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YOUR BLUE BOY TUBE BENDER

The Blue Boy Tube Bender is a product of over ten years of continuous research, development, and product improvement. Following the simple installation and maintenance instructions given herein will insure you long, efficient, and trouble-free service.

Blue Boy Tube Benders are manufactured with the finest materials and components available. They are equipped with rugged precision tooling, designed for day-to-day production in your shop.

Though there are detail differences from model to model, the basic machine design is the same for all models. This manual covers the installation, maintenance, and use of all Blue Boy Tube Benders. Skip over parts of the manual that tell about features your machine does not have.

BASIC DESIGN

Blue Boy Tube Benders perform two functions:

1. They bend tubing of diameters within their tooling capacity to specified angles and radii.

2. They expand the ends of tubes to specified configurations.

Tube bending is done with a hydraulically-driven ram die and a matching pair of back shoes. Tubing is held in place prior to bending by spring pressure on the ram die. When the operator is sure the tubing is positioned properly, he actuates the machine.

The ram die moves smoothly forward. The back shoes swing smoothly back, continually exerting pressure against the ram die while allowing it to pass between them, making a uniform bend. The precision contours of the matching ram die and back shoes hold the tubing securely. They cause the tubing to maintain its round cross-section while bending it through the correct angle. After the desired depth of bend is reached, the ram die retracts, releasing the bent tubing.

The expanding and shaping capability is performed in two distinct ways. These are called, respectively, swaging and hydra-sizing. Both swaging and hydra-sizing capabilities are found on some models of Blue Boy Tube Benders.

Figure 1. Bending Head
In the swaging operation the tubing is clamped securely in the over-center clamp assembly. A precision contour expanding die is pushed hydraulically into the open tube end to a specified depth, enlarging the tubing inner diameter as it moves into the tube.

In the hydra-sizing operation the tubing is placed over the hydra-sizing tool with its end flush to the limit ring, and the limit ring flush to the segment set. Within the limit ring are a set of segments which make up an expandable head. Inside the segments is a tapered arbor. With the tubing in place, the arbor is hydraulically withdrawn through the segments, forcing them outward to meet the limit ring. Since the hydraulic action is a pulling one, and the tubing cannot move past the limit ring, there is no need to clamp it in place for a hydra-sizing operation.

Because clamping is not needed, hydra-sizing is basically a faster operation than swaging. However, the swaging device makes use of a versatile set of tooling. With the swager you can flare tube ends and form flanges, ball joints, domes, and other special tubing ends.
**DEFINITION OF TERMS**

The front of the machine is the end with the single swivel caster (closely-mounted pair of casters on Model 214MS) where the operator customarily stands to do his bending work. This front end of the machine also carries the controls for the bending operation.

When you stand in front facing the machine, the left side of the machine is to your left, the right side of the machine is to your right, and the back of the machine is farthest away from you.

**INSTALLING YOUR MACHINE**

Always use your Blue Boy Tube Bender on a solid, level floor, sturdy enough to support the weight of the machine properly.

Every Blue Boy Tube Bender is built using the same basic design. All machine frames (except Model 214MS) are equipped with three heavy duty casters which simplify leveling of the machine.

While all actions of Blue Boy Tube Benders are hydraulic, primary power is electric. The machine makes use of a hydraulic pump driven by an electric motor. The pump is always located on the cross channel, coupled to the motor shaft.

Two kinds of electric motors are available on customer specification: single-phase and three-phase.

**ELECTRICAL HOOK-UP, SINGLE PHASE**

All single-phase Blue Boy Tube Benders are factory pre-wired with a 3-prong "crow-foot" type plug. No receptacle is shipped with the machine. The standard receptacle for this plug is found in many commercial and industrial buildings. It is also readily obtained at hardware or electrical supply stores.

The receptacle should be wired into a junction box which supplies a full 220-volt, single-phase, 60-cycles, properly fused or breaker-protected. This receptacle hook-up is best done by a qualified electrician.

