

Huth Tube Benders

**Operators and
Maintenance
Manual**

Models

2008

2806

1600

HB-10

2600HD

TO THE OWNER

INTRODUCTION

Carefully read and understand this manual before operation begins. Every HUTH TUBE BENDER is constructed from the finest materials by highly trained, experienced craftsmen.

They have profound interest in your bender's successful performance and have prepared this manual to give you the benefit of their experience.

The manner in which you operate and the care you provide for this bender, will have a direct bearing on its continued successful performance. The manual has been prepared to make it easy for you to learn the methods for proper operation and care.

READ THIS ENTIRE MANUAL. KEEP IT FOR FUTURE REFERENCE.

Huth's policy is to improve its products whenever possible. Huth reserves the right to make changes and/or improvements without incurring any obligation to do so on previously sold products.

This manual relates to benders built after January 1, 2004. For more details on specifics of older benders please call Huth.

WARRANTY OF HUTH PRODUCTS

This warranty is made for the exclusive benefit of the original owner and is not transferable. There is no other warranty applicable to HUTH PRODUCTS, and no representative has any authority to make any representation, promise or agreement except as stated in the warranty.

ONE YEAR WARRANTY*

For one year from the date of invoice the seller will repair the bender if found to be defective in material and workmanship without cost to the purchaser. Following the first 90 days from the date of original invoice, replacement parts are shipped from the seller to the purchaser freight collect. Return parts are shipped prepaid to the seller.

In effecting such repairs, the seller may at its election, repair or replace any part which it finds to be defective. Tools and dies are warranted for a period of (90) ninety days against defect in material and workmanship.

* During the first 90 days from date of original invoice the seller will pay freight charges for replacement of defective parts.

Model Number _____

Serial Number _____

Date Delivered _____

Huth Mfg. Corp.

260 Grant Street

P.O. Box 270467

Hartford, WI 53027

Telephone: 1-800-558-7808

In Wisconsin: 262-673-9440

Fax: 262-673-9443

<http://www.huthbenders.com>

Table Of Contents

Introduction	2
To The Owner	2
Warranty Of Huth Products	2
1. Upon Delivery	4
2. Important Safety Instructions	4
3. Bender Terminology/Component Location	5
4. Bender Component Descriptions	8
5. Bender Controls Description List	9
6. Bending Tools	10
7. Huth Program Cards	11
8. Bending Operations	14
9. Pattern Bending	16
10. Swaging And Expanding	18
11. Periodic Maintenance	28
12. Troubleshooting	31
Electrical Troubleshooting	31
Hydraulic Troubleshooting	32
13. Machine Repair	37
General Repair	37
Calibration Decal Replacement	37
Hydraulic Repair	37
Electrical Repair	40
Electrical Schematics	42
Frame	46
Electrical Components - 2008 & 2806	52
Electrical Components - HB-10, 1600	54
Electrical Control Box Components - 2008 & 2806	56
Electrical Wiring Diagram - 2008 & 2806	56
14. Tooling	58
Bending Dies	57
Shoes	58
End Finishing Tools - Swager	59
End-finishing Tools - Expander	60
Silhouette Chart - Segment Set Teeth	62
Decals	72

1. UPON DELIVERY

INTRODUCTION

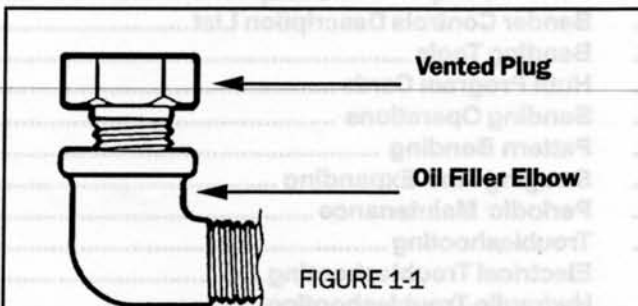
Upon deliver of the Huth Bender, check the following:

1. Carefully uncrate and discard all packing material properly.
2. Inspect for signs of damage due to shipment. Report any shipping damage 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 Huth Benders operate on 220 volts or more! The phase will be indicated on the motor plate and the control box plate.

NOTE: 3-phase motors must rotate counter clockwise as seen when facing the pump. To change motor rotation see page 41.

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. IMPORTANT SAFETY INSTRUCTIONS

INTRODUCTION

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

DANGER!

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.

WARNING!

6. Unplug the machine from the power source before servicing. Electrical shock may result if this is not done.

WARNING!

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.

WARNING!

8. This equipment uses earth ground protection for operator safety. This equipment must be grounded. If the ground is broken do not use this equipment until it is repaired by a qualified service position.

DANGER!

9. Keep hands clear when dies are in motion.
10. Never place your hands or other body parts between bending dies.

DANGER!

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 the 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 the 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 lenses; 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.

WARNING!

25. Before operation, check rotation of hydraulic pump/ electric motor. It should rotate counter clockwise as viewed when facing the pump. (See page 41)

WARNING!

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

WARNING!

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

SAVE THESE INSTRUCTIONS

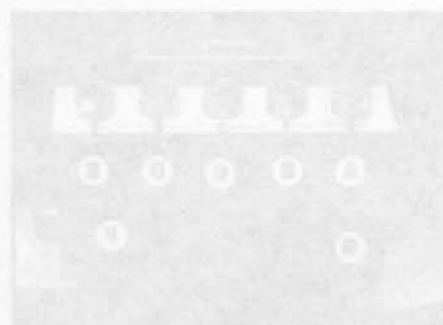
3. BENDER TERMINOLOGY/COMPONENT LOCATION

INTRODUCTION

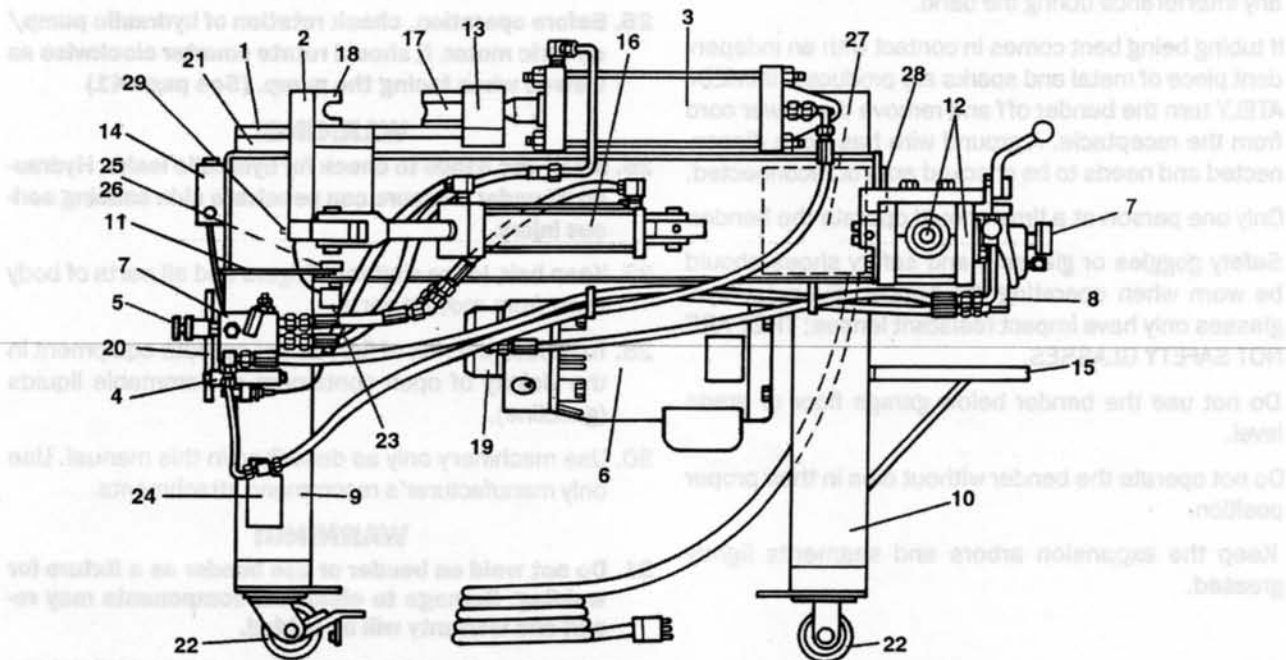
Before bending operations can begin it is important to familiarize yourself with the terms/names and locations of the components used on the Huth Bender. Several different models are shown. Study the illustrations on the following pages and read the terms and descriptions that apply to your model(s).

The descriptions 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 Descriptions. To find the description of the controls, look up the corresponding letter in Section 5: Bender Control Descriptions.

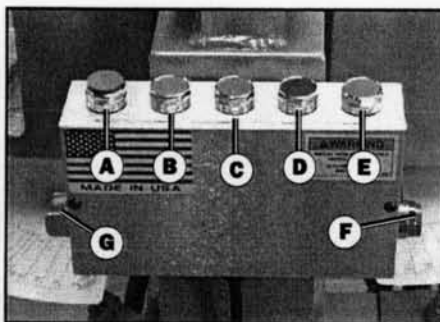
The terms used will be used throughout the manual and this section of the manual may be referred to in order to clarify or illustrate a location.



MODEL 2008, 2806

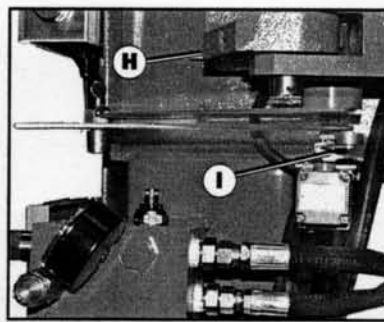


- | | |
|--|--|
| 1. Guide Plate | 16. Side Cylinder |
| 2. Swing Gate | 17. Radius Die |
| 3. Main Cylinder | 18. Back Shoes |
| 4. Directional Valve | 19. Hydraulic Pump |
| 5. Sequence Valve | 20. Knee Control Pedal |
| 6. Motor | 21. Riser |
| 7. Hydraulic Pressure Gauge | 22. Casters |
| 8. Swager Control Valve | 23. Depth-of-Bend Limit Switch |
| 9. Front Leg/Hyd. Reservoir W/Oil Filler Elbow | 24. Filter Assembly |
| 10. Rear Leg | 25. Manual Depth-of-bend Indicator (Left Side) |
| 11. Auto Depth-Of-Bend Pointer | 26. Depth-of-bend Plate (Left Side) |
| 12. Swager/Expander | 27. Control Box (Left Side) |
| 13. Sled | 28. Auxiliary Start - Stop (Model 2008 Only) (Left Side) |
| 14. Control Box (Button Box) | 29. Home Position Switch |
| 15. Tool Tray (Model 2008 Only) | |

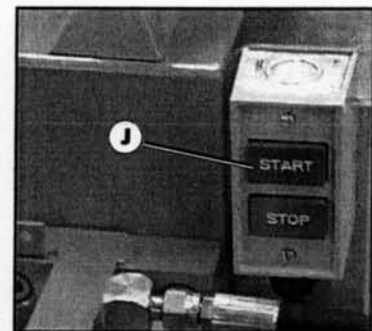


MODEL 2008 & 2806 CONTROLS

- A. STOP CONTROL BUTTON
B. START CONTROL BUTTON
C. FORWARD CONTROL BUTTON

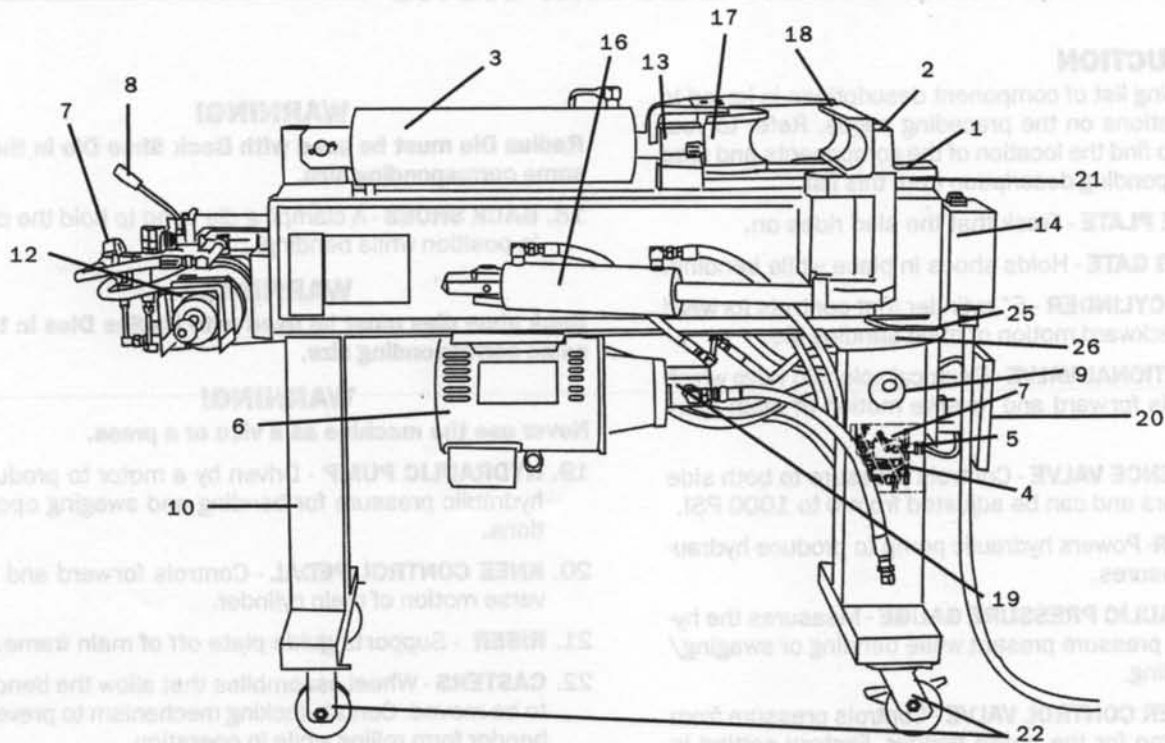


- D. REVERSE CONTROL BUTTON
E. AUTOMATIC CONTROL BUTTON
F. EMERG./REVERSE CONTROL BUTTON



- G. KNEE PEDAL ON/OFF SWITCH
H. HOME POSITION SWITCH
I. DEPTH-OF-BEND LIMIT SWITCH
J. AUXILIARY START - STOP SWITCH

COMPONENT LOCATION HB-10, 1600

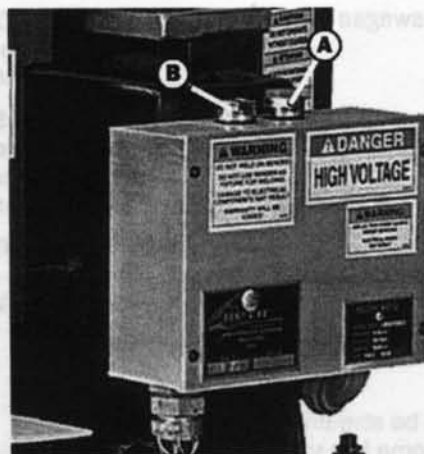


1. Guide Plate
2. Swing Gate
3. Main Cylinder
4. Directional Valve (Right Side)
5. Sequence Valve (Right Side)
6. Motor
7. Hydraulic Pressure Gauge (Right Side)
8. Swager Control Valve
9. Front Leg/Hyd. Reservoir W/Oil Filler Elbow
10. Rear Leg
12. Swager/Expander
13. Sled

14. Control Box (Button Box)
16. Side Cylinder
17. Radius Die
18. Back Shoes
19. Hydraulic Pump
20. Knee Control Pedal
21. Riser
22. Casters
25. Manual Depth-of-Bend Indicator (Left Side)
26. Manual Depth-of-Bend Plate (Left Side)

MODEL HB-10 CONTROLS

- A. STOP CONTROL BUTTON
- B. START CONTROL BUTTON



4. BENDER COMPONENT DESCRIPTIONS

INTRODUCTION

The following list of component descriptions is keyed to the illustrations on the preceding pages. Refer to your model(s) to 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** - Holds 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** - Controls pressure to both side cylinders 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** - Controls pressure from the pump for the entire bender. Factory setting is approximately 3000 PSI. Also controls the swager/expander.
9. **FRONT LEG/HYDRAULIC RESERVOIR 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. **REAR LEG** - 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. (MODELS 2008, 2806)
12. **SWAGER/EXPANDER** - Expands and swages 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 components.
15. **TOOL TRAY** (Model 2008 Only) - Shelf provided for storage of tools.
16. **SIDE CYLINDERS** - Cylinders maintain pressure on the swing gates to form the bend.
17. **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.

18. **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.

19. **HYDRAULIC PUMP** - Driven by a motor to produce hydraulic pressure for bending and swaging operations.
20. **KNEE CONTROL PEDAL** - Controls forward and reverse motion of main cylinder.
21. **RISER** - Supports guide plate off of main frame.
22. **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.

23. **DEPTH-OF-BEND LIMIT SWITCH** - Controls the depth-of-bend to which the tubing is bent when the bender is in automatic mode. (2008, 2806)
24. **FILTER ASSEMBLY** - Filters hydraulic oil of bender. (Models 2008, 2806)
25. **MANUAL DEPTH-OF-BEND INDICATOR** - Located on left side of bender. Indicates gate opening in degrees.
26. **DEPTH-OF-BEND PLATE** - Indicates degrees of bend. Used for both manual and auto bending.
27. **CONTROL BOX** - The box located at the left side of the bender, houses the electrical controls and components. (2008-2806)
28. **AUXILIARY START-STOP SWITCH** - (Model 2008 only). Located at the rear of the bender. Allows the operator to control the motor from the swager/expander end of the bender.
29. **HOME POSITION SWITCH** - Signals that the gates are closed to control the reverse stroke of the main cylinder. (2008-2806)

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 Huth 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. When using this control button on Models 2008 or 2806, the depth-of-bend handle should be pushed to the 180 degrees setting to avoid damaging the automatic stop. 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 degrees 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. **AUXILIARY START - STOP CONTROL**. (Model 2008 only.) Supplies power to the motor from the swager/expander end of the machine.
- K. **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.
- L. **KNEE CONTROL PEDAL** - Controls forward and reverse motion of main cylinder.

FIGURE 5-1, 2008, 2806

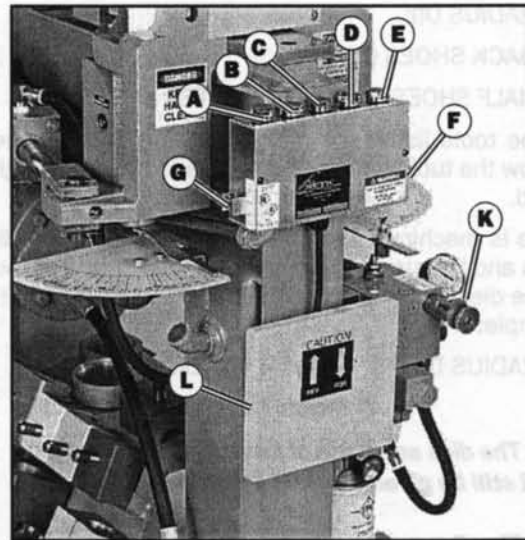


FIGURE 5-2, HB-10, 1600



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.

Huth Manufacturing has a wide variety of tooling available as well as the ability to manufacture custom tooling to fit your needs.

RADIUS DIE

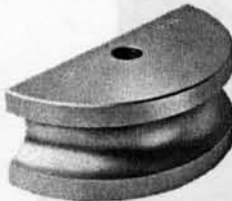


FIGURE 6-1

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

FIGURE 6-2



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!

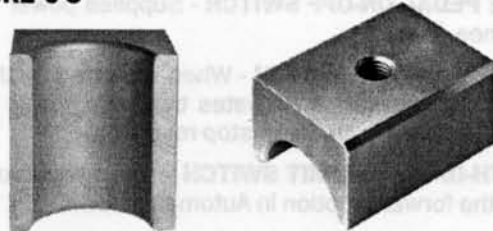
Back shoe dies must be used with Radius Dies with the same corresponding size.

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

FIGURE 6-3



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. HUTH PROGRAM CARDS

INTRODUCTION

Huth's copyrighted program cards are available as paper cards or on Compact Disc for IBM-compatible computers.

