-Ring Face Seal Coupling

SAE 100R1 & SAE 100R2

figure 1: Photo of components



D. SELECT COMPONENTS - *figure 1*

1. 1 ea. 1/2” x 12’ 100R2AT Hose.
2. 1 ea. 1/2” x 8” hydraulic tube for stem cut to length. (Stem may be cut extra long to support a bend that will be near an extremity of the tube.)
4. 1 ea. 1/2” ORFS Nut.
5. 1 ea. 1/2” ORFS Sleeve.
6. 1 ea. 1/2” x 1/2” SBM Braze On Stem.
7. 1 ea. 1/2” FHP Ferrule # FHP2-08.

3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

– You will need to bend the tube.

– You will need to form the flange.

– You will need to crimp the hose.

You will, therefore, need to use all three stations to complete this complex assembly. Even thought assembly is complex the Tubes N’ Hoses® procedure is simple.

1. Bend Station.
   a. 1/2” Bend Dies.
   b. 1/2” Roller (support dies).

O-Ring Face Seal Coupling

SAE 100R1 & SAE 100R2

2. Forming Station.
   a. 1/2” Facing (flare) Bar.
   b. 45º Flare Die.
   c. Flat Face Flange Die.
   d. Cam Lock.

3. Crimping Station.
   a. Crimp Chart for SAE 100R2AT Hose w/FHP2-08 Ferrule.
   b. #5 Crimp Dies.

C. STEPS TO FABRICATE -

When manufacturing an assembly from “scratch” you must anticipate the sequence, which will give you the simplest procedure to begin and finish the assembly.

In this case you know you will have a flange on the fitting end of the tube, you will braze a stem on the other end of the tube with bends in the middle. From which end do you start? Choose a sequence and plan the procedure.

1. If the bend nearest the flange end of the tube is not too near the flange you can flange the tube first or bend the tube and flange later. In this case, we will create the flange first.
2. Install cam lock at forming station.
3. Install facing bar with flat face toward actuator.
4. Install tube in 1/2” bore of the form bar.
5. Extend tube proper length to form flange. *figure 2*

figure 2: Photo of no.5

TUBES N' hoses INTERNATIONAL
TRAINING

O-Ring Face Seal Coupling

SAE 100R1 & SAE 100R2

figure 3: Photo of no. 7

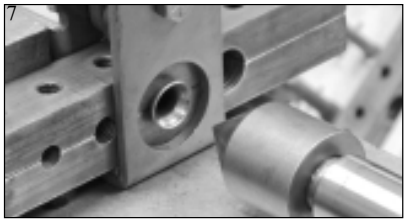


figure 4: Photo of no. 8

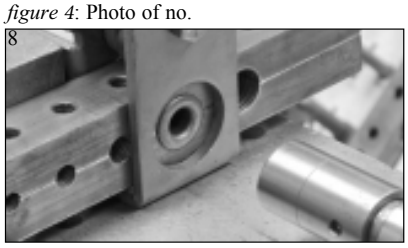


figure 5: Photo of no. 9, 10, 11, & 12

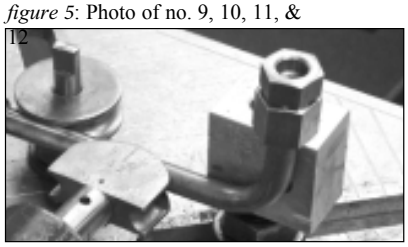


figure 6: Photo of no. 13

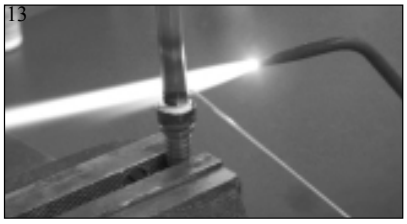
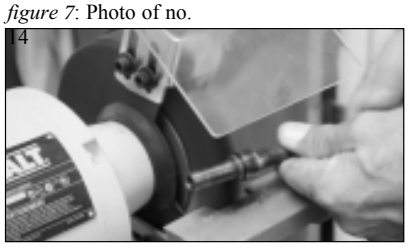


figure 7: Photo of no. 14



6. Install 45º flare die on actuator and advance toward tube.
7. Carefully engage the end of the tube and advance die until tube flares to 45º. Be extremely careful not to put pressure on inside of tube where it contacts the opening of the facing bar. *figure 3*
8. Retract actuator, remove 45º flare die and install flat flange facing die (Use 8mm down size tool). Retract die and remove tube. At this point you have the option of bending the tube or brazing on the SBM and bending later. In this case, we will bend the tube first. *figure 4*
9. Install 1/2" dies at the bending station.
10. Locate bending points on tube and proceed.
11. Before starting bends, install flange sleeve with flat face forward. Install nut. You can secure the nut to the end of the tube with masking tape.
12. Proceed with bending. *figure 5*
13. Braze SBM onto tube. *figure 6*
14. Clean SBM stem and prepare to crimp hose onto stem. *figure 7*

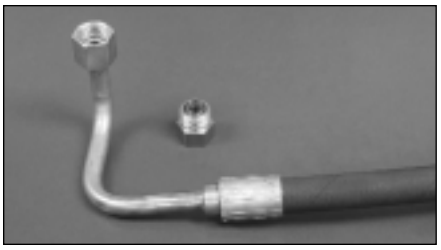
O-Ring Face Seal Coupling

SAE 100R1 & SAE 100R2

figure 8: Photo of no. 15, 16, & 17

15. Install ferrule onto hose and insert stem.
16. Refer to crimp chart and crimp to proper dimension.
17. Install ferrule and stem on opposite end of hose and crimp to size. *figure 8*

figure 9: Photo of validation



4. VALIDATION -

A. Verify Crimps – Crimps should always be verified before removing from cam crimper. *figure 9*

B. Verify Braze.

C. Verify bends.

D. Verify OA length.

TUBES N' hoses INTERNATIONAL
TRAINING

STEP-UP RECOVERY PROCEDURE

SAE 100R1 & SAE 100R2

NOTE: Never Fabricate This Procedure Without A Properly Authorized Disclaimer Form Signed By Equipment Owner Or Manager. This Must Indicate That The Application Is Non Critical As To Fire, Load Drop, Or Safety Of Any Kind.

figure 1: Photo of "step-up"

1. EXPLANATION -

The Step-Up Procedure is a variation of standard stem recovery. *figure 1*

Again, it is an emergency procedure and must be carefully used. The Step-up is a two-step crimp procedure.

2. IDENTIFICATION -

A. BY PRODUCT -

With this procedure it will always be a hose assembly from which you recover the stem.

B. BY APPLICATION - Type Equipment, Cost?

Type and brand of equipment, system application and type of components the system operates.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

1. 1/2" SAE 100R2 Hydraulic Hose.
2. 1/2" Stem with special or odd fitting.

STEP-UP RECOVERY PROCEDURE

SAE 100R1 & SAE 100R2

figure 2: Photo of components

D. SELECT COMPONENTS - *figure 2*

1. Recovered Stem.
2. R2A-08 Hydraulic Hose.
3. FHP2-08 Ferrule.

3. FABRICATION -

A. ORGANIZE COMPONENTS -

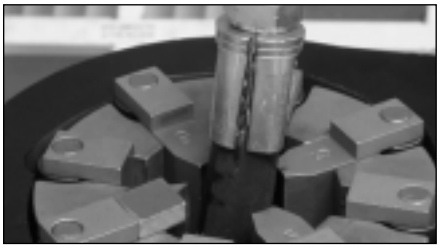
B. SELECT WORK STATION & TOOLING -

1. Crimp Station.
2. #_?_ Stake Dies.
3. #5 Crimp Dies.
4. R2A x FHP2 Crimp Chart.

C. STEPS TO FABRICATE -

1. Split old ferrule form old hose and stem, recover stem. *figure 3*

figure 3: Photo of split ferrule



2. Clean stem.

   NOTE: When recovering a stem that requires the step-up assembly procedure, you will notice that the stem shoulder is smaller than standard for the FHP ferrule. This requires the use of the staking dies to reduce the lip of the ferrule into the shoulder of the stem until fully engaged.

