

# ***HYDRAULIC TUBE BENDER***

***MODEL: EPB-3***



**OPERATION MANUAL**

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# 1. Introduction

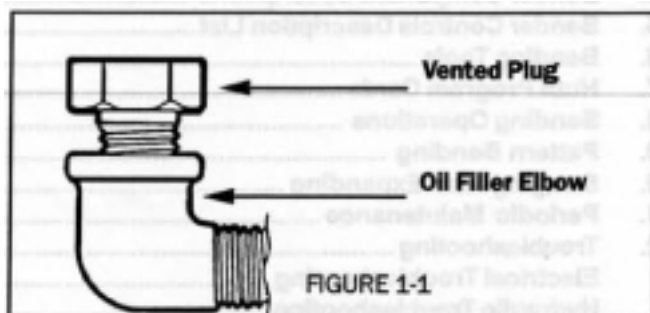
Carefully read and understand this manual before operation begin. Hydraulic tube bender EPB-3 is constructed from the finest materials by highly trained, experienced craftsmen.

- (1) Carefully uncrate and discard all packing material properly
- (2) Inspect for signs of damages due to shipment. Report any shipping damages promptly to the carrier.
- (3) Review enclosed packing list. Be certain all components have been shipped.
- (4) Check the voltage and the phase of your electrical supply. All these data will be indicated on the model plate.

**NOTE: 3-phase motors must rotate counter clockwise as seen when facing the pump.**

Make sure that the bender is protected by the proper size breaker, dedicated to the bender. Check plug and receptacle for amperage rating.

- (5) Remove oil filler plug and replace with vented plug. See Figure 1-1. The oil filler elbow is found on the left side of the front leg, directly under the manual depth-of- bend plate.



# 2. Safety instruction

Common sense should always be used when equipment is operating. Ensure safe usage- **READ AND UNDERSTAND ALL SAFETY WARNINGS AND PROCEDURES BEFORE OPERATION BEGINS.**

- (1) Do not operate this machinery without safety guards in their proper position.
- (2) Make sure electrical connections are good, solid connections. Never use an extension cord! If the power cord becomes damaged or frayed, have a qualified person examine or replace it.
- (3) Ensure an unrestricted power cord. Do not place cord where damage may occur.
- (4) Never alter electrical components used on this machine.

- (5) Always unplug equipment from electrical outlet when not in use. Never use the cord to pull the plug from the outlet. Grasp the plug, twist and pull to disconnect.
- (6) Unplug the machine from the power source before servicing. Electrical shock may result if this is not done.
- (7) Risk of explosion. This equipment has internal arcing or sparking parts which should not be exposed to flammable vapors. This equipment should not be located in a recessed area or below floor level.
- (8) This equipment uses earth ground protection for operator safety. This equipment must be grounded. If the ground is broken don't use this equipment until it is repaired by a qualified service position.
- (9) Keep hands clear when dies are in motion.
- (10) Never place your hands or other body parts between bending dies.
- (11) Use caution while removing and installing bending dies. They are heavy.
- (12) Before using the swager/expander, make sure no tools have been left in the swager frame. These can cause the swager shaft to bend or break.
- (13) Do not use frayed or loose fitting gloves while operating this machine. Gloves alter the sense of touch and can be caught in moving parts.
- (14) After pipe is cut, the ends may be sharp. Use caution when handling pipe. Good practice is to file the inside edges after cutting.
- (15) One hand should always be kept free to operate the control. Never use another part of body to operate the controls with the exception of the knee control plate.
- (16) When using benders equipped with foot pedals or knee controls, always ensure that there is no contact with the foot pedal or knee control between bends.
- (17) There must be a "SAFETY CIRCLE OF SWING" around the bender. There should be at least ten feet of space on each side of bender so tubing will not encounter any interference during the bend.
- (18) If tubing being bent comes in contact with an independent piece of metal and sparks are produced, immediately turn the bender off and remove the power cord from the receptacle. A ground wire has been disconnected and needs to be checked and / or reconnected.
- (19) Only one person at a time should operate the bender.
- (20) Safety goggles or glasses, and safety shoes should be worn when operating the bender.

Everyday eyeglasses only have impact resistant lense, they are not safety glasses.

(21) Do not use the bender below garage floor or grade level.

(22) Do not operate the bender without dies in their proper position.

(23) Keep the expansion arbors and segments lightly greased.

(24) Read and understand all decals on the bender and replace decals that are damaged or unreadable.

(25) Before operation, check rotation of hydraulic pump / electric motor. It should rotate counter clockwise as viewed when facing the pump.

(26) Never use hands to check for hydraulic leaks. Hydraulic oil under pressure can penetrate skin causing serious injury.

(27) Keep hair, loose clothing, fingers and all parts of body away from moving parts.

(28) To reduce the risk of fire, do not operate equipment in the vicinity of open containers of flammable liquids (gasoline).

(29) Use machinery only as described in this manual. Use only manufacturer's recommend attachments.

(30) Do not weld on bender or use bender as a fixture for welding. Damage to electrical components may result and warranty will be voided.

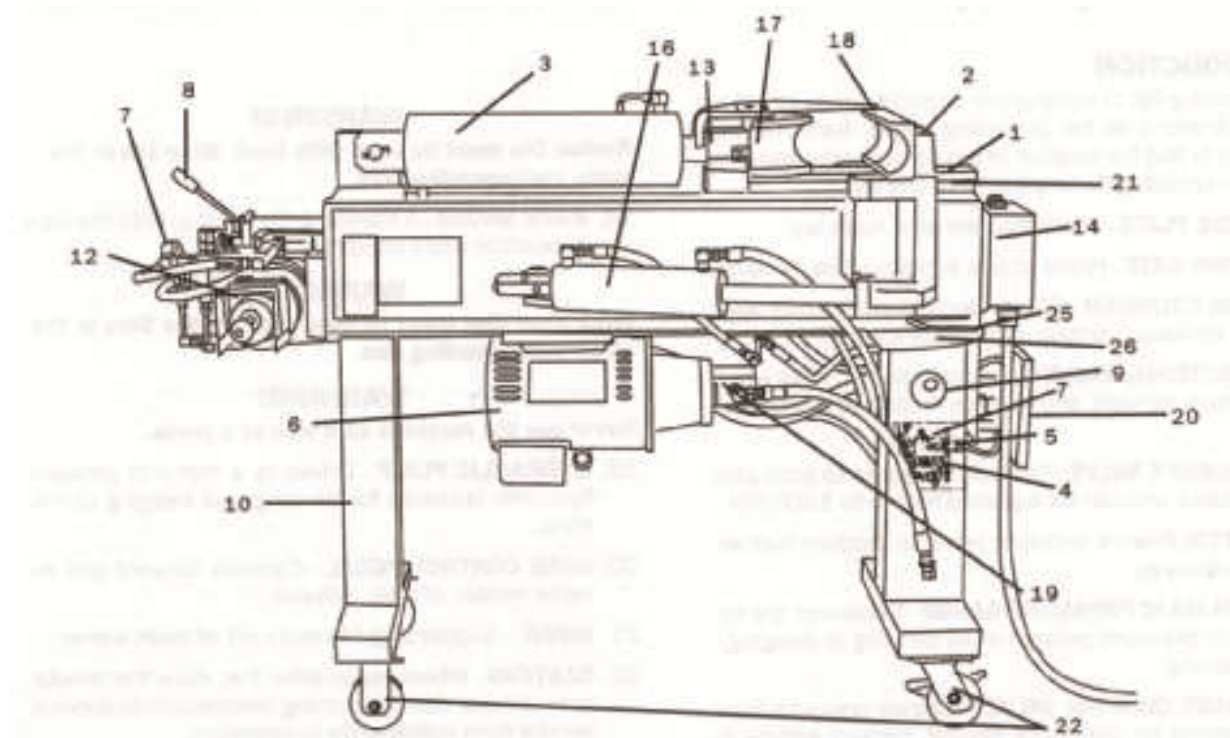
### **3. Bender terminology / component location**

Before bending operation can begin it is important to familiarize yourself with the terms / names and location of the components used on the bender. Study the illustration on the following pages and read the terms and descriptions that apply to your machinery.

The description are number coded to the numbers on the illustrations. To find the description of a component, look up the corresponding number in section 4: Bender component description. To find the description of controls, look up the corresponding letter in section 5: Bender control description.

The terms used will be used throughout the manual and this section of the manual may be referred to in order to clarify or illustrate a location.

## Component location



1	Guide plate	10	Rear leg	19	Hydraulic pump
2	Swing gate			20	Knee control pedal
3	Main cylinder	12	Swager / expander	21	Riser
4	Directional valve (right side)	13	Sled	22	Casters
5	Sequence valve (right side)	14	Control box (button box)		
6	Motor				
7	Hydraulic pressure gauge (right side)	16	Side cylinder	25	Manual depth-of-bend indicator (left side)
8	Swager control valve	17	Radius die	26	Manual depth-of-bend plate (left side)
9	Front leg/hyd. Reservoir W/Oil filler elbow	18	Back shoes		

## 4. Bender component descriptions

The following list of component description is keyed to the illustrations on the preceding pages. Find the location of the components and read the corresponding description from this list.

- (1) GUIDE PLATE-Track that the sled rides on.
- (2) SWING GATE-Hold shoes in place while bending.
- (3) MAIN CYLINDER-5” cylinder that controls forward and backward motion of main bending die.
- (4) DIRECTIONAL VALVE- Electrical solenoid valve which controls forward and reverse motion of main cylinder.
- (5) SEQUENCE VALVE – Control pressure to booth side cylinder and can be adjusted from 0 to 1000 PSI.
- (6) MOTOR – Powers hydraulic pump to produce hydraulic pressures.
- (7) HYDRAULIC PRESSURE GAUGE – Measures the hydraulic pressure present while bending or swaging / expanding.
- (8) SWAGER CONTROL VALVE – Control pressure from the pump for the entire bender. Factory setting is approximately 300 PSI. Also control the swager/expander.
- (9) FRONT LEG/HYDRAULIC PRESERVOIR W/OIL FILLER ELBOW – Indicates the front of the machine and is also the hydraulic reservoir. The oil filler elbow is on the left side.
- (10) REARLEG – Indicates the rear (swager/expander end) of the machine.
- (11) AUTO DEPTH-OF-BEND POINTER – This protractor is the automatic stop device to ensure accurate bends. As the machine is bending, the protractor arm engages a limit switch that switches the bender to a reverse operation.
- (12) SWAGER/EXPANDER – Expands and swager pipe.
- (13) SLED – Guides main bending die.

**WARNING: Do not operate or move this part without a die in position.**

- (14) CONTROL BOX (BUTTON BOX) – Houses controls and electrical componenets.
- (15) SIDE CYLINDERS – Cylinders maintain pressure on the swing gates to form the bend.
- (16) RADIUS DIE – Die allows the tubing to be stretched and “pulled” through the bend. Dies come in a variety of OD sizes and radii.

WARNING: Radius die must be used with back shoe die in the same corresponding size.

- (17) BACK SHOES – A clamping die used to hold the pipe in position while bending.

**WARNING: Back shoe dies must be used with radius dies in the same corresponding size.**

**WARNING: Never use the machine as a vice or a press.**

(18) HYDRAULIC PUMP – Driven by a motor to produce hydraulic pressure for bending and swaging operations.

(19) KNEE CONTROL PEDAL – Controls forward and reverse motion of main cylinder.

(20) RISER – Supports guide plate off of main frame.

(21) CASTERS – Wheel assemblies that allow the bender to be moved. Contain locking mechanism to prevent bender from rolling while in operation.

**WARNING: Be sure casters are locked while machine is in operation.**

(22) DEPTH-OF-BEND LIMIT SWITCH – Controls the depth-of-bend to which the tubing is bent when the bender is in automatic mode.

(23) FILTER ASSEMBLY – Filters hydraulic oil of bender.

(24) MANUAL DEPTH-OF-BEND INDICATOR- Located on left side of bender. Indicates gate opening in degrees.

(25) DEPTH-OF-BEND PLATE- Indicates degrees of bend. Used for both manual and auto bending.

(26) CONTROL BOX – The box located at the left side of the bender, houses the electrical controls and components.

(27) HOME POSITION SWITCH – Signals that the gates are closed to control the reverse stroke of the main cylinder.

## **5. Bender controls description list**

### **Introduction**

This list of bender control descriptions refers to the illustrations on the preceding pages. This is meant to show the location and describe the controls. Reading and understanding the descriptions will assist you in getting the most from your bender.

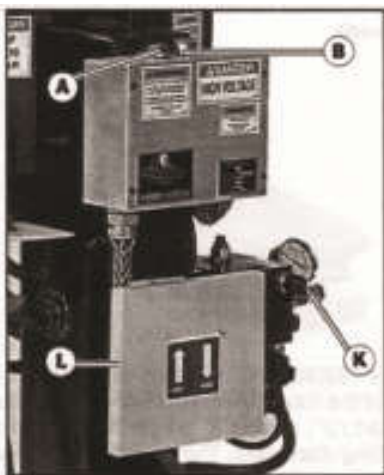
A. Stop control button – Depress this button to completely stop the bender.

B. Start control button – Depress this button start the electrical motor and hydraulic pump.

C. Forward control button – Depress this button to manually start forward motion of the main cylinder. Use of this control button will override automatic stop and push it around its dial, which could cause damage to the switch.



- D. Reverse control button – Depress this button to manually reverse the main cylinder.
- E. Automatic control button – Depress this button to cycle the bender automatically through the forward and reverse motion of the main cylinder. When using automatic control, move the depth-of-bend handle to the degree of bend desired and press the button. The depth-of-bend handle must be moved from 0 degree or this button will not cause the bender to operate.
- F. Emergency / Reverse control button – Depress this button to reverse the forward motion of the main cylinder and return it to its original position.
- G. Knee pedal on-off switch – Supplies power to the knee pedal.
- H. Home position switch – When activated by the gate bolt, this switch activates the timing relay to signal the main cylinder to stop reversing.
- I. Depth-of-bend limit switch – This switch controls the forward motion in automatic mode.
- J. Sequence valve adjusting knob – The sequence valve controls pressure to both side cylinders and the valve is adjustable from 0 to 1000 PSI with the use of the adjusting knob. To adjust the hydraulic pressure, turn the knob and read the pressure on the adjacent pressure gauge. Normal bending pressure should not exceed 1000 PSI.
- K. Knee control pedal – Controls forward and reverse motion of main cylinder.



## 6. Bending tools

### Introduction

Three types of tools are used to bend tubing:

1. radius die
2. back shoes (1 pair)
3. half shoes or three-quarter shoes

All of the tools listed are called bending dies. These dies allow the tubing to be stretched and pulled through the bend.

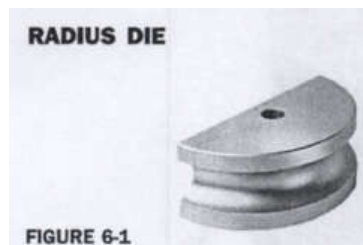
Each die is machined and sized according to tubing diameters and the sizing is stamped on the surface of the dies. The dies come in a variety of O.D. sizes and radii,

For example:

1. radius die - 5"radius = 10" diameter bend  
4"radius = 8" diameter bend

Note: the dies are made of hardened steel, but care should still be given to avoid damaging them.

Note: the dies perform better if they are lightly oiled and are free from flaws and foreign material. EPB-3 has a wide variety of tooling available as well as the ability to manufacture custom tooling to fit your needs.



Radius dies (see figure 6-1) are used to produce the inside diameter of the tubing that is being bent. The dies are available in 3-1/2", 4" and 5" center line radii, and in a variety of tubing diameters. The dies are sold separately in combinations with the back shoe dies.

**Warning !**

**Radius dies are heavy-handle them with care.**

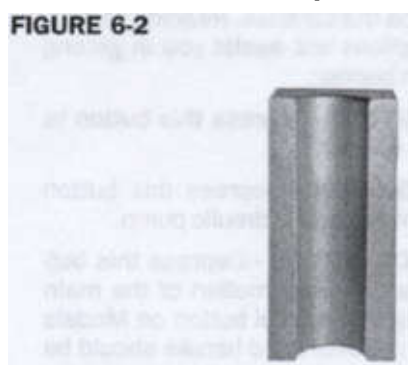
**Warning !**

**Radius dies must be used with back shoe dies in the corresponding size.**

**Warning !**

**Never use the bender as a vice or a press, with or without the back shoes in position.**

Back shoes



Back shoes (see figure 6-2) mount to the swing gates. These dies are used to clamp the tubing

into position while bending and they form the outside radius of the tubing that is being bent. The dies are available in a variety of tubing diameters. The dies are sold separately in combinations with the radius dies.

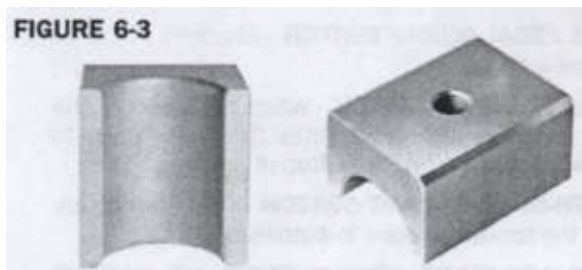
**Warning !**

**Back shoe dies must be used with radius dies with the same corresponding size.**

**Warning !**

**Never use the machine with or without the back shoe dies in position as a vice or a press.**

**Half shoe and three-quarter shoe dies**



Half shoe and three-quarter shoe dies (see figure 6-3) mount to the swing gates. The half shoe dies are exactly 1/2 the size of a back shoe die. The three-quarter shoe dies are exactly 3/4" the size of a back shoe die. These dies are used only when one bend is less than ten inches from the previous bend. Its position is always on the same side as the last bend; normally, this will be on the left side.

The dies are available in a variety of tubing diameters. The dies are sold separately in combinations with the radius dies.

**Warning !**

**Half shoe dies and three-quarter shoe dies must be used with radius dies with the same corresponding size.**

## **7. Bending operations**

### **Introduction**

**Warning !**

Before operation begins, read topic "pump/motor rotation" in the section "machine repair".

After you have determined and selected die sizes and have installed them into the machine, there are three basic elements to consider.

1. centerline of bend – measured in inches.

2. rotation – stated in degrees (change of plane).
3. depth-of-bend – stated in degrees.

### **First bend**

With the above elements in mind, proceed with the following steps to produce the first bend:

1. select straight tubing of required O.D.size and sufficient length (12” longer than cutoff point).
2. turn on bender.
3. wipe tubing to remove excess oil. Place tubing in bender between back shoe and radius dies with the greater portion of the tubing extending out the left side of the bender.
4. rotate tubing so the seam line is facing up. This provides a start reference point for the rotation dial.
5. engage dies until tube is held firmly with the greater portion of tubing extended from the left side of the bender.
6. use the information on the program card, mark off in inches with a felt tip pen where each bend is to be made. Make your marks heavy and at least halfway around the tubing. The last mark you will make on the tubing is the final cutoff or overall length.