Each card contains instructional data for a specific application. FIGURE 7-1 defines each section of the card.

It is critical that you read the entire card before you attempt to set up the machine.

Study the illustration below and read the instructions that follow.

All the information necessary for bending is included on the card. Cards are filed numerically according to their last four digits.

First, look up the vehicle you are working on in the card catalog. Then, remove from the file the card number for your application. The card number will contain either a "T" for tail or an "E" for exhaust. The beige color cards are for tail pipes, blue cards for exhaust pipes.

In some cases, the "F" (front) and "R" (rear) will be reversed; therefore, you will be making the bends or procedures from the R (rear) to the F (front). This does not affect your method of bending, but indicates which end is being worked from.

To avoid unnecessary waste of tubing, DO NOT CUT the tube until the last bend has been made. If that is not feasible, you can cut the tube at least 12" from the overall cutoff point.

TERMINOLOGY/SYMBOLS

The following information describes the symbols used on the Huth cards and the related terms that apply to the symbol.

When symbols are indicated on the card, the required step or action will appear in the order that it is to be done. This is located under "REMARKS". The symbols will appear above each applicable bend. (See FIGURE 7-2).

The electronic and paper versions contain the same information, although in a slightly different format. The following information refers to the paper cards. The electronic version is similar.

1. **•CHANGE OF RADIUS.** One radius die is called for when using a program card. When it is necessary to make a radius change, it will be indicated on the program card with the symbol • (a dot). For example, if a radius change is required from a 3" to a 4" radius die to a 5" radius die, it is indicated as such

(•)Use 5" Radius.

When a change of radius is used or in the boxed area (See "Boxed Area") of the card, it will be indicated if it is to be used on the remaining bends. (See FIGURE 7-2, Item A)

6T5160 MFG. NO. MODIFIED YEAR 87-88

M FORD THUNDERBIRD M (REFER TO CATALOG)

A

K

E

DIAM. IN. 2 GA 16 OA IN. 79

DEPTH OF BEND (DEGREES)

ROTATION OF BEND (DEGREES)

LENGTH BETWEEN BENDS (INCHES)

	F	3 3/4	10 3/4	22 1/2	31	41	59 1/4	65	70	75	R
DEPTH OF BEND (DEGREES)	0	27	25	19	83	152	195	18	228		
ROTATION OF BEND (DEGREES)	31	92	145	130	90	45	66	18	12	17	28

REMARKS:

USE 3" RADIUS EXCEPT AS NOTED IN BOXED AREA

1 REVERSE PIPE & USE 3/4 SHOE

BOXED AREA: USE 5" RADIUS FOR 145 DEGREE BEND

USE 4" RADIUS FOR 130 DEGREE BEND

USE 3" RADIUS FOR 90 DEGREE BEND

CUT 2" OFF "F" & SIZE TO 2" O.D. X 2" LONG

ANGLE CUT "R" TO SUIT APPEARANCE

REUSE BRACKET OR USE F2002

REVISED 09-01-91 © 1988, HUTH MANUFACTURING CORP.

Program Card

BENDING INSTRUCTIONS FOR PARTICULAR APPLICATIONS

6T5160 MFG. NO. MODIFIED YEAR 87-88
 FORD THUNDERBIRD
 REFER TO CATALOG

DIAM. IN. 2 GA 16 OA IN. 79

	F	5 3/4	10 3/4	22 1/2	31	41	59 1/4	65	70	75	R
CENTER LINE MARKS	0	271	253	191	83	152	195	18	228		
ROTATION IN DEGREES	31	92	145	130	90	46	66	18	12	17	28
DEPTH IN DEGREES											

REMARKS:
 USE 3" RADIUS EXCEPT AS NOTED IN BOXED AREA
 REVERSE PIPE & USE 3/4 SHOE
 BOXED AREA : @ USE 5" RADIUS FOR 145 DEGREE BEND
 USE 4" RADIUS FOR 130 DEGREE BEND
 USE 3" RADIUS FOR 90 DEGREE BEND
 CUT 2" OFF "F" & SIZE TO 2" O.D. X 2" LONG
 ANGLE CUT "R" TO SUIT APPEARANCE
 REUSE BRACKET OR USE F2002

REVISED 09-01-91 © 1988, HUTH MANUFACTURING CORP.

Figure 7-2. A. Boxed Area; B. Reverse Pipe

frmCardInfo

Exit Print Huth Card

Part Number TA05160 Length 6T Card 1 of 1
 O.E. Number MODIFIED Application Year 87-88

Make And Model FORD THUNDERBIRD

Instructions

2 Dia. 16 Ga. 79 O.A. Length

	#	<--	@	-->	#							
F	5-3/4	10-3/4	22-1/2		31	41	59-1/4	65	70	75	R	
G	0	271	253		191	83	152	195	18	228		
	31	92	145	130	90	46	66	18	12	17	28	

USE 3" RADIUS EXCEPT AS NOTED IN BOXED AREA
 # REVERSE PIPE & USE 3/4 SHOE
 BOXED AREA : @ USE 5" RADIUS FOR 145 DEGREE BEND
 USE 4" RADIUS FOR 130 DEGREE BEND
 USE 3" RADIUS FOR 90 DEGREE BEND
 CUT 2" OFF "F" & SIZE TO 2" O.D. X 2" LONG
 ANGLE CUT "R" TO SUIT APPEARANCE
 REUSE BRACKET OR USE F2002

Last Revised 090191 Date Released 100188 (c) 88 HUTH MANUFACTURING CORP.

Figure 7-3 Electronic Card Display

- A. Card number
- B. Make of car
- C. Year-application
- D. Pipe diameter O.D., Gauge, Overall length of pipe or cutoff point
- E. Length between bends (Inches)
- F. Rotation of bend (degrees)
- G. Depth of bend (degrees)
- H. Bending instructions for particular applications
- I. Indicates Boxed Area (<--@-->)
- J. When symbols are used in line I, they are explained in the remarks section (H).

2. ***Use 1/2 SHOE or 3/4 SHOE.** The 1/2 shoe or 3/4 shoe symbol is used when it is necessary to use the 1/2 shoe die or 3/4 shoe in place of a full shoe.

When the symbol is used in several positions and a block of wood is used the symbol will be used in the following manner.

*Use 1/2 shoe with block of wood on 6th and 7th bends

3. **§852 BLANK PLATE.** The 852 blank plate symbol is used when it is necessary to use Tool 852, Tool 852 is used for flattening operations or with a 1/2 shoe. When the symbol for the blank plate is used alongside the symbol for 1/2 shoe, it will be indicated on the card in the following manner:

§ Use 1/2 Shoe with 852 Blank Plate

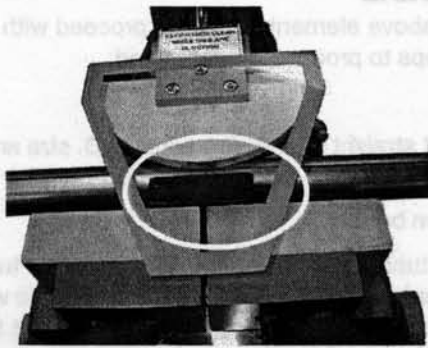


Figure 7-4. 852 Blank Plate in use

NOTE: When 852 is used with 1/2 shoe, it is positioned the same as when using a block of wood.

When a combination of a block of wood and a blank plate are employed with the 1/2 Shoe in several positions, it will be indicated in the following manner:

*Use 1/2 shoe - Use block of wood on 6th and 7th bends - §852

4. **† REVERSE PIPE.** The reverse pipe symbol is used when it is necessary to change the feed of the pipe from the right side to the left side of the bender. A reverse is used when the bend prior to the reversed bend will hit portions of the bender in the feed order.

NOTE: Unless otherwise stated, after a reverse bend is made, you must return the pipe to the original side for the next bend.

DO NOT REMOVE THE ROTATION DIAL

At times, more than one reverse bend symbol is used in a row. In that instance leave the tubing on the left side of the machine until no more reverse signs are shown. Then return the tubing to the original side.

Under normal bending procedures, the rotation dial is on the right side of the bender. When a reverse symbol is shown, the rotation dial will be on the left side. (See FIGURE 7-2, Item B)

5. **‡ REVERSE and 1/2 SHOE.** The reverse and 1/2 shoe symbol is used when it is necessary to reverse the tubing (see REVERSE PIPE symbol) and it also requires the use of 1/2 shoe. (See 1/2 SHOE or 3/4 SHOE symbol.) The 1/2 or 3/4 shoe is used on the side closest to the last bend.

When the reverse and 1/2 shoe with either a block of wood or the blank plate are needed, it will be indicated in the following manner:

‡ Reverse and 1/2 shoe with block of wood or,

‡§ Reverse and 1/2 shoe with 852 blank plate. (See FIGURE 7-2, Item B.)

6. **BOXED AREA ([]).** Boxed areas indicate special instructions. There are several types of boxed areas that employ different terminology to best explain the manner of reproducing that particular bend. When the following situations occur, they will be indicated in the following manner:

NOTE: Boxed area statements on the Huth card may be underlined.

The first descriptive form of a boxed area is when a 1/2 shoe, with or without a block of wood, is used to prevent hitting the prior bend. For example:

Boxed area & note: Using two full shoes, bend to 96 degrees then using *1/2 shoe and block of wood bend to 115 degrees.

The second descriptive form is when a Reverse is used, for example:

Boxed area & note: † Reverse pipe, then using two full shoes bend to 96 degrees then using *1/2 shoe and block of wood bend to 115 degrees.

The third descriptive form is when a radius is employed, for example:

Boxed area & note: • Use 4" radius then using two full shoes bend to 96 degrees then using *1/2 shoe and block of wood bend to 115 degrees.

The fourth form is when a double strike is employed with a radius change. The prime reason being to get maximum depth beyond the perimeters of the equipment. For example:

Boxed area & note: • Use 4" radius and two full shoes bend to 100 degrees then using a 3" radius and two full shoes bend to 96 degrees using the

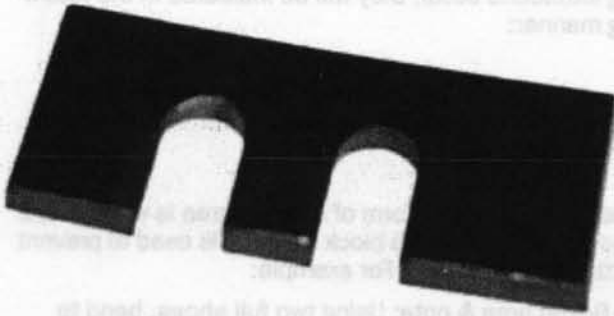
same centerline and the same degree of rotation.
(See FIGURE 7-2, Item A)

There are other derivations of this double strike. For example, a triple strike using 3 different radii plus the use of 1/2 shoe and block of wood or 852 blank plate. The combinations that are to be used must be indicated in the manner stated above. The terminology used in explaining a boxed area will also employ the symbols that indicate what tooling or reverse in the boxed area. The symbols will be the same about the centerline mark number as employed in the remarks. After the boxed area bends are completed the remaining bends will be done with the original die used before the boxed area unless otherwise stated.

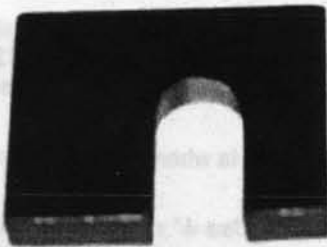
SPACER PLATES

These plates are placed behind the back shoes. They are used to create more bending clearance in the gate area or to achieve a deeper bend.

PART # 1079 FULL SHOE SPACER



PART # 1080 HALF SHOE SPACER



— 8. 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 shoes and radius die 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. Using 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 tube 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 Models 2008 and 2806 set the Depth-of-Bend Dial by moving the pointer arm to the desired degree and secure the pointer in position with the thumb screw.

NOTE: The pointer must be accurately adjusted and secured. It must be on the degree marking that is stated on the program card. A variance of just one or two degrees can result in improper fitting tubing that needs to be scrapped.

10. On Models 2008 and 2806 depress the AUTOMATIC button. The bender will start and continue the bending operation, reverse itself and stop (unless you stop or reverse the bender with the REVERSE or EMERG REVERSE buttons).

When using the FORWARD button (manual operation) to make bends, set the right protractor to 180 degrees, thus avoiding damage to the limit switches. Read the protractor on the left side of the bender for the degree of depth of bend.

11. On Models 1600 and HB-10, 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.
3. Engage the dies until the tubing is snug, but movable.
4. Rotate the tubing until the desired setting is obtained on the rotation dial.
5. On the 2008 and 2806, set the Automatic Depth-of-Bend indicator for the desired depth-of-bend.
On the HB-10 and 1600, or in manual mode on the 2008 and 2806, refer to the manual depth-of-bend indicator on the left side of the bender.
6. Press the right side of the knee pad.
7. 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.

FIGURE 8-1

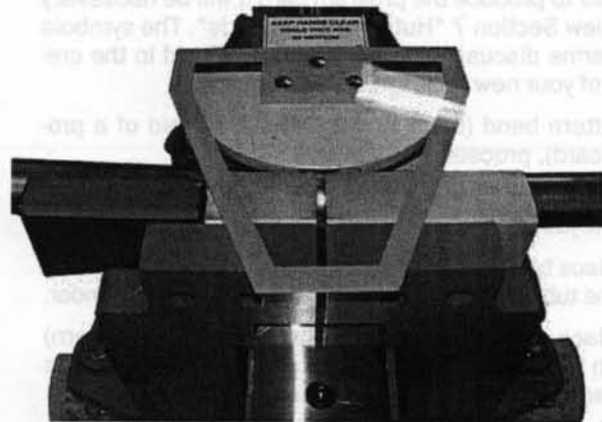


Figure 8-1: Block of wood being used with half shoe.

NOTE: BLOCK OF WOOD - Some exhaust system applications require a "cushion" to accurately bend a pipe. The term "Use block of wood" appears on some program cards. Use a piece of wood approximately 2" x 4" x 4". Remove one 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.)

8. When all bends are complete, remove the rotation dial and cut the tubing at the cutoff line.
9. Complete the end finishing of the tubing as required. (See Section 11 "Swaging and Expanding".)

9. PATTERN BENDING

INTRODUCTION

When program cards are not available, 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.

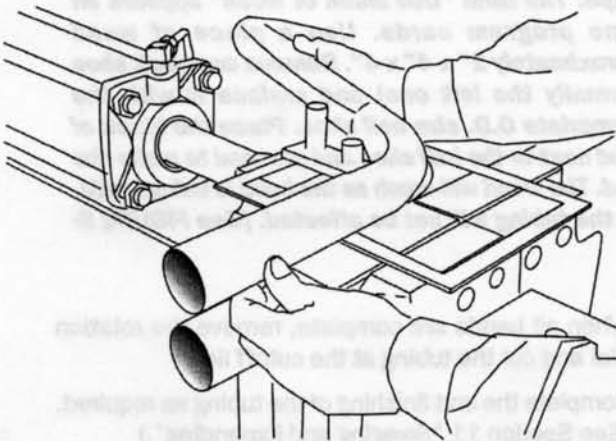
In order to produce the program card it will be necessary to review Section 7 "Huth Program Cards". The symbols and terms discussed in that section will aid in the creation of your new program card.

To pattern bend (bend tubing without the aid of a program card), 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.

FIGURE 9-1

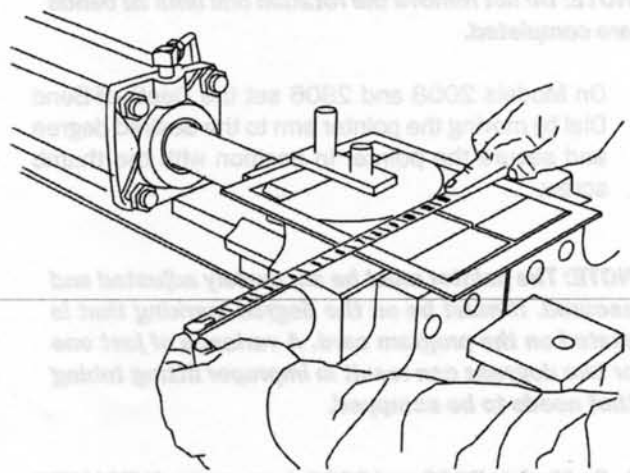


4. Extend the tubing out the left side of the bender so it matches in length with the master pattern. Secure the tubing. (See FIGURE 9-1.)

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.

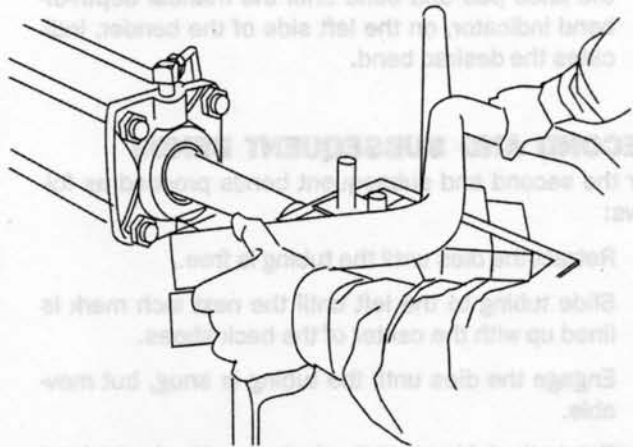
5. Measure the distance from the end of the tubing to the center of the back shoes. This is the measurement to the first bend and should be recorded on the first line of a blank program card on the first line of tubing called "CENTER LINE MARK". (See FIGURE 9-2.)

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 points to zero degrees. This reading is the rotation of the 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.

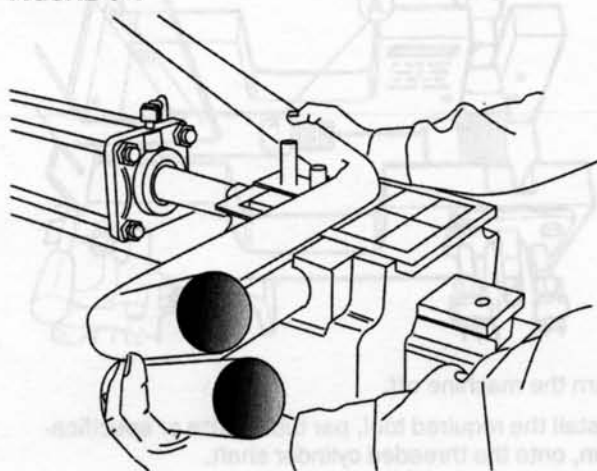
FIGURE 9-3



7. You are now ready to make your first bend. Place the first bend of the master pattern on top of the back shoes or against the back side of the gates. Gradually extend the dies, opening the gates. Continue bending until the gates are parallel or open flush with the first bend of the master pattern. (See FIGURE 9-3.)

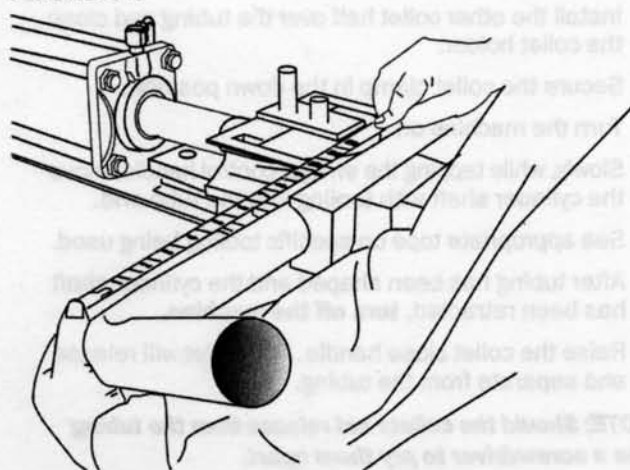
8. Look at the Depth-of-Bend Gauge on the left side of the bender. This is the depth of the first bend. Record this degree reading on the third line of the program card under "DEPTH OF BEND".
9. Release the tubing and feed it to the left through the dies. Place the pattern on top of the back shoes. Line 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 the dies.

FIGURE 9-4



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.