STEP-UP RECOVERY PROCEDURE

SAE 100R1 & SAE 100R2

figure 4: Photo of no. 3

figure 5: Photo of no. 4

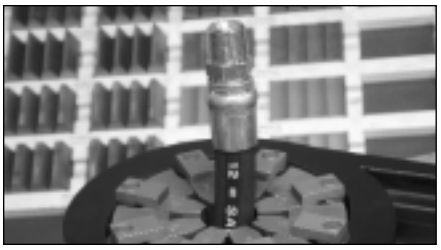
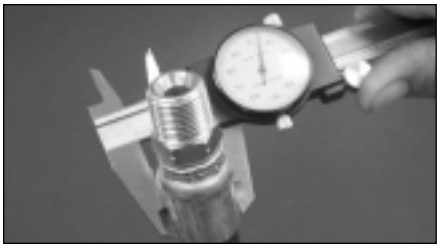


figure 6: Photo of validation



3. Insert short piece of hose between ferrule and stem to center and keep them parallel. Locate staking dies even with top of ferrule and stake (compress) the ferrule lip until fully engaged (at least .050 or more per side of the ferrule). The ferrule is now hooked (or staked-behind) the stem. You may proceed with the hose crimp procedure. *figure 4*

4. Install # 5 crimp dies into crimper. Engage the full length of the ferrule and crimp to R2A hose x FHP ferrule crimp dimensions. *figure 5*

4. VALIDATION - *figure 6*

A. Visually verify all contact points.

B. Verify dimensions with calipers and other tools as needed.

TUBES N' hoses INTERNATIONAL TRAINING

STEP-DOWN PROCEDURE

SAE 100R1 & SAE 100R2

NOTE: NEVER FABRICATE THIS PROCEDURE WITHOUT A PROPERLY AUTHORIZED DISCLAIMER FORM SIGNED BY EQUIPMENT OWNER OR MANAGER. THIS MUST INDICATE THAT THE APPLICATION IS NON CRITICAL AS TO FIRE, LOAD DROP, OR SAFETY OF ANY KIND.

figure 1: Photo of Step-down

1. EXPLANATION -

The step-down procedure is a variation of standard stem recovery. Step-down is a two-step crimp procedure. *figure 1*

2. IDENTIFICATION -

A. BY PRODUCT -

With this procedure it will always be a hose assembly from which you recover the stem.

B. BY APPLICATION - Type Equipment, Cost?

Type and brand of equipment, system application and type of components the system operates.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

1. 1/2” SAE 100R2 Hydraulic Hose
2. 1/2” Stem with special or odd fitting.

figure 2: Photo of components

D. SELECT COMPONENTS - *figure 2*

1. Recovered Stem.
2. R2A Hydraulic Hose.
3. FHP2 Hose Ferrule.

STEP-DOWN PROCEDURE

SAE 100R1 & SAE 100R2

3. FABRICATION -

A. ORGANIZE COMPONENTS -

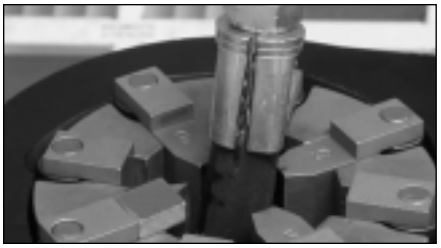
B. SELECT WORK STATION & TOOLING -

1. Crimp Station.
3. #5 Crimp Dies.
4. R2A x FHP2 Crimp Chart.

C. STEPS TO FABRICATE -

1. Split old ferrule from old hose and stem, recover stem.
   figure 3

figure 3: Photo of no. 1

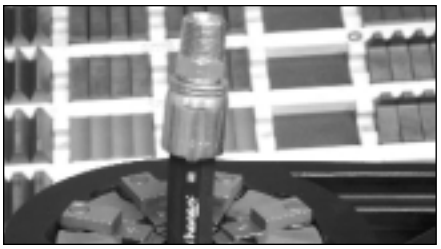


2. Clean stem.
   NOTE: When recovering a stem that requires the step-down assembly procedure you will notice that the stem shoulder is larger than the lip of the ferrule. You must, therefore, bore the throat (lip) of the ferrule until it just clears the shoulder of the stem. Always leave at least .050 lip (measured inside the ferrule lip). This insures at least that much engagement behind the shoulder of the stem.

STEP-DOWN PROCEDURE

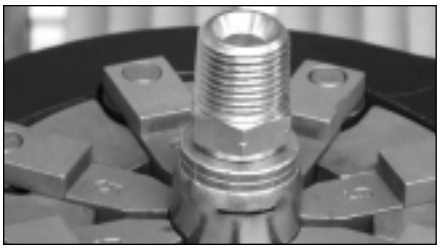
SAE 100R1 & SAE 100R2

figure 4: Photo of no. 3



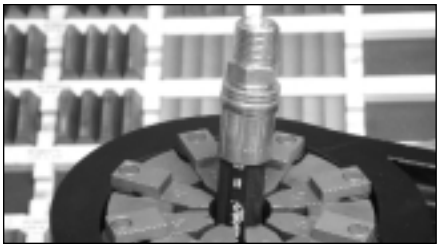
3. Use #5 crimping die to engage the ferrule into the shoulder of the stem. *figure 4*

figure 5: Photo of no. 4



4. Mark the outside of the ferrule opposite the forward tooth of the ferrule. This mark locates opposite the top edge of the #5 crimp dies. *figure 5*

figure 6: Photo of no. 5



5. With the mark located even with the top of the # 5 dies, crimp to proper dimension for the R2A-08 x FHP-08 hose/ferrule combination. Verify crimp before removing. *figure 6*

figure 7: Photo of validation

4. VALIDATION - *figure 7*

A. Visually verify all contact points.

B. Verify dimensions with calipers and other tools as needed.

TUBES N' hoses INTERNATIONAL
TRAINING

THERMOPLASTIC HOSE

figure 1: Photo of thermoplastic

1. EXPLANATION -

Thermoplastic hose is used in several different applications. Hydraulics, food and beverage industry, chemicals and other special applications. *figure 1*

At the present, our catalog includes thermoplastic hose products used in the hydraulic industry.

Other categories will be introduced at a later date.

2. IDENTIFICATION -

You will be able to identify thermoplastic used in hydraulics by the lay-line on hose.

There are two categories:

SAE 100R7 Medium Pressure Conductive (Black)

SAE 100R7 Medium Pressure Non-Conductive (Orange)

SAE 100R8 High Pressure Conductive (Black)

SAE 100R8 High Pressure Non-Conductive (Orange)

A popular application is the SAE 100R7 black conductive found in medium pressure hydraulic applications on fork lifts and similar applications.

TUBES N' hoses INTERNATIONAL
TRAINING

THERMOPLASTIC HOSE

NOTES

Also extremely, if not more popular is the SAE 100 R7 Orange colored non-conductive found in applications where electrical conductivity between fittings are not allowed. This hose will be found on bucket trucks, manlifts, utility vehicles, safety and rescue vehicles, as well as other applications. It can be found as a replacement fro the black non-conductive R-7.

T&H Thermoplastic hose is identified by the following Tubes N' Hoses® numbers:

TP 7 = SAE 100 RT Conductive (black)

TP 72 = SAE 100 RT Conductive (black) Twinline

TP 7N = SAE 100 RT Non-Conductive (orange)

TP 7N 2= SAE 100 RT Non-Conductive (orange) Twinline

TP 8 = SAE 100 R8 Conductive (black)

TP 82 = SAE 100R8 Conductive (black) Twinline

TP 8N = SAE 100R8 Non-Conductive (black)

TP 8N = SAE 100R8 Non-Conductive (black) Twinline

R7 and R8 types are produced in what we call TWIN-LINE configuration. This simply means that two lines of hose are bonded together which allows for very compact routing of both the pressure line and the return line.