**CHECKING ROTATION DIRECTION — SINGLE-PHASE**

Rotation is pre-set at the factory for all single-phase motors. No rewiring should be necessary. However, if, for any reason, motor wiring is adjusted, immediately check the motor shaft to insure counter-clockwise rotation as viewed facing the motor.

**CAUTION:** If the shaft turns in the wrong direction, shut the machine off immediately! Prolonged running in clockwise rotation will badly damage the pump shaft seals. Unplug the machine.
and correct the internal motor wiring by referring to the motor schematic.

**ELECTRICAL HOOK-UP, THREE-PHASE**

Three-phase Benders are factory pre-wired with a standard bayonet-type plug. A receptacle for this plug is shipped with the machine. This receptacle should be wired into a junction box which supplies three-phase current, properly fused or breaker-protected. All Blue Boy Tube Benders must be wired to a full 220-volt, 60-cycle power source, unless special motors are specifically ordered. This receptacle hook-up is best done by a qualified electrician.

The bayonet plug can be put into the receptacle in only one position. You can determine the right position by matching the keyways on the plug and the receptacle. The three-phase plug must be turned after insertion into the receptacle to lock it into place. Turn it clockwise to lock it securely.

**CHECKING ROTATION DIRECTION – THREE-PHASE**

All Blue Boy Tube Benders are equipped with pumps which must rotate in a counter-clockwise direction as viewed by the operator while he is facing the motor. After electrical hook-up is complete and the machine reservoir has been checked for proper fluid level, start the machine momentarily by pushing the START switch. Immediately check the motor shaft for proper rotation direction.

**CAUTION:** If the shaft turns in the wrong direction, shut the machine off immediately! The pump does not lubricate itself when running backwards. Prolonged running in clockwise rotation will badly damage the pump shaft seals.

**TO CORRECT REVERSE ROTATION – THREE-PHASE**

First, make sure the machine is unplugged from wall receptacle. Direction of rotation in three-phase machines is determined by the relative lag of each phase. Open the starter box located on the front leg of the machine and reverse the leads to connections 1 and 3, located below the START-STOP switch. Do not alter any other wiring. Have your electrician do this if possible.

Restart the machine as above and again check the rotation which should now have correct direction.

**OPERATING YOUR MACHINE FOR THE FIRST TIME**

All Blue Boy Tube Benders make use of the rear pedestal of the machine as the hydraulic fluid reservoir. This reservoir is filled to the proper level at the factory.

Check the sight gauge on the rear pedestal to make sure that the reservoir is filled with fluid to the proper level. At any time that the level of fluid visible in the sight gauge is less than 1/2 of the way to the top of the gauge, refill the reservoir with one of the approved hydraulic fluids, listed on page 15 of this manual. NEVER start or operate the machine unless the hydraulic reservoir is filled to the proper level.

**MODEL FEATURES**

The various models of the Blue Boy Tube Benders are similar in design and operation. But the hydraulics and controls vary somewhat from
model to model. It is important that you become familiar with the particular model you are using prior to checking out the hydraulic circuits and machine operation.

Models vary first of all in the bending capacity or size range of tubing which they can bend. They also vary by model in swaging or hydra-sizing equipment. Lastly, they vary in mode of operation.

The first, or numeric, part of the model number indicates the bending capacity and expanding units of the model. The second, or alphabetic, part of the model number indicates the mode of operation.

The characteristics of each available model of the Blue Boy Tube Bender are given in the chart of model numbers which follows on the next page. Determine the model number of your Blue Boy before proceeding, and write it here in the space provided: _________________________

You may also want to circle the number on the chart on the next page.

MACHINE FAMILIARIZATION & OPERATION

After you have completed electrical set-up and acquainted yourself with its particular model features, you are ready to check out the machine.

Your Blue Boy Tube Bender has been thoroughly factory tested. All adjustments have been made for proper operation. However, it is good practice to familiarize yourself with hydraulic system pressures and machine operation. While you do this you will assure yourself that your machine is set up correctly.