FIGURE 9-5

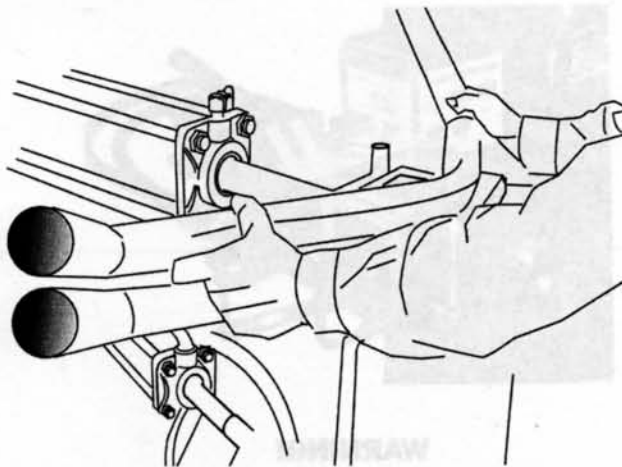


11. Your second bend is now correctly located. The measurement for the second bend should now be taken. Since bent tubing is difficult to measure, it is best to measure from the center of the first bend (between the back shoe dies marks) to the center of the second bend (between the back shoes). This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

gram 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 card.

FIGURE 9-6

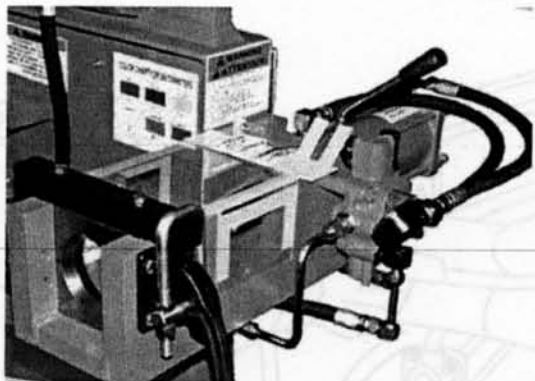


13. You are ready to make the second bend. Place the second bend of the master pattern on the back shoes or against the gates and gradually make your bend until the gates are parallel or open flush with the second bend of the pattern. (See FIGURE 9-6.)
14. When the above is accomplished, take the reading 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.

10. SWAGING AND EXPANDING

INTRODUCTION

FIGURE 10-1



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.)

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.

You **cannot** bend tubing and use the swager/expander at the same time.

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.

SWAGING OPERATIONS

After the tubing has been bent, it may be necessary to finish the end of the tubing. The swager portion of the swager/expander unit will make ball joints, 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.

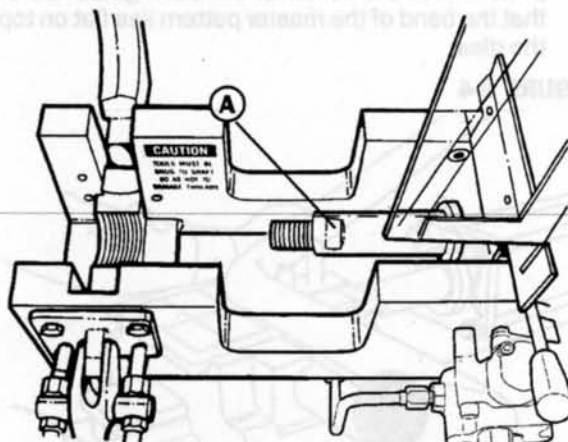
To produce a specific end finish refer to the appropriate topic. (For example: to produce a flare, read the basic swaging operation, then read the operation of the topic "Flare".)

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.)

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 topic 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.

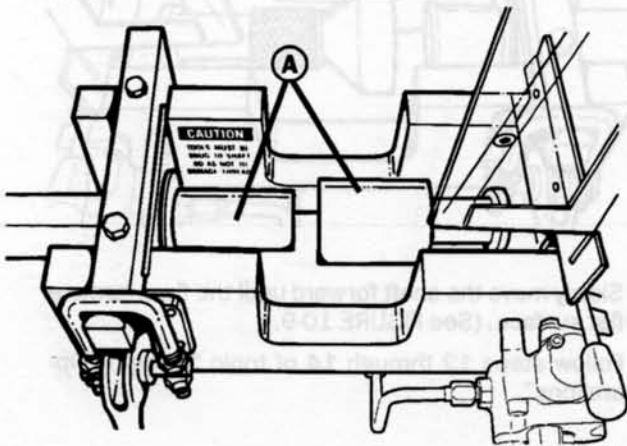
14. Remove the tooling and return it to the storage rack.

REDUCE SWAGE (SWAGE DOWN)

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

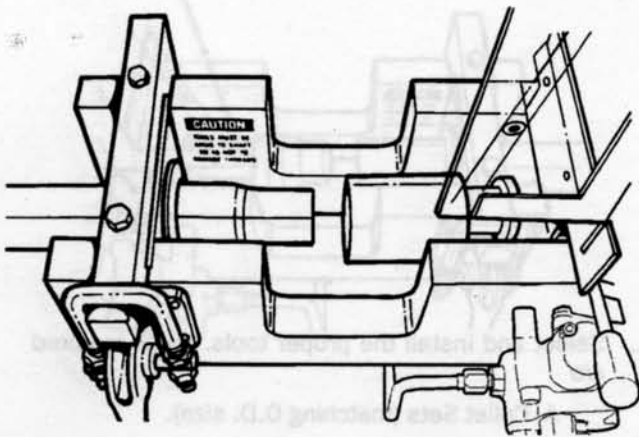
1. Select and install the proper collet set tooling and reducing die (A). (See FIGURE 10-3.)

FIGURE 10-3



2. Follow steps 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



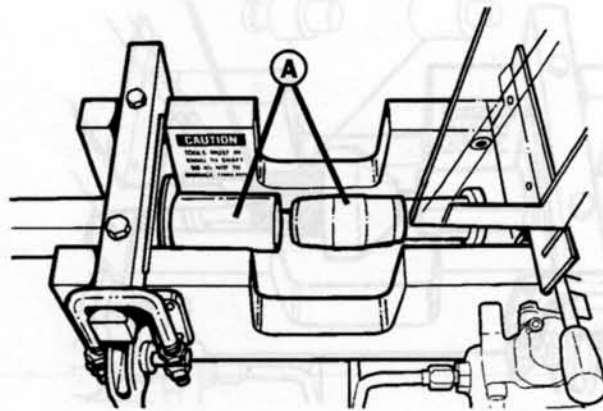
4. Retract the cylinder shaft and tool. (See FIGURE 10-4.)
5. Follow steps 12, 13, and 14 of topic "Swaging Operations".

INTERNAL SWAGE (SWAGE UP)

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

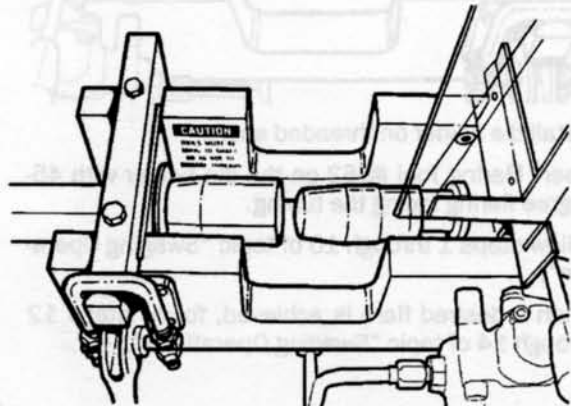
1. Select and install the proper collet set tooling and swage die (A). (See FIGURE 10-5.)

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 the swage die.
4. Retract shaft and tool (See FIGURE 10-6.)

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 Flare 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 figures 10-7 and 10-8.)

FIGURE 10-7

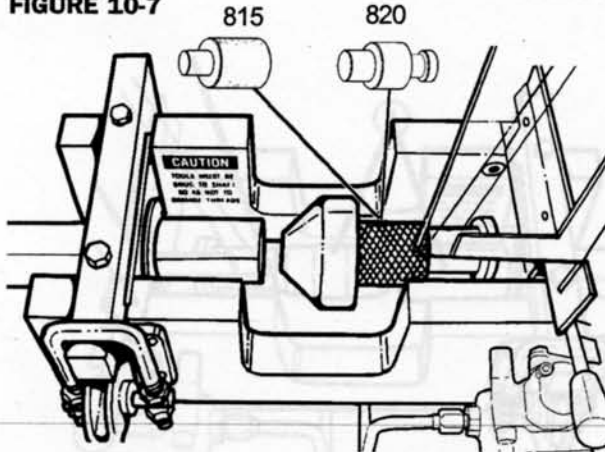
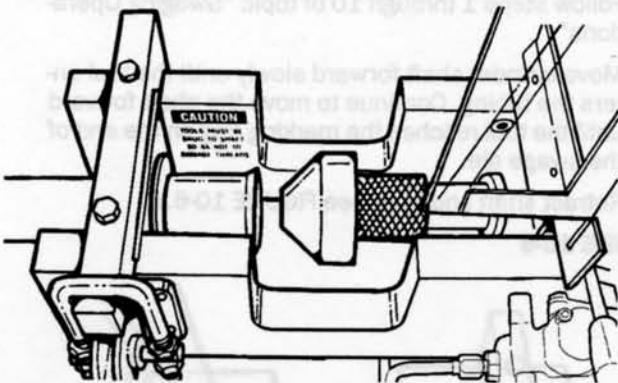


FIGURE 10-8



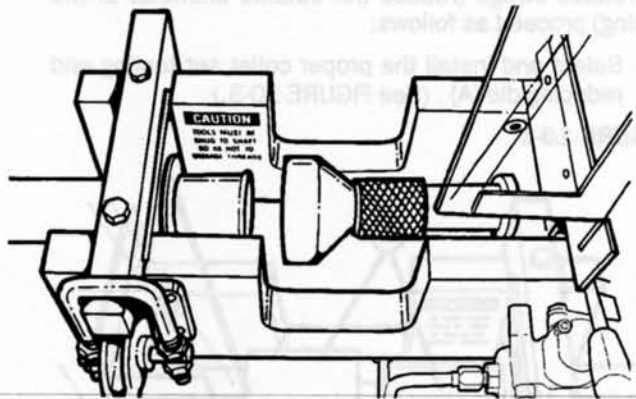
1. Install die holder on threaded shaft.
2. Insert Flaring Tool #853 on the die holder with 45-degree flaring facing the tubing.
3. Follow steps 1 through 10 of topic "Swaging Operation".
4. When a desired flare is achieved, follow steps 12 through 14 of topic "Swaging Operations".

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.

FIGURE 10-9



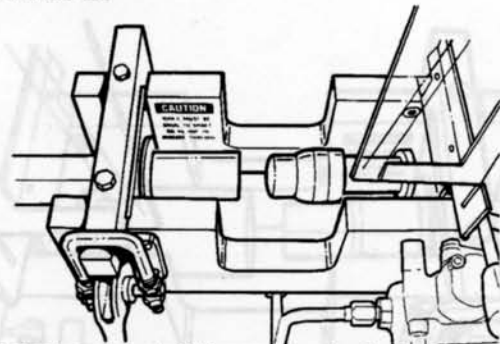
3. Slowly move the shaft forward until the flare forms a flat surface. (See FIGURE 10-9.)
4. Follow steps 12 through 14 of topic "Swaging Operations".

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.

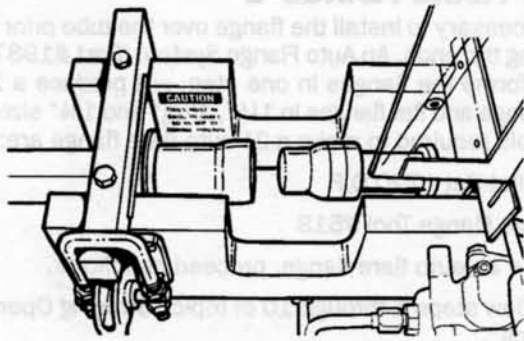
To make a Ball Joint, proceed as follows: (See FIGURE 10-10.)

FIGURE 10-10



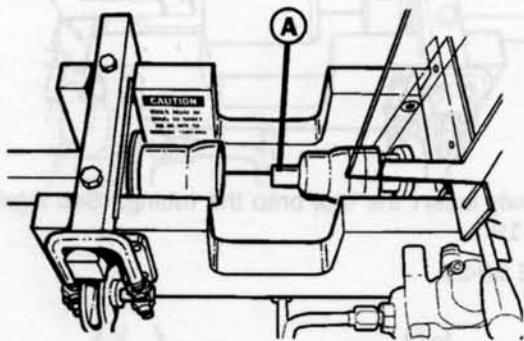
1. Select and install the proper tools. Tools required are
 - A. Collet Sets (matching O.D. size).
 - B. Male Ball (in the specific size).
 - C. Domer (in the specific size).
 - D. Female Ball (in the specific size).
 - E. Die Holding Pin - part number 816.
2. Follow steps 1 through 10 of topic "Swaging Operation".

FIGURE 10-11



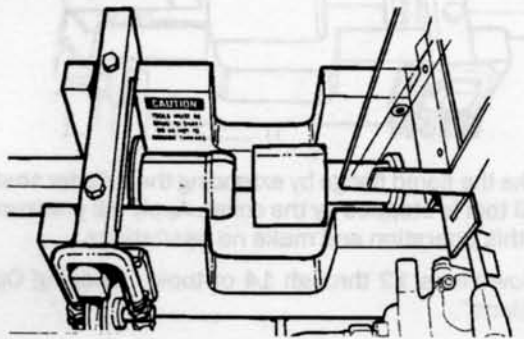
3. Using the male ball joint tool, slowly insert it into the tube until it reaches the second marking ring on the end of the tool. (See FIGURE 10-11.)
4. Retract the tool. Do not remove the clamp.
5. Install die holding pin #816 (A) into male ball tool. (See FIGURE 10-12.)

FIGURE 10-12



6. Install domer die on pin #816. (See FIGURE 10-13.)

FIGURE 10-13

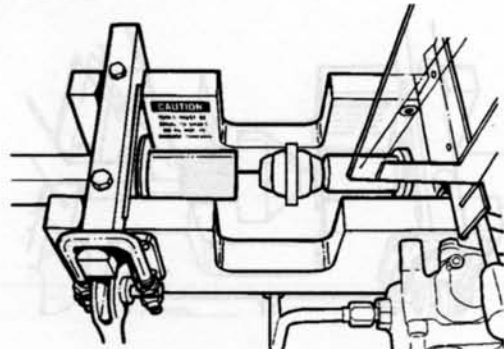


7. Move the shaft with the tool forward over the tube. Continue to move forward until a desired ball is formed. When it is achieved, retract the piston and turn off the bender. Remove the domer and the tube. (See FIGURE 10-13.)
8. This completes the male ball forming process. Do not remove any other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

FEMALE BALL SOCKET

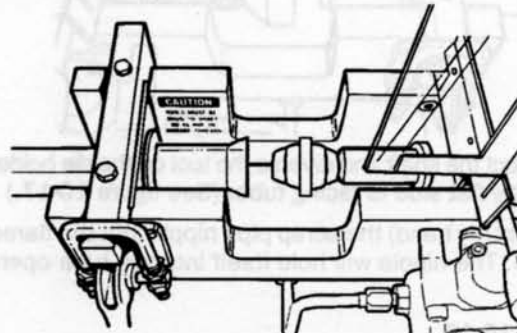
It is necessary to install the flange over the tube prior to finishing the ends. To make the female ball socket, proceed as follows:

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 steps 1 through 10 of topic "Swaging Operations".

FIGURE 10-15



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.)
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 scrap piece of tubing, approximately 1½" 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)

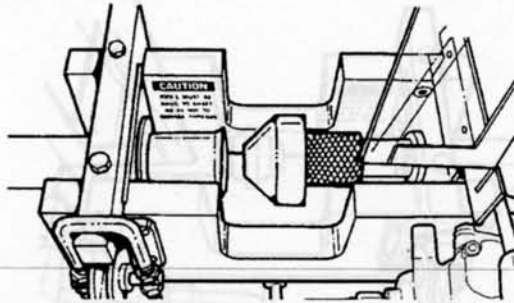
Flanger tool - #853

Die Holder - #815

To make a large flange, proceed as follows:

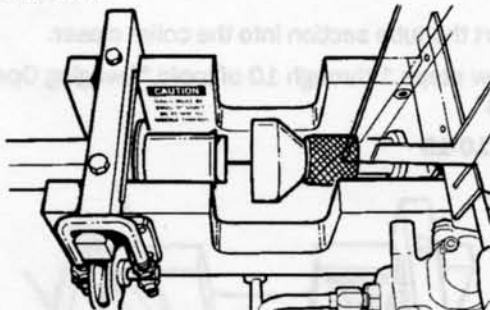
1. Follow steps 1 through 10 of topic "Swaging Operation".

FIGURE 10-16



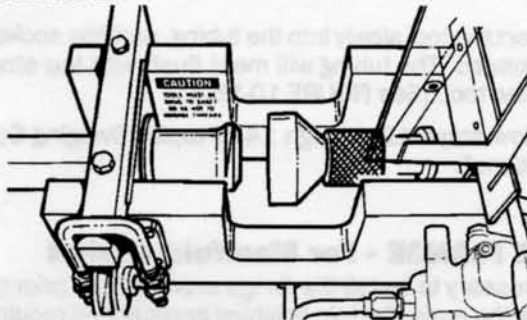
2. Slowly insert the tool into the tubing, making a flared shape. (See figure 10-16.)

FIGURE 10-17



3. Retract the shaft and reverse the tool on the die holder so the flat side is facing tube. (See figure 10-17.)
4. Insert (by hand) the scrap pipe nipple into the flared tube. The nipple will hold itself into the tube opening.

FIGURE 10-18



5. Remove your hands from the swager box and slowly move the tool forward, forcing the nipple into the tube until it protrudes $\frac{1}{2}$ ". This forms the seat for the round gasket. (See 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 $1\frac{1}{2}$ ", $1\frac{5}{8}$ " and $1\frac{3}{4}$ " sizes. The tools required to make a 2" auto flare flange are:

Collet Set 1720 D.F.

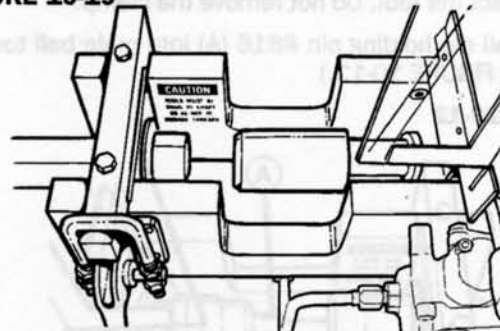
Flare Flange Tool #518

To make an auto flare flange, proceed as follows.

1. Follow steps 1 through 10 of topic "Swaging Operations".

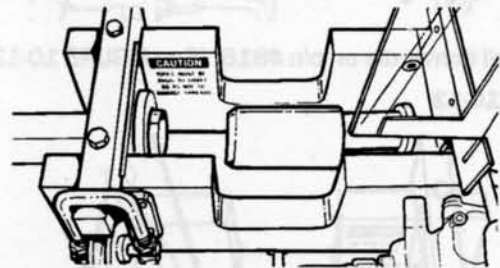
NOTE: For this operation, the tubing should extend $1\frac{1}{8}$ " beyond the end of the collet and the flared end of the collet should face tool #518.

FIGURE 10-19



2. Slowly insert the tool onto the tubing. (See figure 10-19.)

FIGURE 10-20



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 steps 12 through 14 of topic "Swaging Operations".

FLAT FLANGES

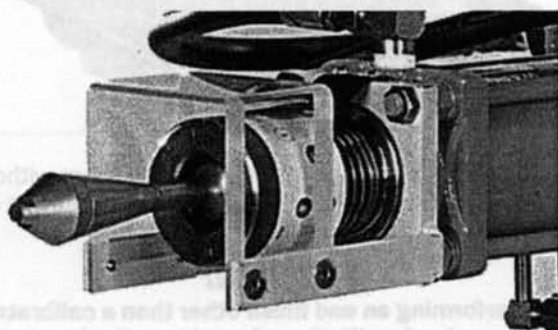
It is necessary to install the flange over the tube prior to finishing the ends. Flat flanges can also be produced. The tools required are: Collet Set (Pair in matching O.D. and size) and Flat Flange Tool (matching O.D. size).

To make a flat flange, follow the steps listed for topic '2" Auto Flare Flange'. (See figures 10-19 and 10-20.)