**Note: do not cut the tubing until after the final bend is made.**

7. disengage the dies. Reposition the tubing in the dies so that the greater part of the tubing extends from the right side of the bender and is positioned on the first inch mark. Center inch mark between back shoes and engage the dies until the tube is held firmly in place.

**Note: pipe bending is always done by feeding the pipe from the right side of the bender to the left side.**

8. place the rotation dial on the extreme right end of the tubing, at least 12 inches from the final bend, with the numbered side facing the bender. Rotate the dial until the indicator points to zero, which should line up with the seam line, and secure the dial.

**Note: do not remove the rotation dial until all bends are completed.**

9. On model EPB-3, press the right side of the knee pad and bend until the manual depth-of-bend indicator, on the left side of the bender, indicates the desired bend.

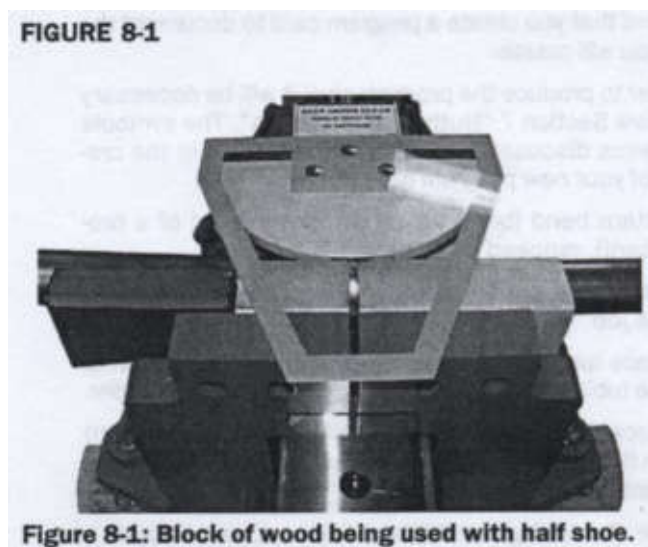
### **Second and subsequent bends**

For the second and subsequent bends proceed as follows:

1. retract the dies until the tubing is free.
2. slide tubing to the left until the next inch mark is lined up with the center of the back shoes.

- engage the dies until the tubing is snug, but movable.
- rotate the tubing until the desired setting is obtained on the rotation dial.
- on the model EPB-3, refer to the manual depth-of bend indicator on the left side of the bender.
- press the right side of the knee pad.
- after the bend is made, slide the tubing to the next mark and repeat the above operations until the last bend has been made.

**Note: half shoes – if a bend is required that would be close to the last bend, use the half shoe. Always place the half shoe on the side facing the previous bend.**



**Note: block of wood – some exhaust system applications required a “cushion” to accurately bend a pipe. Use a piece of wood approximately 2” x 4” x 4”. Remove on back shoe (normally the left one) and replace it with the appropriate O.D.size half shoe. Place the block of wood next to the half shoe and proceed to make the bend. The wood will crush as the bend is being made, but the tubing will not be affected. (see figure 8-1)**

- when all bends are complete, remove the rotation dial and cut the tubing at the cutoff line.
- complete the end finishing of the tubing as required. (see section 11 “swaging and expanding”)

## **8. Pattern bending**

### **Introduction**

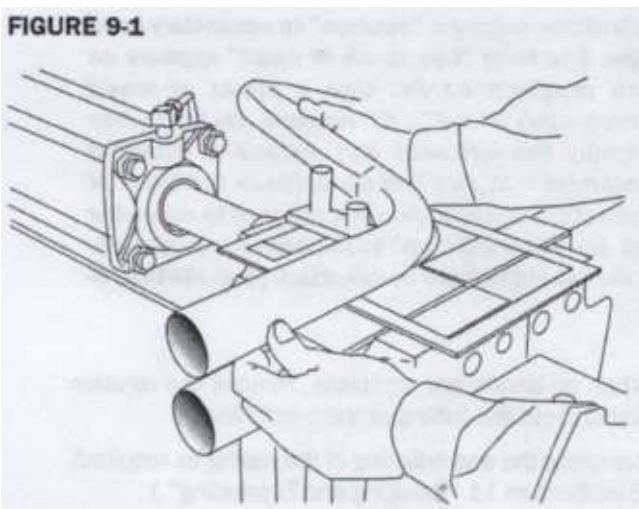
You can bend tubing by using an existing pipe as a master pattern, or you can make a wire pattern to replicate the pipe. It is recommended that you create a program card to document the

pipe you will create.

The pattern bend, proceed as follows:

1. select the proper tubing size and the die set to do the job.
2. place tubing in the bender with the greater portion of the tubing protruding out the right side of the bender.
3. place the master pattern, (tail pipe or wire pattern) on the top of the back shoes so that the first bend is centered between the shoes.

**Note: the tubing must fill the full cavity of the back shoe. It may be cut shorter after the pipe is made.**

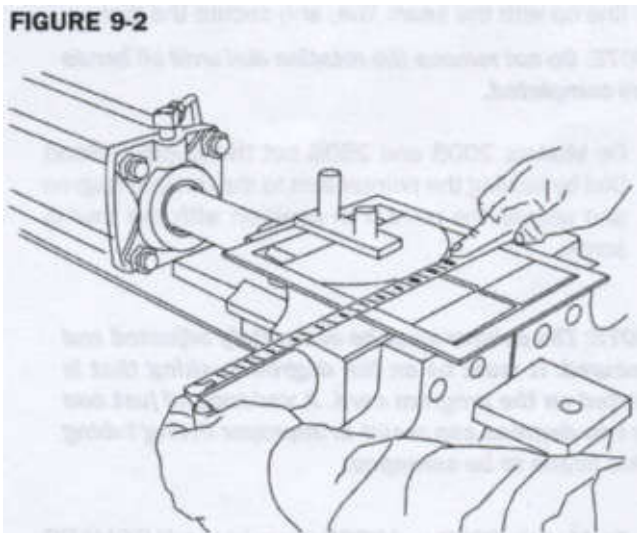


4. extend the tubing out the left side of the bender so it matches in length with the master pattern. Secure the tubing. (see figure 9-1)

If the left end of the tubing does not fill the back shoe, extend the tubing to the left until it does. Mark the first bend on the tubing where it meets the center of the back shoes.

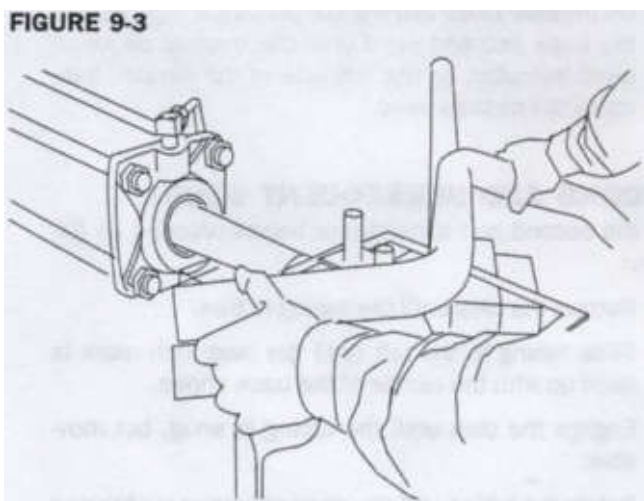
5. measure the distance from the end of the tubing to the center of the back shoes. This is the measurement to the first bend and should be recorded on the first line of a blank program card on the first line of tubing called "center line mark". (see figure 9-2)

**FIGURE 9-2**



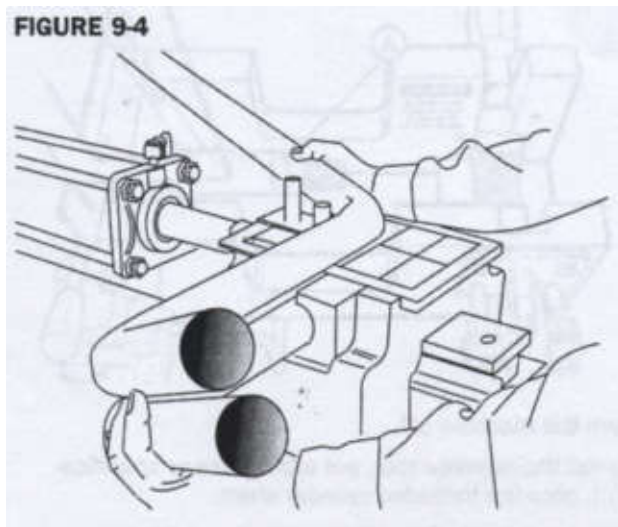
6. place the rotation dial over the far right end of the tubing so the numbered side faces the bender. Secure it in place when the indicator point to zero degrees. This reading is the rotation of tubing for each particular bend and should be recorded on the second line of tubing called “rotation in degrees” on the program card. The first bend is always 0 degrees.

**FIGURE 9-3**



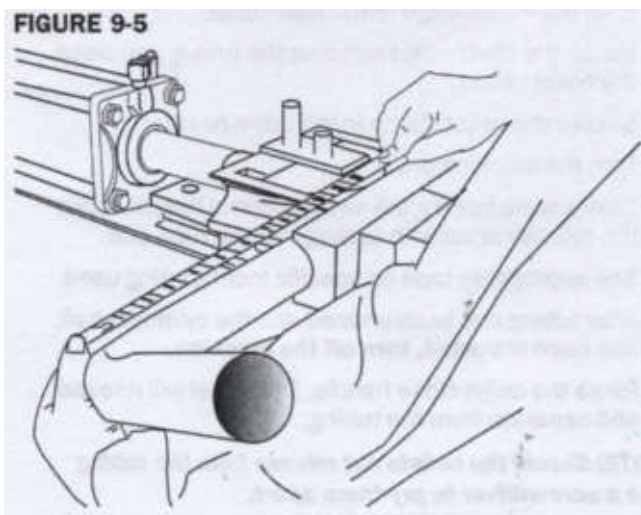
7. you are now ready to make your first bend. Place the first of the master pattern on the top of the back shoes or against the back side of the gates. Gradually extend the dies, opening the gates. Continue bending until the gate are parallel or open flush with the first bend of the master pattern. (see figure 9-3)
8. look at the depth-of-bend gauge on the left side of the bender. This is the depth of the first bend. Record this degree reading on the third line of the program card under “depth of bend”.
9. release the tubing and feed it to the left through the dies. Place the pattern on top of the back shoes. Line up the center of the second bend of the master pattern with the center of

the back gates. Be sure that the bend of the master pattern lies flat on top of that dies.



10. line up the first bend of the new pipe with the first bend of the pattern and rotate the new pipe until it lies parallel with the master pattern. Be sure the pattern lies flat on the dies with the bend centered. Close the dies to secure the tubing.

11. your second bend is now correctly located. The measurement for the second bend should now be taken. Since bent tubing is difficult to measure, it is best to measure from the center of the first bend (between the back shoe dies marks) to the center of the second bend (between the back shoes). This measurement is added to the measurement of the first bend and recorded on the first line of tubing on the program card. (see figure 9-5)



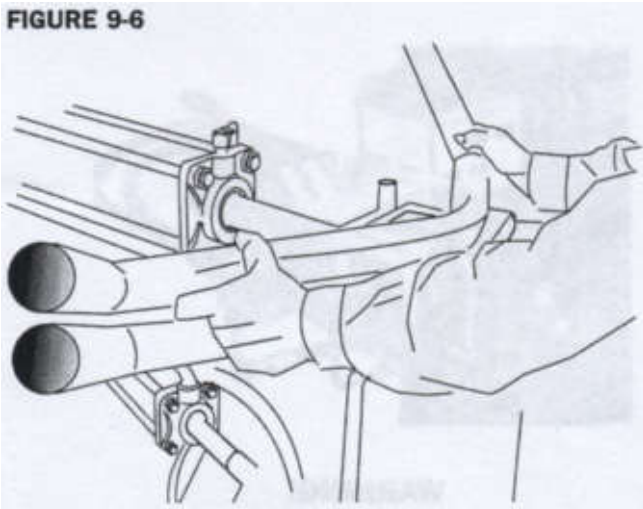
12. look at the rotation dial and take the reading of the tubing rotation for the second bend. This reading is recorded on the second line of tubing on the program car

13. you are ready to make the second bend. Place the second bend of the master pattern on the back shoes or against the gates and gradually make your bend until the gates are parallel or



open flush with the second bend of the pattern. (see figure 9-6)

FIGURE 9-6



14. when the above is accomplished, take the reading from the depth-of-bend gauge and record it on the third line of tubing on the program card.
15. continue to make the necessary bends following the steps from step 9. When all the bends are completed, perform the needed end finishing and measure the cutoff length. Note this information on the program card.

## 9. Swaging and expanding

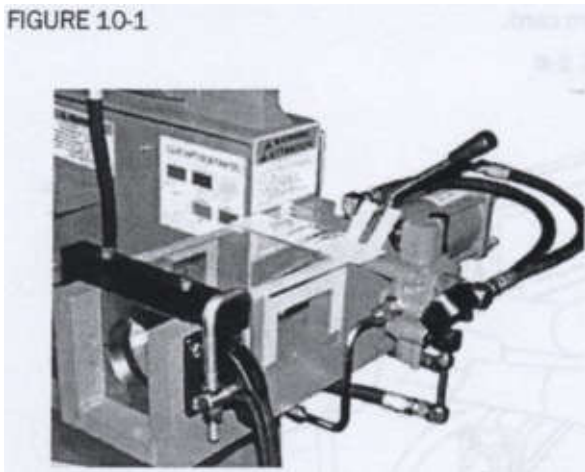
### Introduction

### Warning !

**Be sure all safety guards are securely in position before operating the unit.**

The attachment mounted on the rear of the bender is a swager/expander. It expands on one end and swages on the other. (see figure 10-1)

FIGURE 10-1



The swager/expander unit will end-finish all exhaust and tail pipes to original equipment specifications. This attachment is controlled manually by the operator at all times.

**Caution !**

**Safety is a must when using the swager/expander due to the high pressure used by this unit.**

**Warning !**

**Alteration or removal of any guards could result in injury.**

**Caution !**

**When swaging or expanding always lubricate tooling.**

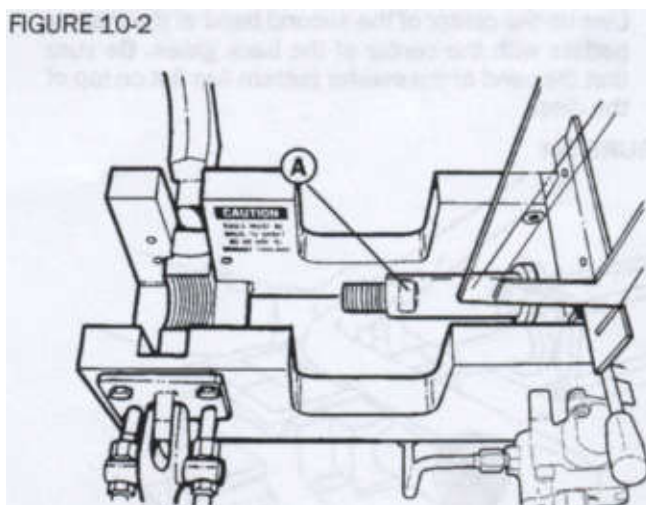
**Swagering operations**

After the tubing has been bent, it may be necessary to finish the end of tubing. The swager portion of the swager/expander unit will make ball jobs, flares and slip joints. In addition, it will expand tubing (swage up) and reduce tubing (swage down). The following procedure is provided as a basic step-by-step process used to install the tooling and begin the swaging operation.

To produce a specific end finish refer to the appropriate topic. (for example: to produce a flare, read the basic swaging operation, then read the operation of the topic “flare”.)

To begin basic operation, proceed as follows:

1. turn the machine on.
2. depress the swager control valve handle and extend the threaded cylinder shaft (A) into the swager box approximately three inches. (see figure 10-2)



3. turn the machine off.
4. install the required tool, per tubing size or specification, onto the threaded cylinder shaft.

5. install one-half of a collet set in the collet closer, threads facing up.

**Note: always use the correct O.D.size collets to match the O.D.tube size.**

6. insert the end of the tubing at least three inches from the inside edge of the half-collet.

7. install the other collet half over the tubing and close the collet holder.

8. secure the collet clamp in the down position.

9. turn the machine on.

10. slowly, while tapping the swager control handle, move the cylinder shaft with tooling into the tube end.

11. see appropriate tope on specific tooling being used.

12. after tubing has been shaped and the cylinder shaft has been retracted, turn off the machine.

13. raise the collet close handle. The collet will release and separate from the tubing.

**Note: should the collets not release from the tubing use a screwdriver to pry them apart.**

**Warning !**

**Do not beat the collets on the bender.**

**Caution !**

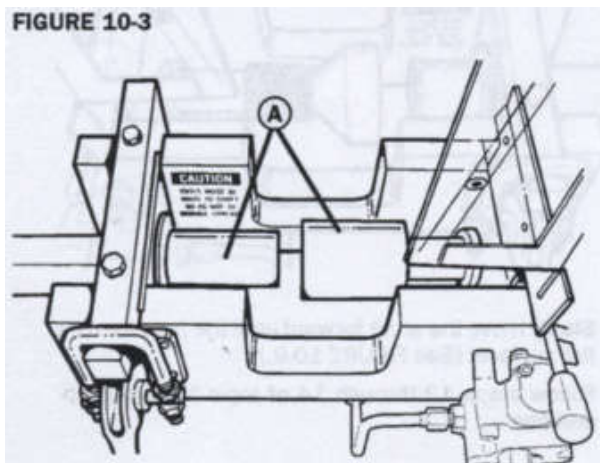
**Always remove the tooling from the swager box after each usage to avoid damage when expanding on the expander side.**

14. remove the tooling and return it to the storage rack.