POWER-BEYOND VALVE

Every Blue Boy Tube Bender with expanding capability has a Power-Beyond valve mounted near the rear of the machine. All hydraulic fluid output of the pump is directed to this valve which regulates pressure for the entire hydraulic system.

The valve has five ports, each with a hydraulic connection. However, design and appearance of the valve will vary somewhat among various machines and models due to different component suppliers.

The Power-Beyond valve always has a pressure gauge associated with it. This gauge is mounted on the rear of the top cylinder of the machine. Since the Power-Beyond valve regulates pressure for the whole machine, its output is applied directly to the top cylinder. Hence its output pressure may be read there. This is the basic pressure beyond the valve, thus the name, “Power-Beyond” valve.

Full pressure will register on the gauge only with the top cylinder fully extended or “bottomed out” against the back shoes.

CHECKING POWER-BEYOND VALVE ADJUSTMENT

To check operation of the Power-Beyond valve, proceed as follows:

1. Install a 5" radius ram die (never a bumper die) in your machine. Install a matching set of back shoes.

2. If you have an automatic or semi-automatic model (SA, SAL, or MSA), move the depth-of-bend limit switch to its farthest position beyond the end of the scale.

3. Now actuate the bend control valve (on Model MSA depress the forward foot pedal). The ram should extend fully and smoothly until the top cylinder bottoms out. NOTE: Do not stand in front of the machine. Read the pressure gauge near the rear of the top cylinder. The gauge should read 2800 to 3000 P.S.I. For Models 153 and 214 only, the system pressure is set at 3000 P.S.I. If the gauge does not register correctly within plus or minus 50 P.S.I., adjust the pressure following these steps:

   1. On or adjacent to the Power-Beyond valve there is a large acorn nut. This acorn nut covers Figure 7. Power-Beyond Valve
Table 1. Summary of Available Models and Options

<table>
<thead>
<tr>
<th>MODEL</th>
<th>TYPE OF EXPANDER</th>
<th>CLAMP-DOWN SWAGER ONLY</th>
<th>HYDRA-SIZER EXPANDER ONLY</th>
<th>TWO-WAY EXPANDER ONLY</th>
<th>BOTH SWAGER AND HYDRA-SIZER</th>
<th>CLAMP-DOWN SWAGER ONLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>100MS</td>
<td>110MS</td>
<td>120MS</td>
<td>130MS</td>
<td>150MS</td>
<td>153MS</td>
<td>214MS</td>
</tr>
<tr>
<td>100ML</td>
<td>110ML</td>
<td>120ML</td>
<td>130ML</td>
<td>150ML</td>
<td>153ML</td>
<td></td>
</tr>
<tr>
<td>100SA</td>
<td>110SA</td>
<td>120SA</td>
<td>130SA</td>
<td>150SA</td>
<td>153SA</td>
<td></td>
</tr>
<tr>
<td>100SAL</td>
<td>110SAL</td>
<td>120SAL</td>
<td>130SAL</td>
<td>150SAL</td>
<td>153SAL</td>
<td></td>
</tr>
<tr>
<td>100MSA</td>
<td>110MSA</td>
<td>120MSA</td>
<td>130MSA</td>
<td>150MSA</td>
<td>153MSA</td>
<td></td>
</tr>
</tbody>
</table>

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**MAXIMUM BENDING CAPACITIES**

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<tr>
<th>FRAME SIZE</th>
<th>BENDING CAPACITY</th>
</tr>
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<tbody>
<tr>
<td>2½&quot;</td>
<td>0 = 2½” Diameter Maximum</td>
</tr>
<tr>
<td>3’</td>
<td>3 = 3” Diameter Maximum</td>
</tr>
<tr>
<td>4’</td>
<td>4 = 4” Diameter Maximum</td>
</tr>
</tbody>
</table>

**OPERATING MODE**
- MS – Manual, hand operated
- ML – Manual, knee operated
- SA – Semi-Automatic, hand operated
- SAL – Semi-Automatic, knee operated
- MSA – Fully Automatic

**TYPES OF EXPANDERS**
- O – NONE
- 1 – K-100 Clamp-Down Swager
- 2 – P-100 Hydra-sizer Expander
- 3 – KP-100 Two-Way Expander
- 5 – Both K-100 Clamp-Down Swager and P-100 Hydra-sizer Expander

PANZITTA SALES & SERVICE
72 George Avenue
Wilkes-Barre, PA 18705
570-822-6720  800-822-6720
www.panzittasales.com
for the pressure-adjusting screw. Remove the acorn nut.