EXPANDING OPERATIONS

The Huth 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



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 ½" - 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 overtighten.

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 it 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

5 APPEARS FOR 2" I.D. EXPANSION

EXPANDING CHART			
SETTING	SIZE	SEGMENT	TIP
②	1 ½ ID	4	4
①	1 ⅝ ID	7	9
③	1 ¾ ID	3	8
④	1 ⅞ ID		
⑤	2 ID		
⑧	2 OD		4
⑨	2 ⅛ OD		
⑩	2 ⅜ ID		9
⑪	2 ¼ OD		
⑥	2 ¼ ID	4	9
⑦	2 ½ ID	7	
⑫	2 ¾ ID	5	
⑬	3 ID	4	
		7	
⑬	3 ½ ID	6	
		477	

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 1½" - 1¾" expansion with the #473 Yellow Segment. All other expansion greater than 1¾" will use the #499 Arbor Tip.

USING EXPANDING TOOLS

The following procedure 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, then 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".

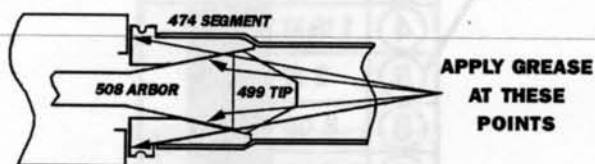
3. Install the appropriate arbor, being certain it is threaded all the way onto the cylinder shaft.
4. Grease the arbor thoroughly.

NOTE: Arbor and face of adjustable collar should always be well lubricated with grease.

5. Install the appropriate segment set on the arbor by simply forcing the set over the end of the arbor. (See FIGURE 10-23.)

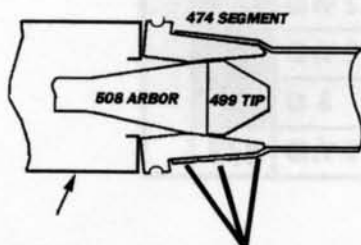
FIGURE 10-23

Correct



INCORRECT USAGE OF ARBOR AND SEGMENT COMBINATIONS WILL RESULT IN PREMATURE WEAR AND BREAKAGE OF SEGMENT SETS.

Incorrect



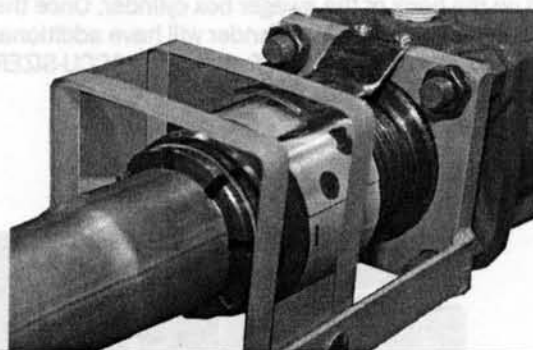
SEGMENT WILL CRACK (NO SUPPORT HERE). THIS IS CAUSED BY IMPROPER ADJUSTMENT OF ADJUSTABLE COLLAR.

CAUTION!

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

6. Place tube halfway over the segments and tap the control handle slightly. This will remove any burrs.
7. Close the segments and run the tube to the base of the segments.
8. 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.)

FIGURE 10-24



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

WARNING!

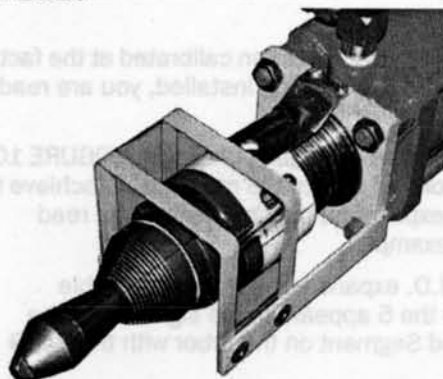
When performing an end finish other than a calibrated I.D., always begin with the adjustable collar located inward and advance it to make the desired finish. If the collar is left fully extended, prolonged use may distort the end threads and may lock up the collar.

#440 FLARING SEGMENT SET

With a #440 Flaring Segment Set, flares from 1½" to and including 2½" can be completed quickly using the expander. To produce a flare, proceed as follows:

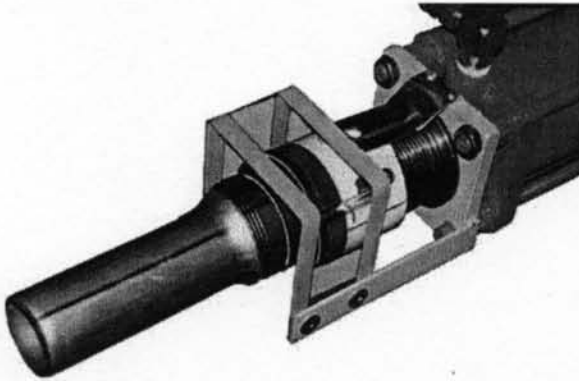
1. Install the Arbor and Tip #499 being sure they are securely tightened onto the cylinder shaft.
2. Slide the Flaring Segment Set over the Arbor. (See FIGURE 10-25.)

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.*

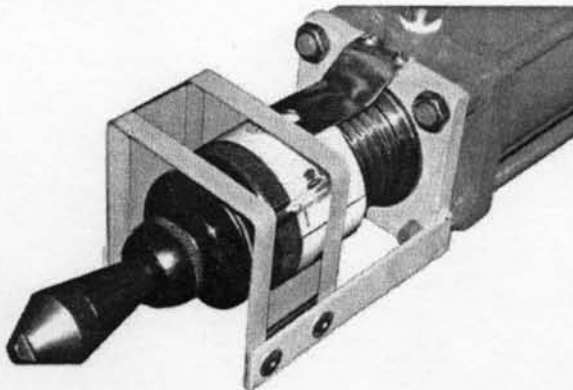
Ball Joint Segment Sets

Ball Joint Segment Sets are used to produce male and female joints on tubing from 1 $\frac{3}{4}$ " to and including 3".

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

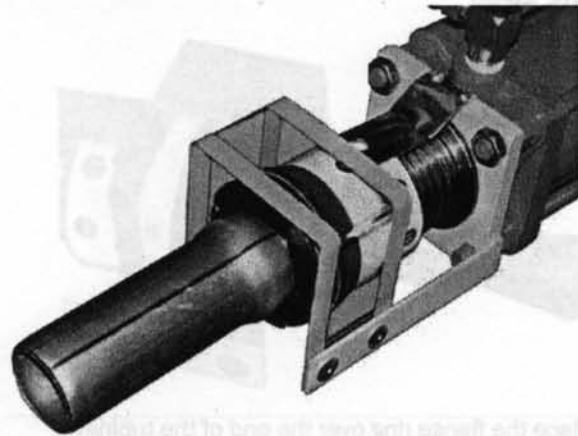
1. Install the Arbor and tip #499. Be sure they are secured tightly to the cylinder shaft.
2. Slide the Ball Joint Segment over the Arbor (See FIGURE 10-27)

FIGURE 10-27



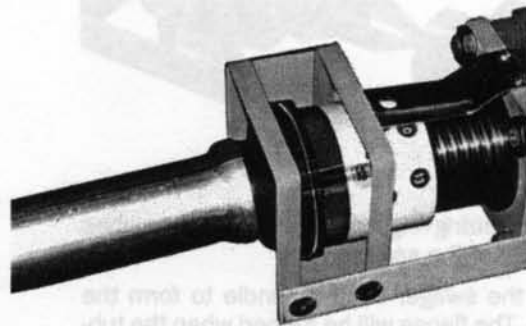
3. Place the tubing over the Arbor and the Segments Set until the end of the tubing touches the base of the segment set.
4. Depress the control handle to form the ball, being careful not to distort the open end of the tubing. (See FIGURE 10-28)

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



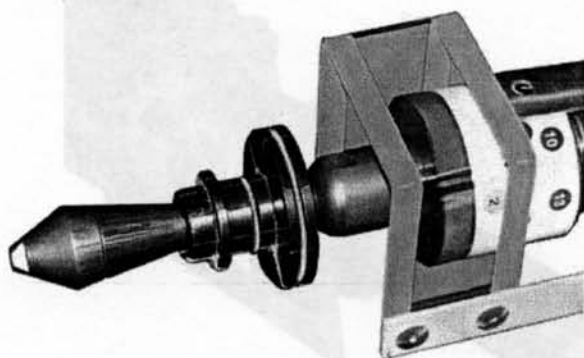
FLANGE SEGMENT SETS

Expanding Flange Segment sets come in sizes 2" - 2 $\frac{1}{2}$ " tubing with sizing rings for 2", 2 $\frac{1}{4}$ " and 2 $\frac{1}{2}$ "

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

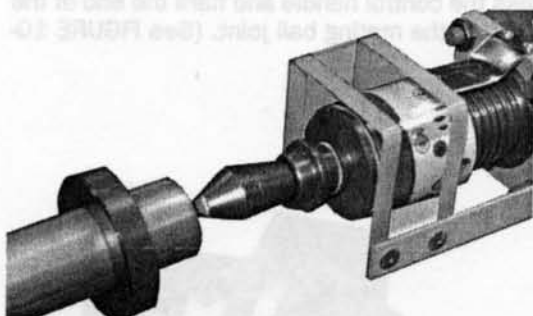
1. Place the segment set over the arbor. Secure into position. (See Figure 10-30)

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)

FIGURE 10-32



Huth Expanding Tool Chart

A Ready Reference For Matching Tools to Their Arbors

For The Accu-Sizer™

Size	Arbor	Tip	Seg. 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° Flaring Work

Size	Arbor	Tip	Seg. 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	Seg. 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	Seg. 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

**Requires a 570 Spacer

11. PERIODIC MAINTENANCE

INTRODUCTION

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

DAILY

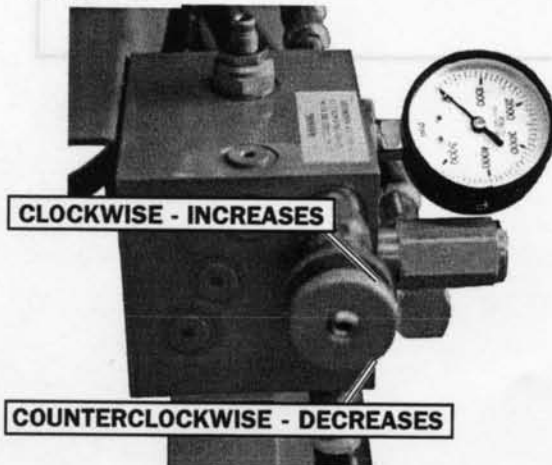
Clean and lubricate the following:

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.
4. Verify Pressure Settings - 2800-3000 psi at the swager and 500-700 psi at the sequence valve.

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 1,000 psi.

FIGURE 11-1



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 counterclockwise decreases the pressure. (See FIGURE 12-1.)

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

SWAGING/EXPANDING PRESSURE

1. Turn on the bender.

WARNING!

Remove any tooling from the swager box.

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.

WARNING!

Never allow swaging pressure to exceed 3,000 psi.

3. Read the pressure on the gauge. Pressure should be approximately 3,000 psi. Pressure should not exceed 3,000 psi. **If pressure exceeds 3,000 psi, release the valve lever immediately; pull the valve lever up to relieve pressure and reset the valve to a lower pressure.**

FIGURE 11-2

ACORN NUT



4. If the pressure is incorrect, remove the acorn nut and loosen 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 12-2.)
5. After the pressure setting has been adjusted, recheck the pressure setting.

TWICE-A-WEEK AUTOMATIC DEPTH-OF-BEND CALIBRATION (2008, 2806)

Check the alignment of the Depth-of-Bend Limit Switch. (2008, 2806)

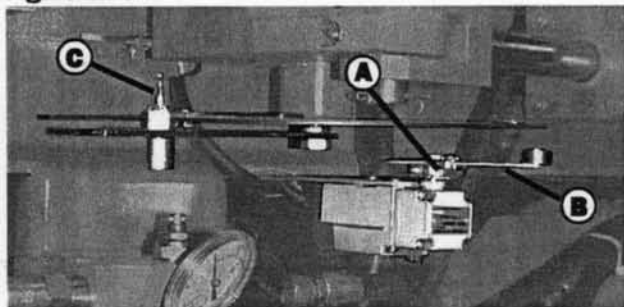
1. Using a 5" radius die and appropriate back shoes, engage the dies and extend the ram die until the pointer on the depth-of-bend plate reads 90-degrees.
2. Using a carpenter's square, check the alignment of the back gates to ensure a true 90-degree reading.

Note: Different materials have different amounts of spring-back.

The depth-of-bend plate and adjustable pointer are located under the right side gate. To check this calibration, use a carpenter's square and proceed as follows:

1. Align the gates at 90-degrees.
2. Turn the bender off.

Figure 11-3

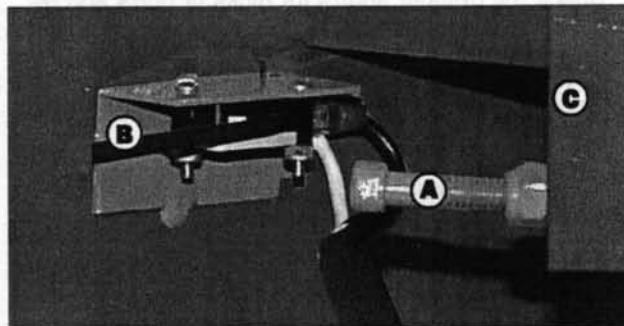


3. Move the adjustable pointer slowly past the 90-degree mark on the Depth-of-Bend Plate. As the pointer crosses 90 degrees, you should hear the limit switch trip (click). If the limit switch does not trip at 90-degrees, perform the following steps: (See FIGURE 12-3.)

- A. Loosen the nut or screw holding the roller arm to the limit switch (key A in fig 12-3).
 - B. Move the arm (key B in fig 12-3).
 - C. Tighten the nut or screw.
 - D. Move the adjustable pointer across the 90-degree mark (key C in fig 12-3). If the limit switch does not trip at 90-degrees, repeat steps A through D.
4. Turn the bender on and move the pointer across the 90-degree mark. As the pointer crosses the 90-degree mark, the gates should begin to close.

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-degrees by tapping gently on the depth-of-bend plate or loosening the bolts and nuts.

WEEKLY

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.

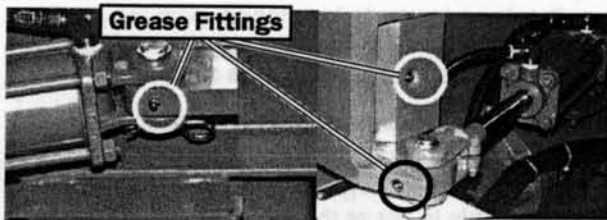
2. Clean dirt and oil from the bending dies and remove any burrs.
3. Check the cylinder shafts for nicks or burrs and remove them using emery cloth.
4. Inspect the segment sets for cracks or damage. Replace if necessary.

CAUTION!

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

6. Inspect hoses and fittings for leaks. Tighten as required.
7. Check for bolts or nuts that may have loosened.
8. 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".)
9. Grease the six grease fittings as shown in FIGURE 11-5 using a medium weight, all-purpose grease.

FIGURE 11-5



10. Ensure that the bolts in the guide plate are tight.
11. 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:

1. Check the oil level of the bender. The bender contains approximately 4 gallons of hydraulic fluid. To check the oil level:
 - A. Reduce the pressure on the sequence valve to 0 psi.
 - B. Using a 5" radius die and back shoes, advance the ram die until the main cylinder is fully extended and stop the bender.
 - C. 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: Do not retract the dies before adding oil.

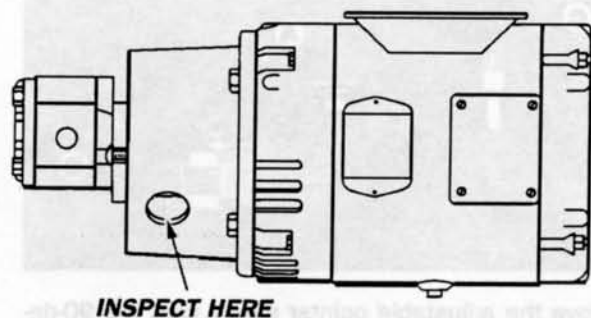
D. If oil can not be seen or felt, add oil to the filler elbow until it is visible.

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 32 Grade** rating.

2. 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.

FIGURE 11-6



3. Inspect the coupling between the pump and the motor to ensure the allen set screws have not loosened. (See 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.

12. TROUBLESHOOTING

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 sections: 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.

Call Huth Manufacturing for assistance at 1-800-558-7808.

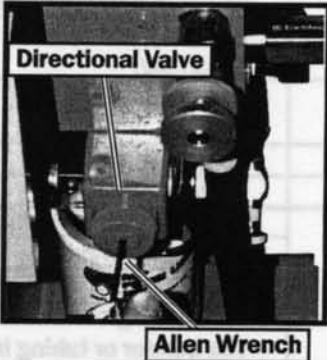
WARNING!

Turn off 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 needed.
	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.
Motor shuts off	Overload safety turning motor off.	Reset overload switch and restart. If problem persists, check wiring for short circuits.
		Check to determine if motor is overloaded.
	Overload amp setting is too low.	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.

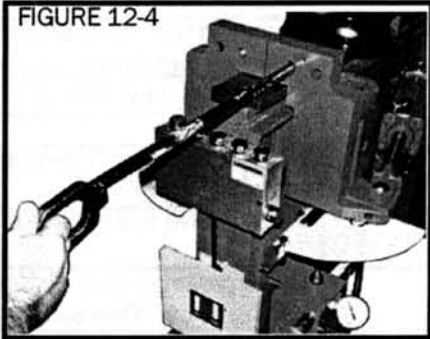
HYDRAULIC TROUBLESHOOTING

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", page 35
	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 cannot 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.
Direction valve chatters.	Filter in front leg clogged.	Remove, clean and replace.
	Back shoe pressure too high.	Lower back pressure.
	Low voltage.	Check fuse.
		Check that bender has its own circuit breaker.
		Check incoming voltage.
Power at swager control valve, but not at the main cylinder.		Ensure plug and receptacle make good contact.
		Check cord.
		Check internal wiring and conduit for breaks.
	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".
	FIGURE 12-1 	
	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 at the end farthest from the 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 bypassing internally.	Replace valve.

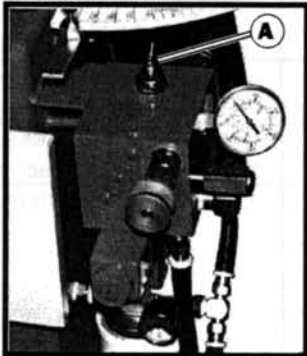
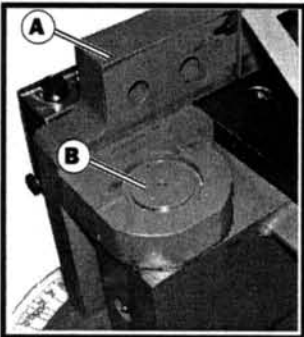
HYDRAULIC TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
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.
	Limit Switch (2008, 2806)	Determine if the limit switch has been tripped. If it hasn't, readjust the switch. See "Automatic Calibration". "Home Position Calibration". Sec. 11.
	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.
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.	Directional control valve is defective or dirty.	Clean and test directional control valve. Replace if necessary. See figure 12-1.
	Seals worn is 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 pressure drops	Pump defective.	Test pump. See problem "Loss of Power to Entire Machine", page 35.
		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 damaged.
	Spider on coupling is worn.	Replace coupling or spider.
	The pump is bad.	See "Loss of Hydraulic Power to Entire Machine", page 35.
Pressure reads 3000 psi at swager but there is a loss of bending power.	Main cylinder seals bad.	See "Power at swager, not at main cylinder", page 32.