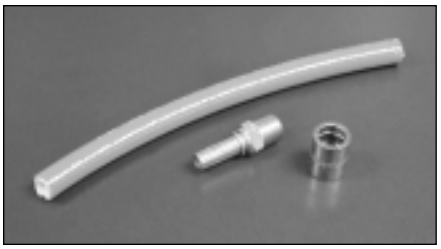
A. BY PRODUCT -

Read lay-line.

B. BY APPLICATION - Type Equipment, Cost?

THERMOPLASTIC HOSE

figure 2: Photo of components



C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

D. SELECT COMPONENTS - *figure 2*

1. 1ea. - TP7N-08 (1/2”) R-7 Non-Conductive hose.
2. 1ea. - MP-0808 (1/2” x 1/2”) Male Pipe Stem.
3. 1ea. - FTP-08 (1/2”) Ferrule.

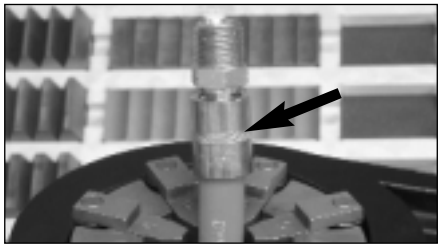
3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Crimp Station.
2. Thermoplastic Crimp Chart.
3. Crimp Dies (as indicated by crimp chart).

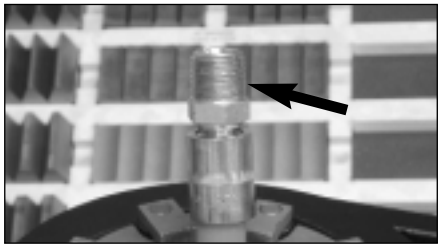
figure 3: Photo of no. 1



C. STEPS TO FABRICATE -

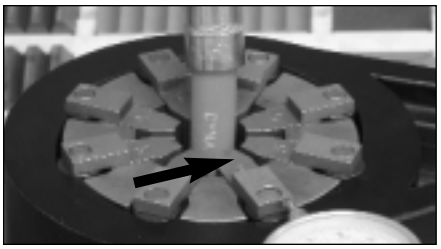
1. Insert ferrule onto hose. *figure 3*

figure 4: Photo of no. 2



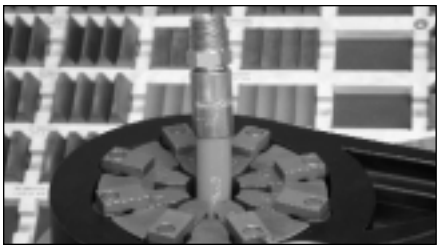
2. Insert stem into hose (bottom out). *figure 4*

figure 5: Photo of no. 3



3. Insert crimping dies as indicated on crimp chart. *figure 5*

figure 6: Photo of no. 4



4. Crimp to dimension. *figure 6*

figure 7: Photo of validation

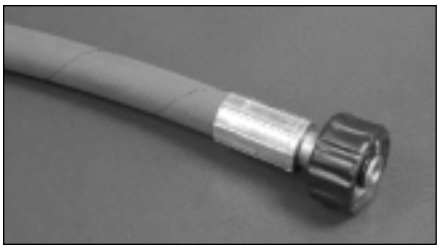
4. VALIDATION - *figure 7*

A. Physical checks:

B. Performance checks:

PRESSURE WASH HOSE CRIMPING

figure 1: Photo of pressure wash hose



1. EXPLANATION -

Pressure wash hose potential was brought on by the introduction of the high pressure water pump which converted pressurized water into a cleaning tool. *figure 1*

Pressure wash hose fabrication is similar to that of hydraulic hose.

The hose itself is very similar to hydraulic SAE 100R1 and R2. In the development days hydraulic hose was used for pressure wash applications.

In recent years manufacturers have built in benefits specific to the requirements of pressure washing.

2. IDENTIFICATION -

Pressure wash hose assemblies are easily identifiable.

They are usually long in length, running from twenty five to one hundred feet in length.

A. BY PRODUCT -

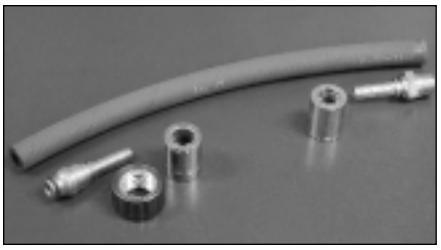
Configuration with fitting peculiar to pressure wash assemblies.

B. BY APPLICATION - Type Equipment, Cost?

PRESSURE WASH HOSE CRIMPING

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes Components are usually of a standard configuration and dimension.

figure 2: Photo of components



D. SELECT COMPONENTS - *figure 2*

1. 1ea. - PW-06 (3/8) x 12” Hose.
2. 1ea. - MP-0606 3/8 x 3/8” Male Pipe Fitting.
3. 1ea. - FMP-06 (3/8) Ferrule.

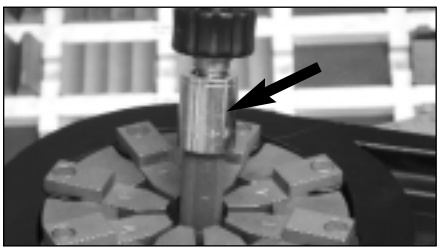
3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Crimp Station
2. Pressure Wash Crimp Chart.
3. Use chart to select # ? crimp dies.

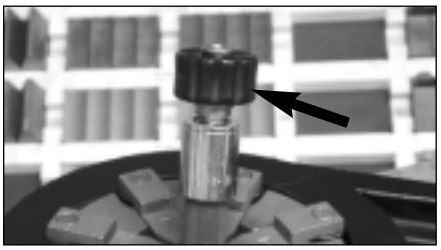
figure 3: Photo of ferrule onto hose



C. STEPS TO FABRICATE -

1. Assemble ferrule onto hose. *figure 3*

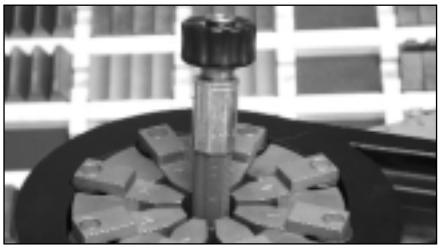
figure 4: Photo of no. 2



2. Insert stem fully into assembly. *figure 4*

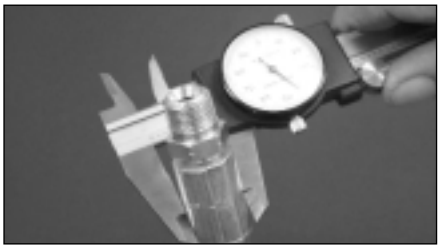
PRESSURE WASH HOSE CRIMPING

figure 5: Photo of no. 3



3. Crimp to dimensions on crimp chart. *figure 5*

figure 6: Photo of validation



4. VALIDATION - *figure 6*

A. Verify crimp dimension.

B. Check swivel joints.

TUBES N' hoses INTERNATIONAL
TRAINING

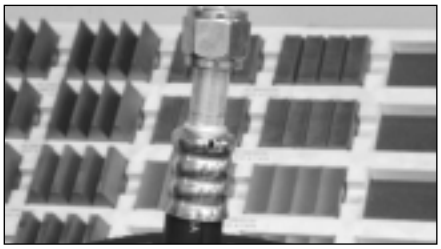
A/C BUBBLE CRIMP PROCEDURE

WITH CAM CRIMPER

1. EXPLANATION -

This procedure is useful when stems have an odd diameter and must be attached with a variable or smaller diameter. *figure 1*

figure 1: Photo of bubble crimp



2. IDENTIFICATION -

Identify as air conditioning hose assembly.