2. Loosen the lock nut. With a screwdriver, turn the threaded relief valve shaft clockwise to increase pressure or counter-clockwise to decrease pressure.

3. Tighten the lock nut holding the threaded screw in position.

4. Check the adjustment with another retraction and bottoming of the ram. Readjust if necessary, beginning at step 2, to get the correct reading.

5. Replace the acorn nut when you have made the correct adjustment.

SEQUENCE VALVE ADJUSTMENT

The sequence valve regulates the amount of pressure in the bottom cylinder. This cylinder holds pressure on the back shoes through two chains attached to its piston rod.

The sequence valve is located in the center of the left side of the machine. The sequence valve pressure gauge is mounted on the valve itself and is supplied with a pressure adjustment knob. To check sequence valve pressure, take the following steps:

1. Read the sequence valve gauge while running the ram die out to a depth-of-bend between 40° to 60°.

2. The sequence valve pressure should be between 1100 and 1200 P.S.I. in order to bend tubing of 2-1/2” or less diameter.

3. If adjustment is required, turn the adjustment knob clockwise to increase pressure, or counter-clockwise to decrease pressure.

3” TUBE BENDING PROCEDURE

High initial back gate pressure is required when bending 3” tubing in order to get good, uniform bends. Good bends will normally result only when 13 gauge (.095” wall thickness) tubing is used. 14 gauge may be used, but some tube damage or inconsistency may result.

When bending 3” diameter tubing, use the following special procedure. (NOTE: Use either the manually-operated front control valve or the forward and reverse foot pedals. DO NOT USE automatic push button controls.)

1. Install 3” bending dies. Set the sequence valve pressure between 1600 and 1800 P.S.I. by turning the adjustment knob clockwise to increase pressure. CAUTION: Do not attempt to turn beyond the jam nut position. Further adjustment may cause valve packaging.

2. Position the tubing in the bender and begin the bend. Be sure to use only the front control valve or the foot pedals.

3. At a depth of bend between 30° and 40° start to reduce sequence valve pressure by turning the adjustment knob counter-clockwise until you have a gauge reading of about 400 P.S.I.

4. If the bender bogs down, further reduce the sequence valve pressure on the back gates, and continue bending and reducing pressure until the desired depth of bend is reached (maximum depth of bend is 95°).

5. If further 3” diameter bends are required, repeat the procedure, starting with step one. Otherwise, set the sequence valve pressure between 1100 and 1200 P.S.I. which is normal setting for 2-1/2” and smaller diameter tubing.
FLOW CONTROL VALVE ADJUSTMENT

The flow control valve regulates gate return or back pressure on the bottom cylinder by creating a slight pressure differential between the top and bottom cylinders. This is the pressure that closes the back shoe gates after a bend. This valve is the metallic colored, hexagon shaped valve located on the center left side of the machine directly above the sequence valve. See figure 8. To set the gate return pressure:

1. Run the ram out until the ram die engages the back shoes and the gates open to between 40° and 50°.
2. Retract the ram.
3. At the instant the bottom cylinder bottoms out (about the moment when the ram die disengages from the back shoes) the pressure should register 250 to 400 P.S.I. on the sequence valve gauge.
4. If the pressure is not within these limits, loosen the lock nut.
5. Turn the screw clockwise to increase pressure, or counter-clockwise to decrease pressure.
6. If the back gates hesitate or remain open after disengaging, increase the flow control pressure.
7. If the back gates and ram hesitate when returning while still in contact, decrease the flow control pressure. If the back shoes dig into the tube when returning, decrease the flow control pressure.
8. After the proper setting is obtained, tighten the lock nut while holding the threaded shaft in position with your wrench.