HYDRAULIC TROUBLESHOOTING (continued)

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Hydraulics are "jumpy" or erratic	Air in hydraulic system.	Ensure that all hoses and fittings are tight.
	Air in hydraulic pump.	Proceed as follows: 1. Top off oil level in reservoir with fresh oil. See Section 11 - 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.
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: 1. Remove depth-of-bend plate. 2. Remove degree pointer. 3. Remove clevis pin and move cylinder out of the way. 4. Remove snap ring from swing gate bearing pin. 5. Press out bearing pin. 6. Remove gate. 7. Clean parts, lubricate and reassemble.
	Sequence valve out of adjustment.	See Problem "Pipe Collapses".
	Air in system.	See "Hydraulics 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 cylinders 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 seals in the side cylinders 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 cannot move. If the seals leak, oil will come from the fittings.
		
Side cylinders leaking.	Cylinders worn.	Replace Seals. See above and Section 13 - Machine Repair.
Bender cannot 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 is 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 2¼" or larger tubing has at least 13-gauge wall thickness. (continued)

HYDRAULIC TROUBLESHOOTING (continued)

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Pipe collapses. (Continued)	Setting on sequence valve is incorrect. (Travel time of sled and die extension and retraction should be the same.) FIGURE 12-5 	If extension and retraction travel times are not equal: 1. Loosen jam nut on top of sequence valve. 2. Using an allen wrench, turn the adjustment screw (A) on top of valve. (See FIGURE 12-5.) 3. When the extension and retraction speeds match, tighten the locknut to lock adjustment screw in place.
	Side cylinders are worn. Gates not operating properly. FIGURE 12-6 	See problem "Gates move slowly". Check operation of 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 bushings 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.
Loss of hydraulic power to entire machine	Defective pump.	Hold down swager valve handle and look at the pressure gauge. If pressure decreases 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 bypassing internally.	Replace valve.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
---------	----------------	-------------------

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.	Test pump. See "Loss of Power to Entire Machine" in this section.
	Clogged filters.	Clean or replace filters.

13. 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 VALVE(S) REPLACEMENT

To replace control valve(s), 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 cannot 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 any 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 replacement 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.

6. Unscrew hoses from the fittings on the cylinder and cap or plug hoses.
7. Remove the cotter pins or clips retain clevis pin at the cylinder head end.
8. Remove clevis pin.
9. 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 way 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 retains 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 they are soft metal and can be damaged easily.
7. Cycle the cylinder several times and perform a bend to ensure proper operation.

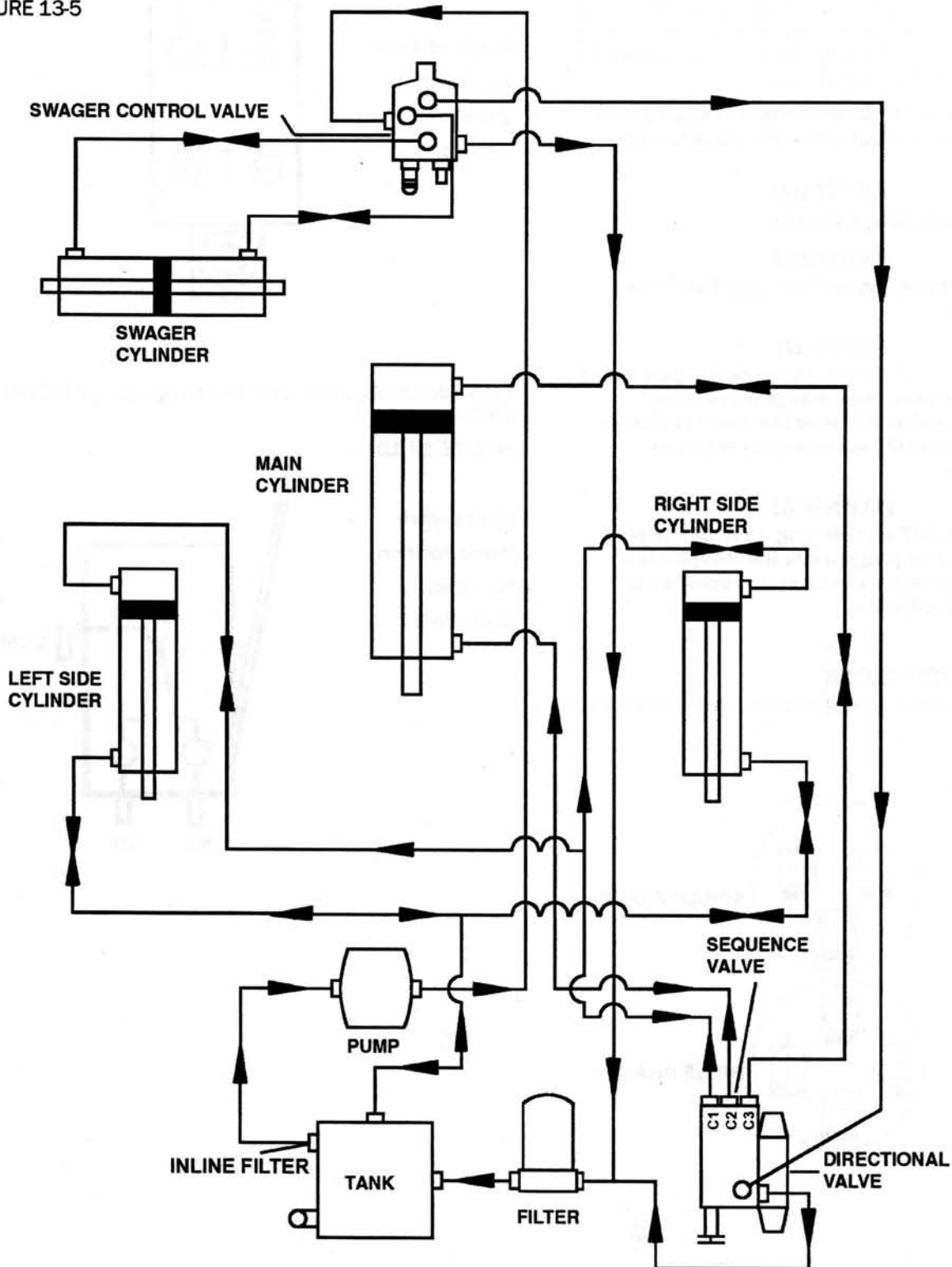
HYDRAULIC FLOW SYSTEM

There is no pressure in the hydraulic system when work is not being done on the bender. All valves are open center and the 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 troubleshooting any bender hydraulic trouble.

Model 2008, 2806, HB-10, 1600

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 cannot be repaired and require only removal and replacement. If replacement parts are installed, refer to figures 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 repairs. High voltage may still be present in the control box after the power is disconnected. Capacitors in the bender box retain an electrical charge.

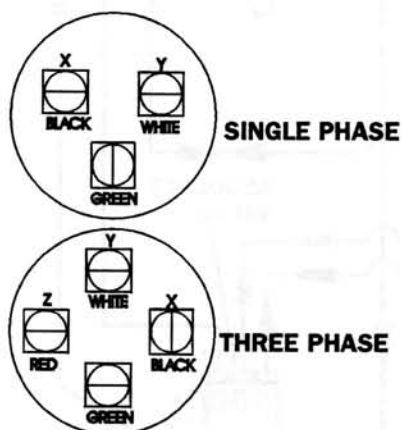
WARNING!

LOCK OUT, TAG OUT electric plug. (Secure the plug so that it cannot 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.

FIGURE 13-7



LIMIT SWITCHES

For Model 2008-2806 Limit Switch wiring, see FIGURE 13-8.

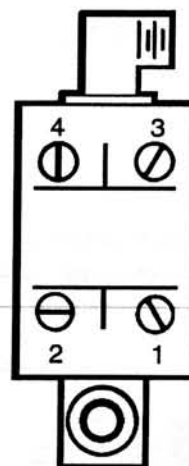
FIGURE 13-8

Depth-of-Bend

Limit Switch

2-Black

1-White



For Model 2008, 2806 Limit Switch wiring, see FIGURE 13-10

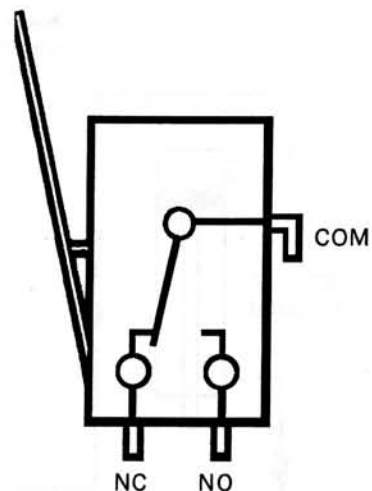
FIGURE 13-10

Limit Switch

Home Position

No - Black

Com - WHT

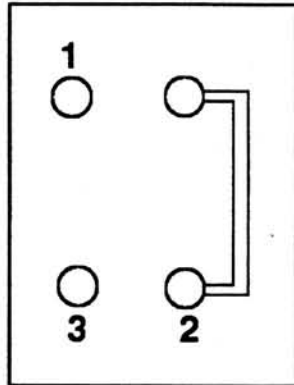


AUXILIARY START - STOP STATION MODELS 2008, 2806

For auxiliary start-stop station wiring, See FIGURE 13-11

FIGURE 13-11

**1 - BLACK
2 - GREEN
3 - WHITE**

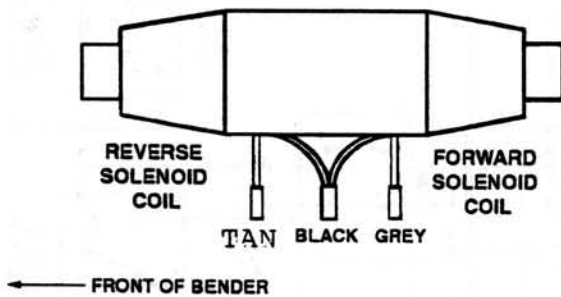


DIRECTIONAL VALVE

MODELS 2008, 2806, HB-10, 1600

For directional control valve wiring, see FIGURE 13-13.

FIGURE 13-13



MOTOR

For motor lead connections, refer to the charts below.

Single Phase- 230 Volt

- 1+5 Black Motor Lead
- 4+8 Black Motor Lead

Three Phase - 230 Volt

- 4+5+6 Together
- 7+1 Black Motor Lead
- 8+2 Black Motor Lead
- 9+3 Black Motor Lead

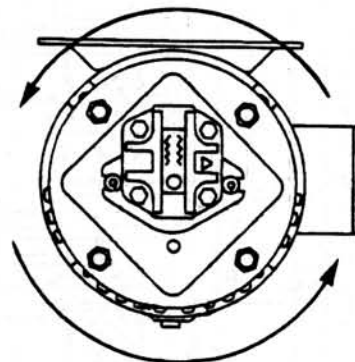
Three Phase High Voltage

- 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.)

FIGURE 13-15



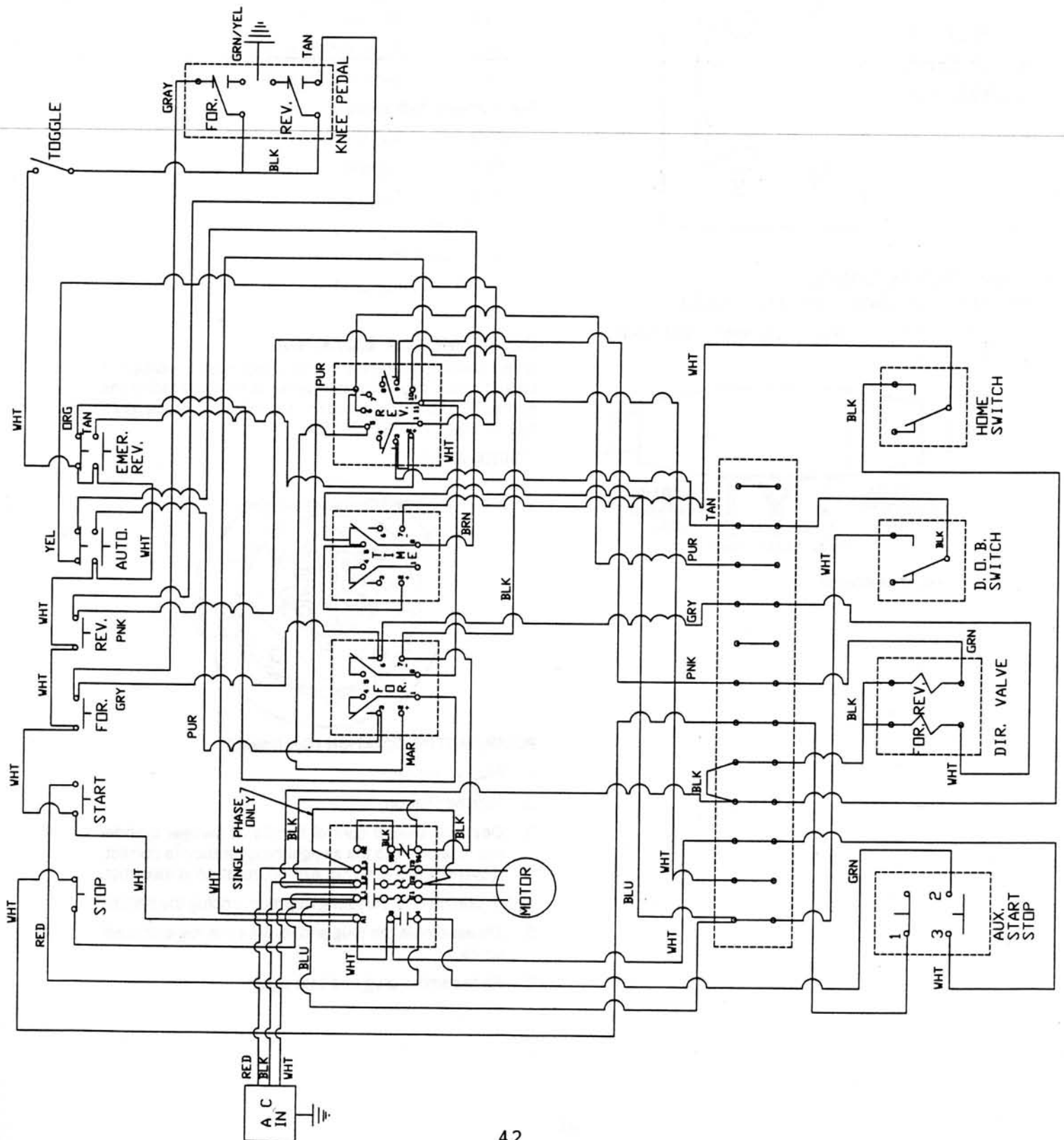
PUMP/MOTOR ROTATION (Continued)

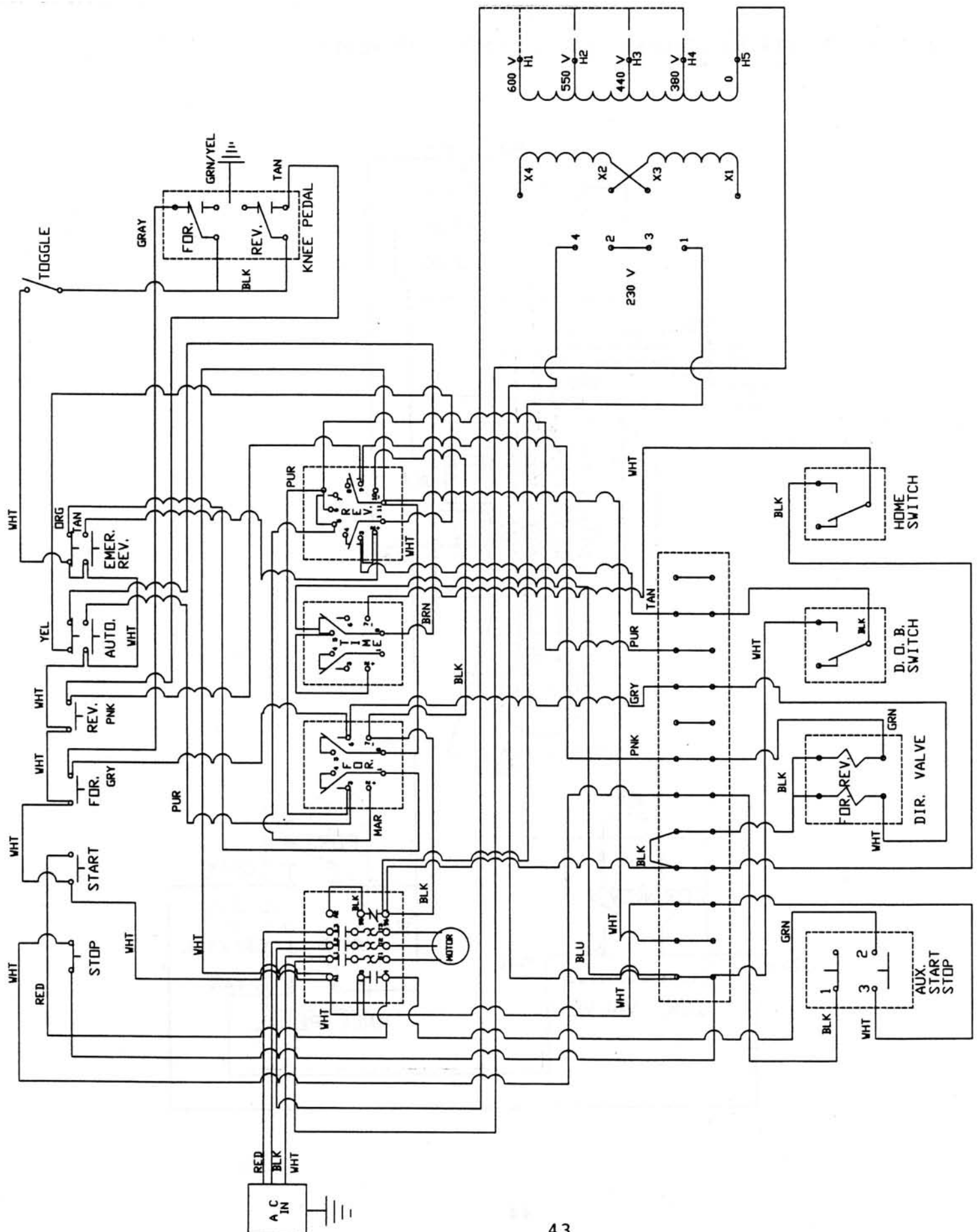
1. Plug in bender.
2. Turn bender on.
3. Depress swager control handle. If swager cylinder rod extends into the swager box, rotation is correct. If cylinder rod does not extend, rotation is incorrect.
4. If rotation is in the wrong direction, unplug the bender.
5. Disassemble the plug and reverse the red and black wires.
6. Reassemble plug and test again.