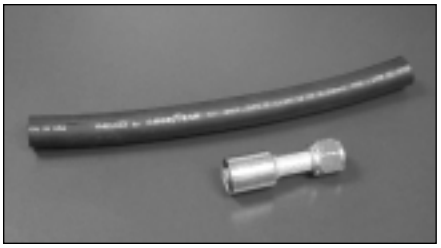
A. BY PRODUCT -

If American identify whether standard O.D. or small O.D. barrier hose. Of foreign identify whether metric or American hose and stem sizes.

B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

figure 2: Photo of components



D. SELECT COMPONENTS - *figure 2*

1. #10 standard barrier hose x 10”.
2. BL-1302 Bead Lock Fitting.

3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

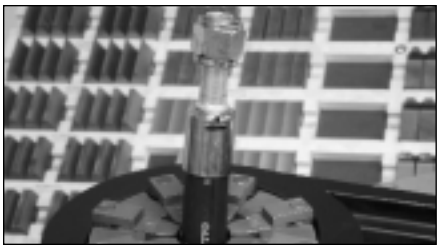
1. Select Crimp Station.
2. Select #10 A/C Bubble Dies.

TUBES N' hoses INTERNATIONAL
TRAINING

A/C BUBBLE CRIMP PROCEDURE

WITH CAM CRIMPER

figure 3: Photo of no. 1 & 2



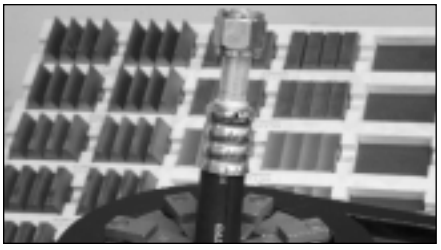
C. STEPS TO FABRICATE -

1. Install #10 crimp dies.
2. Assemble #10 hose and fitting. *figure 3*

figure 4: Photo of no. 3 & 4

3. D/E locating assembly in crimper and position for crimp.
4. D/E how to clamp ferrule with crimp dies. *figure 4*

figure 5: Photo of no. 5, 6, & 7



5. D/E how to set and use dial indicator to achieve proper crimp dimension.
6. Actuate crimper to proper dial setting allowing for spring-back.
7. Retract, remove and verify crimp dimension. *figure 5*

figure 6: Photo of validation

4. VALIDATION - *figure 6*

A. Verify visually.

B. Pressure test.

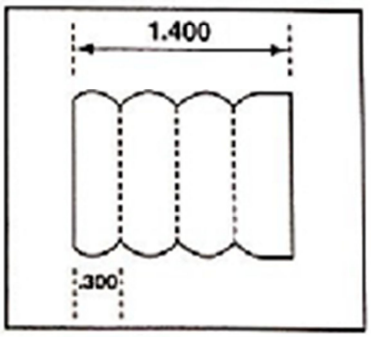
CRIMP CHART-REDUCED O.D. AIR CONDITIONING
BARRIER HOSE
HOSE: GOODYEAR GALAXY REDUCED O.D. BARRIER HOSE
***Tubes n' Hoses* Reduced Bead Lock Fittings**

SIZE	3/8	13/32	1/2	5/8
# SIZE	#6	#8	#10	#12
CRIMP DIAMETER	.550	.654	.730	.890
CRIMP TRAVEL	.110	.140	.115	.135
DIE SIZE	#6 Bubble	#8 Bubble	#10 Bubble	#12 Bubble
FERRULE PRE-CRIMP DIAMETER	.660	.794	.845	1.025
DIAL INDICATOR SETTING	**DIAL IS ALWAYS 1/2 OF THE CRIMP TRAVEL**			
CRIMP/SWAGE LENGTH	1.100	1.100	1.100	1.100

CRIMP CHART-AUTOMOTIVE AIR CONDITIONING
HOSE: SAE J-2064 BARRIER HOSE
Fitting: Bead Lock/Bubble Crimp Couplings

SIZE	5/16	13/32	1/2	5/8
# SIZE	#6	#8	#10	#12
CRIMP DIAMETER	.660	.830	.936	1.014
CRIMP TRAVEL	.162	.160	.154	.191
DIE SIZE	#6 Bubble	#8 Bubble	#10 Bubble	#12 Bubble
FERRULE PRE-CRIMP DIAMETER	.822	.990	1.090	1.205
DIAL INDICATOR SETTING	**DIAL IS ALWAYS 1/2 OF THE CRIMP TRAVEL**			
CRIMP/SWAGE LENGTH	1.100	1.100	1.100	1.100

Locate the top edge of the crimp die tooth .300 from the front of the shell (ferrule) on all sizes.



TUBES N' hoses INTERNATIONAL
TRAINING

A/C SMOOTH CRIMP PROCEDURE

figure 1: Photo of smooth crimp

1. EXPLANATION -

Smooth crimping is a procedure that gives the Tubes N' Hoses® dealer another option in the fabrication of air conditioning assemblies. *figure 1*

It is especially useful when you need to recover one of the old style A/C barb stems.

The procedure can also be used to crimp the current style A/C bead lock stems.

2. IDENTIFICATION -

A. BY PRODUCT -

Air conditioning.

B. BY APPLICATION - Type Equipment, Cost?

Auto, off road, truck.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

1. #10 Barrier Hose.
2. #10 Barb Stem.
3. #10 Shell Ferrule.

NOTE: When reusing a barb type stem the hose will be retained internally instead of externally as with the bubble crimp.

TUBES N' hoses INTERNATIONAL
TRAINING

A/C SMOOTH CRIMP PROCEDURE

D. SELECT COMPONENTS - *figure 2*

1. 1ea. - Cut #12 Hose to length.
2. Clean old barb stem.
3. 2ea. - #12 Shell Ferrule - (not recovery type).

figure 2: Photo of components

3. FABRICATION -

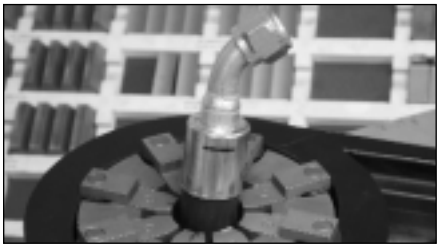
A. ORGANIZE COMPONENTS -

figure 3: Photo of 3

B. SELECT WORK STATION & TOOLING -

1. You work at the Crimp Station.
2. Select A/C bubble crimp chart.
3. Select smooth crimp dies that match the A/C bubble crimp dies in terms of starting crimp size. Install in crimper. *figure 3*

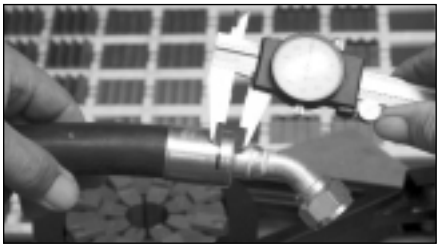
figure 4: Photo of 1 & 2



C. STEPS TO FABRICATE -

1. Assemble #12 shell ferrule onto #12 hose.
2. Insert barb stem. *figure 4*

figure 5: Photo of 3

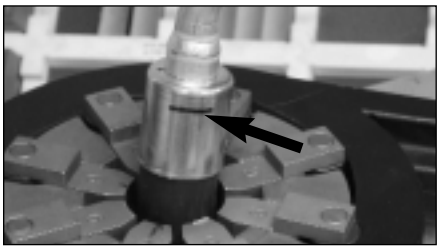


3. Mark shell ferrule .300 behind shoulder. *figure 5*

A/C SMOOTH CRIMP PROCEDURE

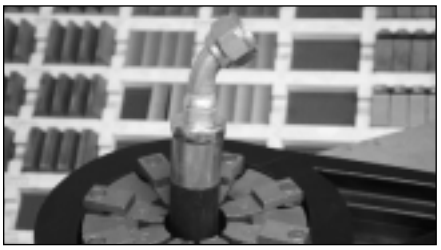
4. Align mark with top of crimp dies. *figure 6*

figure 6: Photo of 4



5. Crimp to surface of hose plus _____. Check before removing from crimper. *figure 7*

figure 7: Photo of 5



4. VALIDATION - *figure 8*

Perform standard A/C routine.