SETTING SWAGER PRESSURE

Model 150 is equipped with a swager cylinder regulated by a four-port valve which has no associated pressure gauge. Pressure is set up on the swager cylinder from the standpoint of performance. To set pressure of the swager:

1. Install the flaring tool on the swager cylinder.
2. Select a pair of collar adaptors for 2-inch tubing. Place a collar adaptor in the stationary clamp block so that the flange is fully in its recess, and the adaptor collar is flush with the face of the clamp block.
3. Place a piece of 2-inch, 16 gauge (.065") tubing in the collar with 3 to 4 inches toward the expander cylinder.
4. Install the upper collar adaptor, making sure that it is aligned with the lower adaptor.
5. Clamp the tube firmly in place.
6. Actuate the swager valve (right rear of the machine) and flare the tubing until you have made a 1/4-inch lip.
7. Retract the cylinder. Remove the flaring tool and reverse it, putting the flat side toward the tube.
8. Apply pressure to the tube end, causing the tube to collapse in an "accordion" pattern.
9. If pressure is not sufficient to collapse the tube in accordion fashion, remove the acorn nut cover and increase pressure by turning the relief valve shaft clockwise with a screwdriver until there is enough pressure just to collapse the tube. Not all tubing will give a uniform accordion design.
10. Tighten the lock nut while holding the adjustment. Replace the acorn nut.

BACK GATE ALIGNMENT

The gates should be regularly checked to make sure they are level with each other and the guide plate, and are closing evenly. If the gates are not level with each other and the guide plate, tighten the shaft nuts as follows:
1. Seat shaft using a lead hammer.
2. Tighten shaft nut.
3. Clean Top Plate of dirt, grease, chips, burrs, hammer indentations, etc.

If the back gates do not close evenly, check tension on the two chains (located under the Body near the front) as follows to avoid severe bottom cylinder rod damage:
1. Fully retract and disengage the ram die from the back shoes.
2. If one of the chains has more slack, tighten the nut which fastens the chain connector to the tee-bar on the cylinder rod end. Both chains should be equally snug so that the gates work evenly.
3. If gates hesitate when closing, increase the

Figure 10. Back Gate Alignment
SWAGING

Always check to make sure you have a matched set of collars. Make sure you install the lower collar parting edge flush with the top of the fixed block. Install the upper collar to match. Misalignment of the collar slots with the block will result in broken collars. Be sure that the front lip on each collar is flush against the block. Space between the lip and the block will result in broken collars.

Thread all tooling securely onto the piston rod. Loose tooling will result in broken tools or stripped threads.

DO NOT expand into the collars. Expanding into the collars is the greatest single reason for broken collars. Make sure you have sufficient clearance.

HYDRA-SIZING

Be sure that you have the arbor screwed securely onto the piston rod. Check its tightness frequently during a series of operations. Because
2. If it does not, loosen the lock nut on the axis of the indicator arm, and move the arm until it is aligned with the 90° mark exactly.

3. Tighten the lock nut, holding the indicator arm in proper position relative to the depth-of-bend plate scale.

At the same time you adjust the depth-of-bend indicator, also adjust the return micro-switch as follows:

1. With gates and indicator arm both at 90°, swing the automatic stop pointer handle over until its limit-switch hits the striker plate. The pointer should read 90°.

2. Adjust the limit-switch, as required, by loosening the two screws which hold it in place. Slide it toward or away from the striker plate to get the proper position.

3. Now cycle the machine and check the operation of the limit switch.

4. If the limit-switch does not trip at exactly 90°, readjust it until it trips at the proper setting.

For Manual Machines

If you have a manual model (operating models MS and ML), adjust the depth-of-bend pointer as follows:

1. Check to insure the pointer is tightly bolted in the right back gate.

2. With the back gates set at 90° using a carpenter’s square, tap the pointer lightly, if necessary, to read exactly 90° on the depth-of-bend plate.