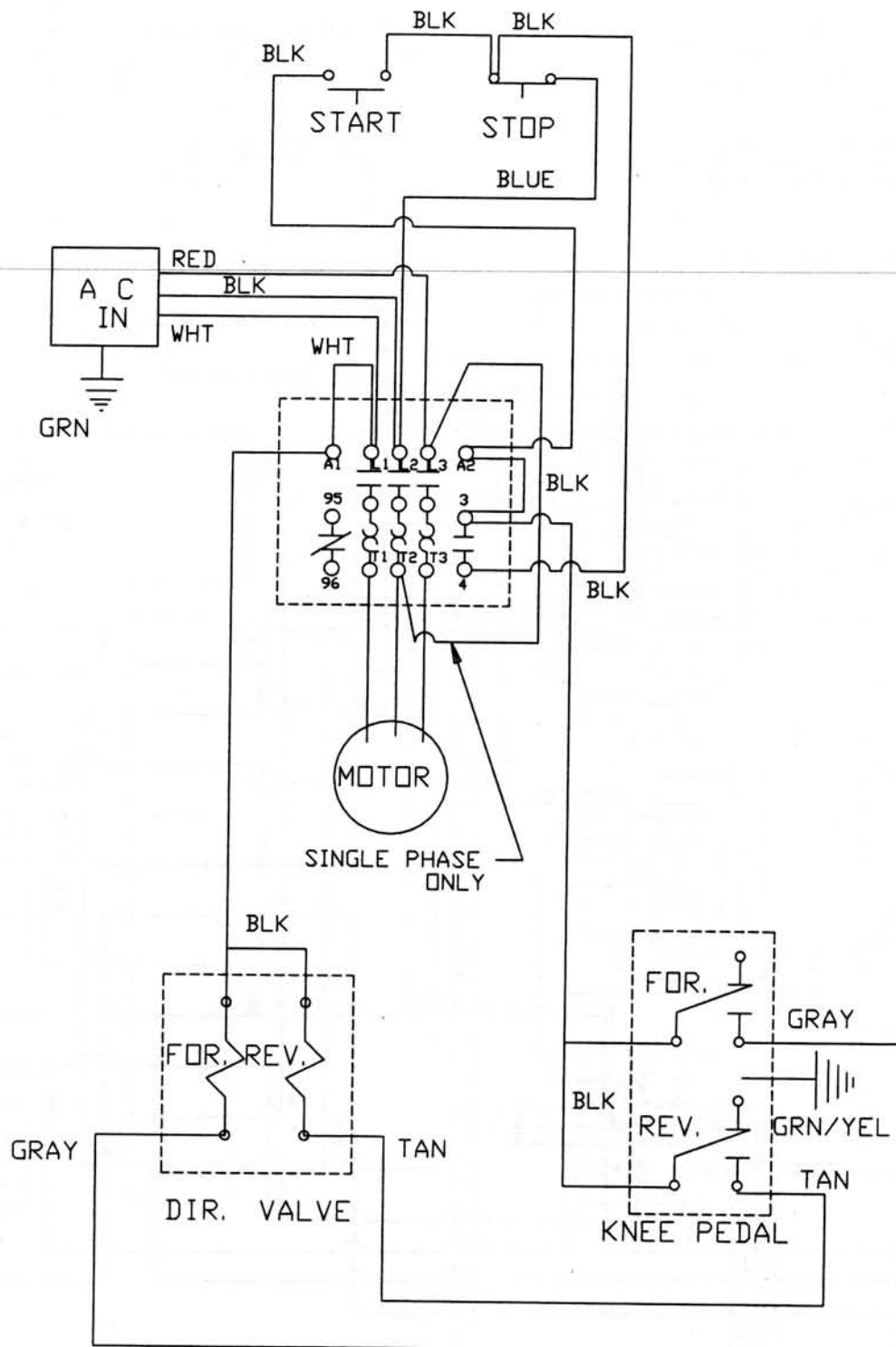
ELECTRICAL SCHEMATICS

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

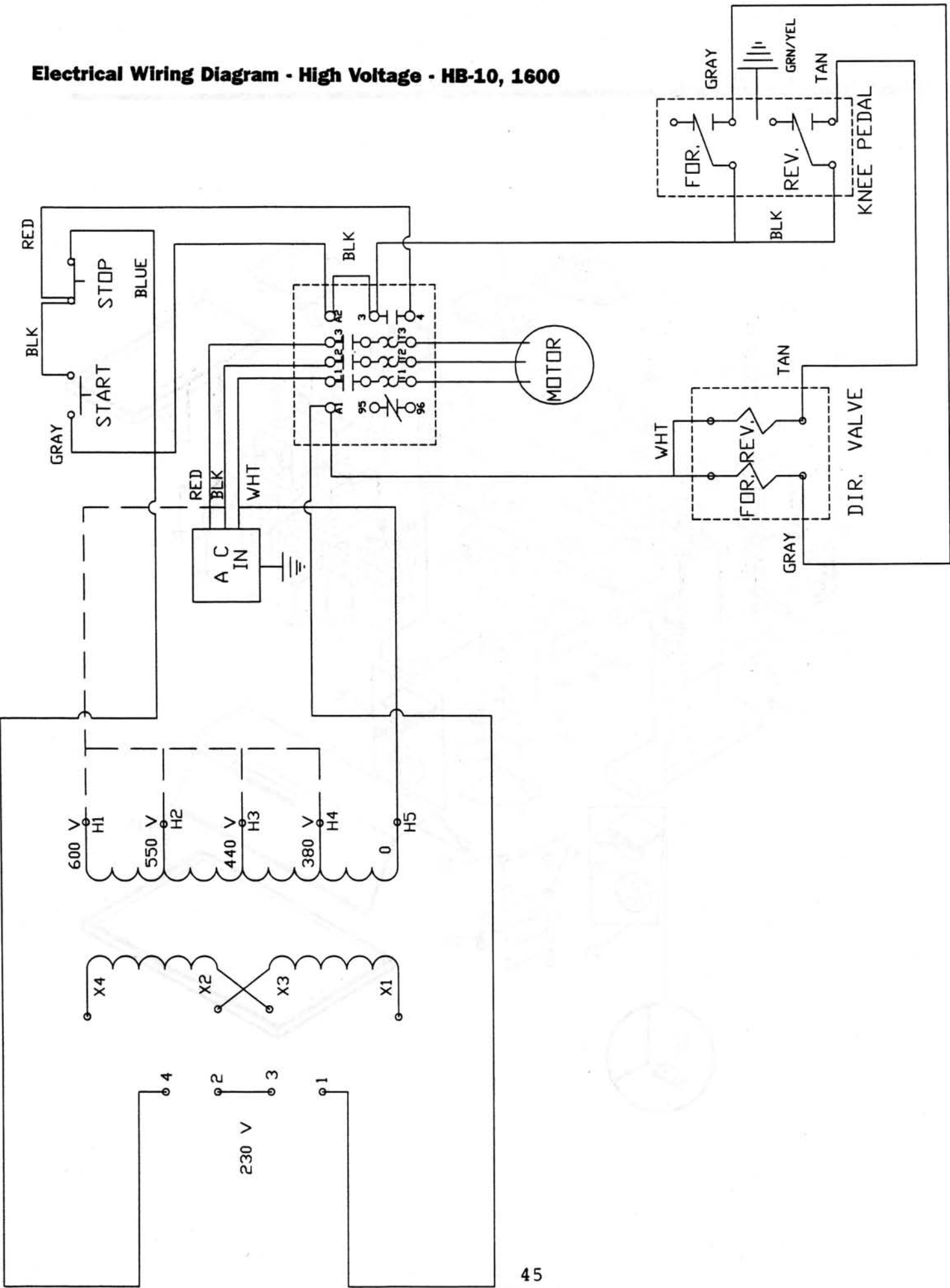
Electrical Wiring Diagram - 2008-2806, 230 VOLTS



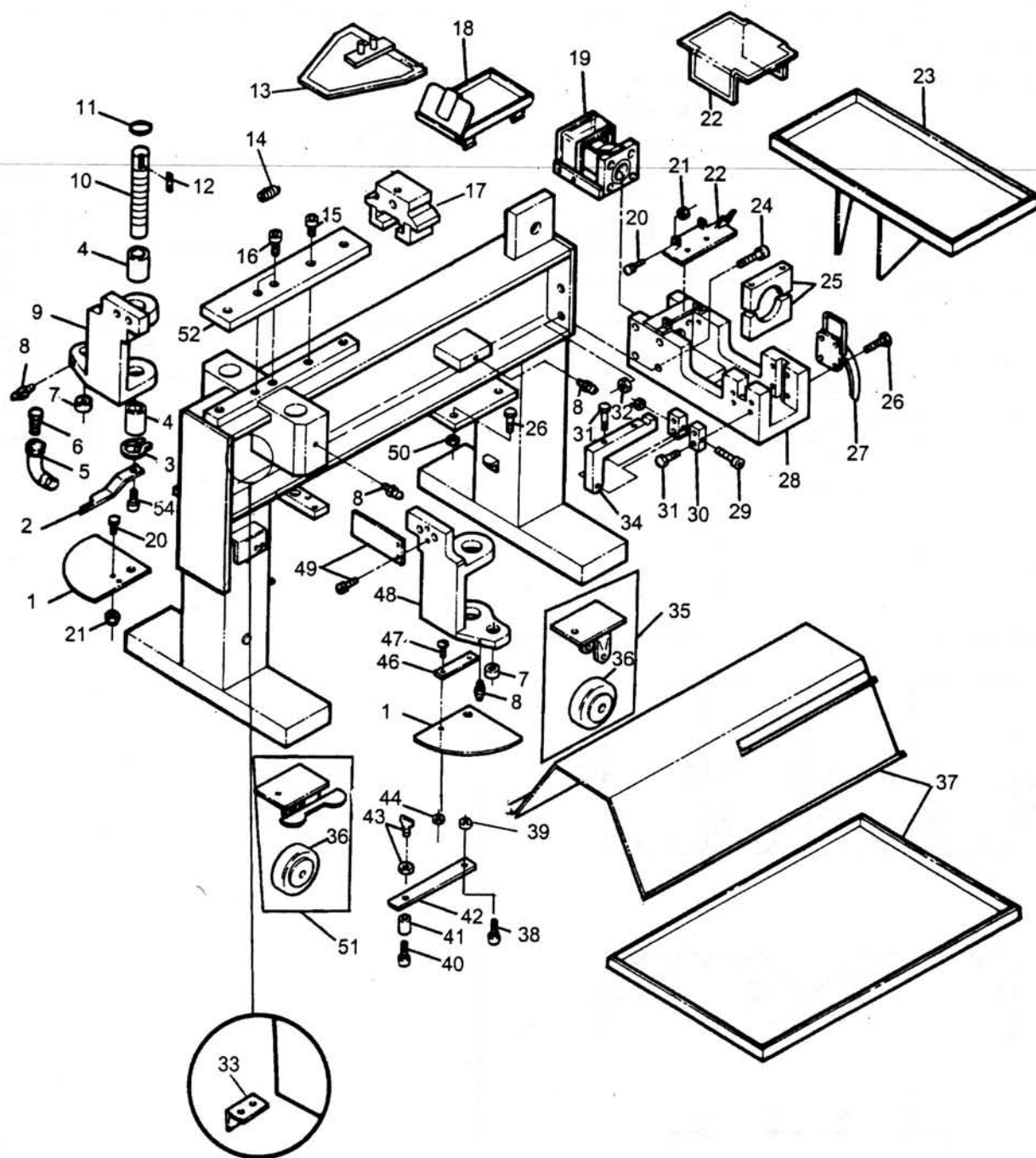




Electrical Wiring Diagram - High Voltage - HB-10, 1600



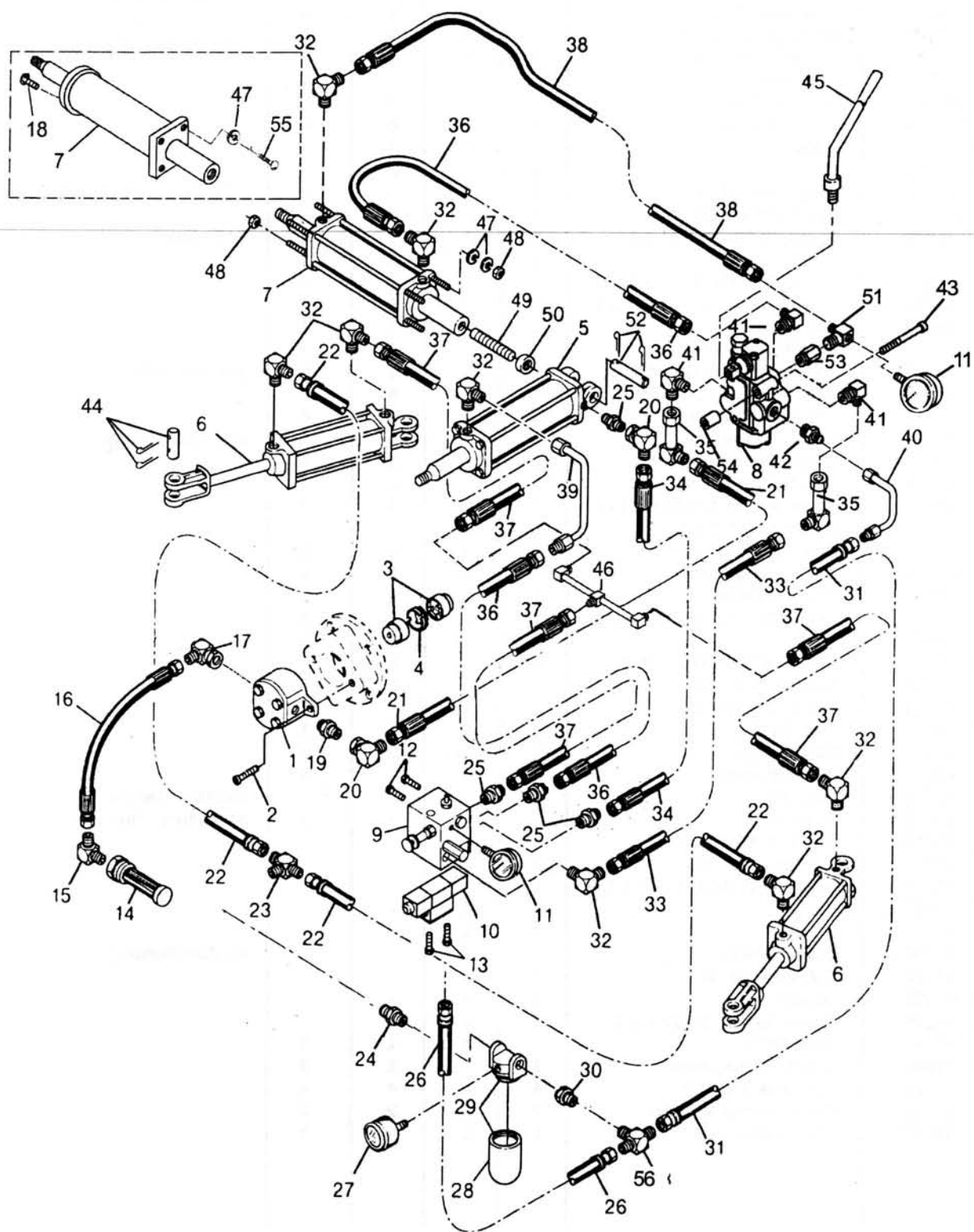
Frame Replacement Parts



Frame Replacement Parts

KEY	PART NO.	DESCRIPTION	Quantity				REMARKS
			2008	2806	1600	HB-10	
1	91160	Plate, Depth Of Bend	2	2	1	1	For Man.Bending
2	91153	Pointer	1	1	1	1	
3	90094	Ring, Outside Snap	2	2	2	2	
4	91050	Bushing, Head Block	4	4	4	4	
5	92042	Elbow, Street 3/4	1	1	1	1	
6	839	Cap, Vent	1	1	1	1	
7	91052	Bushing, Gate	2	2	2	2	
8	97234	Fitting, Grease	6	6	6	6	
9	91034	Gate, Left	1	1	1	1	
10	91042	Pin, Gate	2	2	2	2	
11	90093	Ring, Inside Snap	2	2	2	2	5" Radius
12	90092	Key, 5/16 x 5/16	2	2	2	2	
13	41040	Guard, Radius Die Retainer	1	1	1	1	
14	97050	Spring	1	1	1	1	
15	97204	Screw, Soc. Hd. 1/2 - 13 x 1	3	3	3	3	
16	97205	Screw,Soc.Hd.1/2-13 x 2-1/4	2	2	2	2	
17	91033	Sled	1	1	1	1	
18	995	Tray, Program Card	1	1	-	-	
19	41047	Adjustable Collar Guard Assy.	1	1	1	1	
20	97260	Bolt, Hex. 1/4 - 20 x 3/4	4	4	4	4	Incl. Adj.Collar
21	97210	Nut, Lock 1/4 - 20	4	4	4	4	
22	41043	Guard, Swager Box	1	1	1	1	
	41011	Guard, Swager Plastic	1	1	1	1	
23	91078	Tray, Swager Tooling	1	-	0	-	
24	97217	Screw,Soc.Hd.1/2-13 x 1-1/2	4	4	4	4	
25	891	Holder, Collet, Short	1	1	1	1	
26	97267	Bolt, Hex. 3/8 - 16 x 1	8	8	8	8	
27	97176	Clamp, Swager Arm	1	1	1	1	
28	34012	Frame, Swager	1	1	1	1	Incl. Handle,Hinge
29	97232	Screw, Soc. Hd. 1/2 - 13 x 4	1	1	1	1	
30	91061	Hinge	2	2	2	2	
31	97231	Bolt, Hex 3/8 - 16 x 1-3/4	6	6	6	6	
32	97208	Nut,Jam 1/2 - 13	5	5	5	5	
33	91098	Home Switch Bracket	1	1	-	-	
34	91060	Arm, Swager	1	1	1	1	
35	97062	Caster, Rigid	2	2	2	2	
36	97060	Wheel, Phenolic	4	4	4	4	
37	91096	Tray, Die	1	-	-	-	Industrial, Deluxe Agricultural, Flat
	91025	Tray, Die	-	1	1	1	
38	97211	Bolt 1/2 -13 x 1-1/2	1	1	-	-	
39	97222	Nut,Lock 1/2 - 13	2	2	-	-	
40	97226	Screw, Soc. Hd.1/4 - 20 x 7/8	1	1	-	-	
41	97000	Cam	1	1	-	-	
42	91152	Handle	1	1	-	-	
43	91150	Pointer, Brass	1	1	-	-	
44	97224	Nut, Lock 10 -32	1	1	-	-	
46	91151	Support	1	1	-	-	For Auto Bending
47	97239	Screw, Rd. Hd. 10-32 x 1/2	1	1	-	-	
48	91035	Gate, Right	1	1	1	1	
49	41044	Guard, Gate w/rivets	1	1	1	1	
50	97225	Nut, Lock 3/8 - 16	4	4	4	4	
51	97061	Caster, Swivel w/Brake	2	2	2	2	
52	91047	Plate, Guide	1	1	1	1	