**Reduce swage (swage down)**

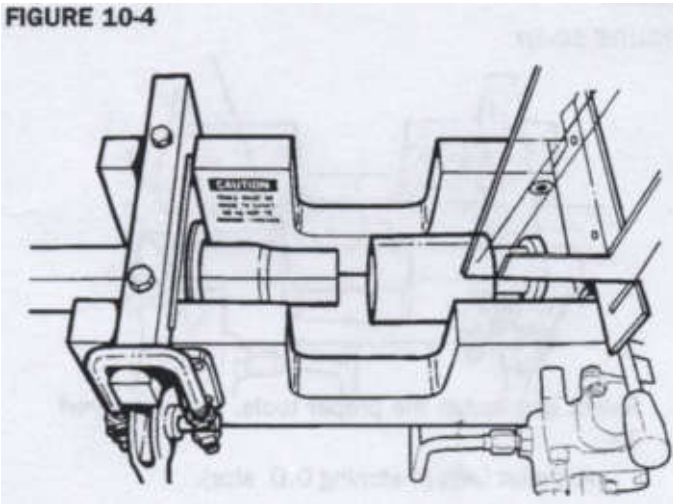
To reduce swage (reduce the outside diameter of the tubing) proceed as follows:

1. select and install the proper collet set tooling and reducing die (A). (see figure 10-3)



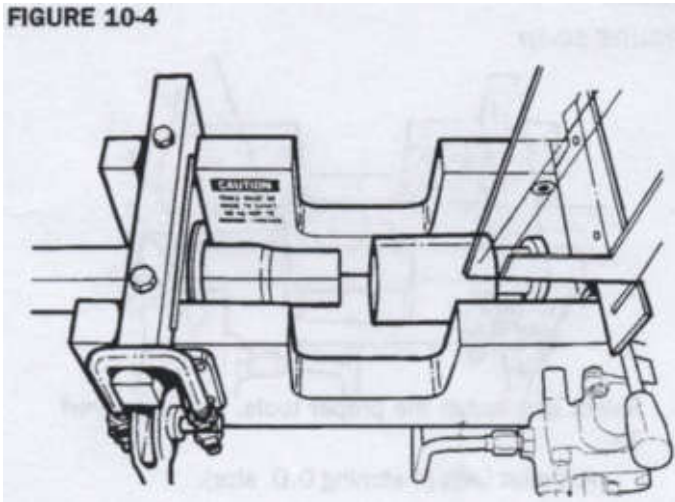
2. follow step 1 through 10 of topic “swaging operations”.
3. move cylinder shaft forward slowly until tool is over the tube. Continue to move shaft until the tube has been formed.

FIGURE 10-4



4. retract the cylinder shaft and tool. (see figure 10-4)

FIGURE 10-4



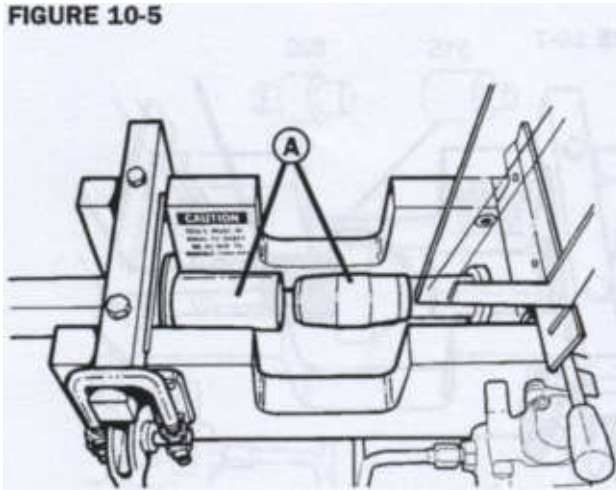
5. follow step 12, 13, and 14 of topic “swaging operations”.

Internal swage (swage up)

To internal swage (enlarge the outside diameter of the tubing), proceed as follows:

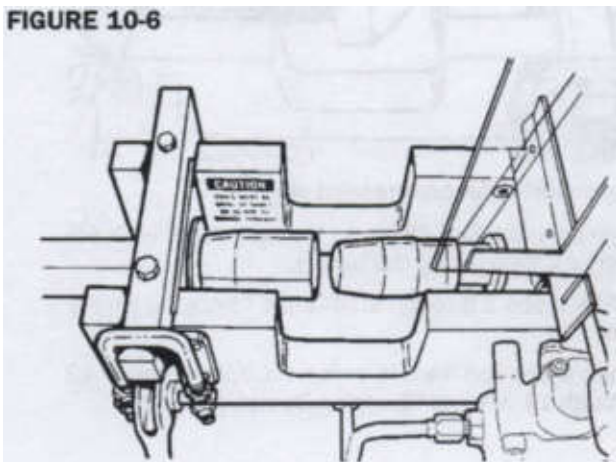
1. select and install the proper collet set tooling and swage die (A). (see figure 10-5)

FIGURE 10-5



2. follow steps 1 through 10 of topic “swaging operations”.
3. move cylinder shaft forward slowly until the tool enters the tubing. Continue to move the shaft forward until the tool reaches the marking ring on the end of swage die.

FIGURE 10-6



4. retract shaft and tool. (see figure 10-6)
5. follow steps 12 through 14 of topic “swaging operations”.

#### **45° flare**

It is necessary to install a flange over the tube prior to finishing the ends. To make a flare or flat the same tool is used – one side flares, the other side flattens.

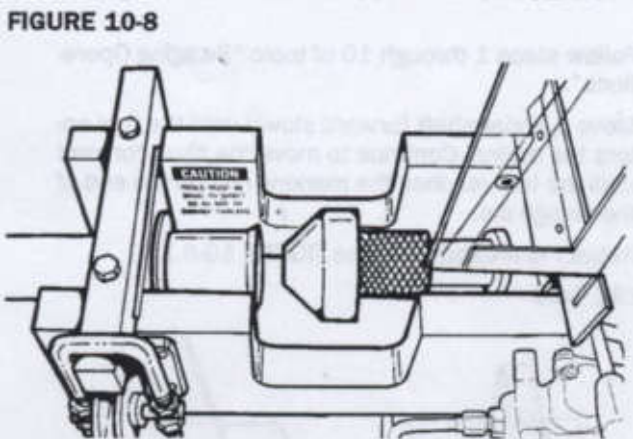
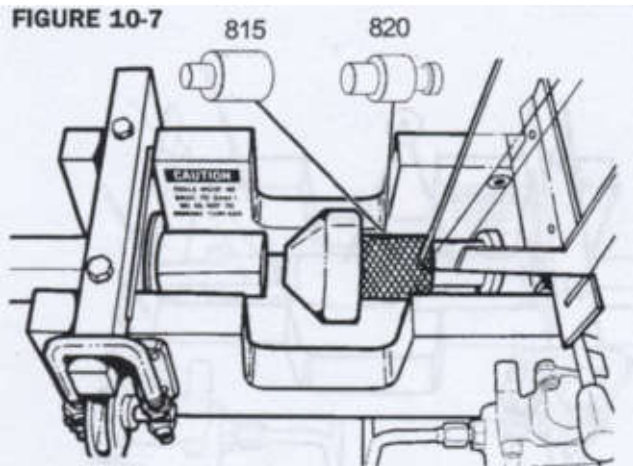
The tools required to make a flare are:

Die holder #815 or #820 quick disconnect

Flaring tool #853

Collet set (pair in matching O.D.size)

To make a flare proceed as follows: (see figure 10-7 and figure 10-8)



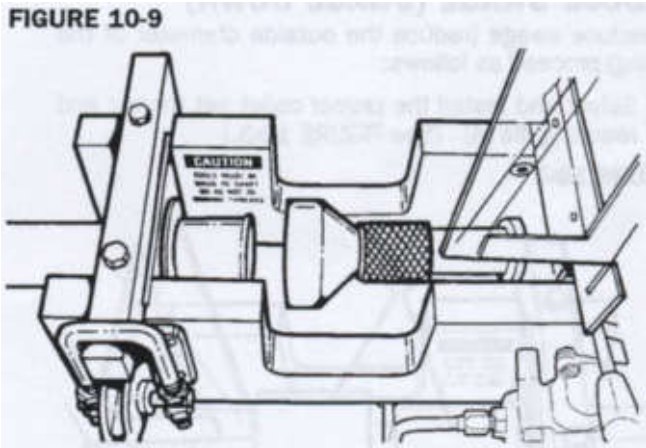
1. install die holder on threaded shaft.
2. insert flaring tool #853 on the die holder with 45 degree flaring facing the tubing.
3. follow step 1 through 10 of topic "swaging operation".
4. when a desired flare is achieved, follow steps 12 through 14 of topic "swaging operation".

### **Flat flare**

It is necessary to install the flange over the tube prior to finishing the ends. To complete a flat flare, proceed as follows:

1. complete the 45° flare process as described above.
2. after retracting the cylinder shaft, reverse flaring tool #853 and install onto the die holder.  
Extend the shaft forward until the tool meets the flared tube.
3. slowly move the shaft forward until the flare forms a flat surface. (see figure10-9)
4. follow step 12 through 14 of topic "swaging operation".

**FIGURE 10-9**

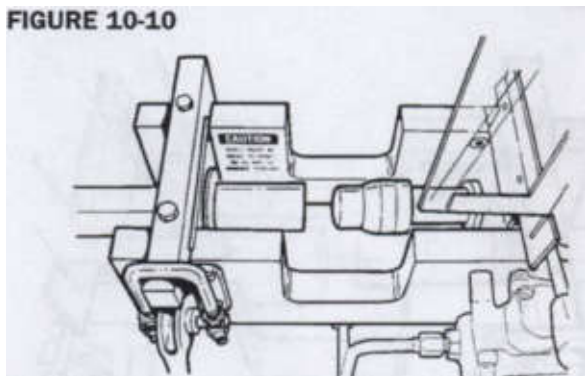


### **Male ball joints**

A male ball and female socket are generally made at the same time. In each case, it is necessary to install the flange over the tube prior to finishing the ends.

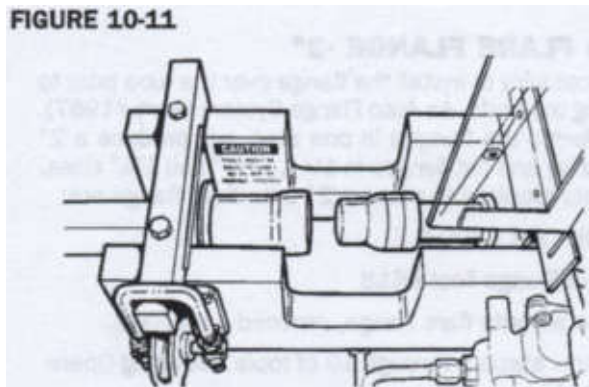
To make a ball joints, proceed as follows: (see figure 10-10)

**FIGURE 10-10**



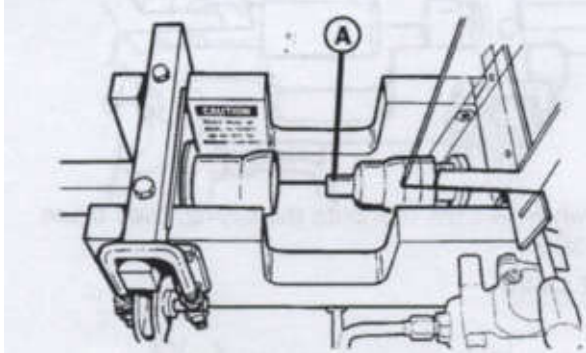
1. select and install the proper tools. Tools required are
2. follow steps 1 through 10 of topic "swaging operation".
3. using the male ball joints tool, slowly insert it into the tube until it reaches the second marking ring on the end of tool. (see figure 10-11)

**FIGURE 10-11**



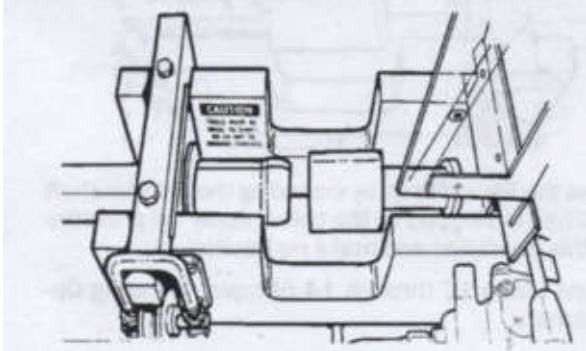
- retract the tool. Do not remove the clamp.
- install die holding pin #816 (A) into male ball tool. (see figure 10-12)

FIGURE 10-12



- install domer die on pin #816. (see figure 10-13)

FIGURE 10-13

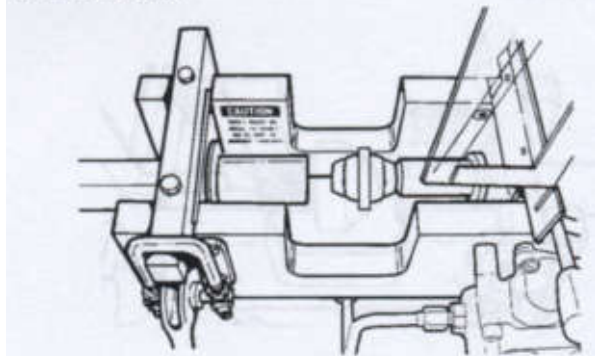


- move the shaft with the tool forward over the tube. Continue to move forward until a desired ball is formed. When it is achieved, retract the piston and turn off the bender. Remove the domer and the tube. (see figure 10-13)
- this completes the male ball forming process. Do not remove any other tooling if a female ball socket is to be made. If a socket is not required, remove tooling.

### Female ball socket

It is necessary to install the flange over the tube prior to finishing the ends. To make the female ball socket, proceed as follows:

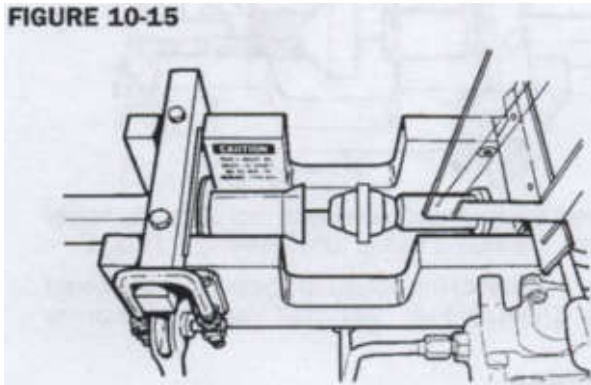
FIGURE 10-14





1. install female ball tool on die holding pin #816. The tool is reversible for another size. (see figure 10-14)
2. insert the tube section into the collet closer.
3. follow step 1 through 10 of topic “swaging operations”.
4. insert the tool slowly into the tubing, until the socket is formed. The tubing will meet flush with the stop on the tool. (see figure 10-15)

**FIGURE 10-15**



5. follow steps 12 through 14 of topic “swaging operations”.

### **Flare flange – for manifold gasket**

It is necessary to install the flange over the tube prior to finishing the ends. Certain finishing applications require a round manifold gasket. To make this application, it is necessary to use a scarp piece of tubing, approximately 1-1/2” long, in the next smaller O.D.size. This tubing scrap, or nipple, will be inserted into a formed tube end. The tools required to make a flare flange are:

Collet set (matching O.D.size)

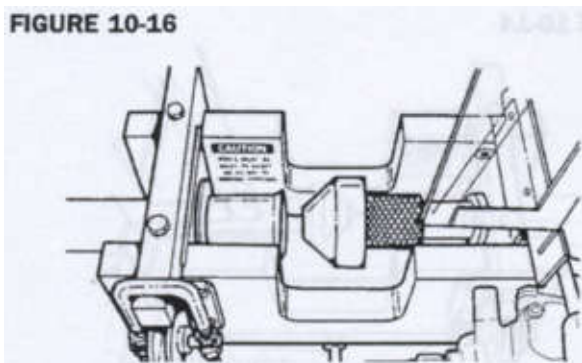
Flanger tool - #853

Die holder - #815

To make a large flange, proceed as follows:

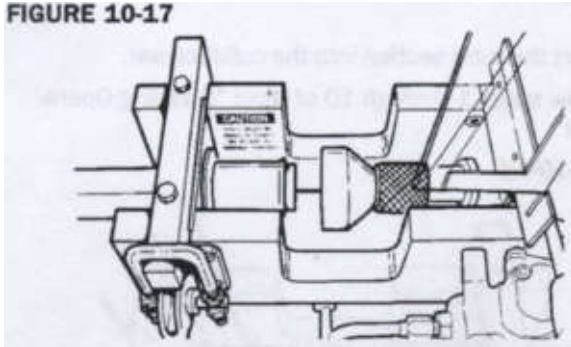
1. follow step 1 through 10 of topic “swaging operations”.
2. slowly insert the tool into the tubing, making a flared shape. (see figure 10-16)

**FIGURE 10-16**



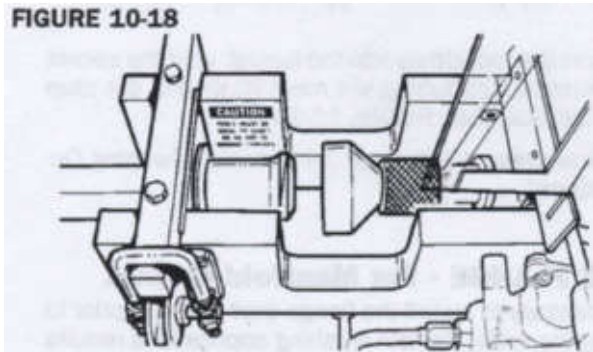
3. retract the shaft and reverse the tool on the die holder so the flat side is facing tube. (see figure 10-17)

FIGURE 10-17



4. insert (by hand) the scarp pipe nipple into the flared tube. The nipple will hold itself into the tube opening.
5. remove your hands from the swager box and slowly move the tool forward, forcing the nipple into the tube until it protrudes 1/2". This forms the seat for the round gasket. (see figure 10-18)

FIGURE 10-18



6. follow steps 12 through 14 of topic "swaging operations."

### **Auto flare flange – 2"**

It is necessary to install the flange over the tube prior to finishing the ends. An auto flange system (part #1987), which forms the flanges in one step, will produce a 2" flare flange and flat flanges in 1-1/2", 1-5/8" and 1-3/4" sizes. The tools required to make a 2" auto flare flange are:

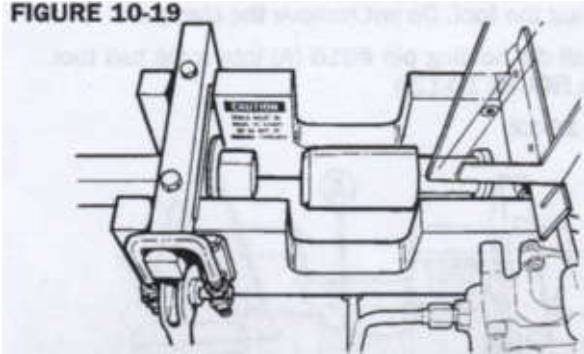
Collet set 1720 D.F.

Flare flange tool #518

To make an auto flare flange, proceed as follows.

1. follow step 1 through 10 topic "swaging operations".
2. slowly insert the tool onto the tubing. (see figure 10-19)

**FIGURE 10-19**



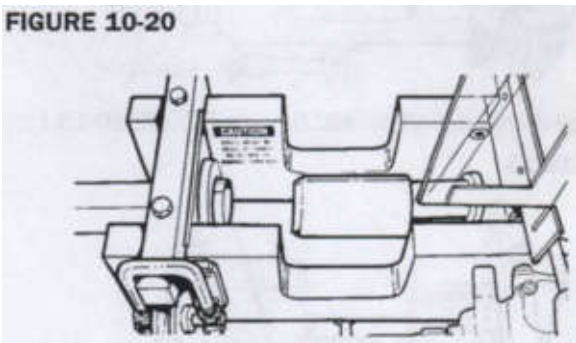
3. make the flared flange by extending the cylinder shaft until tool is stopped by the collet. Apply full pressure for this operation and make no hesitations.
4. follow step 12 through 14 of topic "swaging operations".