Troubleshooting

Properly used, your Blue Boy Tube Bender will give you continuous and reliable service. There are minor problems which may occur from time to time which you can readily correct, as well as good operating practices which help you avoid problems.

Familiarity with the use and operation of your Blue Boy includes knowledge of good operating practices, and trouble-shooting minor problems:

Bending

Always have a full set of dies in place whenever you operate the top cylinder. Operating without dies will cause severe damage.

Never extend the bending die beyond the back shoes. Such action can cause severe damage and may result in having to disassemble the gates in order to remove tubing. Avoid bending beyond the following depths with the bend radii given when possible:

- 130° with 3 1/2-inch bumper die
- 150° with 4-inch bumper die
- 160° with 5-inch ram die

If bends indicate die mismatch:

Check the back gate alignment as described on page 10.

If the Outside Diameter is flattened after bending:

The sequence valve bend pressure is too low. Adjust as described on page 8. NOTE: High sequence valve pressures can cause bottom cylinder rod damage if the chains do not have equal tension. Do not exceed recommended pressures. Be sure to check chain tension weekly to avoid problems.

If the tubing is crimped on the bend inside diameter:

Check back gate alignment as described on page 10. Increase sequence valve pressures as described on page 8. If this does not eliminate the problem, check the thickness of the tubing you are using. Minimum thicknesses for consistently good bends are:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2 1/4-inch</td>
<td>16-gauge, .065 inch</td>
</tr>
<tr>
<td>2 1/4- to 2 1/2-inch</td>
<td>14-gauge, .083 inch</td>
</tr>
<tr>
<td>3-inch</td>
<td>13-gauge, .095 inch</td>
</tr>
<tr>
<td>3 1/2-inch</td>
<td>12-gauge, .109 inch</td>
</tr>
<tr>
<td>4-inch</td>
<td>11-gauge, .120 inch</td>
</tr>
</tbody>
</table>

If the tubing is sucked in on the bend outside diameter:

While this is almost always an indication that tubing wall is too thin, also check back gate alignment, sequence and flow control pressures.

If the back gates do not close evenly:

Check chain tension as described on page 10.

If the back gates hesitate when closing or back shoes dig into the tube when closing:

Adjust the flow control valve as described on page 9.
bottom cylinder pressure by adjusting the flow control valve as previously described.

DEPTH-OF-BEND ADJUSTMENT

To check depth-of-bend adjustment, use a carpenter's square, or equivalent 90° square. Proceed as follows:

1. Run the gates out manually, holding the square against the back of the gates.
2. Jog the gates back and forth (using the foot switches on automatic models) until the square rests flush against the back of each gate. The back gates are now set physically at 90°.

For Automatic or Semi-Automatic Machines

If you have an automatic or semi-automatic machine (operating models SA, SAL, and MSA), adjust the depth-of-bend indicator as follows:

1. Check the depth-of-bend indicator which should read exactly 90°.

Figure 12. Depth-of-Bend Adjustment

Figure 11. Setting Bend Angle
the action in hydra-sizing is a pulling one, the tool
has a tendency to unthread itself. A loose arbor will
result in broken tools or stripped threads. ALWAYS
KEEP YOUR ARBOR AND SEGMENTS
LUBRICATED WITH LIGHT GREASE SPRAY.

CAUTION: Whenever inspecting or repairing
the electrical system, UNPLUG YOUR BENDER.

SOLENOID VALVE

The solenoid valve controls the direction of the
bending operation for automatic and semi-automatic
models. It is located near the rear of the machine
behind the motor. If the solenoid fails to sequence
properly, check as follows:

1. Operate the valve manually by using a
   pencil, or equivalent wooden or non-conducting
   rod to push the armature in. Manually
   operating the switch will often dislodge foreign
   particles which become trapped in the valve
   spool and may cause the spool to stick.
2. If the spool is free and the valve still does
   not sequence properly, check to see if the coil
   is short circuited by removing the protective
   cover.
3. If the spool is free and the coil is not
   shorted, check the automatic control box
   and limit-switches for loose or burnt wires.