A. Verify length.

B. Check fittings.

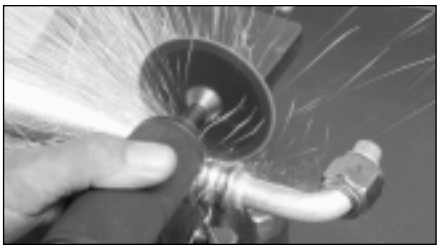
C. Pressure test on pressure tester. Test at 400 PSI.

figure 8: Photo of validation

TUBES N' hoses INTERNATIONAL
TRAINING

A/C STEM RECOVERY FERRULES
Procedure

figure 1: Photo of stem recovery



1. EXPLANATION -

Due to the fact that only a limited percentage of air conditioning couplings can be purchased off the shelf, it is a necessary procedure to "recover" and reuse stems from air conditioning. In order to accomplish this it was necessary to develop the A/C recovery ferrules on which Tubes n' Hoses holds the patents. Use of the recovery ferrules means that you never turn away a potential profit. This fantastic device will be worth several thousand dollars per year for as long as you are in busi-ness. The procedure is fast and easy. *figure 1*

2. IDENTIFICATION -

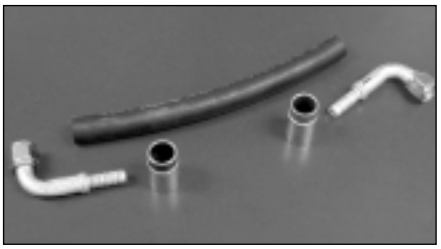
Identify as an A/C and select components assembly on which the stems must be recovered and reused.

A. BY PRODUCT -

A/C assembly.

B. BY APPLICATION - Type Equipment, Cost?

figure 2: Photo of components



C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

D. SELECT COMPONENTS - *figure 2*

1. #10 Barrier Hose.
2. #10 Recovery Stem.
3. #10 Recovery Ferrules.

A/C STEM RECOVERY FERRULES
Procedure

3. FABRICATION -

Plan the procedure you will use to re-man the assembly. In this procedure you must disassemble before you can reassemble.

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Crimp Station.
2. Ferrule Splitter.
3. #10 Bubble Dies.

C. STEPS TO FABRICATE -

1. Identify the assembly as simple or complex. If it has elbow fittings, parallel stems or non-standard configuration, it is complex. *figure 3*

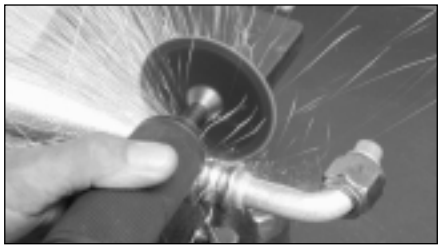
figure 3: Photo of no. 1

2. In the case of elbow stems, you must identify the "timing" which the stems have in relation to each other. Mark each stem in the same exact plane so they can be reassembled to their original alignment. *figure 4*

figure 4: Photo of no. 2 & 3

3. We are now ready to split and remove the old ferrules in order to recover the stems.
4. Clamp the assembly in the vise to split the old ferrule off with the ZIZ wheel or use the ferrule splitter. *figure 5*
5. If using the ZIZ wheel, notice how we carefully split the first side being careful not to nick the bead on the old stem.

figure 5: Photo of no. 4 & 5



TUBES N' hoses INTERNATIONAL
TRAINING

A/C STEM RECOVERY FERRULES
Procedure

figure 6: Photo of no. 6 & 7

6. Rotate the ferrule and split the other side. Use a screwdriver, pliers, etc. being very careful to avoid sharp edges. *figure 6*
7. Retrieve the old stem and clean properly for reassembly.

figure 7: Photo of no. 8 & 9

8. Using the recovered stems, select the proper recovery ferrules for hose and bead size on recovered stems. *figure 7*
9. Measure the old hose and cut the new hose to length.

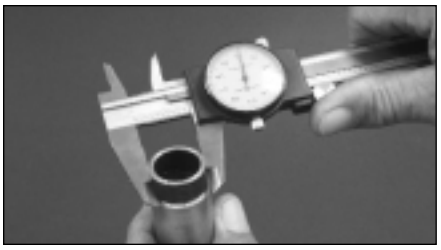
figure 8: Photo of no. 10

10. Locate the recovery ferrule over the bead of the old stem with the skirt of the ferrule flush with the end of the stem. *figure 8*

figure 9: Photo of no. 11 & 12

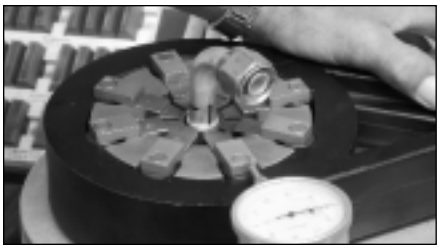
11. Mark the O.D. of the stem at the front edge of the ferrule shoulder. This is where we “hook” the ferrule over the old bead on the stem for retention. *figure 9*
12. Proceed with the hook procedure using the appropriate staking dies.
13. Use a short piece of A/C hose to center the stem in the ferrule. Measure the O.D. of the ferrule shoulder to select the proper staking dies for hooking the shoulder over the bead. *figure 10*
14. Insert the hose into the assembly for crimping. The hose must be fully inserted.

figure 10: Photo of no. 13 & 14



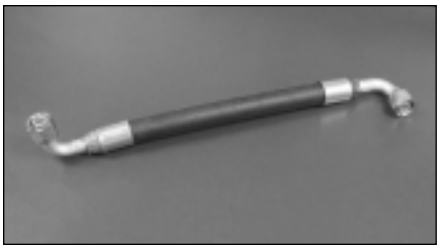
A/C STEM RECOVERY FERRULES
Procedure

figure 11: Photo of no. 15 & 16



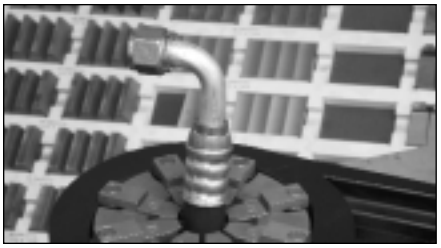
15. We now have the option of crimping the ferrule with the Cam Crimper or the Blade Crimper. It depends on two things: 1) The proximity of the stems, 2) The technicians choice.
16. If the Cam Crimper is used, be sure to refer to the crimp chart. If the Blade Crimper is used, identify the location only as the crimp dimension is dedicated. *figure 11*

figure 12: Photo of no. 17



17. Align the ferrule and the stem location points, then align the timing marks. *figure 12*

figure 13: Photo of no. 18



18. Proceed and conclude with the crimping. *figure 13*

figure 14: Photo of no. 14

4. VALIDATION - *figure 14*

A. Always pressure test.

B. Check and verify fittings and timing.

C. Check overall length.

TUBES N' hoses INTERNATIONAL
TRAINING

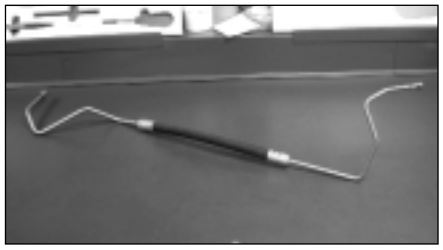
P/S ASSEMBLY

MANUFACTURED FROM RAW MATERIAL

1. EXPLANATION -

Power steering assemblies have become a staple for the Tubes N' Hoses® dealers. They are complex, but are very easy for dealers to fabricate and rebuild. They are also very profitable. *figure 1*

figure 1: Photo of p/s assembly



Although power steering assemblies are generally complex, the size of components remain simple and consistent. American assemblies are usually 3/8" hose, tube and fittings. You may expect them to start becoming more complex in the future.