### **Flat flanges**

It is necessary to install the flange over the tube prior to finishing the ends, flat flanges can also be produced. The tools required are collet set (pair in matching O.D. and size) and flat flange tool (matching O.D. size).

To make a flat flange, follow the steps listed for topic '2" auto flare flange'. (see figure 10-19 and 10-20.)

**FIGURE 10-20**

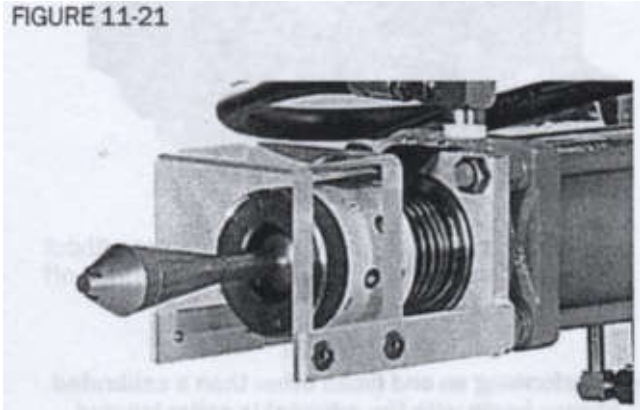


### **Expanding operations**

The EPB-3 bender comes equipped with the ACCU-SIZER™ Expanding Kit. The ACCU-SIZER needs to be installed into position on the back of the swager box cylinder. Once the ACCU-SIZER is installed, your bender will have additional capabilities of expanding tubing. To install the ACCU-SIZER on your bender, proceed as follows:

Figure 11-21

FIGURE 11-21



1. slip the adjustable collar guard assembly (part#41047) over the cylinder shaft and tie rod.
2. secure the assembly to the cylinder using two 1/2" – 13 jam nuts (part#97208) which are provided. Locate these in opposite corners.
3. screw the arbor (part#508) securely onto the cylinder shaft. A wrench may be used to secure the arbor and tip.

Do not over tighten.

4. screw the large arbor tip (part#499) onto the arbor.
5. lightly grease the arbor and face of the adjustable collar.

The adjustable collar has been calibrated at the factory. Therefore, once is has been installed, you are ready to expand tubing.

The bender has an expanding chart (see figure 10-22) located on the side of the machine. To achieve the desired I.D. expansion, the chart should be read across, for example:

For a 2" I.D. expansion – set the adjustable collar so the 5 appears in the sight. Place the #474 red segment on the arbor with the #499 large tip.

Note: should the calibration decal need to be replaced, see "machine repair" section.

Figure 10-22

EXPANDING CHART			
SETTING	SIZE	SEGMENT	TIP
②	1 1/2 ID	4	4
①	1 5/8 ID	7	9
③	1 3/4 ID	3	8
④	1 7/8 ID		
⑤	2 ID		
⑧	2 OD		4
⑨	2 1/8 OD		
⑩	2 1/8 ID		9
⑪	2 1/4 OD		
⑥	2 1/4 ID	4	9
⑦	2 1/2 ID	7	
⑫	2 3/4 ID	5	
⑬	3 ID	4	
⑬	3 1/2 ID	7	
		6	
		477	

5 APPEARS FOR 2" I.D. EXPANSION

Note: always be sure the arbor and tips are securely screwed in place before expanding begins.  
 Note: the #498 small tip is only used for 1-1/2" – 1-3/4" expansion with the #473 yellow segment.  
 All other expansion greater than 1-3/4" will use the #499 arbor tip.

**Using expanding tools**

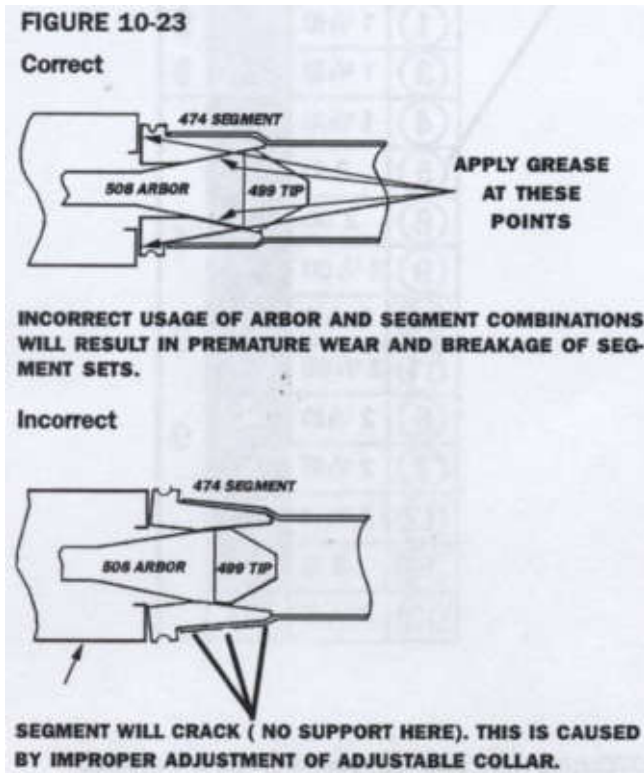
The following procedure is provides as a basic step-by-step process to install tooling and begin the expanding. To produce a specific end finish, it will be necessary to refer to the appropriate topic. For example: to produce a flare, read the basic operation steps, the read the steps of the topic "flare".

To begin the basic operation, proceed as follows.

1. turn the machine on.
2. lift the swager control valve handle and extend the cylinder shaft approximately 12".
3. install the appropriate arbor, being certain it is threaded all the way onto the cylinder shaft.
4. grease the arbor thoroughly.

**Note: arbor and face of adjustable collar should always be well lubricated with grease.**

- install the appropriate segment set on the arbor by simply forcing the set over the end of the arbor. (see figure 10-23)

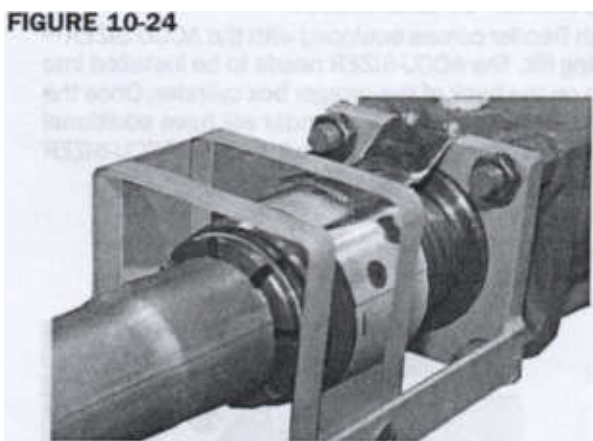


Segment will crack (no support here). This is caused by improper adjustment of adjustable collar.

Caution !

Always use the correct segment with the correct arbor and arbor tip. Failure to do so will result in tool breakage.

- place tube halfway over the segment and tap the control handle slightly. This will remove any burrs.
- close the segments and run the tube to the base of the segments.
- tapping the control handle up and down while turning the pipe clockwise at the same time will give a smooth, round expansion. (see figure 10-24)



9. segments may be removed from the arbor without disassembling the tool. Simply pull the segment off the arbor.

Warning !

When performing an end finish other than a calibrated I.D., always begin with the adjustable collar located inward and advance it to make the desired finish. If the collar is left fully extended, prolonged use may distort the end threads and may lock up the collar.

### **#440 flaring segment set**

With a #440 flaring segment set, flares from 1-1/2" to and including 2-1/2" can be completed quickly using the expander. To produce a flare, proceed as follows:

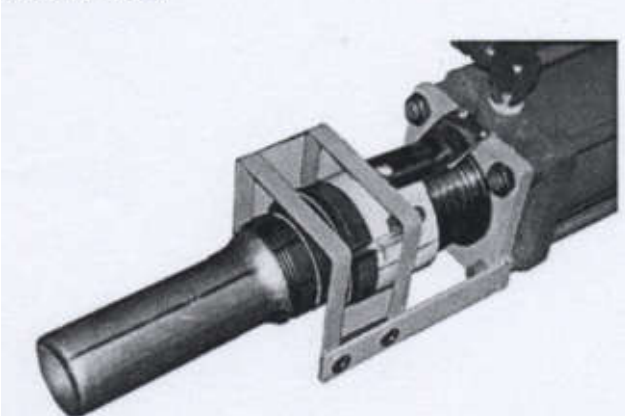
1. install the arbor and tip #499 being sure they are securely tightened onto the cylinder shaft.
2. slid the flaring segment set over the arbor. (see figure 10-25)

**FIGURE 10-25**



3. place the tubing over the arbor and segment set, but do not place the end of the tubing past the last step (tooth) on the segment. (see figure 10-26)

**FIGURE 10-26**



4. depress the control handle and rotate the tubing to produce the desired flare.

Note: smaller diameter should be gradually worked up onto the segment set.

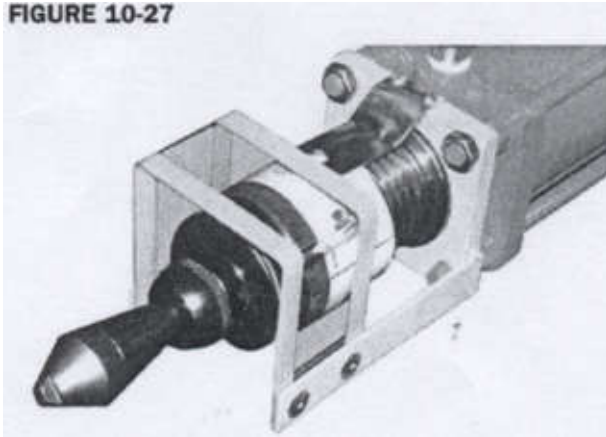
## Ball joint segment sets

Ball joint segment sets are used to produce male and female joints on tubing from 1-3/4" to and including 3"

The joints can be made quickly using the expander. To produce a ball joint, proceed as follows:

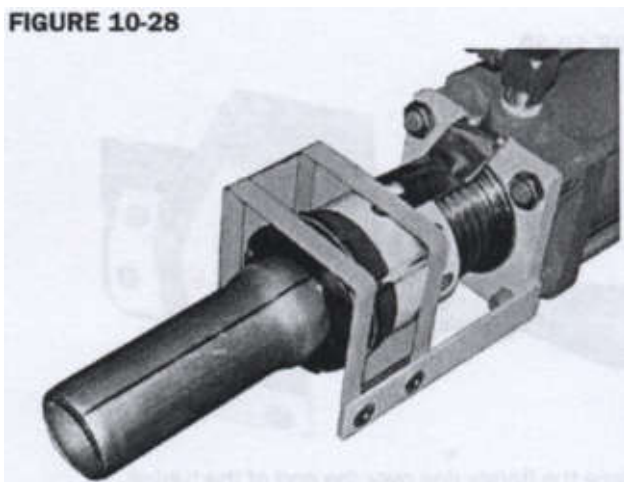
1. install the arbor and tip #499. Be sure they are secured tightly to the cylinder shaft.
2. slide the ball joint segment over the arbor (see figure 10-27)

FIGURE 10-27



3. place the tubing over the arbor and the segments set until the end of the tubing touches the base of the segment set.
4. depress the control handle to form the ball, being careful not to distort the open end of the tubing. (see figure 10-28)

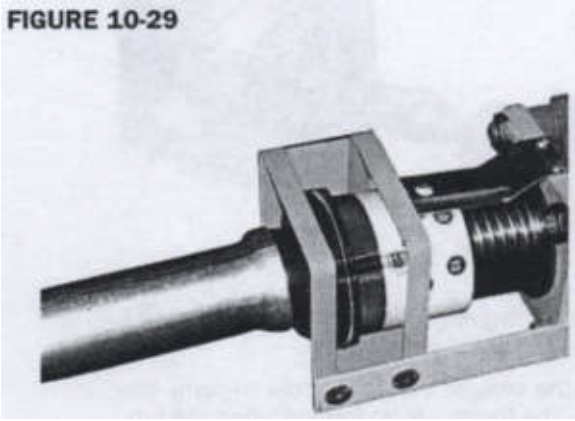
FIGURE 10-28



5. to make the female, place the tubing over the arbor and segment set until the end of the tubing is at the groove on the ball.
6. depress the control handle and flare the end of the tubing to fit the mating ball joint. (see figure 10-29)



FIGURE 10-29



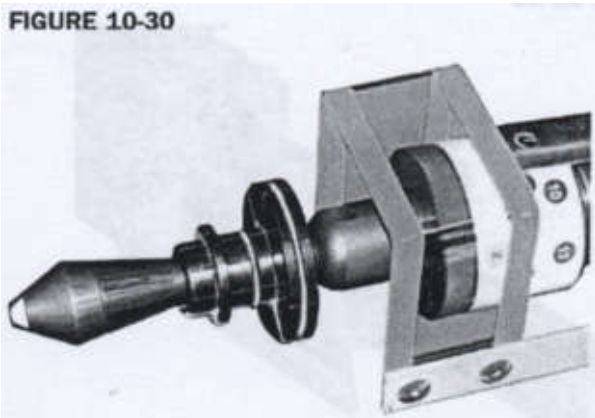
### flange segment sets

expanding flange segment sets come in size 2" – 2-1/2" tubing with sizing rings for 2", 2-1/4" and 2-1/2"

to produce a flange, select the correct segment set, flange ring and proceed as follows:

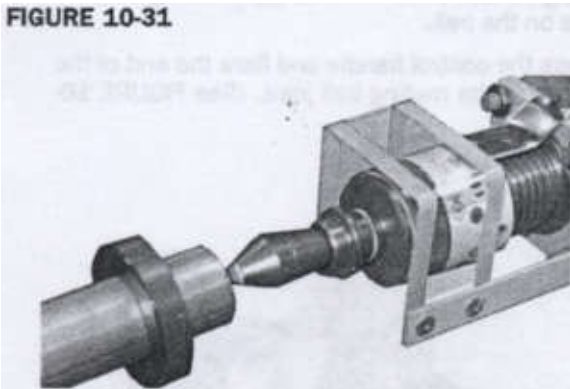
1. place the segment set over the arbor. Secure into position, (see figure 10-30)

FIGURE 10-30



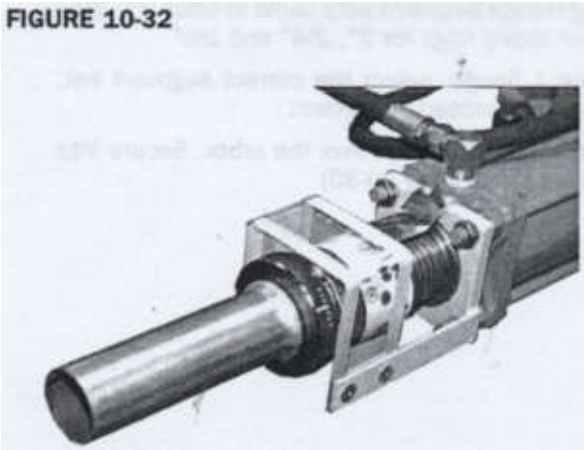
2. place the flange ring over the end of the tubing.
3. place the tubing over the arbor and segment set until it meets the base of the segment set. (see figure 10-31)

FIGURE 10-31



4. push the sizing ring forward until it also touches the base of the segment set.
5. press the swager control handle to form the flange. The flange will be formed when the tubing

meets the inside of the flange ring. (see figure 10-32)



**EPB-3 expanding tool chart**

**A ready reference for matching tools to their arbors**

**For the accu-sizer TM**

Size	arbor	tip	segment set	collar
1-1/2" – 1-3/4"	508	498	473	41047
1-3/4" _ 2-1/8"	508	499	474	41047
2-1/8" – 2-1/2"	508	499	475	41047
2-1/2" – 3"	508	499	476	41047
3" – 3-1/2"	508	499	477	41047

**For 45 degree flange work**

Size	arbor	tip	segment set	collar
1" – 1-1/2"	575*		405	41047
1-1/2" – 2-1/2"	508	499	440	41047
2-1/2" – 3-1/2"	508	499	441	41047

\* requires 570 spacer

### For making ball joints

Size	arbor	tip	ball joint tool	collar
1-3/4"	508	499	410	41047
2"	508	499	419	41047
2-1/4"	508	499	420	41047
2-1/2"	508	499	421	41047
3"	508	499	452	41047

### For flanges

Size	arbor	tip	segment set flange	collar
2"	508	499	411 w/413 flange ring	41047
2-1/4"	508	499	411 w/414 flange ring	41047
2-1/2"	508	499	412 w/418 flange ring	41047

### For expansion work

Size	arbor	segment set	collar
15/16" – 13/32"	575**	470	41047
13/32" – 1-1/4"	575**	404	41047
13/16" – 1-1/2"	500	400	41047
2-3/4" – 3-1/8"	503	403	523
3-1/8" – 3-1/2"	503	406	523
3-1/2" – 4"	503	408	523
4" – 4-7/8"	503	450	523
4-7/8" – 5-1/2"	503	451	523

\*\*require a 570 spacer

## 10. Periodic maintenance

### Introduction

The following maintenance should be performed regularly to ensure the long life and proper performance of your bender.

## Daily

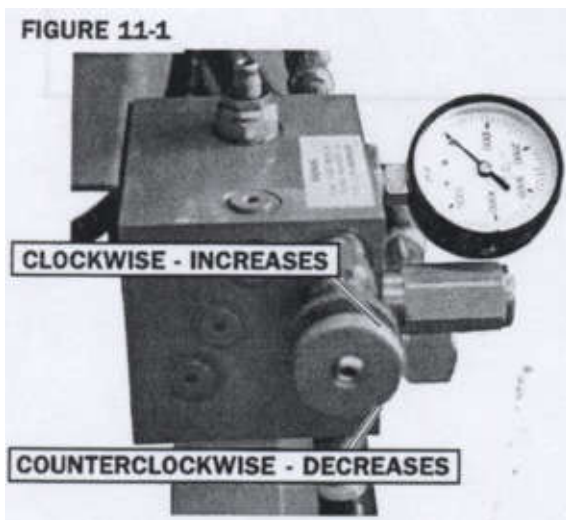
Clean and lubricate the following:

1. guide plate – lubricate with grease. Remove any nicks or burrs.
2. sled – keep clean at all times. Never move the sled without a die in position on it.
3. riser – guide plate – clean any dirt and grit from around the riser – guide plate to allow free movement of the sled.

## To change the pressure setting

### bending pressure

1. install a 5" radius die and appropriate back shoes on the bender.
2. turn on the bender.
3. advance until the dies are engaged.
4. read pressure from the gauge of the sequence valve. Normal bending pressure for tubing is between 500 and 700 psi. The pressure can only be read as the dies are being engaged. Never exceed 10000psi.