AUTOMATIC CONTROL BOX

If one or more buttons do not work and you
have already inspected the solenoid valve:

1. Operate the foot switch.
2. If the foot switch works, check inside the
   control box for loose wires and to insure the
   relays are completely plugged in.
3. If the foot switch does not work, check
   inside the foot switch for loose wires.
4. If there are no apparent loose or burnt
   connections in either the box or foot switch,
   check the limit-switches for loose connections.
5. With power off, repair and reinstall loose
   wires. If no loose or burnt connections are
   evident, then the circuits of the automatic box
   should be checked for continuity using the
   electrical schematic given on page 24. This is
   often best performed by a qualified electrician.

NOISY MOTOR/PUMP COMBINATION

A whining or growling noise from the motor/
pump can be indicative of a damaged pump.
Continued operation can cause serious damage
to all components in the hydraulic system. Always
locate the source of unusual, new noises and
correct them immediately for extended service life.

1. Check for counter-clockwise shaft rotation
   as described on pages 4 and 5.
2. Check the fluid level. Low fluid level will
   cause pump cavitation.
3. Check to insure that the motor, pump, and
   pump foot mount are securely fastened to
   the mounting plate. If any one of the above
   is loose, remove the coupling guard and align
   the motor and pump shafts within .010 inches.
   Misalignment will cause reduced life due to
   excessive motor and/or pump bearing wear.
   After aligning, secure all mounting bolts,
   recheck alignment, and replace coupling guard.
4. Check for leakage from the pump. If
   leakage is noted, the pump seals should be
   replaced immediately to prevent damage to
   the balance of the system.
5. If none of the above steps eliminate unusual
   noises, the motor and/or pump bearings may
   be damaged and require replacement.
SMOKE FROM THE MOTOR
Check the motor box for shorted, frayed insulation, or loose connections. Replace wires and connections as required. Always check pump rotation after any motor repairs. If smoke continues, or if obviously from motor main case, motor may be worn out and need rebuilding or replacement.

SCHEDULED MAINTENANCE
An important part of getting maximum use and long-term reliability from your Blue Boy Tube Bender is to set up and adhere to a regular schedule of maintenance. It is a good idea to prepare a chart and a check-off list for regular maintenance functions. This may be kept at a conspicuous spot near the machine, such as on the wall adjoining the work area, and marked off by the person responsible as the maintenance functions are performed.

WEEKLY
1. Apply light grease spray (WD40 or LPS) to the hydra-sizer segment set and arbor.

MONTHLY
1. Grease the zirk fittings on the left barrel and the right barrel.
2. Grease the zirk fittings on each wheel caster (using SAE 90W in each instance).
3. Check the sight gauge and refill the reservoir as required.

DO NOT USE TRANSMISSION FLUID!
Transmission fluid often has additives which are harmful to the valve and the cylinder seals and often results in leaks. Use only one of the following approved oils in your machine’s hydraulic system:
- Mobil DTE 24
- Arco Eagle Oil RSO-X light
- Texaco Regal BR&O
- Pennzoil Medium #10
- Chevron OC Turbine 11

If there is a visual change in the color of your hydraulic oil, particularly if the oil develops a greyish appearance, completely drain the hydraulic system and reservoir, clean the filter, and refill the machine with fresh hydraulic oil.

4. Check all fittings for leaks and tighten as required. CAUTION: Teflon tape, known for its excellent lubricating properties, is also an excellent sealant. Unfortunately, because it lubricates so well, fittings sealed with teflon tape turn easily even after an effective seal has been accomplished. DO NOT attempt to bottom or effect a firm joint when using teflon tape. Overtightening will crack valve body and cylinder head castings causing costly repairs.