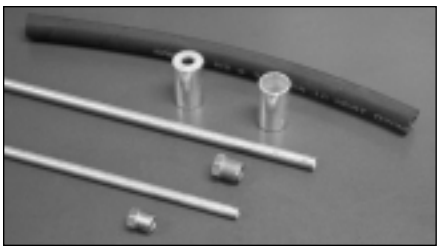
2. IDENTIFICATION -

A. BY PRODUCT -

B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

figure 2: Photo of components



D. SELECT COMPONENTS - *figure 2*

1. 3/8" x 10" R-3 Hose.
2. 5/16" x 12" Hydraulic Tube.
3. 3/8" x 15" Hydraulic Tube.
4. 5/16" Inverted Flare Nut.
5. 3/8" Inverted Flare Nut.
6. #6 P/S Stake on Ferrules.

3. FABRICATION -

Select best procedure. Will you bend tubes before crimping hoses or visa versa?

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Bend Station.
2. 5/16” Bend Dies.
3. 3/8” Bend Dies.
4. Forming Station.
5. 5/16” Up-Swage Die.
6. 5/16” Double Flare Die.
7. 3/8” Beading Die.
8. Crimp Station.
9. #4 P/S Bubble Crimp Dies.

figure 3: Photo of no. 1 & 2

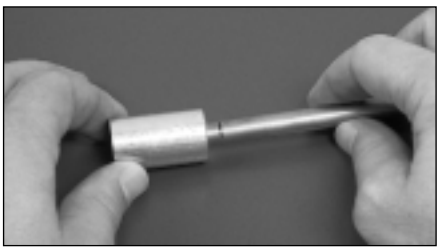
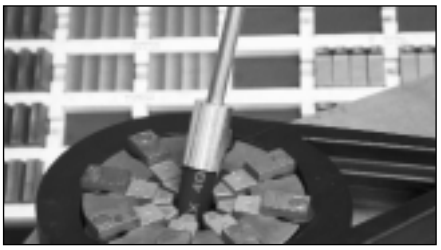


figure 4: Photo of no. 3, 4, & 5



C. STEPS TO FABRICATE -

1. D/E Upswage 5/16” tube to 3/8”. *figure 3*
2. Locate stake point on 5/16” tube and mark.
3. Install stake dies.
4. Support the ferrule with a short piece of hose.
5. Mark the tube and locate the ferrule. *figure 4*

P/S Assembly

Manufactured From Raw Material

figure 5: Photo of 6 & 7

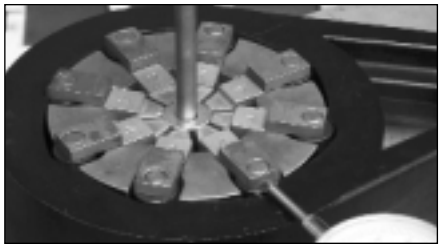


figure 6: Photo of 8

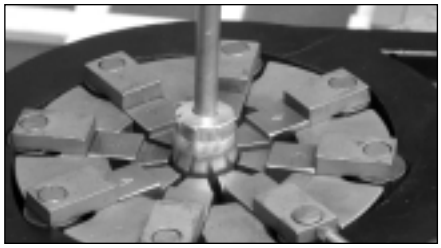


figure 7: Photo of 12, 13

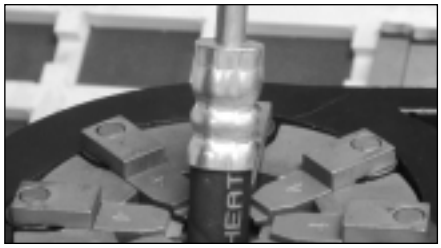
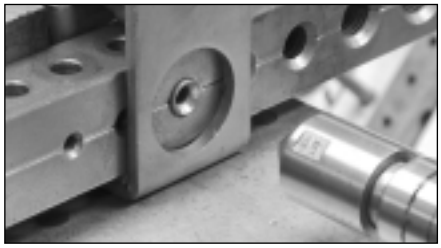


figure 8: Photo of a, b



6. Stake the ferrule onto the tube, then advance the actuator until the ferrule lip makes contact with the tube. *figure 5*
7. Advance the actuator enough to show .020 on the dial indicator. This imbeds the ferrule lip .025 to .030 into the outer wall of the tube.
8. Use the same stake procedure to stake the ferrule onto the 3/8" tube answering questions as necessary. *figure 6*

NOTE: At this point (preferably at beginning) explain that we have the option of bending the complex tube ends before or after the hose is crimped onto the stem. Explain that if the tube is too complex we cannot get it out of the crimper and therefore must be crimped before bending. If crimping before bending is selected, proceed with crimps.

9. D/E bubble dies.
10. D/E how to install and use.
11. D/E how to use crimp chart.
12. D/E how to locate ferrule in bubble die.
13. D/E how to calculate crimp with dial indicator. *figure 7*

14. Form end on tubes -
    a. Install 5/16" inverted flare nut on 5/16".
    b. Install 5/16" double flare using double flare nose die, 45º flare bar and 45º flare die. Explain while proceeding. *figure 8*

P/S ASSEMBLY

MANUFACTURED FROM RAW MATERIAL

figure 9: Photo of c & d

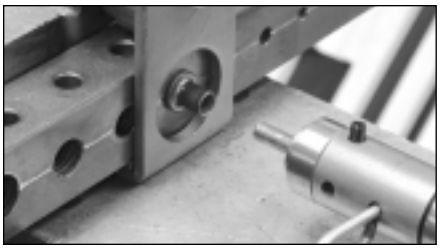
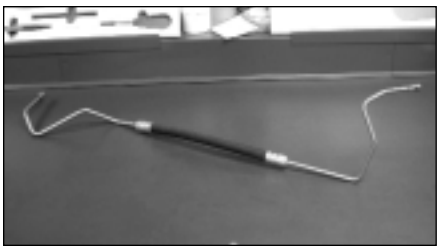


figure 10: Photo of a & b

figure 11: Photo of c & d

figure 12: Photo of validation



c. Install 3/8” inverted flare nut on 3/8” tube.

d. Install 3/8 bead using 3/8 beading die and facing side of flare bar. *figure 9*

15. Bend 5/16” tube -

a. Install 5/16” bending dies. Explain the complexity of power steering tube ends.

b. Bend 5/16” tube into trainees configuration of choice. *figure 10*

c. Install 3/8” bending dies.

d. Bend to trainee’s configuration of choice. *figure 11*

4. VALIDATION - *figure 12*

A. Verify all dimensions.

B. Verify all fittings.

C. Pressure test if critical application or any question of assembly integrity.

POWER STERRING CRIMP CHART

HOSE: SAE 100R3

Tubes n' Hoses **Special Power Steering Ferrule**

SIZE	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2
DASH SIZE	-3	-4	-5	-6	-8	-10	-12	-16	-20	-24	-32
CRIMP DIAMETER		.550		.695	.850						
CRIMP TRAVEL		.140		.180	.210						
DIE SIZE		#3 P/S Bubble		#4 P/S Bubble	#10 A/C Bubble						
PRE-CRIMP DIAMETER		.690		.875	10.60						
DIAL INDICATOR SETTING	**DIAL IS ALWAYS 1/2 OF THE CRIMP TRAVEL**										
GAUGE PRESSURE											
CRIMP LENGTH		.750		.800	1.200						
STAKE (LOCATION)		FLUSH		FLUSH	FLUSH						
STAKE (TRAVEL)		#3S S/D .040 after firm contact with stem		#4 S/D .040 after firm contact with stem	#5 S/D .040 after firm contact with stem						

TUBES N' hoses INTERNATIONAL TRAINING

P/S STEM RECOVERY PROCEDURE

With Hook Lip Ferrules

figure 1: Photo of stem recovery

1. EXPLANATION -

One of the most profitable procedures in the fluid line industry is manufacturing and recovering complex hybrid hose/tube assemblies. *figure 1*

Power steering fluid line assemblies have become a system where two complex tube assemblies are married to a relatively short piece of metric or American fiber braided hose.