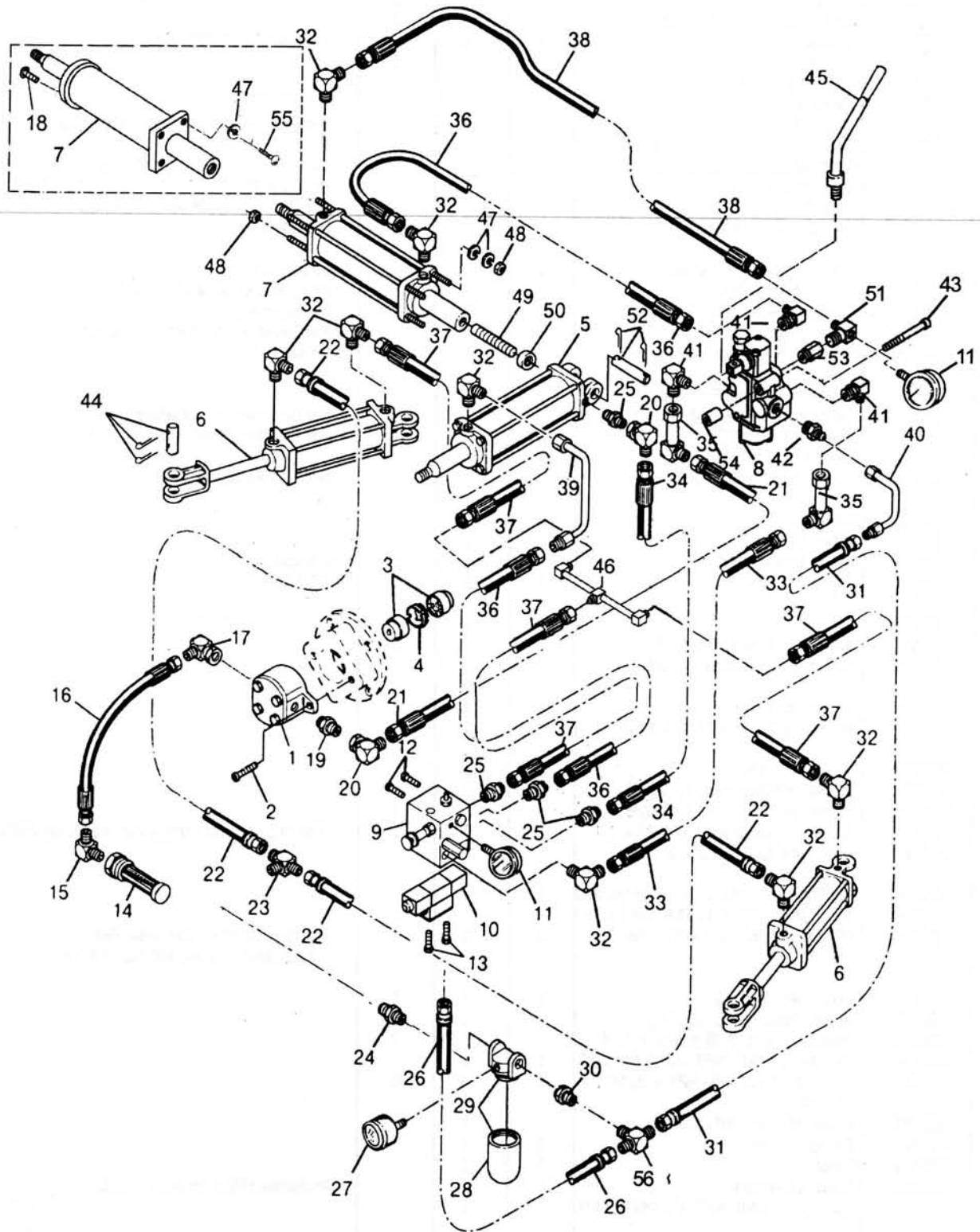
Hydraulic Replacement Parts



Hydraulic Replacement Parts -

KEY	PART NO.	DESCRIPTION	QUANTITY			REMARKS
			2008	2806	HB-10 1600	
1	92116	Pump, Hydraulic	1	1	-	For 7½ HP motor. Not available for HB-10
	92117	Pump, Hydraulic (High Speed)	1	1	1	
	92114	Pump, Hydraulic	-	-	1	
2	97267	Bolt, Hex Hd. 3/8"-16 x 1"	2	2	2	Includes P/N 92358 Spyder
3	92357	Coupler	1	1	-	
	92356	Coupler	-	-	1	
4	92358	Spyder, Rubber	1	1	1	Includes Pin Includes All Seals for P/N 92169 For P/N 92169 Sold without Seals for P/N 92169 Includes Pin For Benders Built After 3/1/91 Includes Pin
5	92169	Cylinder, Main Industrial	1	-	-	
	92235	Seal Kit	1	-	-	
	92161	Rod, Tie	4	-	-	
	92048	Cartridge, Packing Gland	1	-	-	
	92158	Cylinder, Main Agricultural	-	1	-	
	92208	Seal Kit for 92158	-	1	-	
	92172	Cylinder, Main Welded	-	-	1	
6	92150	Cylinder, Side Industrial	2	-	-	Includes Pins Includes All Seals for P/N 92150 Includes Pins For Benders Built After 3/1/91 Includes Pins
	92236	Seal Kit for 92150	1	-	-	
	92159	Cylinder, Side Agricultural	-	2	-	
	92207	Seal Kit for 92159	-	1	-	
	92173	Cylinder, Side Welded	-	-	2	
7	92256	Cylinder, Double End, Ag. 3½"	1	1	1	For Benders Built Before 5/90 For Benders Built After 3/1/91 Sold as Assembly Only
	92355	Cylinder, Double End, Ind. 3"	1	-	-	
	92209	Seal Kit for 92256	1	1	-	
	92205	Seal Kit for 92355	1	-	-	
	92174	Cylinder, Double End	-	-	1	
8	92103	Valve, Swager	1	1	1	24 Volt 220 Volt
9	92165	Valve, Sequence	1	1	1	
10	92168	Valve, Directional	-	-	-	
	92164	Valve, Directional	1	1	1	
11	92100	Gauge, Pressure	2	2	2	
12	97221	Bolt, Hex 3/8"-16 x 1/2"	2	2	2	
13	97377	Screw, Sk. Hd. Cap 10-24 x 7/8"	4	4	4	
14	92045	Filter, Easy Flow	1	1	1	
15	92010	90 Ftg, 1/2ML NPT x 3/8ML JIC	1	1	1	
16	92272	Hose, #8, 18" Lg.	1	1	1	(For high speed pump, not avail. on HB-10)
17	92077	Elbow, 90 Degrees, 1/2-3/4	1	1	-	
	92078	Elbow, 90 Degrees, 1/2-5/8	-	-	1	
	92075	Elbow, 90 Degrees, 3/4-3/4	1	1	1	
18	97256	Bolt, Hex 1/2" - 13 x 1	-	-	2	
19	92026	Str Ftg, 5/8 SAE O'R x 3/8ML JIC	1	1	-	For rear of Main Cyl.-Use Ref. #32 (Mdl. 2806, HB-10, 1600)
	92006	Str, 3/8ML JIC x 1/2ML SAE O'R	-	-	1	
20	92021	90 Elb, 3/8ML JIC x 3/8FM JIC SVL	2	1	1	
21	92273	Hose, #6, 41" Lg.	1	1	1	Includes Filter, Head & Gauge
22	92277	Hose, Return, #6, 24" Lg.	2	2	2	
23	92015	Branch, T Ftg, 3/8 x 3/8 x 1/4	2	2	2	
24	92028	Str Ftg, 1/2ML NPT x 3/8ML NPT	1	1	-	
25	92002	Str. Ftg., 1/2" ML NPT x 3/8" ML JIC	5	4	5	
26	92280	Hose, Return, #6, 13" Lg.	1	1	1	
27	92292	Gauge, Filter	1	1	-	
28	92290	Filter	1	1	-	
29	92289	Filter Assembly	1	1	-	
30	92027	Str Ftg, 1/2ML NPT x 1/4FM NPT	1	1	-	
31	92279	Hose, Return, #6, 56" Lg.	1	1	1	
32	92009	90 Ftg, 1/2ML NPT x 3/8ML JIC	9	10	9	

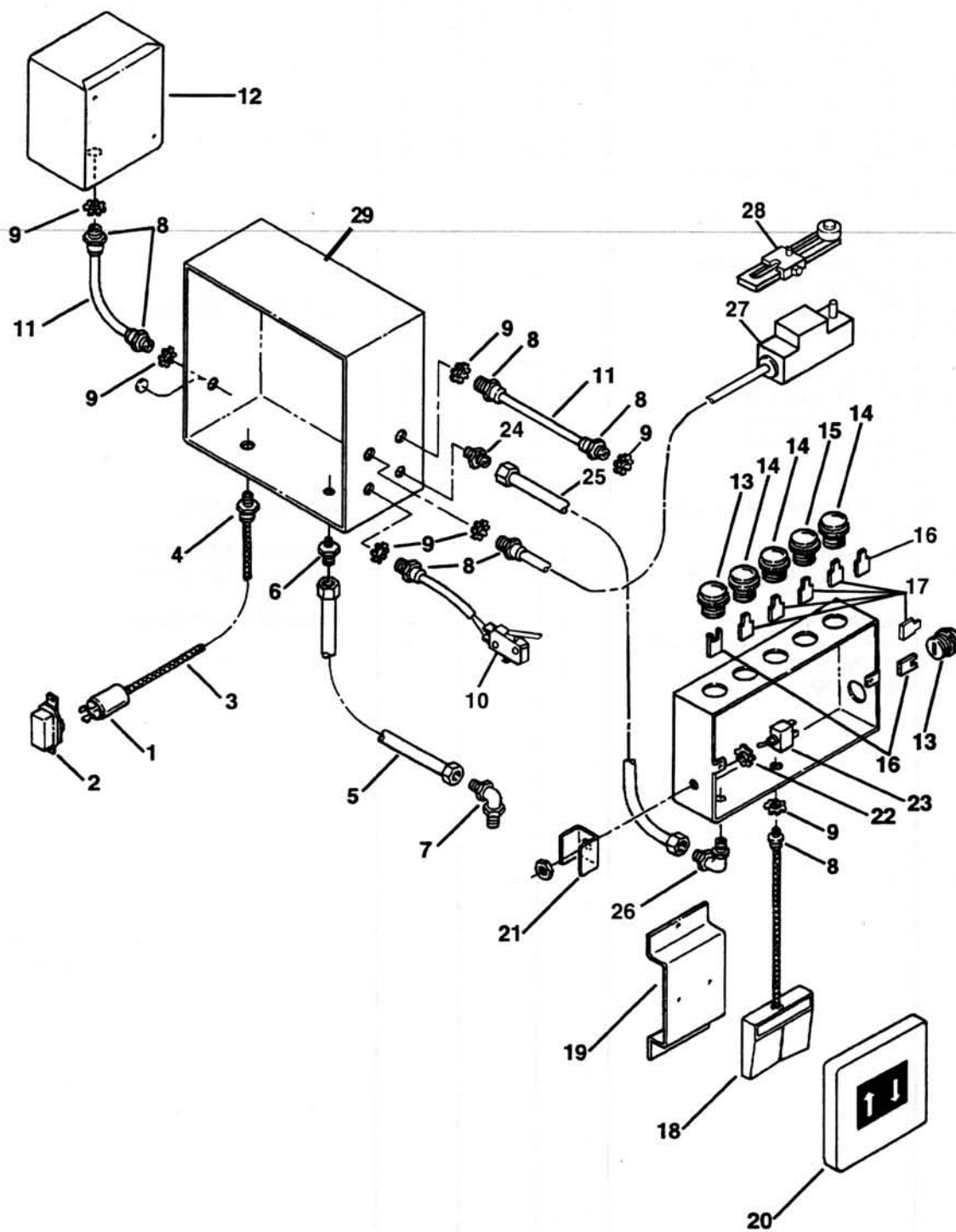
Hydraulic Replacement Parts - 2008, 2806, 2100, 2007, 2801, HB-10, 1600



Hydraulic Replacement Parts -

KEY	PART NO.	DESCRIPTION	QUANTITY			REMARKS
			2008	2806	HB-10 1600	
33	92275	Hose, #6, 58" Lg.	1	1	1	
34	92274	Hose, #6, 50" Lg.	1	1	1	
35	92023	90 Lg Elb, 3/8 ML JIC x 3/8FM JIC	2	2	2	
36	92264	Hose, #6, 23-1/2" Lg.	2	2	2	
37	92261	Hose, #6, 15-1/2" Lg.	3	3	3	
38	92263	Hose, #6, 19" Lg.	1	1	1	
39	92312	Tube, 6-6	1	1	1	Cylinder Valve
40	92313	Tube, 6-6	1	1	1	
41	92004	90 Elb, 1/2ML SAE O'R 3x8ML JIC	3	3	3	
42	92006	Str, 3/8ML JIC x 1/2ML SAE O'R	1	1	-	
43	97206	Socket Head Cap Screw, 3/8"-16 x 3-1/4"	2	2	2	
44	92202	Pin, Side Cylinder	4	4	4	Industrial & Agricultural
45	92109	Handle, Swager	1	1	1	
46	92314	Fitting, 3-Way	1	1	1	
47	97383	Washer, Lock 1/2"	8	8	4	
48	97208	Nut, Jam 1/2"-13	6	6	-	
49	97051	Stud, Thread 1-14	1	1	1	
50	97100	Nut, Knurl	1	1	1	
51	92009DT	90 Ftg, 1/2ML NPT x 3/8ML JIC, DT	1	1	1	For Pressure Gauge
52	92203	Pin, Main Cylinder	1	1	1	Industrial & Agricultural
53	92008	Str Ftg, 1/2ML SAE O'R x 1/2 FM NPT	1	1	1	Industrial & Agricultural
54	70045	Bushing, Steel	2	2	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	1	1	-	

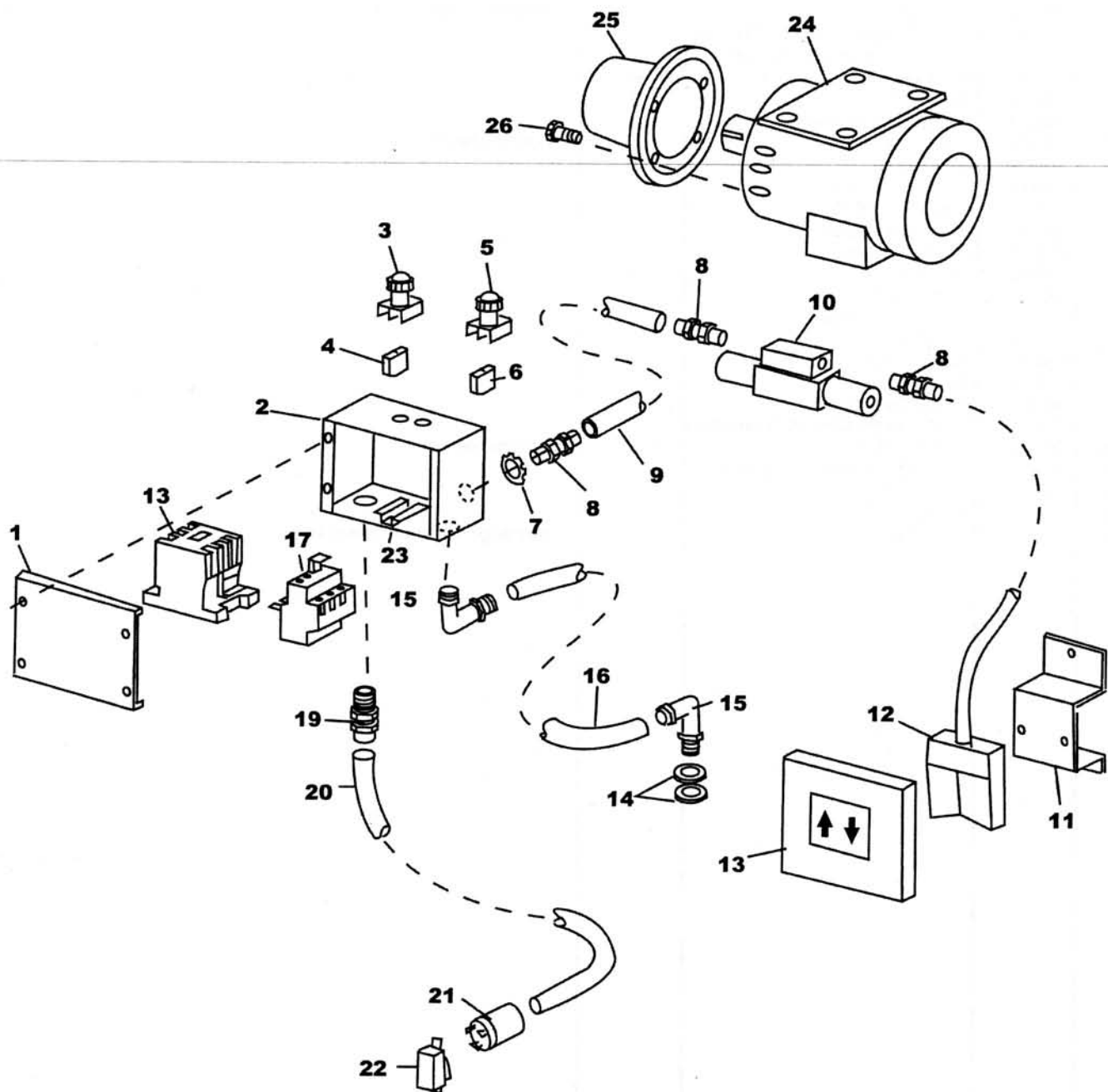
Electrical Components - 2008 & 2806



Electrical Components - 2008 & 2806

REF.	PART NO.	DESCRIPTION	QUANTITY	REMARKS
1	95206	Plug	1	Single Phase
1	95208	Plug	1	Three Phase
2	95207	Receptacle	1	Single Phase
2	95209	Receptacle	1	Three Phase
3	95370	Power Cord	1 each	Single Phase (Sold by the foot)
3	95371	Power Cord	1 each	Three Phase (Sold by the foot)
4	95172	Kellum	1	
5	95234	3/8" Conduit	1 each	Sold by the inch
6	95235	3/8" Straight Connector Conduit	1	
7	95236	3/8" 90° Connector Conduit	1	
8	95449	Cord Grip	7	
9	95429	Lock Nut	7	
10	95420	Home Position Switch	1	
11	95508	16-3 Cord	1 each	Sold by the inch
12	95509	Sub Station	1	
13	95511	Red Push Button	2	
14	95512	Green Push Button	3	
15	95513	Black Push Button	1	
16	95514	Closed Contact	3	
17	95515	Open Contact	5	
18	95419	Pedal Control	1	
19	97447	Pedal Mount Plate	1	
20	97448	Knee Pad	1	
21	95091	Switch Cover	1	
22	97254	Star Washer	1	
23	95087	Toggle Switch	1	
24	95227	1/2" Straight Conduit Connection	1	
25	95228	1/2" Conduit	1 each	Sold by the inch
26	95226	1/2" 90° Conduit Connection	1	
27	95522	Limit Switch	1	
28	95523	Roller Arm	1	
29		Control Box		See page 56 for components

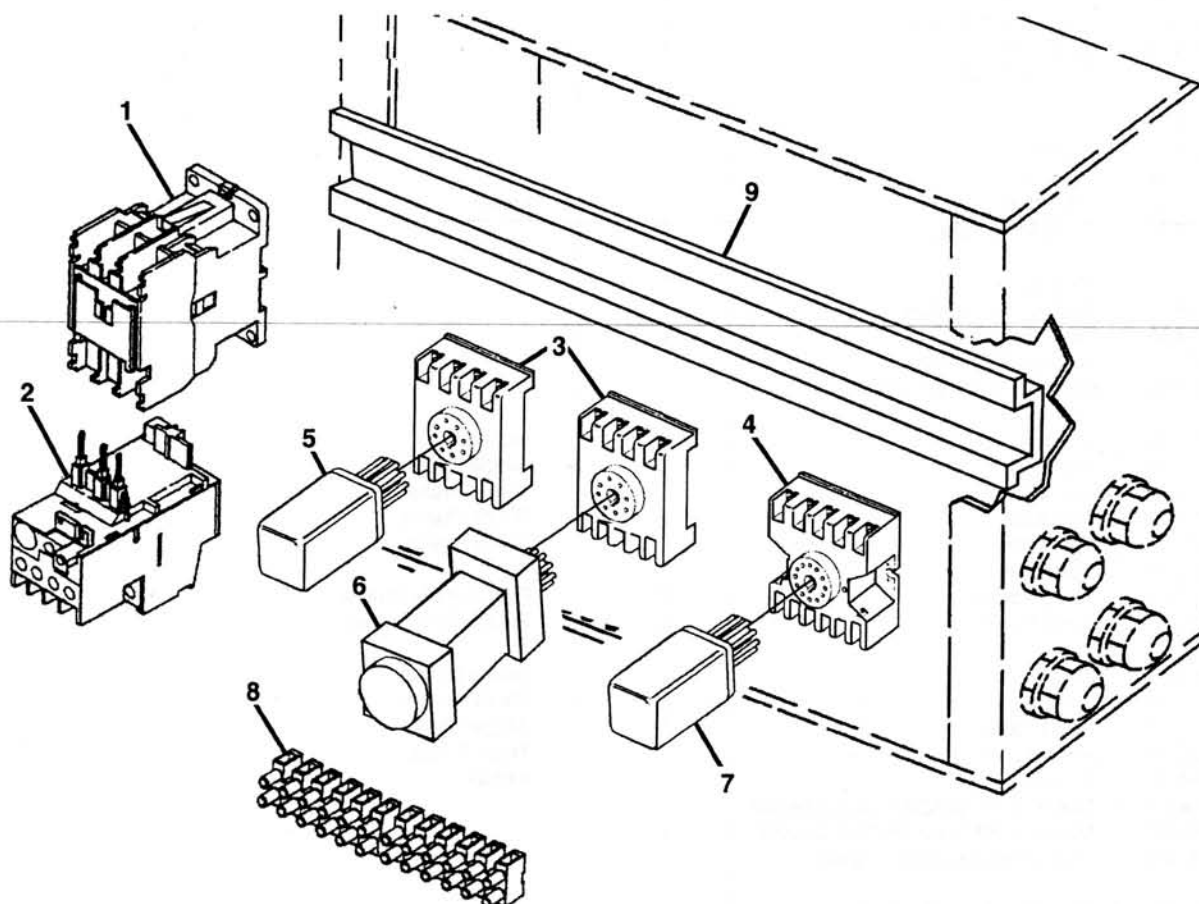
Electrical Components - HB-10, 1600



Electrical Components - HB-10, 1600

REF.	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	Locknut	1	
8	95549	Cord Grip	3	
9	95508	16-3 Cord	39	Inches
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	Inches
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	Inches
24	95019	Motor, 5 HP Single Phase, Leeson	1	
	95020	Motor, 5 HP Three Phase, Leeson	1	
25	95021	Motor Pump Mount, Leeson	1	
26	97400	Bolt, Hex 1/2-13 x 3/4	4	