5. if pressure is incorrect, adjust pressure using the pressure regulator dial knob of the sequence valve. Turning the knob clockwise increases the pressure. Turning it counter clockwise decreases the pressure. (see figure 11-1)

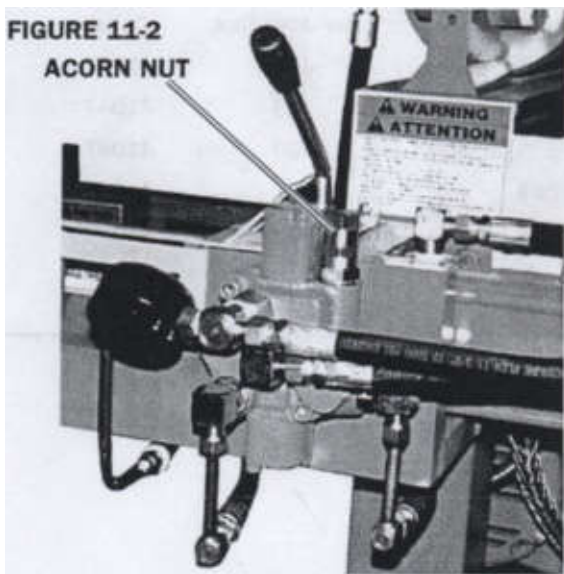
if your pressure gauge does not read zero when the dies are disengaged, replace the gauge.

### Swaging / expanding pressure

1. turn on the bender
2. press swager control handle down until the cylinder extends completely into the swager box (to the left). The pressure can only be read as the cylinder is completely engaged. When the

pressure is relieved from the cylinder, the gauge should read 0 psi.

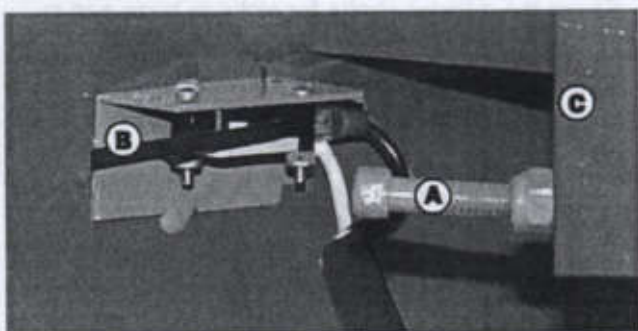
3. read the pressure on the gauge. Pressure should be approximately 3000psi. Pressure should not exceed 3000 psi. If pressure exceed 3000 psi, release the valve lever immediately; pull the valve lever up to relieve pressure and reset the valve to a lower pressure.
4. if the pressure is incorrect, remove the acorn nut and loose the jam nut on the swager valve pressure stem. With an allen wrench, turn the pressure stem to adjust the pressure, turning it clockwise will increase the pressure. Turning it counterclockwise will decrease the pressure. Tighten the jam nut and replace the acorn nut to secure the pressure adjusting stem. (see figure 11-2)



5. after the pressure setting has been adjusted, recheck the pressure setting.

### **Return to home position calibration**

Figure 12-4



The home position switch (figure 12-4) calibration should rarely be necessary. The gate bolt (A) triggers the switch (B) exactly when the gates (C) close. To adjust the bolt, loosen the locknut and move the bolt in or out, then lock down the locknut.

### **Caution !**

**Do not overextend the bolt and exert pressure on the switch.**

If the switch is no longer being tripped, perhaps an object or dirt buildup is stopping the gate from closing all the way. Always keep the bending area clean.

**Manual depth-of-bend calibration**

You may notice that the degree pointer connected to the left side gate may read 1 degree below zero on the depth-of-bend plate. This is set at the factory to compensate for the “spring back” in tubing and should be checked occasionally as follows:

1. using a 5” radius die and appropriate back shoes, engage the dies and extend the ram die until the pointer on the depth-of-bend plate reads 90 degrees.
2. using a carpenter’s square, check the alignment of the back gates to ensure a true 90 degree reading.
3. set the pointer to 90 degree by tapping gently on the depth-of-bend plate or loosening the bolts and nuts.

**Caution !**

**Do not use strong solvents to clean dirt from the bender; solvents may damage some components.**

1. using a mild detergent, remove all dirt buildup from the bender. Ensure there is no dirt built up between the gates and the guide plate. Also, check for dirt at the top of the gates and the gate pins. Dirt can cause excessive wear.

**Caution !**

**Do not use an air hose near the control box.**

2. clean dirt and oil from the bending dies and remove any burrs.
3. check the cylinder shafts for nicks or burrs and remove them using emery cloth.
4. inspect the segment sets for cracks or damage. Replace if necessary.

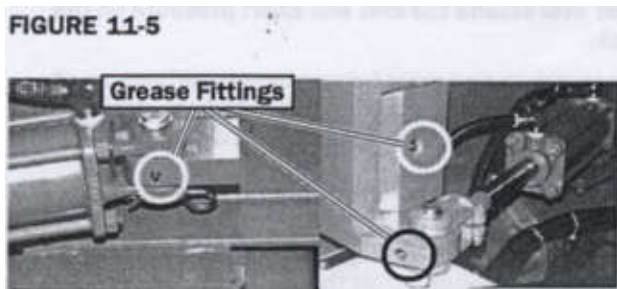
**Caution !**

**Hose fittings are made of soft metal. Overtightening may damage the fittings and cause leaks.**

5. inspect hose and fittings for leaks. Tighten as required.
6. check for bolts or nuts that may have loosened.
7. inspect all the electrical components, i.e. plug, receptacle, cord, foot pedal, conduit, etc. replace any damaged electrical components immediately. (see section 14” bender

repair”.)

- grease the six grease fittings as shown in figure 11-5 using a medium weight, all-purpose grease.



- ensure that the bolts in the guide plate are tight.
- check that the depth-of-bend indicate plate(s) are tight. If a plate is loose, tighten it so that it is parallel to the bender's main beam. Recalibrate the bender using the procedure explained in the section titled "depth-of-bend calibration".

### **MONTHLY**

Perform the following maintenance monthly:

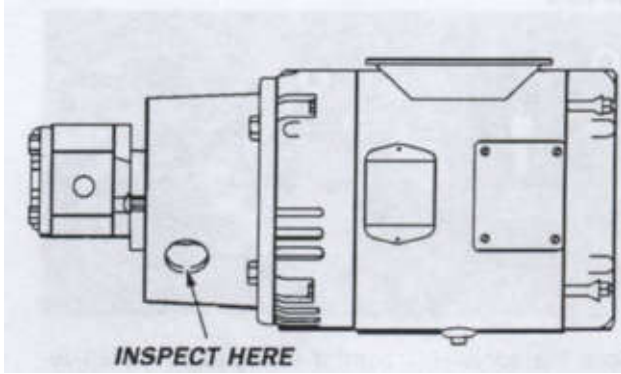
- check the oil level of the bender. The bender contains approximately 4 gallons of hydraulic fluid. To check the oil level:
  - reduce the pressure on the sequence valve to 0 psi.
  - using 1 5" radius die and back shoes, advance the ram die until the main cylinder is fully extended and stop the bender.
  - visually check the oil level in the filler elbow located on the left side of the machine under the depth-of-bend indicator plate. Oil should appear in the filler elbow or can be felt by inserting your fingertip into the elbow.

**Note: if oil must be added to the system frequently, check for leaks.**

You can use any 10 medium weight, mineral based hydraulic fluid with non-foaming additive. The oil should have an ISO 32grade rating.

- clean all tooling to remove old grease and nicks and burrs. A light application of lubricating oil is recommended for bending dies and back shoes. Swage and expanding tools should be lightly greased.
- inspect the coupling between the pump and the motor to ensure the allen set screw have not loosened. (see figure 11-6)

**FIGURE 11-6**



make sure the two halves of the coupling are separated by the rubber spider.

4. check and tighten any loose connections in the hose leading from the reservoir to the pump.

Note: a loose connection on this hose may not always show a leak, but it will suck air and cause aeration in the system, causing the bender to react with uneven operation.



# 11. TROUBLE SHOOTING

## Introduction

The troubleshooting procedures charted on the following pages contain the problem, the possible cause and the corrective action to be taken.

There are two basic section: electrical troubleshooting and hydraulic troubleshooting.

After identifying the problem, proceed with the appropriate corrective action. The chart is organized from the most simple to the more difficult procedures. Be certain the person performing the work has the necessary ability and skills. Observe all safety rules when working on the bender.

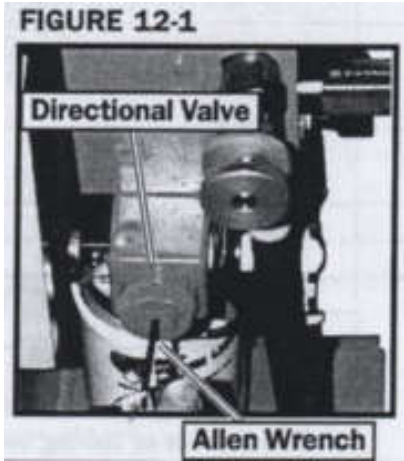
## Warning !

**Turn of the bender and lock out, tag out power before servicing.**

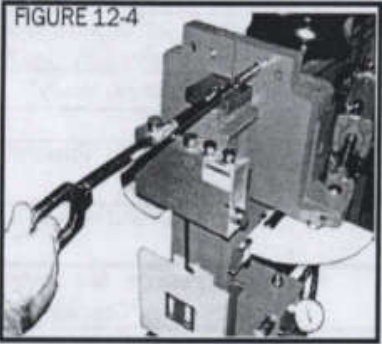
Electrical troubleshooting		
problem	Possible cause	Corrective action
Motor does not run	Circuit breaker is off	Turn breaker on
	Incorrect wiring	Check voltage supply, phase and wiring
	Poor connection at plug	Check wiring
	Cut in power cord	Check and replace at once
	Defective start/stop switch	Test and replace if needed
	Motor defective	Test motor-check with local electrical motor supplier for service center. Replace if need.
	Overload at contactor tripped	Reset overload
Internal wiring has become disconnected	Check wiring at contactor and buttons	
Motor smokes	Centrifugal switch sticking in open position	Remove motor-service at local service center

Electrical troubleshooting		
Problem	Possible cause	Corrective action
Motor shuts off	Overload safety turning motor off	Reset overload switch and restart. If problem persists, check wiring for short circuits.
	Overload amp setting is too low	Check to determine if motor is overloaded
		Compare to amp draw of motor on motor's specification tag
	A poor connection at plug or a cut in the power cord exists	Repair or replace
	Motor starter defective	Replace starter
	Motor capacitors defective	Replace
Bender emits shocks	Lost ground connection	Check plug-to-receptacle fit
		Check plug wiring
		Check cord for damage
		Check the ground connection at control box. The bender or tubing being bent must not come in contact with any other object.
Buttons do not activate functions	Directional valve problem	Check wiring
		Check for bad coils
		See "power at swager control valve but not at main cylinder" in hydraulic troubleshooting section
	Wiring problem	Check wiring and connections
Contact block loose	Re-secure block to back of button	

Hydraulic troubleshooting		
problem	Possible cause	Corrective action
Loss of power on either end of bender	Low pressure	Adjust pressure. See section 11- periodic maintenance.
	Pump not functioning properly	Key sheared on coupling/coupling loose. Test pump. See topic "loss of power to entire machine",
	Bender low on oil	Fill tank. See section 11- periodic maintenance
	Hose from tank to pump loose, sucking air	Secure hose
	Aeration of oil	Check all hoses and fittings. Stop all leaks
	Filter in front leg clogged	Remove, clean and replace
	Swager control valve leaks internally-will not build pressure	Check oil flow to valve. Replace valve
Bender stops after bending a few degrees or swaging can not be done; motor bogs down	Low voltage	Check fuse
		Check that bender has its own circuit breaker
		Check incoming voltage
		Ensure plug and receptacle make good contact
		Check cord
	Bender low on oil	Fill tank. See section 11-periodic maintenance
	Filter in front leg clogged	Remove, clean and replace
Back shoe pressure too high	Lower back pressure	

Hydraulic troubleshooting		
Problem	Possible cause	Corrective action
Direction valve chatters	Low voltage	Check fuse
		Check that bender has its own circuit breaker
		Check incoming voltage
		Ensure plug and receptacle make good contact
		Check cord
		Check internal wiring and conduit for breaks
Power at swager control valve, but not at the main cylinder	Directional valve not operating properly  	Operate valve manually by: using an allen wrench, push the small button on the end of the coil. (see figure 12-1). Left coil retracts cylinder; right coil extends it. Main cylinder should move. If button will not move, the valve is defective. Replace valve. See section 13- machine repair “control valve replacement”. If manual operation is possible, check for voltage at coil on valve. If voltage is present, the coil is bad. Replace valve. See section 13- machine repair “control valve replacement”.

Hydraulic troubleshooting		
Problem	Possible cause	Corrective action
Power at swager control valve, but not at the main cylinder	Seals in main cylinder are bad	With a 5" radius die in place, extend the main cylinder as far as possible. Remove the hose from the front of the main cylinder. Place the end of the hose in a bucket and press the forward button. If the seals are good, no oil will come out of the hose.
	Sequence valve PSI set too high	See section 11- periodic maintenance
	Swager control valve leaking internally	Replace valve
	Sequence valve by passing internally	Replace vale
Hydraulics are "jumpy" or erratic	Air in hydraulic system	Ensure that all hoses and fittings are tight
	Air in hydraulic pump	Proceeds as follows: 1. top off oil level in reservoir with fresh oil. See section11-periodic maintenance 2. run bender through its cycle several times until the entire system is purged of air bubbles.
	Oil in reservoir is low	Add oil. See section 11-periodic maintenance

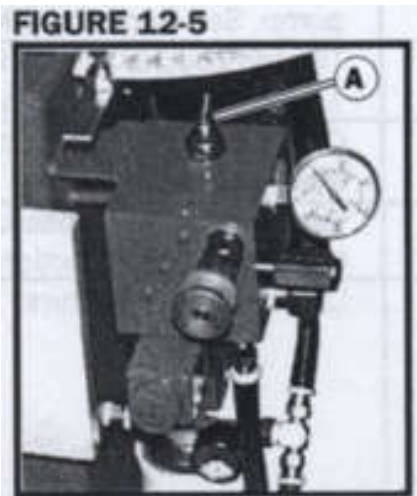
Hydraulic troubleshooting		
Problem	Possible cause	Corrective action
Gates do not return correctly	Pressure setting at sequence valve is incorrect	Reset pressure. See section 11-periodic maintenance
	Dirt or grease buildup on gate bearing pins	Clean and lubricate using the following procedures: <ol style="list-style-type: none"> <li>1. remove depth-of-bend plate</li> <li>2. remove degree pointer</li> <li>3. remove clevis pin and move cylinder out of the way</li> <li>4. remove snap ring from swing gate bearing pin</li> <li>5. press out bearing pin</li> <li>6. remove gate</li> <li>7. clean parts, lubricate and reassemble</li> </ol>
	Sequence valve out of adjustment	See problem “pipe collapses”
	Air in system	See “hydraulic are ‘jumpy’ or erratic” (above)
	Side cylinder seals are bad	See “gate move slowly” (below)
Gates move slowly	Pressure setting incorrect	Adjust pressure. See section 11-periodic maintenance
	Side cylinder are worn 	Set sequence valve to 100 psi. with gates closed and power off, pry the gates open.(see figure 12-4). If the gates open, the seal in the side cylinder are worn and should be replaced. See section 13.  Test seals (PSI set above 100). With a 5” radius die in place, extend the main cylinder as far as possible. Remove the hoses from the front (shaft end) of the side cylinder. (if the hoses drop they will drain the tank.) depress the forward button. The machine can not move. If the seal leak, oil will come from the fittings


Hydraulic troubleshooting		
Problem	Possible cause	Corrective action
Side cylinder leaking	Cylinders worn	Replace seals. See above and section 13-machine repair
Bender can not complete bend (motor running properly)	Pressure set too high (usually on large diameter tubing)	reduce pressure slowly while bending until bender provides a good quality, even bend.
Pipe collapses	Swaging valve pressure setting in incorrect	Adjust pressure. See section 11-periodic maintenance
	Defective tubing	Attempt a bend on another piece of tubing
	Buildup or caking of material on surface of dies	Clean dies and lightly oil
	Gauge of tubing too thin for diameter	Ensure that 2-1/4" or large tubing has at least 13 gauge wall thickness
Main cylinder keeps moving until it bottoms out after button or lever is released	Direction valve spring is broken	Replace valve. See section 13- machine repair. See corrective action under "control valve replacement". (above)
	Dirt in directional valve prevents spring return to neutral center position	Replace valve. See section 13-machine repair "control valve replacement". (above) Override valve. See figure 12-1
	Electric button	The button may not have released. Clean and check contacts
	Knee pedal control	Check controls and wiring
	Loose pointer	Secure pointer
	Depth-of-bend plate and pointer do not travel horizontally	Adjust plate and pointer. See "automatic depth-of-bend calibration in periodic maintenance".