Today almost all automobiles have power steering and therefore complex assemblies.

Dealers and parts distributors can only inventory a small percentage of the incredible inventory of power steering assemblies on mobile equipment and automotive fleets of the world.

Most manufacturers drop coverage on power steering assemblies after a few years.

2. IDENTIFICATION -

Stem recovery for power steering.

A. BY PRODUCT -

Is it metric or American?

B. BY APPLICATION - Type Equipment, Cost?

A/C STEM RECOVERY FERRULES
Procedure

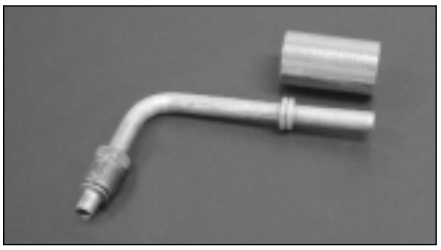
With Hook Lip Ferrules

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

D. SELECT COMPONENTS - *figure 2*

1. Cut hose to length (R-3).
2. 2 ea. - PSH-06. Select the hook lip ferrule that best matches the shoulder on the recovered tubes.

figure 2: Photo of components



3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Cam Crimper.
2. Power Steering Crimp Chart.
3. #4 Staking Dies. Install in crimper.
4. #4 P/S Bubble Crimp Dies.

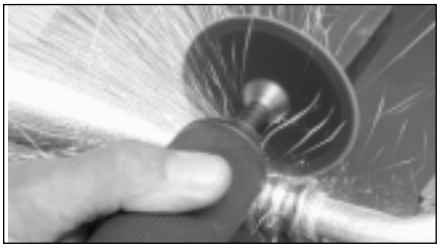
figure 3: This shows the timing marks

C. STEPS TO FABRICATE -

In this procedure we must disassemble before we can identify components.

1. Create parallel timing marks on tube assemblies so they can be reassembled to original configuration. *figure 3*
2. Split old ferrules off with ferrule splitter or ZIZ wheel. *figure 4*

figure 4: Photo of no.2



P/S STEM RECOVERY PROCEDURE

With Hook Lip Ferrules

3. Identify shoulder and select proper hook lip ferrule.
4. Assemble ferrule onto hose.
5. Insert one of the recovered stems.
6. Using the #4 stake dies “hook” the PSH-06 ferrule onto the recovered stem. *figure 5*
7. Replace #4 stake dies with #4 bubble crimp dies. Fully insert the hose into the ferrule and mark the hose at the skirt of the ferrule. Locate the lip of the ferrule at proper location on stem.
8. Mark the crimping point on the ferrule and you are ready to crimp. Select the crimp chart.
9. Compress crimp dies onto ferrule until dial moves slightly. Crimp to dimension on chart. *figure 6*
10. Verify dimension before removing.

figure 5: Photo of no. 3, 4, 5, & 6

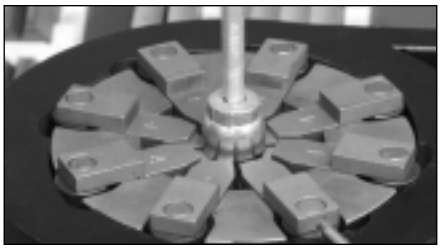


figure 6: Photo of crimping procedure

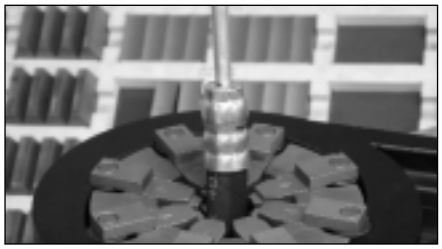


figure 7: Photo of validation

11. Use timing marks to properly align the other end of tubing and repeat the process.

4. VALIDATION - *figure 7*

Visually and manually check for alignment and dimensions; for extra verification test with Testmaster.

TUBES N' hoses INTERNATIONAL
TRAINING

P/S STEM RECOVERY PROCEDURE

With Knife Lip Ferrules

figure 1: Knife lip ferrule.

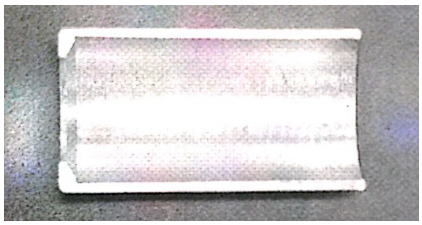
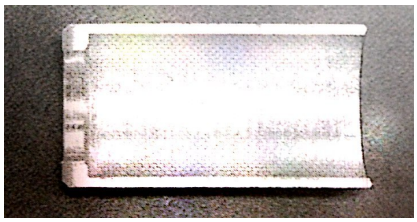


figure 2: Hook lip ferrule.



1. EXPLANATION -

Power steering like many other complex automotive assemblies are the perfect candidate for the amazingly profitable Tubes N' Hoses® recovery program.

The knife lip ferrule is especially designed for recovering stems with beaded or very narrow crimp shoulders. These are popular on Asian automobiles and mobile equipment. *figure 1 & 2*

2. IDENTIFICATION -

A. BY PRODUCT -

Power Steering.

B. BY APPLICATION - Type Equipment, Cost?

Vehicle model and year, pressure line return/return line, get list price from dealer and record in your pricing guideline and reference manual. Use this procedure to get top pricing for your very creative work.

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

Since we are recovering the entire tube assembly the identification is already done except for the hose end of the stem. We need to identify the size of stem and type of shoulder. At this point we need to go ahead and recover the stem by splitting off and removing the old ferrule and hose.

1. 3/8" Stem (most power steering stems are 3/8").
2. Very narrow shoulder.

TUBES N' hoses INTERNATIONAL
TRAINING

P/S STEM RECOVERY PROCEDURE

With Knife Lip Ferrules

NOTES

D. SELECT COMPONENTS -

1. Recovered Stem.
2. 3/8" knife Lip Ferrule.
3. 3/8" SAE 100R3 Hose.

3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Power Steering Crimp Chart.
2. Crimping Station.
3. #4 Staking Dies.
4. #4 Power Steering Bubble Crimp Dies.

C. STEPS TO FABRICATE -

1. Install #4 stake dies in cam crimper.

   NOTE: Only the Tubes N' Hoses® Cam Crimper can perform this procedure to recover complex tube assemblies.

2. Use a short piece of P/S hose to center the ferrule on the stem. Locate the sharp edge of the knife lip ferrule in the center of the bead or the center of the narrow shoulder. Stake down the knife lip until it firmly engages the stem. The ferrule is now permanently attached to the stem.

TUBES N' hoses INTERNATIONAL
TRAINING

P/S STEM RECOVERY PROCEDURE

With Knife Lip Ferrules

NOTES

3. Remove staking dies and replace with #4 power steering bubble dies.
4. Insert new hose (fully bottomed out into the ferrule) into the ferrule and stem. Set timing.

5. Using the power steering crimp chart to locate the crimping point of the top tooth and mark with felt tip pen.
6. Locate crimp die tooth with mark. Advance crimp arm until ferrule is lightly engaged and dial indicator starts to move.

7. Set dial indicator to accomplish crimp dimension indicated on crimp chart advance until complete. Verify with caliper before removing.

NOTE: When recovering the bent stems of a power steering assembly be sure the "timing' is exact (follow timing procedure).

4. VALIDATION -

Visually check everything. It's a very good idea to pressure test with the pneumo tester to 400 PSI.