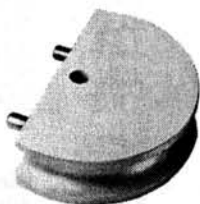
Electrical Control Box Components - 2008 & 2806



REF.	PART NO.	DESCRIPTION	QUANTITY		REMARKS
			2008	2806	
1	95502	Contactor	1	1	Single Phase
	95519	Contactor	1	1	3 Phase
2	95503	Overload Relay	1	1	Single Phase
	95518	Overload Relay	1	1	3 Phase
3	95462	8-Pin Relay Socket	2	2	
4	95463	11-Pin Relay Socket	1	1	
5	95460	DPDT Relay	1	1	
6	95461	Timer Relay	1	1	
7	95435	3P3T Relay	1	1	
8	95507	Terminal Strip	1	1	
9	95510	DIN Rail	1	1	

Bending Dies

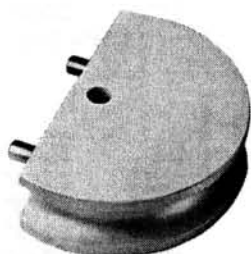
Full 5" Radius Dies*



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

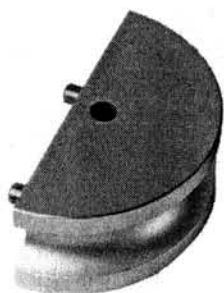
* Requires 41041 Retainers

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

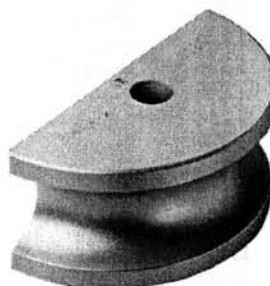


Metric No.	Size
4040	40mm
4042	42mm
4045	45mm
4048	48mm
4050	50mm
4218	54mm***
4055	55mm
4060	60mm

***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

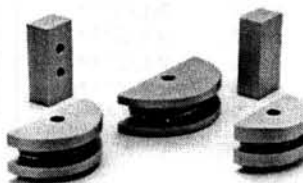


Metric No.	Size
3040	40mm
3042	42mm
3045	45mm
3048	48mm
3050	50mm
3218	54mm***
3055	55mm

***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.)

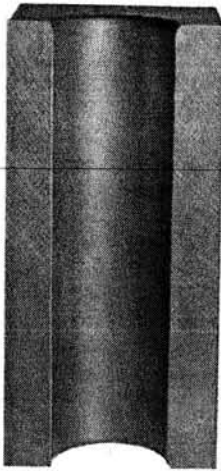
Square Tube Back Shoe* (2 Required)

1000 All Sizes
* (4) #855 Pins Required

All returned parts are subject to a restocking charge

Shoes

Back Shoes* (2 Required)

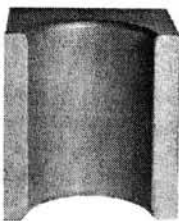


* (2) #855 pins required

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)

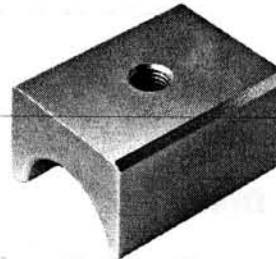


* (1) #855 pin required

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)

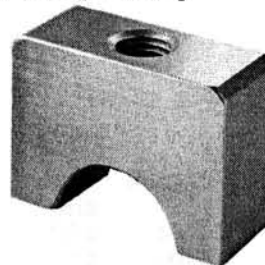


* (1) #855 pin required

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



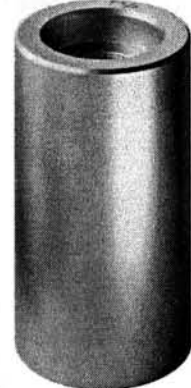
557

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)

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

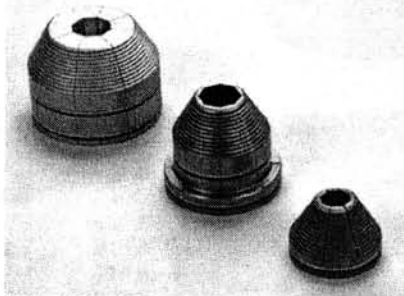


498, 499 508

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.	

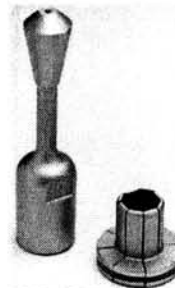
45° Flaring



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	

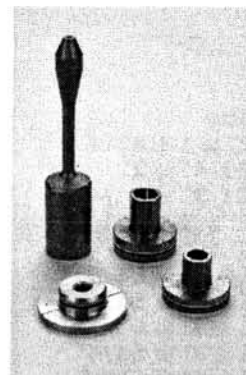
Pre Accu-Sizer™ System



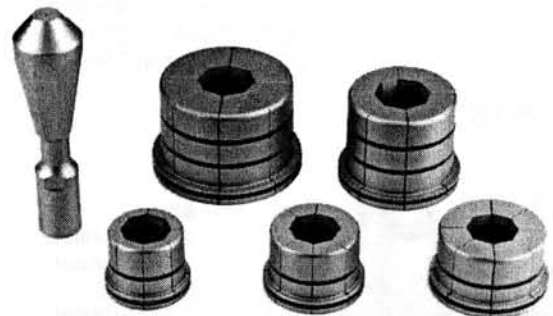
500, 400

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



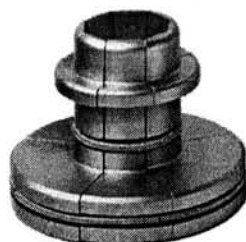
575, 570, 470, 404



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

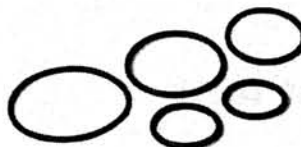


419

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

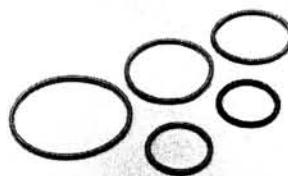
No.	Size
870	Assortment of 50 (10 each size) for Segment Sets: 400, 403, 404, 405, 406, 408, 410, 411, 412, 419, 420, 421, 422, 423, 424, 425, 440, 441, 452, 470, 473, 474, 475, 476, 477, 570 Spacer for Arbor 575



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
O-Rings:
Steel 1-867
Rubber 1-862



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



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



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



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



Tooth
Segment 625
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
O-Rings:
 Steel 1-874
 1-867
 Rubber 1-860
 1-862



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



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



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



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



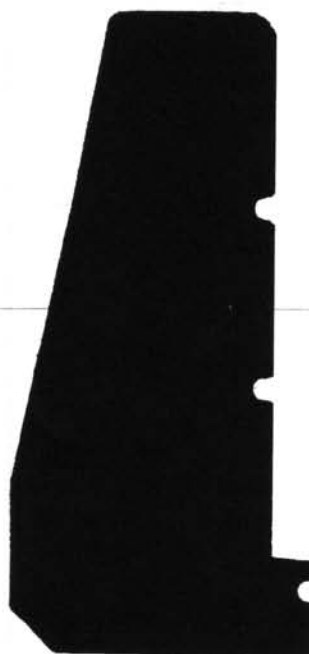
Tooth Segment 622
O-Rings:
 Steel 1-865
 1-867
 Rubber 1-860
 1-862

All returned parts are subject to a restocking charge

Silhouette Chart - Segment Set Teeth



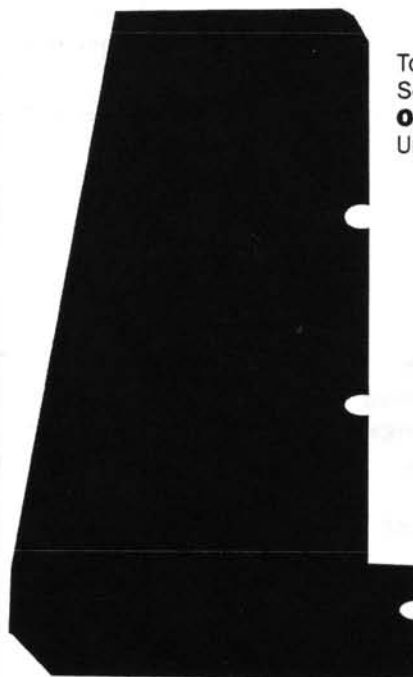
Tooth Segment 608
408
O-Rings:
Rubber 1-864
Urethane 1-877



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

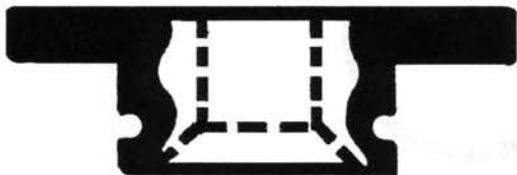


Tooth	641
Segment	441
O-Rings:	
Steel	869
Rubber	864

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

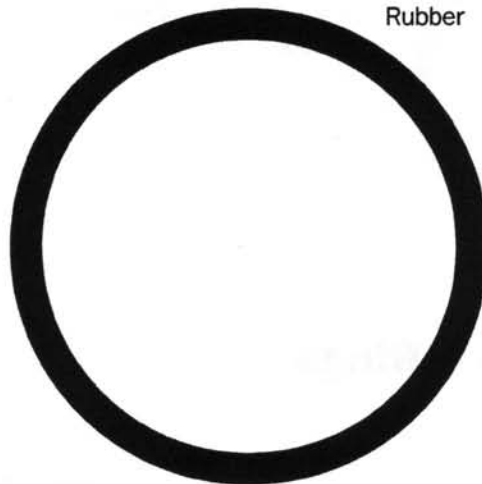


Tooth 612
 Segment 412
O-Rings:
 Steel 1-867
 1-869
 Rubber 1-862
 1-864

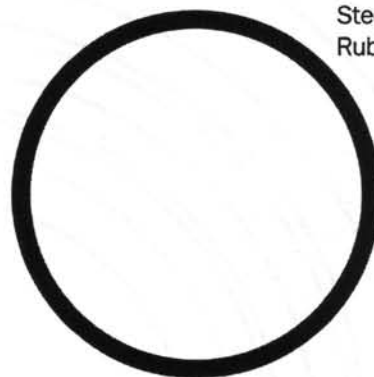


O-Rings

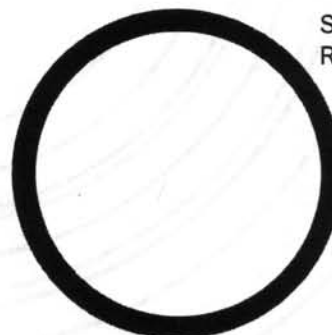
Steel 869
 Rubber 864



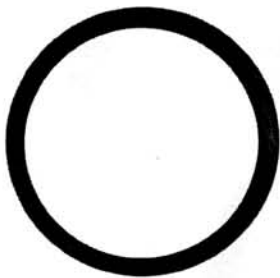
Steel 868
 Rubber 863



Steel 867
 Rubber 862

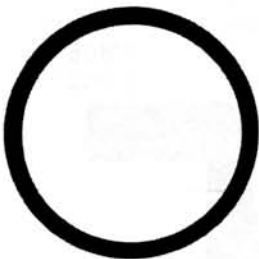


Silhouette Chart - O-Rings



Steel
Rubber

866
861

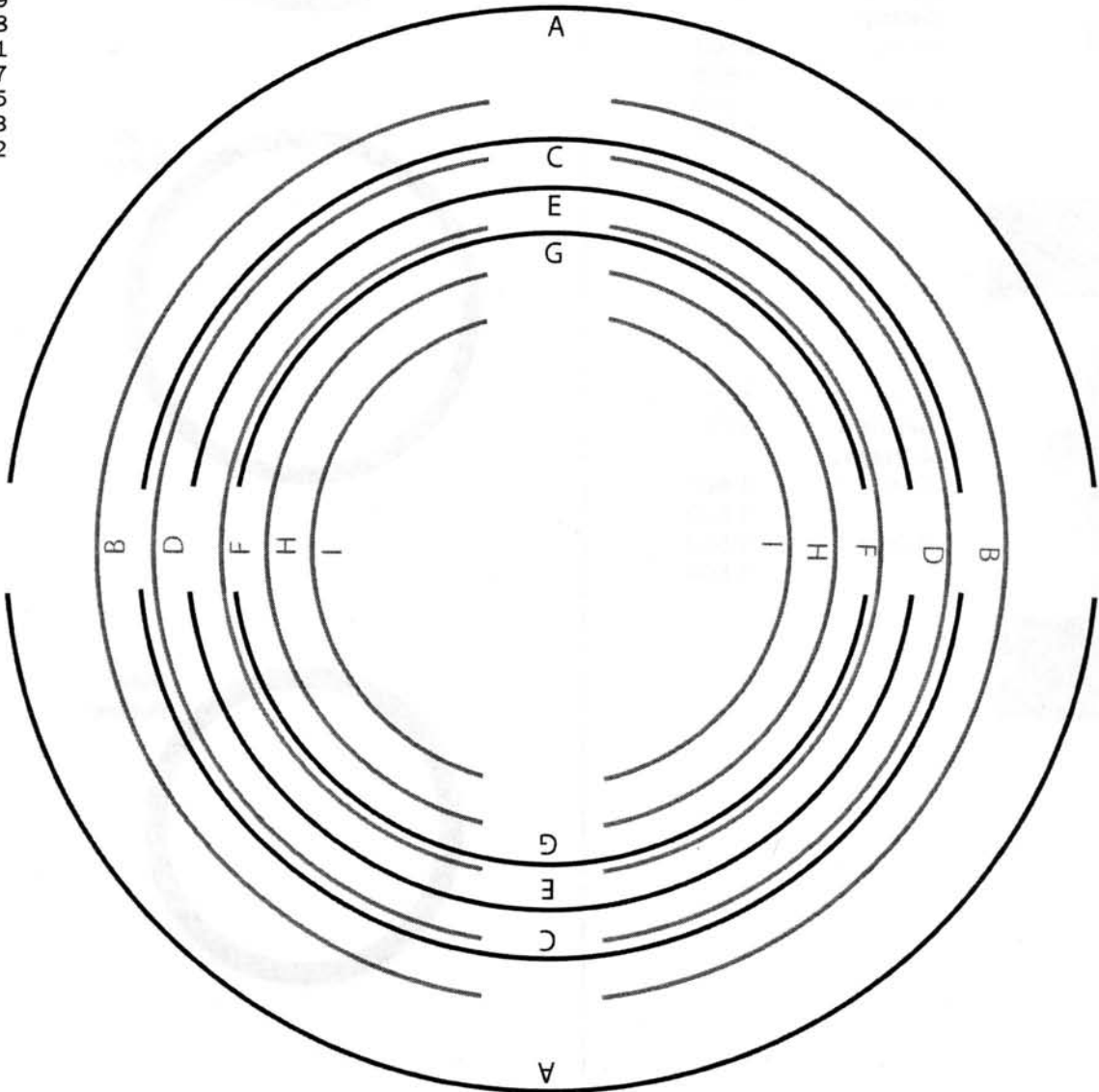


Steel
Rubber

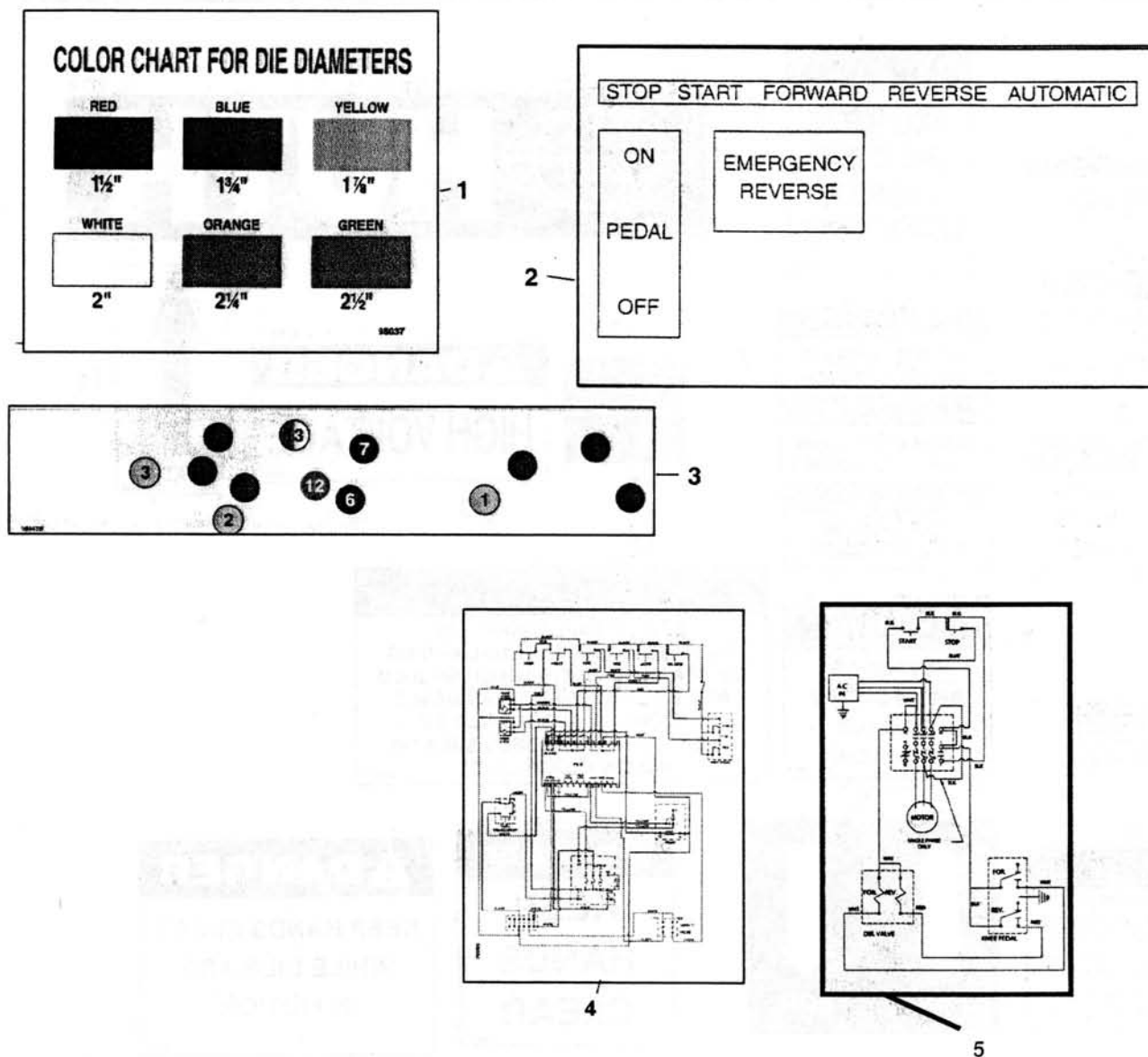
865
860

Urethane O-Rings

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



Decals



REF.	PART NO.	DESCRIPTION	QUANTITY	REMARKS
1	98037	Decal, Color Chart	1	
2	98085	Decal Kit	1	
3	98043	Decal, Accu-Sizer	1	
4	98086	Decal, Schematic	1	Models 2008, 2806
5	98091	Decal Schematic	1	Models 1600, HB-10

Decals



Decals

REF.	PART NO.	DESCRIPTION	QUANTITY	REMARKS
1	98016	Decal, Warning	1	Model 2100
2	98039	Decal, Warning	1	
3	98020	Decal, Warning	1	
4	98070	Decal, Warning	1	
5	98076	Decal, Warning	1	
6	98015	Decal, Warning	1	
7	98033	Decal, Caution	1	
8	98030	Decal, Caution	1	
9	98036	Decal, Forward, Reverse	1	
10	98031	Decal, Huth	1	
11	98018	Decal, "Do not run..."	2	
12	98017	Decal, "Grease Barrels Weekly"	2	
13	98040	Decal, Danger	1	
14	98028	Decal, "Rotation"	1	
15	98014	Decal, Caution	1	
17	98032	Decal, Danger	1	
18	98010	Decal, Danger	1	
19	98013	Decal, Warning	1	
20	98074	Decal, Warning	1	
21	98042A	Decal, Expanding Chart	1	