Hydraulic troubleshooting		
Problem	Possible cause	Corrective action
Directional control valve chatters and will not engage properly	Low voltage	Check voltage and machine wiring including plug and receptacle
	Coil is bad	See possible cause under “directional valve not operating properly”
Directional control valve clicks on return of main cylinder	Low voltage	Check voltage and machine wiring including plug and receptacle
	Coil is bad	See possible cause under “directional valve not operating properly”
After autobend, main cylinder fully retracts	Home position switch not calibrated	See “return to home position calibration” in periodic maintenance, section 11
	Timing relay loose or bad	Secure or test manually
Dies drift after completion of bend	Direction control valve is defective or dirty	Clean and test directional control valve. Replace if necessary. See figure 12-1
	Seals worn in side cylinders	See “gates move slowly”
	Sequence valve worn	Replace valve
	Main cylinder seals bad	Check seals. See “power at swager control but not at main cylinder”
Directional or swager valve leaks	Valve body is cracked	Inspect valve and replace if cracked
Hydraulic pressure is low	Improper adjustment	Adjust pressure. See section 11- periodic maintenance, “operating pressure check”.
	Connectors on intake hose from reservoir to pump are loose. Air leaking in	Tighten connections



Hydraulic troubleshooting		
Problem	Possible cause	Corrective action
Hydraulic pressure drops	Pump defective	Test pump. See problem “loss of power to entire machine”
		Check coupler
		Replace pump
Hydraulic pump noisy	Motor-to-pump coupling loose	Tighten coupling
	Key on motor or pump shaft is sheared	Replace key; inspect motor/pump shaft for damage; replace coupling if damages
	Spider on coupling is worn	Replace coupling or spider
	The pump is bad	See “loss of hydraulic power to entire machine”
Pressure reads 3000psi at swager but there is a loss of bending power	Main cylinder seals bad	See “power at swager, not at main cylinder”
Pipe collapses	Setting on sequence valve is incorrect. (travel time of sled and die extension and retraction should be the same)	<p>If extension and retraction travel times are not equal:</p> <ol style="list-style-type: none"> <li>1. loosen jam nut on top of sequence valve</li> <li>2. using an allen wrench, turn the adjustment screw (A) on top of valve. (see figure 12-5)</li> <li>3. when the extension and retraction speeds match, tighten the locknut to lock adjustment screw in place</li> </ol>
	Side cylinder are worn	See problem “gates move slowly”



Hydraulic troubleshooting		
Problem	Possible cause	Corrective action
Pipe collapses	Gates not operating properly  	Check operation if gates:  1. place a 3" radius die on the sled and extend the main cylinder to open the gates  2. look at the pivot pins on the gates while the gates are opening. The gate (A) and pin (B) (see figure 12-6) should turn at the same time. If the pins do not turn, the key is worn or sheared. The key must be replaced and the pin, bushings, and gate bore inspected for damage. If either are badly scored, replace them
	Gates slip or tilt	Remove side cylinder rod clevis from gate and move gate to check slop in pivot. If slop is significant, check bushing in head block for wear. Replace if needed.
	Tooling is damaged	Check tooling for damage. Replace damaged tooling.
Segment set teeth break	Arbor or tip wrong size	See section 10-swaging & expanding
	Arbor needs lubrication	Apply a thin coating or grease to the arbor and the face of the adjustable collar
	Adjustable collar is not being used correctly	See section 10- swaging & expanding

Hydraulic troubleshooting		
Problem	Possible cause	Corrective action
Loss of hydraulic power to entire machine	Defective pump	Hold down swager valve handle and look at pressure gauge. If pressure decrease during reading, replace pump
	Low oil	Fill oil tank. See section 11-periodic maintenance
	Clogged filter	Clean or replace filters
	Swager valve not set correctly	See section 11- periodic maintenance
	Swager valve by passing internally	Replace valve
Motor runs but pump does not develop pressure	Motor rotating in wrong direction.(3 phase only)	Turn off motor immediately. Motor should be turning counterclockwise as seen when facing the pump. See section 13 machine repair
	Coupler between motor and pump is loose	Tighten coupler. Check keyways. See section 11-periodic maintenance
	Low on oil	Check oil level. See section 11-periodic maintenance
	Defective pump	Check oil level. See section 11 – periodic maintenance
	Clogged filters	Clean or replace filters

## **12. MACHINE REPAIR**

### **GENERAL REPAIR**

#### **Calibration decal replacement**

Should the calibration decal of the accu-sizer need to be replaced, proceed as follows:

1. remove the old decal and clean the area.
2. be sure the #508 arbor and #499 arbor tip are securely tightened to the cylinder shaft
3. place the #474 red segment on the arbor
4. expand a piece of 2" tubing just enough to insert another piece of tubing into it. (2.015" I.D.)
5. locate #5 of the calibration decal in the hole of the gun sight.
6. secure the decal to the adjustable collar.

### **HYDRAULIC REPAIR**

#### **Introduction**

The following hydraulic repair section contains step-by-step instructions for replacing major hydraulic components on your bender. Repair procedures not listed here should be left to qualified service personnel. If you are unfamiliar with hydraulic servicing, contact your distributor for professional service.

#### **Warning !**

Serious injury can occur if hydraulic hoses are connected incorrectly. Pump damage may also occur. Always note the location of hydraulic hoses before removing components to ensure that the hose is connected properly during reassembly.

#### **CONTROL VALVES REPLACEMENT**

To replace control valves, proceed as follows:

- 1 start bender.
2. drop hydraulic pressure to 0 on the sequence or swager valve.

#### **Warning !**

Lock out, tag out electric plug. (secure the plug so that it can not be plugged into the receptacle or place a warning tag on it to prevent it from being plugged into a receptacle)

3. turn off and lock out, tag out all power to the bender.
4. manually cycle all valves several times to relieve pressure which may be present in hydraulic lines.

5. tag and disconnect the hydraulic lines and an wiring to the valve which is to be replaced.
6. remove the attaching hardware that holds the valve in place. Be sure to note the size and quantity of hardware in each location.
7. remove the valve.

**Caution !**

**Overtightening of valve attaching hardware may distort or damage the valve body.**

8. install the replace valve and secure using the original attaching hardware.
9. connect hydraulic hoses or lines to the valve body. Be careful not to overtighten the fittings on the hose ends. They are usually made of soft metal and can be easily damaged.
10. connect any wiring (directional control valves only) that may have been disconnected.
11. turn the bender on and test the new valve for proper operation. Cycle the valve several times to remove any air which may be trapped inside the valve.
12. set the PSI on the valve. See section 11.

**SIDE CYLINDER REMOVAL**

To remove a side cylinder, proceed as follows:

1. turn the bender on and drop the hydraulic pressure to 0 psi using the sequence valve.
2. shut off the bender.
3. lock out, tag out the bender.
4. remove the cotter pins or clips retain the clevis pins.
5. remove the clevis pins at swing gates.
6. swing the cylinder away from swing gates.

NOTE: Do not move cylinder rod after the hydraulic hoses are removed. This will draw air into the cylinders and cause erratic bender performance. If air is drawn into the cylinder, use the bleeding procedure following this removal procedure.

7. unscrew hose from the fittings on the cylinder and cap or plug hoses.
8. remove the cotter pins or clips retain clevis pin at the cylinder head end.
9. remove clevis pin.
10. remove cylinder.

**SIDE CYLINDER BLEED PROCEDURE**

To bleed a side cylinder, proceed as follows.

1. attach the head-end clevis (opposite the rod) to the swing gate and secure in place using a

clevis pin.

2. attach the hydraulic hose which is normally at the rod end of the cylinder to the head end of the cylinder.
3. place a bucket or other suitable container under the rod end port of the cylinder to catch the escaping oil during the bleed procedure.
4. pull the cylinder rod all the way out. This will draw oil from the reservoir into the head end of the cylinder.
5. push the rod all the way in. this will force air out of the cylinder and into the reservoir. Wait thirty seconds for air to rise to the surface of the reservoir. Repeat steps 4 and 5 four or five times. On the last stroke, pull the rod all the ways out and leave it in the extended position.
6. disconnect the hose from the cylinder.
7. remove the clevis pin and cylinder from the swing gate.

NOTE: When installing the cylinder on the bender, you may need to push the rod in to align the holes on the clevis end. Do not pull rod out, as this will draw air into the cylinder.

8. install cylinder on the bender using the “side cylinder installation” procedure.

### **SIDE CYLINDER INSTALLATION**

To install a side cylinder, proceed as follows:

NOTE: Perform bleed procedure to ensure the head of the cylinder is free of air.

1. place head end of cylinder on the bender and secure with a clevis pin.
2. install pin which retain clevis pin.
3. swing cylinder into position on the bender.

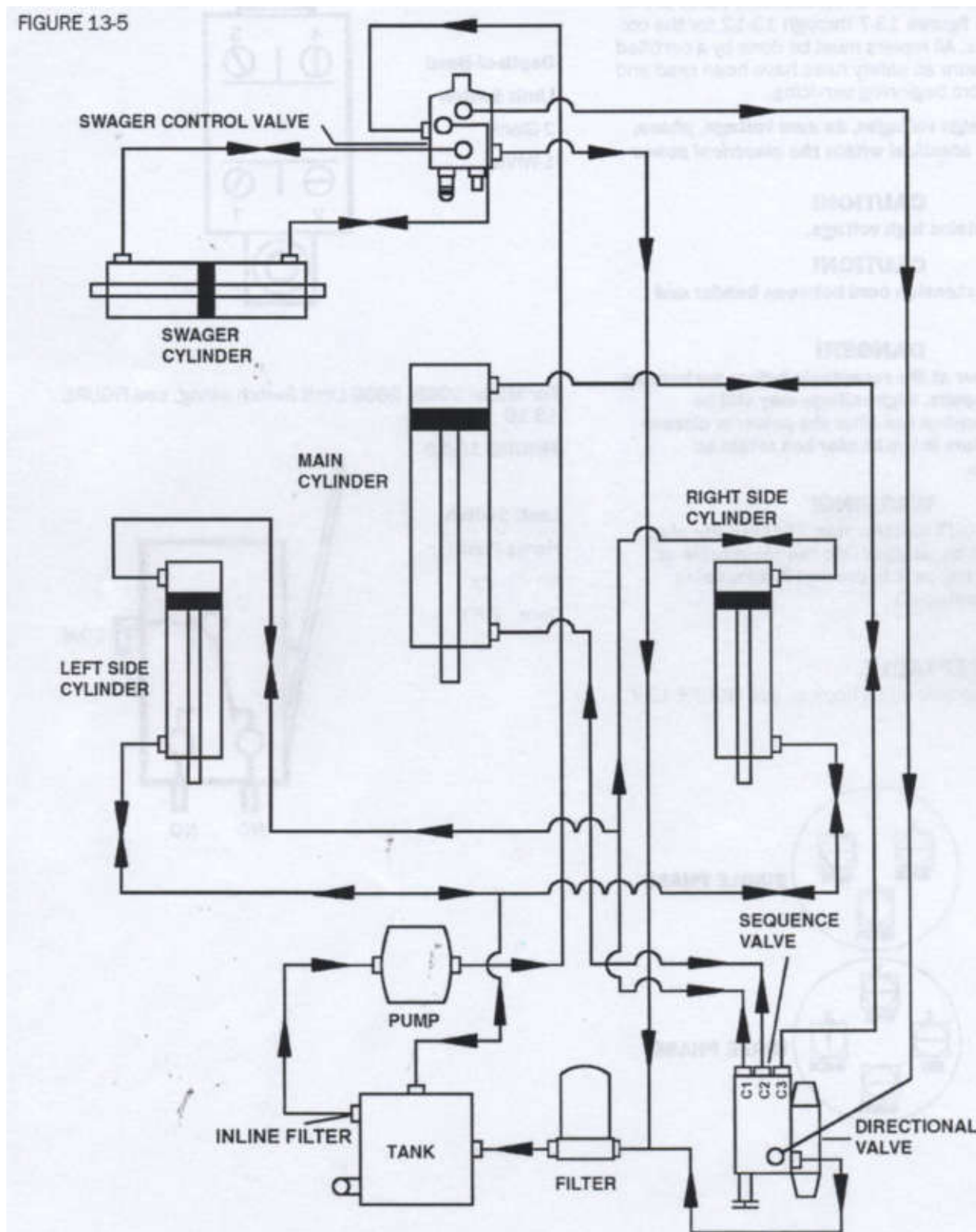
NOTE: When installing the cylinder on the bender, you may need to push the rod in to align the holes on the clevis end. Do not pull the rod out, since this will draw air into the cylinder.

4. align rod end clevis with swing gate and install clevis pin.
5. install clevis pin retainer.
6. install hydraulic hoses. Be careful not to overtighten fittings as the soft metal and can be damaged easily.
7. cycle the cylinder several times and perform a bend to ensure proper operation.

## HYDRAULIC FLOW SYSTEM

There is no pressure in the hydraulic system when work is not being done on the bender. All valves are open center and hydraulic fluid flows through the system until the dies are engaged. On the following pages, you will find the hydraulic flow diagrams. Use these diagrams as a diagnostic tool to aid in trouble shooting and bender hydraulic trouble.

Hydraulic flow diagram Figure 13-5



## ELECTRICAL REPAIR

### Introduction

The following electrical repair section contains schematics and illustrations to aid in electrical repair. Most of the electrical components can not be repaired and require only removal and replacement. If replacement parts are installed, refer to figure 13-7 through 13-12 for the correct connections. All repairs must be done by a certified electrician. Be sure all safety rules have been read and understood before beginning servicing.

**NOTE: For foreign voltages, be sure voltage, phase, and cycle are identical within the electrical power source.**

**Caution !**

**Control box contains high voltage.**

**Caution !**

**Do not use an extension cord between bender and receptacle.**

**Danger !**

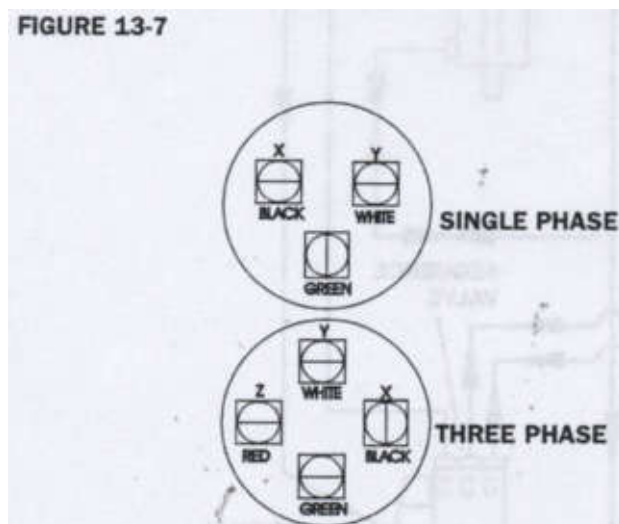
**Disconnect power at the receptacle before performing any electrical repair. High voltage may still be present in the control box after the power is disconnected. Capacitors in the bender box retain an electrical charge.**

**Warning !**

**Lock out, tag out electric plug. (secure the plug so that it can not be plugged into the receptacle or place a warning tag on it to prevent it from being plugged into receptacle.)**

### PLUG & RECEPTACLE

For plug and receptacle wiring hookup, see figure 13-7

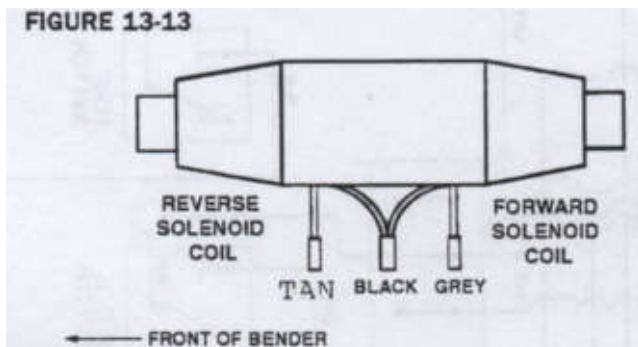




## DIRECTION VALVE

MODEL: EPB-3

For directional control valve wiring, see figure 13-13



## MOTOR

For motor lead connections, refer to the charts below.

Single phase – 230 voltage

1 + 5 black motor lead

4 + 8 black motor lead

Three phase – 230 voltage

4 + 5 + 6 together

7 + 1 black motor lead

8 + 2 black motor lead

9 + 3 black motor lead

Three phase high voltage

6 + 9 together

5 + 8 together

4 + 7 together

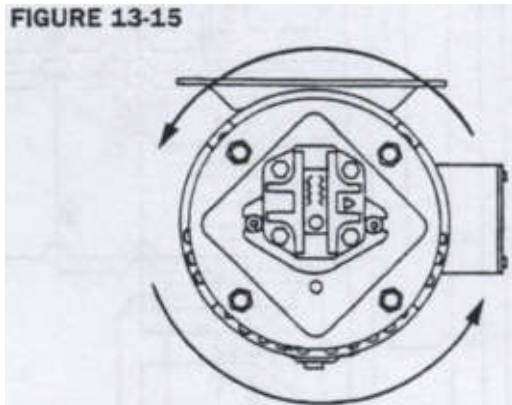
3 black motor lead

2 black motor lead

1 black motor lead

## PUMP / MOTOR ROTATION

When starting a 3-phase motor, check motor rotation. It should rotate counterclockwise as seen when facing the pump. To check the pump / motor rotation, proceed as follows: (see figure 13-15)