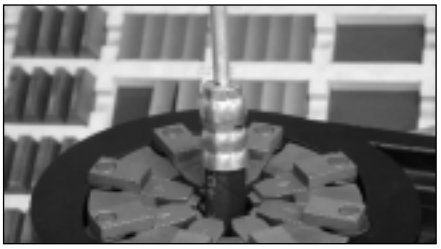
TUBES N' hoses INTERNATIONAL
TRAINING

P/S BUBBLE CRIMP

1. EXPLANATION -

The Power Steering Bubble Crimp is a duplication of the crimps that have been produced by automotive fabricators for several years. *figure 1*

figure 1: Photo of p/s bubble crimp



The bubble type crimp is very popular with fabric reinforced lower pressure hoses.

2. IDENTIFICATION -

A. BY PRODUCT -

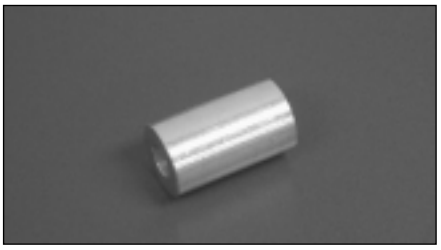
Complex Power Steering Assembly.

B. BY APPLICATION - Type Equipment, Cost?

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

In almost all cases the hose will be 3/8". This is especially true if the vehicle was manufactured in the U.S.

figure 2: Photo of components



We will soon be seeing true metric hose on foreign vehicles as a standard product.

Expect to see 10mm hoses on European and Asian vehicles in the immediate future. We will address the 10mm power steering requirements as needed.

D. SELECT COMPONENTS - *figure 2*

1. 3/8" PSS-06 Power Steering Ferrule.

P/S Bubble Crimp

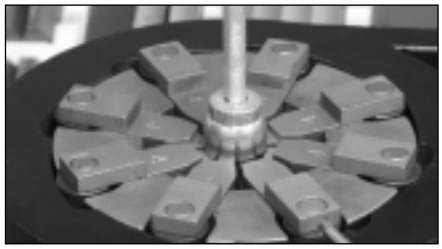
3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Crimp Station.
2. #4 Power Steering Bubble Crimp Dies.
3. Power Steering Crimp Chart.

figure 3: Photo of no. 1



C. STEPS TO FABRICATE -

1. Use #4 stake dies to stake ferrule out of new tube or stem.
   OR
   Use #4 stake dies to hook or stake ferrule onto old or new stem (for other ferrules use appropriate dies - See chart). *figure 3*
2. Insert hose (R-3) fully into ferrule and stem.
3. Install #4 bubble dies into cam crimper.
4. Follow power steering crimp chart to position crimp dies on ferrule.
5. Follow crimp chart and advance crimp dies to proper crimp dimension.
6. Check crimp dimension before removing assembly from crimper.

4. VALIDATION -

A. Double check crimp

B. Pressure test and

C. Match old and new assemblies.

TUBES N' hoses INTERNATIONAL
TRAINING

STAKING
GENERAL PROCEDURE

1. EXPLANATION -

The staking process has been used in production assemblies for many years. It has been especially popular in automotive hose assemblies.

Not until the Tubes N' Hoses® program was it available at the service, repair and distribution levels.

It is a major asset in developing the Tubes N' Hoses® fluidline concept.

The process is also extremely profitable and costs next to nothing to use.

2. IDENTIFICATION -

There are several potentials for application of the staking procedure. All of them are very profitable.

Identify almost any stake. The Tubes N' Hoses® system can duplicate it.

1. Air Conditioning Stem Recovery.
2. Air Conditioning Stem Manufacturing.
3. Power Steering Stem Recovery.
4. Power Steering Stem Manufacturing.
5. Battery Cable Fabrication.

STAKING

GENERAL PROCEDURE

NOTES

3. FABRICATION -

Staking procedure with the cam crimper is easy and fun to do.

Stake procedure is completely universal. The procedure allows technicians flexibility that they have never enjoyed before.

The procedure is not limited to the staking dies. It can also be performed with the standard smooth face crimping dies as a reduction procedure to interface braze components. *figure 2*

The procedure can also be used to attach protective metal sleeves to the exterior of all types of flexible fluid lines. *figure 3*

Staking should be thought of as a metal reduction procedure that can be applied in almost any creative manner to generate a needed finished part.

Any crimping die can be used as a staking die.

Since staking is a professionally correct metal reduction procedure you have the choice of using any of the several types of dies to perform the staking procedure.

BATTERY CABLE FABRICATION

CRIMPING LUGS & TERMINALS

figure 1: Photo of battery cable

1. EXPLANATION -

Battery cable crimping with the cam crimper is another fascinating and profitable benefit of the Tubes N' Hoses® cam crimping system. *figure 1*

Traditional battery cable crimping has never offered the circumference engagement allowed by the Tubes N' Hoses® system.

This allows the Tubes N' Hoses® dealer to offer yet another quality advantage to their customers. A very profitable advantage.

2. IDENTIFICATION -

A. BY PRODUCT -

B. BY APPLICATION - Type Equipment, Cost?

What type of vehicle or system? (If possible check voltage and amperage requirements to be sure of proper size cable).

C. BY DESCRIPTION & SIZE OF COMPONENTS - Take notes

1. Cable size and length.
2. Lug size.
3. Terminal size.

BATTERY CABLE FABRICATION

CRIMPING LUGS & TERMINALS

D. SELECT COMPONENTS - *figure 2*

1. 1/0 Cable.
2. 1/0 Lug.
3. 1/0 Terminal.
4. Shrink Wrap to cover joints.

figure 2: Photo of components

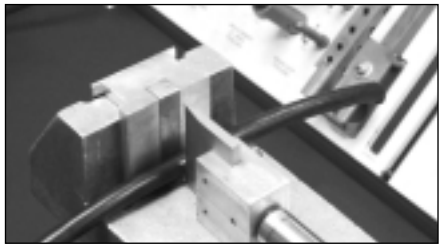
3. FABRICATION -

A. ORGANIZE COMPONENTS -

B. SELECT WORK STATION & TOOLING -

1. Crimp Station.
2. Crimp Chart.
3. Refer to chart - select proper dies.
4. Select # ____ Stake Dies (in some cases you may want to use smooth face dies). Install in crimper.

figure 3: Photo of no. 1



C. STEPS TO FABRICATE -

1. Measure and cut cable to length on blade shear. *figure 3*
2. Measure skive length on the neoprene cover. Cut and remove proper amount of cover being careful not to cut soft copper wire.
3. Install shrink sleeves.

BATTERY CABLE FABRICATION

CRIMPING LUGS & TERMINALS

figure 4: Photo of no. 4

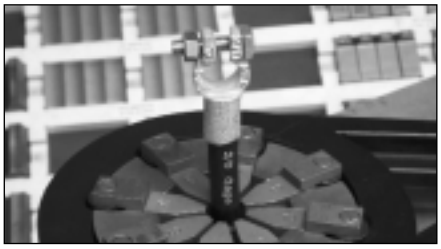


figure 5: Photo of no. 7 & 8

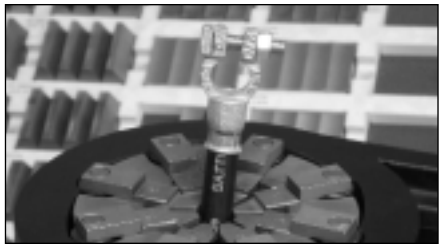


figure 6: Photo of validation

4. Carefully insert the wire into the sleeve of the terminal (or lug) until it bottoms out. *figure 4*

5. Mark the lug and terminal "crimp point". This should always be placed so that the crimp leaves an internal flare on the end of the copper wire.
6. Advance crimp arm (cam) until terminal or lug sleeve makes contact with copper wire.

7. Use crimp chart for proper crimp dimension (travel). *figure 5*
8. On second crimp always check for proper rotation (timing) of the lug and terminal.

4. VALIDATION - *figure 6*

Visual and dimensional checks are usually sufficient.