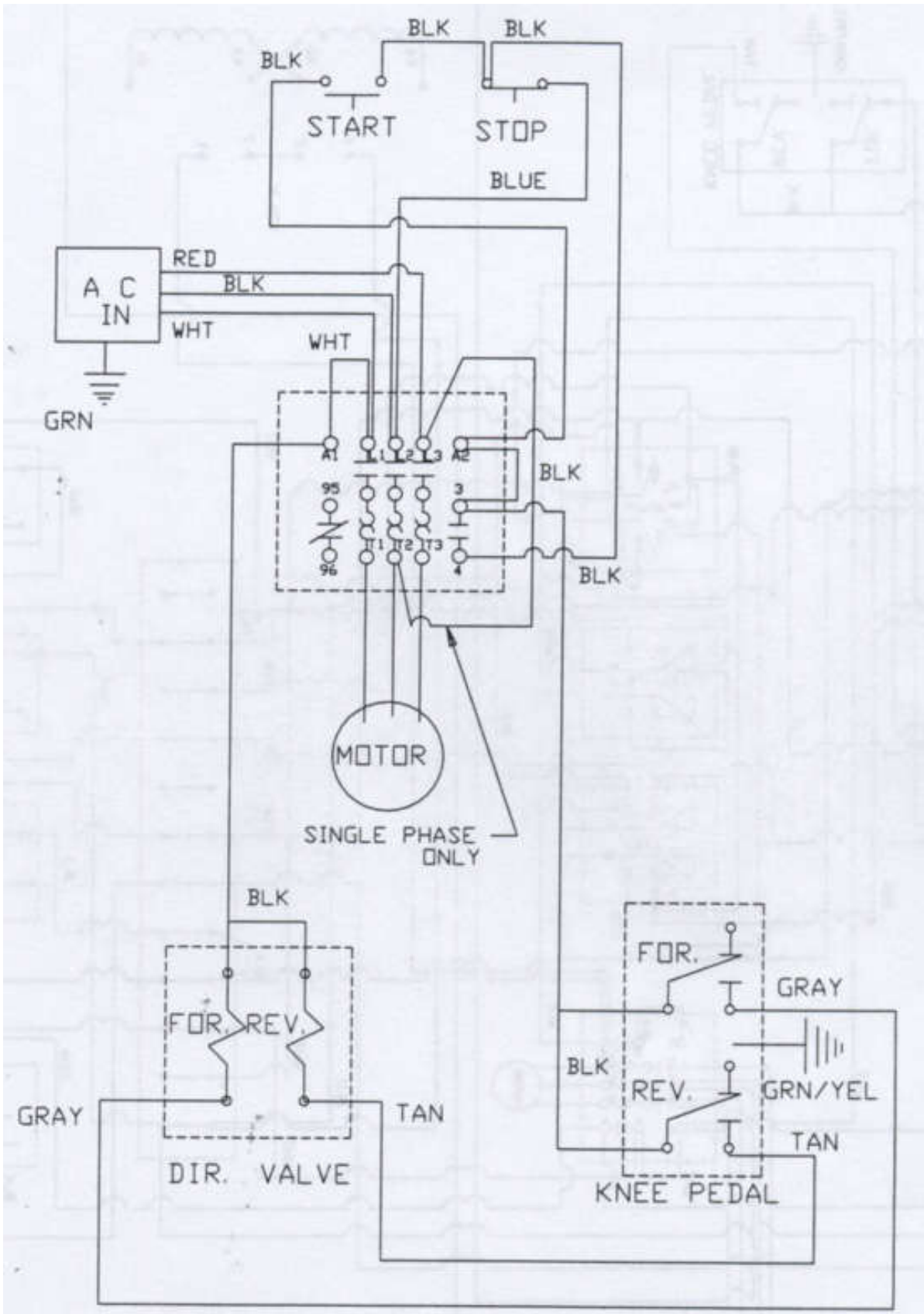


### Pump / motor rotation

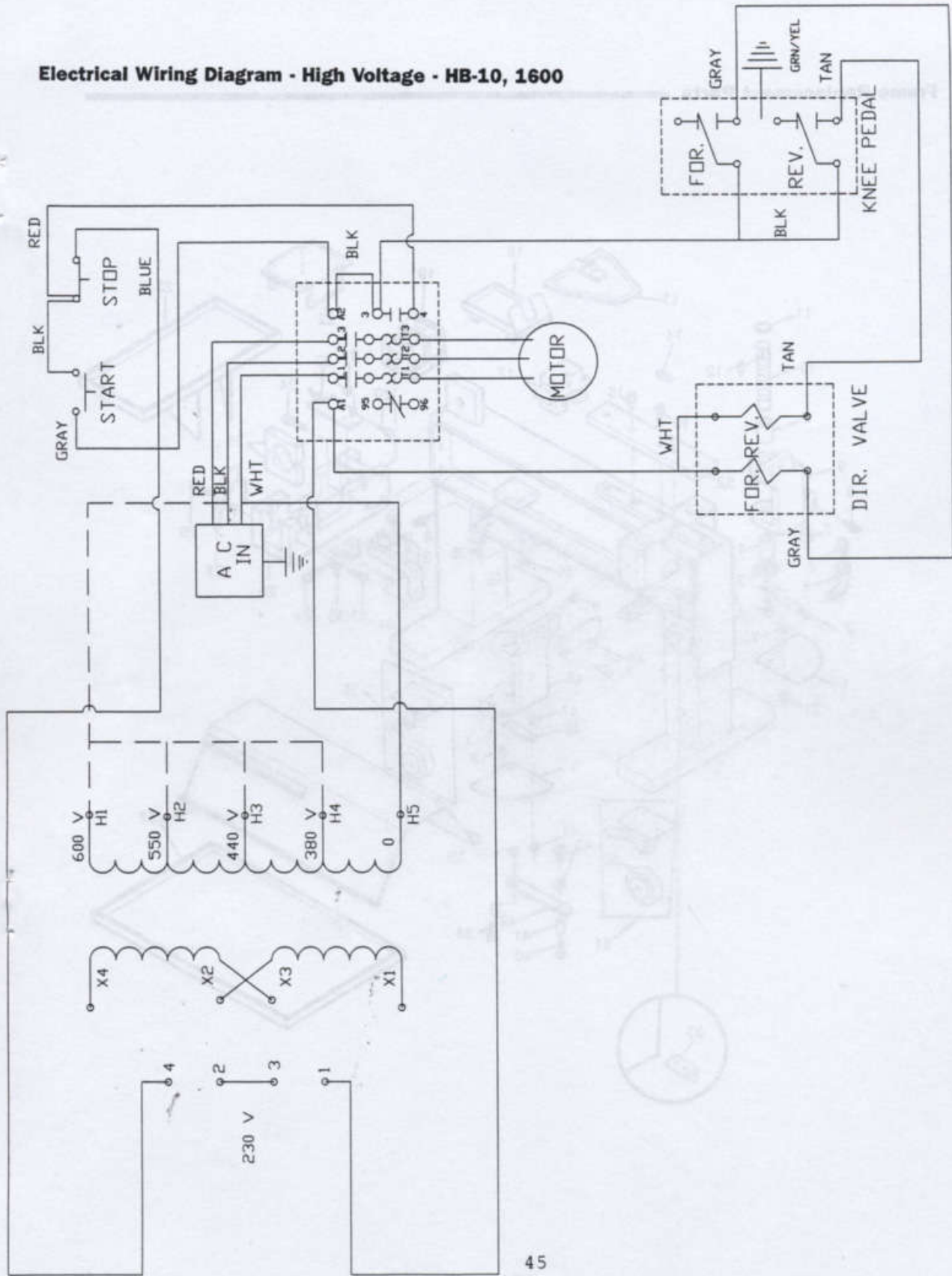
1. plug in bender
2. turn bender on
3. depress swager control handle.  
If swager cylinder rod extends  
Into the swager box, rotation  
Is correct. If cylinder rod does not  
Extend, rotation is incorrect.
4. if rotation is in wrong direction,  
unplug the bender.
5. disassemble the plug and reverse  
the red and black wires
6. reassemble plug and test again.

### 13. ELECTRICAL SCHEMATICS

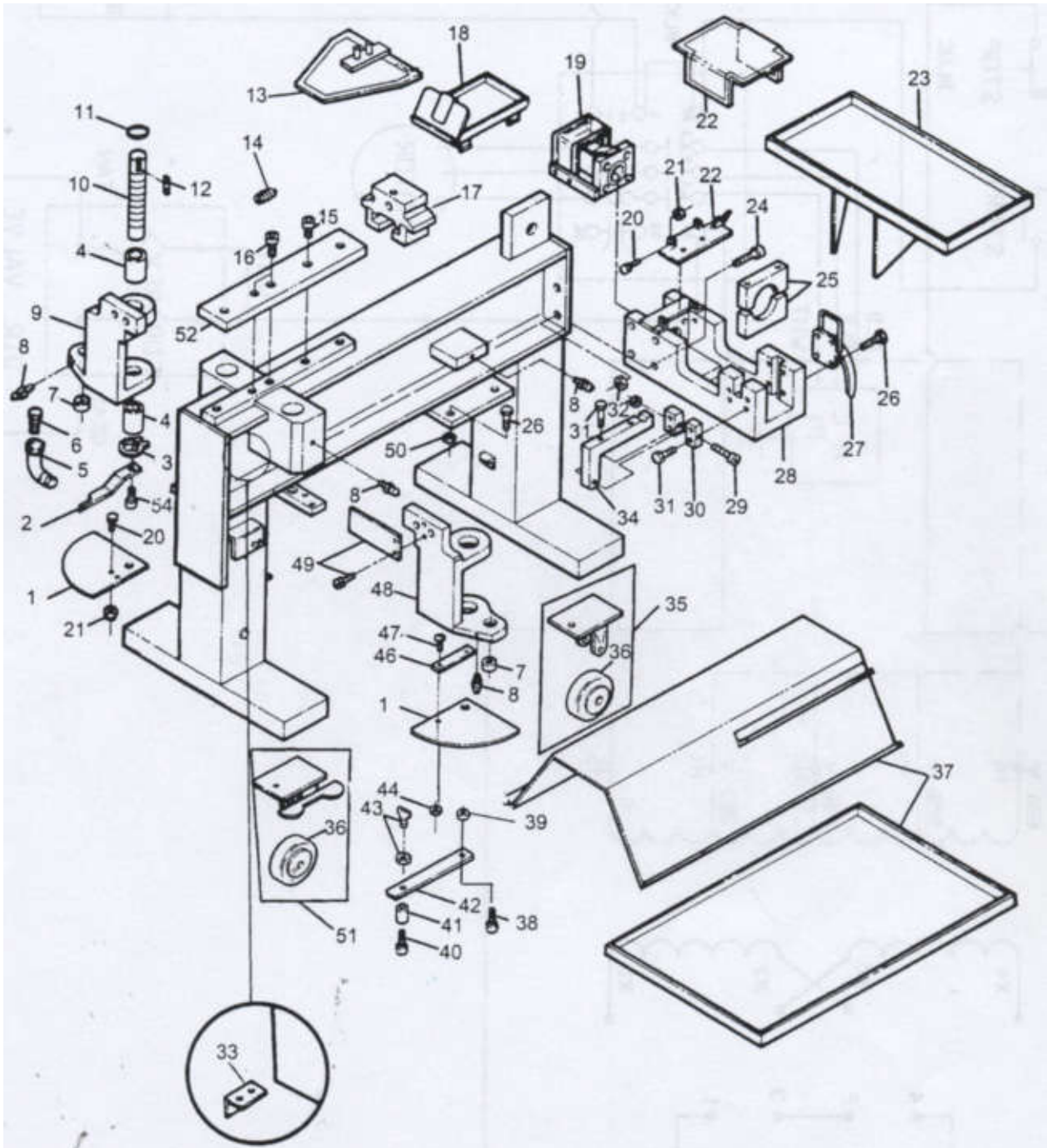
The following schematics may be used as a diagnostic tool in trouble shooting electrical problems.



**Electrical Wiring Diagram - High Voltage - HB-10, 1600**



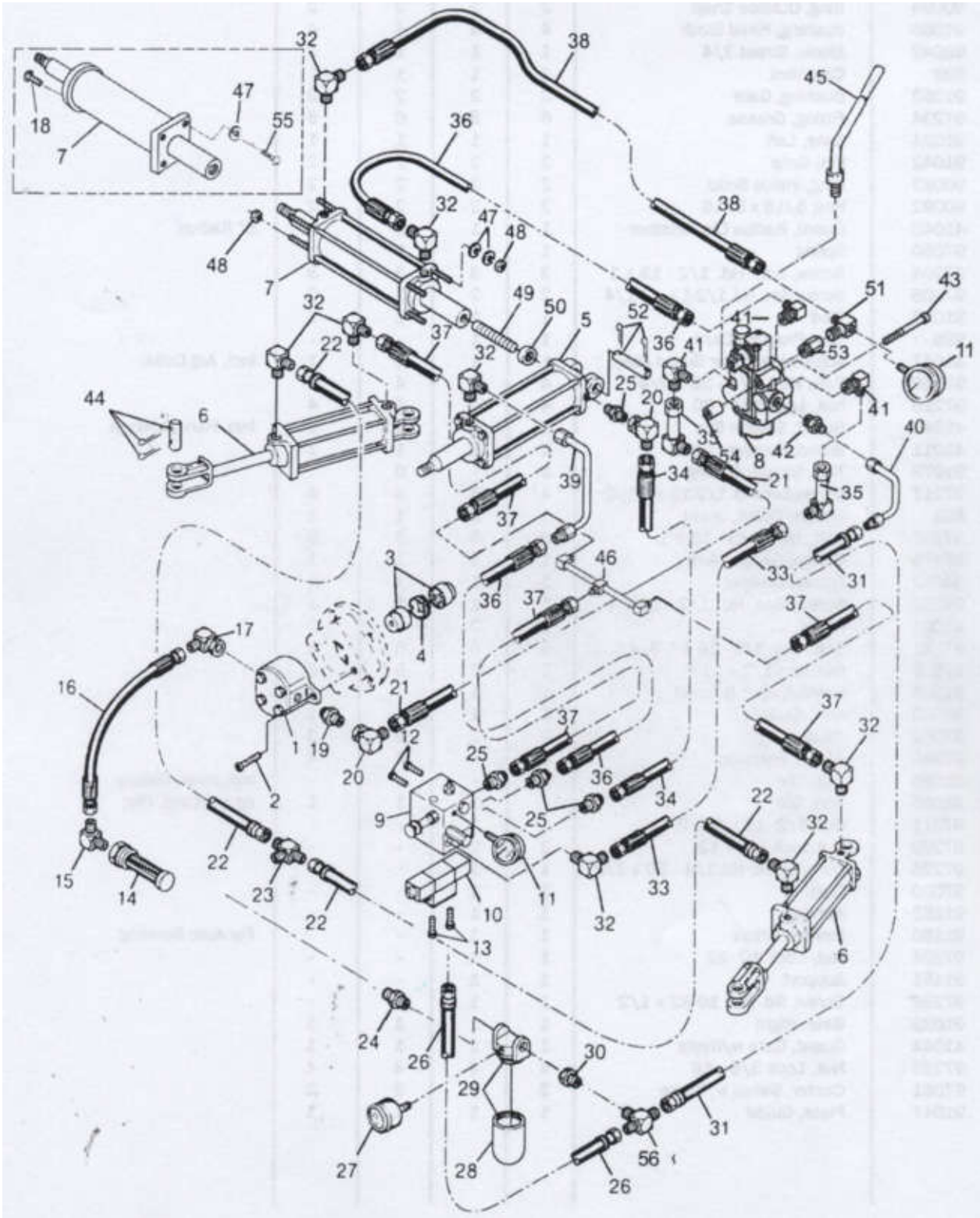
## 14. FRAME REPLACEMENT PARTS



Item	Part No	Description	Quantity	Remarks
1	91160	Plate, depth of bend	1	
2	91153	Pointer	1	For man. bending
3	90094	Ring, outside snap	2	
4	910050	Bushing, head block	4	
5	92042	Elbow, street 3/4	1	
6	839	Cap, vent	1	
7	91052	Bushing, gate	2	
8	97234	Fitting, grease	6	
9	91034	Gate, left	1	
10	91042	Pin, gate	2	
11	90093	Ring, inside snap	2	
12	90092	Key, 5/16 x 5/16	2	
13	41040	Guard, radius die retainer	1	5" radius
14	97050	Spring	1	
15	97024	Screw, soc.Hd.1/2 – 13x1	3	
16	97205	Screw, soc.Hd.1/2-13 x 2-1/4	2	
17	91033	Sled	1	
18	995	Tray, program card	1	
19	41047	Adjustable collar guard assy	1	Incl. Adj.collar
20	97260	Bolt, hex.1/4 – 20x3/4	4	
21	97210	Nut, lock 1/4 - 20	4	
22	41043	Guard, swager box	1	Incl. Handle,hinge
	41011	Guard, swager plastic	1	
23	91078	Tray, swager tooling		
24	97217	Screw, soc.Hd 1/2-13 x 1-1/2	4	
25	891	Holder, collet, short	1	
26	97267	Bolt, hex.3/8-16 x 1	8	
27	97176	Clamp, swager arm	1	
28	34012	Frame, swager	1	

Item	Part No	Description	Quantity	Remarks
29	97232	Screw,soc.Hd.1/2-13x4	1	
30	91061	hinge	2	
31	97231	Bolt, Hex 3/8-16x1-3/4	6	
32	97208	Nut, jam 1/2-13	5	
33	91098	Home switch bracket		
34	91060	Arm, swager	1	
35	97062	Caster, rigid	2	
36	97060	Wheel, phenolic	4	
37	91025	Tray, die	1	Agricultural, flat
38	97211	Bolt 1/2-13x1-1/2		
39	97222	Nut, lock 1/2-13		
40	97226	Screw,soc.Hd.1/4-20 x 7/8		
41	97000	Cam		
42	91152	Handle		
43	91150	Pointer, brass		
44	97224	Nut, lock 10 – 32		For auto bending
46	91151	Support		
47	97239	Screw, Rd.Hd.10-32x1/2		
48	91035	Gate, right	1	
49	41044	Guard, gate w/rivets	1	
50	97225	Nut, lock 3/8 - 16	4	
51	97061	Caster, swivel w/brake	2	
52	91047	Plate, guide	1	

# Hydraulic replacement parts





Item	Part No	Description	Quantity	Remarks
1	92117	Pump, hydraulic(high speed)	1	For 7-1/2 HP motor, not available for EPB-3
	92114	Pump, hydraulic	1	
2	97267	Bolt, Hex Hd.3/8"-16x1"	3	
3	92356	Coupler	1	
4	92358	Spyder, rubber	1	
5	92172	Cylinder, main welded	1	Includes pin
6	92173	Cylinder, side welded	2	Includes pin
7	92256	Cylinder, double end, Ag.3-1/2"	1	
	92174	Cylinder, double end	1	Sold as assembly only
8	92103	Valve, swager	1	
9	92165	Valve, sequence	1	
10	92164	Valve, directional	1	220V
11	92100	Gauge, pressure	2	
12	97221	Bolt, Hex 3/8" – 16 x 1/2"	2	
13	97377	Screw, Sk. Hd. Cap 10-24x7/8"	4	
14	92045	Filter, easy flow	1	
15	92010	90 Ftg, 1/2ML NPT x 3/8ML JIC	1	
16	92272	Hose, #8,18" Lg.	1	
17	92078	Elbow, 90 degree, 1/2-5/8	1	
	92075	Elbow 90 degree, 3/4 – 3/4	1	For high speed pump, not available for EPB-3
18	97256	Bolt. Hex 1/2" – 13x1	2	
19	92006	Str, 3/8 ML JIC X 1/2ML SAE O'R	1	
20	92021	90 Elb, 3/8 ML JIC x 3/8FM JIC SVL	1	For rear of main cyl.-use ref #32
21	92273	Hose, #6, 41"Lg.	1	
22	92277	Hose, return, #6, 24"Lg.	2	

Item	Part No	Description	Quantity	Remarks
23	92015	Branch, T Ftg, 3/8x3/8x1/4	2	
24	92028	Str Ftg, 1/2ML NPTx3/8ML NPT		
25	92002	Str. Ftg., 1/2"ML NPTx3/8"ML JIC	5	
26	92280	Hose, trturn, #6,13"Lg.	1	
27	92292	Gauge, filter		
28	92290	Filter		
29	92289	Filter assembly		
30	92027	Str Ftg, 1/2ML NPTx1/4FM NPT	1	Includes filter, head & gauge
31	92279	Hose, return, #6, 56"Lg.	1	
32	92009	90 Ftg, 1/2ML NPTx3/8ML JIC	9	
33	92275	Hose, #6, 58"Lg.	1	
34	92274	Hose, #6,50"Lg.	2	
35	92023	90Lg Elb, 3/8ML JIC x 3/8 FM JIC	2	
36	92264	Hose, #6, 23-1/2" Lg	2	
37	92261	Hose,#6, 15-1/2Lg.	3	
38	92263	Hose, #6, 19"Lg.	1	
39	92312	Tube, 6-6	1	Cylinder
40	92313	Tube, 6-6	1	Valve
41	92004	90 Elb, 1/2ML SAE O'R 3X8ML JIC	3	
42	92006	Str, 3/8ML JIC x1/2ML SAE O'R		
43	97206	Socket head cap screw, 3/8"-16x3-1/4"	2	
44	92202	Pin, side cylinder	4	Industrial & agricultural
45	92109	Handle, swager	1	
46	92314	Fitting, 3-way	1	
47	97383	Washer, lock 1/2"	4	
48	97208	Nut, jam 1/2"-13		

Item	Part No	Description	Quantity	Remarks
49	97051	Stud, thread 1-14	1	
50	97100	Nut, knurl	1	
51	92009DT	90 Ftg, 1/2ML NPT x 3/8ML JIC,DT	1	For pressure gauge
52	92203	Pin, main cylinder	1	Industrial & agricultural
53	92008	Str Ftg, 1/2ML SAE O'R x 1/2FM NPT	1	Industrial & agricultural
54	70045	Bushing, steel	2	Industrial & agricultural
55	97217	Screw, socket 1/2-13,1-1/2	4	
56	92028	Str Ftg, 1/2ML NPT x 3/8ML NPT		



Electrical components

Item	Part No	Description	Quantity	remarks
1	95108	Lid, control box	1	
2	95107	Control box	1	
3	95512	Green push button	1	
4	95515	Open contact	1	
5	95511	Red push button	1	
6	95514	Closed contact	1	
7	95429	Lock nut	1	
8	95549	Cord grip	3	
9	95508	16-3 cord	39	Inch
10	92164	Directional valve	1	
11	97469	Mount, pedal	1	
12	95419DT	Switch, knee pedal	1	
13	97448	Pad, knee pedal	1	
14	97248	Washer, reducing	2	
15	95236	Conduit, 3/8" 90 degree	2	
16	95234	Conduit, 3/8"	36	Inch
17	95503	overload	1	Single phase
	95518	overload	1	Three phase
18	95502	contactor	1	Single phase
	95519	Contactor	1	Three phase
19	95457	Cord grip	1	
20	95370	Cord, power	20	Feet, single phase
	95371	Cord, power	20	Feet, three phase
21	95206	Plug	1	Single phase
	95208	Plug	1	Three phase
22	95207	receptacle	1	Single phase
	95209	receptacle	1	Three phase
23	95510	Din rail	2	Inch

## Electrical components

Item	Part No	Description	Quantity	remarks
24	95019	Motor, 5hp single phase, leeson	1	
	95020	Motor, 5hp three phase, leeson	1	
25	95021	Motor pump mount, leeson	1	
26	97400	Bolt, Hex 1/2-13-3/4	4	

# 15. Tooling

## Bending Dies

### Full 5" Radius Dies\*



No.	Size
5812	1-1/2"
5834	1-3/4"
5878	1-7/8"
5820	2"
5824	2-1/4"***
5825	2-1/2" **

\*\* 4" Thick

\* Requires 41041 Retainers

### Full 4" Radius Dies



No.	Size
4858	1-5/8"
4834	1-3/4"
4820	2"

### 5" Radius Dies



English No.	Size
5034	3/4"
5100	1"
5118	1-1/8"
5114	1-1/4"
5056	1-5/16"
5138	1-3/8"
5112	1-1/2"
5158	1-5/8"
5134	1-3/4"
5178	1-7/8"
5200	2"
5218	2-1/8"****
5414	2-1/4"***
5438	2-3/8"***
5412	2-1/2"***
5534	2-3/4"***
5530	3"***

\*\* 4" Thick

Metric No.	Size
5040	40mm
5042	42mm
5045	45mm
5048	48mm
5050	50mm
5218	54mm***
5055	55mm
5060	60mm

\*\*\*2-1/8"= 54mm

### 4" Radius Dies



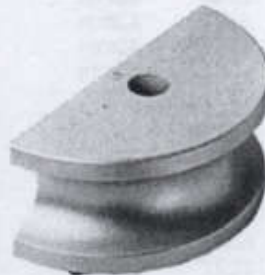
Metric No.	Size
4040	40mm
4042	42mm
4045	45mm
4048	48mm
4050	50mm
4218	54mm***
4055	55mm
4060	60mm

\*\*\*2-1/8"= 54mm

English No.	Size
4012	1/2"
4058	5/8"
4034	3/4"
4078	7/8"
4100	1"
4118	1-1/8"
4114	1-1/4"
4056	1-5/16"
4138	1-3/8"
4112	1-1/2"
4158	1-5/8"
4134	1-3/4"
4178	1-7/8"
4200	2"
4218	2-1/8"****
4414	2-1/4"***
4438	2-3/8"***
4409	2-1/2"***

\*\* 4" Thick

### 3" Radius Dies



Metric No.	Size
3040	40mm
3042	42mm
3045	45mm
3048	48mm
3050	50mm
3218	54mm***
3055	55mm

\*\*\*2-1/8"= 54mm

English No.	Size
3012	1/2"
3058	5/8"
3034	3/4"
3078	7/8"
3100	1"
3118	1-1/8"
3114	1-1/4"
3056	1-5/16"
3138	1-3/8"
3112	1-1/2"
3158	1-5/8"
3134	1-3/4"
3178	1-7/8"
3200	2"
3218	2-1/8"****
3414	2-1/4"***
3438	2-3/8"***

\*\* 4" Thick

### Square Dies



No.	Size
5314	1-1/4" (5" Rad.)
5312	1-1/2" (5" Rad.)
4334	3/4" (4" Rad.)
4310	1" (4" Rad.)
4314	1-1/4" (4" Rad.)
3334	3/4" (3" Rad.)
3310	1" (3" Rad.)

### Square Tube Back Shoe\* (2 Required)

1000 All Sizes  
\* (4) #855 Pins Required

All returned parts are subject to a restocking charge

# Shoes

## Back Shoes\* (2 Required)



\* (2) #855 pins required

English No.	Size
1012	1/2"
1058	5/8"
1034	3/4"
1078	7/8"
1100	1"
1118	1-1/8"
1114	1-1/4"
1256	1-5/16"
1138	1-3/8"
1112	1-1/2"
1158	1-5/8"
1134	1-3/4"
1178	1-7/8"
1200	2"
1218	2-1/8"***
4211	2-1/4"***
4237	2-3/8"***
4412	2-1/2"***
1234	2-3/4"***
1350	3"***

\*\* 4" Thick

Metric No.	Size
1340	40mm
1342	42mm
1345	45mm
1348	48mm
1349	50mm
1218	54mm***
1355	55mm
1360	60mm

\*\*\*2-1/8"= 54mm

## Half Shoes\* (1 Required)

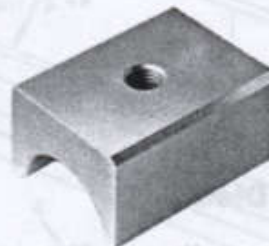


\* (1) #855 pin required

Metric No.	Size
1405	40mm
1425	42mm
1455	45mm
1448	48mm
1450	50mm
1051	54mm***
1445	55mm
1460	60mm

\*\*\*2-1/8"= 54mm

## Three-Quarter Shoes\* (1 Required)



\* (1) #855 pin required

No.	Size
1036	1-3/4"
1044	1-7/8"
1046	2"
1053	2-1/8"***
4413	2-1/4"***
4415	2-1/2"***
1235	2-3/4"***
1351	3"***

\*\* 4" Thick

Metric No.	Size
1540	40mm
1542	42mm
1545	45mm
1548	48mm
1550	50mm
1053	54mm***
1555	55mm
1560	60mm

\*\*\*2-1/8"= 54mm

## Quarter Shoes\* (1 Required)



\* (1) #855 pin required

No.	Size
1084	1-1/4"
1083	1-3/8"
1082	1-1/2"
1081	1-5/8"



# End Finishing Tools - Swager

## Swage Dies



Metric No.	Size
140	40mm
142	42mm
145	45mm
148	48mm
149	50mm
128	54mm***
155	55mm
160	60mm

English No.	Size
110	1"
118	1-1/8"
114	1-1/4"
138	1-3/8"
112	1-1/2"
158	1-5/8"
134	1-3/4"
178	1-7/8"
120	2"
128	2-1/8"***
125	2-1/4"
123	2-3/8"
150	2-1/2"
129	2-3/4"
130	3"

\*\*\*2-1/8" = 54mm

## Reducing Dies\*



\* Requires clamp collet 890 or 891

No.	Size
780	2" to 1-3/4"
781	2-1/4" to 2"
782	2-1/2" to 2-1/4"
783	3" to 2-1/2"
784	2" to 1-7/8"
785	1-3/4" to 1-5/8"
786	1-5/8" to 1-1/2"
787	1-1/2" to 1-3/8"
788	1-3/8" to 1-1/4"
789	1-1/4" to 1-1/8"
790	3" to 2-3/4"

Metric No.	Size
760	(50mm to 45mm OD)
761	(55mm to 50mm OD)
762	(60mm to 55mm OD)

## Ball Joint Tools



550



555

No.	Size
550	1-3/4" (Male)
551	1-7/8" (Male)
552	2" (Male)
553	2-1/4" (Male)
554	2-1/2" (Male)
557	1-3/4" to 2-1/2" (Domer)
558	2-5/8" to 2-3/4" (Domer)
555	1-3/4", 1-7/8", 2" (Female)
556	2-1/4" to 2-1/2" (Female)
564	2-3/4" to 3" (Female)



557

## Flaring/Flanging Tools



518



519



853

No.	Description
518	Flare Tool 1-1/2", 2" (2" requires 1720DF)
519	Flare Tool 1-3/4", 1-5/8"
853	Pipe Flanger 1-1/2" to 3" (Replaces Pipe Flangers 848, 849, 850, 851)

## Header Collector Tool



No.	Size
101	3"
102	3-1/2"

## Clamp Collets (All Models After Jan '85)



Metric No.	Size
1740	40mm
1742	42mm
1745	45mm
1700	48mm
1705	50mm
1728	54mm***
1755	55mm
1760	60mm

English No.	Size
1710	1"
1718	1-1/8"
1714	1-1/4"
1756	1-5/16"
1738	1-3/8"
1712	1-1/2"
1758	1-5/8"
1734	1-3/4"
1778	1-7/8"
1720	2"
1720DF	2"
1728	2-1/8"***
1725	2-1/4"
1723	2-3/8"
1750	2-1/2"
1729	2-3/4"
1730	3"

\*Requires 892 Collet Holder

\*\*\*2-1/8" = 54mm

# End-Finishing Tools - Expander

## Accu-Sizer™ System



498, 499 508

477, 476,  
475, 474, 473

No.	Size
508	Arbor, 1-3/8" to 3-1/2"
498	Tip: 1-1/2" to 1-3/4"
499	Tip: 1-3/4" to 3-1/2"
473	Segment 1-3/8" to 1-3/4" (YELLOW)
474	Segment 1-3/4" to 2-1/8" (RED)
475	Segment 2-1/8" to 2-1/2" (BLACK)
476	Segment 2-1/2" to 3" (GREEN)
477	Segment 3" to 3-1/2"

All sizes are I.D.

## 45° Flaring



441, 440, 405

405	Flaring Segment Set* 1-1/8" to 1-1/2" Tube
440	Flaring Segment Set 1-1/2" to 2-1/2" Tube
441	Flaring Segment Set 2-1/2" to 3-1/2" Tube

\*Requires 575 Arbor 570 Spacer

## Pre Accu-Sizer™ System



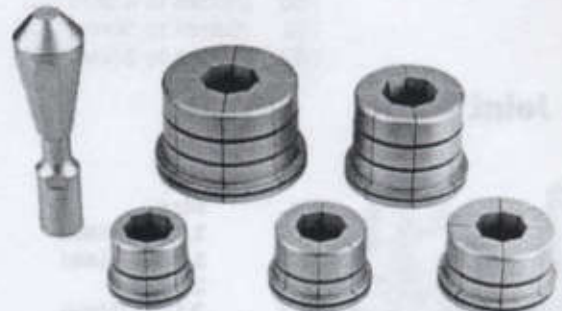
500, 400

No.	Size
575*	Arbor 15/16" to 1-1/4"
500	Arbor 1-1/4" to 1-1/2"
503	Arbor 2-3/4" to 5-1/2"
470	Segment 15/16" to 1-3/32"
404	Segment 1-3/32" to 1-1/4"
400	Segment 1-3/16" to 1-1/2"
403	Segment 2-3/4" to 3-1/8"
406	Segment 3-1/8" to 3-1/2"
408	Segment 3-1/2" to 4"
450	Segment 4" to 4-7/8"
451	Segment 4-7/8" to 5-1/2"

All sizes are I.D.  
\*570 Spacer Required



575, 570, 470, 404



503, 451, 450,  
403, 406, 408

# End-Finishing Tools - Expander

## Flanges



411



413

No.	Size
411	Segment 2", 2-1/4"
413	Flange Ring 2"
414	Flange Ring 2-1/4"
412	Segment 2-1/2"
418	Flange Ring 2-1/2"

## Ball Joints

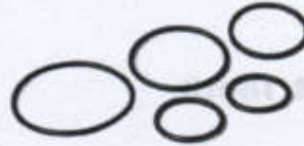


419

No.	Size
410	Segment 1-3/4"
419	Segment 2"
420	Segment 2-1/4"
421	Segment 2-1/2"
452	Segment 3"

## O-Rings, Rubber

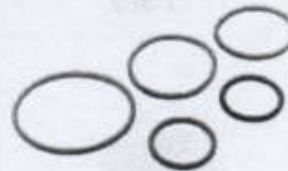
No.	Size
870	Assortment of 50 (10 each size) for Segment Sets: 400, 403, 404, 405, 406, 408, 410, 411, 412, 419, 420, 421, 422, 423, 424, 425, 440, 441, 452, 470, 473, 474, 475, 476, 477, 570 Spacer for Arbor 575



No.	Size
871	Assortment of 10 (2 each size) for Segment Sets: 400, 403, 404, 405, 406, 408, 410, 411, 412, 419, 420, 421, 422, 423, 424, 425, 440, 441, 452, 470, 473, 474, 475, 476, 477, 570 Spacer for Arbor 575

## O-Rings, Steel

No.	Size
859	Assortment of 25 (5 each size) for Segment Sets: 400, 403, 406, 408, 410, 411, 412, 419, 420, 421, 422, 423, 424, 425, 440, 450, 451, 452, 470, 473, 474, 475, 570 Spacer for Arbor 575



## O-Rings, Urethane

No.	For Segments
872	481
873	482
875	483
877	408, 450
878	450, 481, 482
879	451, 483, 485
880	451, 484, 486
881	484
882	485, 486



# Silhouette Chart - Segment Set Teeth

These silhouettes are full scale. To identify the tooth you need, simply match it up with its mate on these pages. You'll get its part number, the part of the segment it belongs to, plus the part numbers and quantity of stainless steel, urethane and/or rubber O-Rings to use.

## Expanding Segment Teeth



Tooth Segment 670  
470  
**O-Rings:**  
Steel 1-867  
Rubber 1-862



Tooth Segment 600  
400  
**O-Rings:**  
Steel 1-867  
Rubber 1-862



Tooth Segment 604  
404  
**O-Rings:**  
Steel 1-867  
Rubber 1-862



Tooth Segment 606  
406  
**O-Rings:**  
Steel 2-869  
Rubber 2-864



Tooth Segment 603  
403  
**O-Rings:**  
Steel 1-868  
1-869  
Rubber 1-863  
1-864



Tooth Segment 625  
425  
**O-Rings:**  
Steel 1-868  
1-869  
Rubber 1-863  
1-864

**All returned parts are subject to a restocking charge**

# Silhouette Chart - Segment Set Teeth



Tooth Segment 673  
 473  
**O-Rings:**  
 Steel 1-874  
 1-867  
 Rubber 1-860  
 1-862



Tooth Segment 674  
 474  
**O-Rings:**  
 Steel 1-866  
 1-868  
 Rubber 1-861  
 1-863



Tooth Segment 675  
 475  
**O-Rings:**  
 Steel 1-867  
 1-868  
 Rubber 1-862  
 1-863



Tooth Segment 624  
 424  
**O-Rings:**  
 Steel 1-867  
 1-868  
 Rubber 1-862  
 1-863



Tooth Segment 623  
 423  
**O-Rings:**  
 Steel 1-866  
 1-868  
 Rubber 1-861  
 1-863



Tooth Segment 622  
 422  
**O-Rings:**  
 Steel 1-865  
 1-867  
 Rubber 1-860  
 1-862

**All returned parts are subject to a restocking charge**

# Silhouette Chart - Segment Set Teeth



Tooth Segment 608  
 408  
**O-Rings:**  
 Rubber 1-864  
 Urethane 1-877



Tooth Segment 650  
 450  
**O-Rings:**  
 Urethane 1-878  
 2-877



Tooth Segment 677  
 477  
**O-Rings:**  
 Steel 2-869  
 Rubber 2-864



Tooth Segment 651  
 451  
**O-Rings:**  
 Urethane 1-880  
 2-879



Tooth Segment 676  
 476  
**O-Rings:**  
 Steel 1-868, 1-869  
 Rubber 1-863, 1-864

# Silhouette Chart - Segment Set Teeth

## Flaring Segment Teeth



Tooth 605  
 Segment 405  
**O-Rings:**  
 Steel 1-867  
 Rubber 1-862



Tooth 640  
 Segment 440  
**O-Rings:**  
 Steel 1-868  
 1-869  
 Rubber 1-863  
 1-864

## Ball-Joint Segment Teeth



Tooth 610  
 Segment 410  
**O-Rings:**  
 Steel 2-869  
 Rubber 2-864



Tooth 619  
 Segment 419  
**O-Rings:**  
 Steel 2-869  
 Rubber 2-864



Tooth 620  
 Segment 420  
**O-Rings:**  
 Steel 2-869  
 Rubber 2-864



Tooth 621  
 Segment 421  
**O-Rings:**  
 Steel 2-869  
 Rubber 2-864

# Silhouette Chart - Segment Set Teeth



Tooth 652  
 Segment 452  
**O-Rings:**  
 Steel 3-869  
 Rubber 3-864



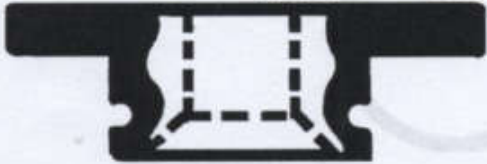
Tooth 641  
 Segment 441  
**O-Rings:**  
 Steel 869  
 Rubber 864



# Silhouette Chart - Segment Set - O-Rings

## Spacer for Arbor 575

Segment 570  
**O-Rings:**  
 Steel 1-865  
 Rubber 1-860



## Flanging Segment Teeth

Tooth 611  
 Segment 411  
**O-Rings:**  
 Steel 1-865  
 1-869  
 Rubber 1-860  
 1-864



Tooth 612  
 Segment 412  
**O-Rings:**  
 Steel 1-867  
 1-869  
 Rubber 1-862  
 1-864

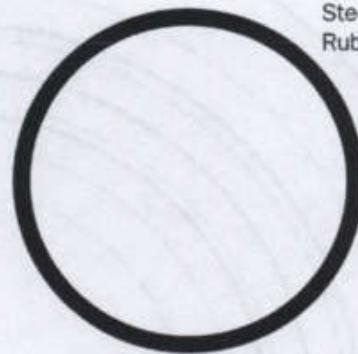


## O-Rings

Steel 869  
 Rubber 864



Steel 868  
 Rubber 863



Steel 867  
 Rubber 862



# Silhouette Chart - O-Rings



Steel 866  
Rubber 861



Steel 865  
Rubber 860

## Urethane O-Rings

- A. 882
- B. 880
- C. 879
- D. 878
- E. 881
- F. 877
- G. 875
- H. 873
- I. 872