5. Spray lube the wear surfaces of all dies and shoes.
Table 2. Parts List

(See pages 17 and 18 for reference numbers.)

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PART NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 114</td>
<td>Top Cylinder</td>
</tr>
<tr>
<td>22. 100 220</td>
<td>Single-Phase Heaters (inside box)</td>
</tr>
<tr>
<td>153 215</td>
<td>Three-Phase Heaters (inside box)</td>
</tr>
<tr>
<td>23. 150 229</td>
<td>240 V Relay (inside box)</td>
</tr>
<tr>
<td>24. 150 226</td>
<td>Emergency Reverse Button</td>
</tr>
<tr>
<td>25. 150 228</td>
<td>Name Plate (Emergency Reverse)</td>
</tr>
<tr>
<td>26. 150 225</td>
<td>Automatic Button</td>
</tr>
<tr>
<td>27. 150 227</td>
<td>Name Plate (Automatic)</td>
</tr>
<tr>
<td>28. 150 201</td>
<td>Automatic Control Box Assembly</td>
</tr>
<tr>
<td>29. 100 217</td>
<td>Automatic Handle Assembly</td>
</tr>
<tr>
<td>30. 100 188</td>
<td>Depth-of-Bend Plate</td>
</tr>
<tr>
<td>31. 150 222</td>
<td>Limit Switch (forward)</td>
</tr>
<tr>
<td>32. 150 211</td>
<td>Striker Plate Arm Assembly</td>
</tr>
<tr>
<td>33. 100 141</td>
<td>Right Hand Gate Assembly</td>
</tr>
<tr>
<td>100 146</td>
<td>Left Hand Gate Assembly</td>
</tr>
<tr>
<td>34. 100 182</td>
<td>Chain Assembly</td>
</tr>
<tr>
<td>35. 100 183</td>
<td>Back Gate Chain</td>
</tr>
<tr>
<td>36. 100 184</td>
<td>Chain Connector</td>
</tr>
<tr>
<td>37. 100 123</td>
<td>Chain Return</td>
</tr>
<tr>
<td>38. 100 209</td>
<td>Chain Connector Lock Nut</td>
</tr>
<tr>
<td>39. 100 122</td>
<td>Bottom Cylinder Bracket</td>
</tr>
<tr>
<td>40. 100 121</td>
<td>Bottom Cylinder</td>
</tr>
<tr>
<td>41. 150 223</td>
<td>Limit Switch (reverse)</td>
</tr>
<tr>
<td>42. 100 118</td>
<td>Top Cylinder Bracket</td>
</tr>
<tr>
<td>43. 100 218</td>
<td>Pressure Gauge</td>
</tr>
<tr>
<td>44. 100 179</td>
<td>Card Clip Assembly</td>
</tr>
<tr>
<td>45. 100 190</td>
<td>Flow Control Valve</td>
</tr>
<tr>
<td>46. 100 177</td>
<td>Sequence Valve</td>
</tr>
<tr>
<td>47. 100 115</td>
<td>Pusher Block</td>
</tr>
<tr>
<td>48. 100 116</td>
<td>L-Block</td>
</tr>
<tr>
<td>49. 100 159</td>
<td>Gate Shaft</td>
</tr>
<tr>
<td>50. 100 117</td>
<td>Shaft Key (inside barrel)</td>
</tr>
<tr>
<td>51. 100 204</td>
<td>Shaft Nut</td>
</tr>
<tr>
<td>52. 100 207</td>
<td>Split Lockwasher</td>
</tr>
<tr>
<td>53. 100 135</td>
<td>Swivel Caster</td>
</tr>
<tr>
<td>54. 100 198</td>
<td>Single-Phase Electrical Plug Male</td>
</tr>
<tr>
<td>153 110</td>
<td>Three-Phase Electrical Plug Male</td>
</tr>
<tr>
<td>55. 153 111</td>
<td>Three-Phase Electrical Socket, Female</td>
</tr>
<tr>
<td>56. 100 200</td>
<td>Single-Phase Electrical Connector Assembly</td>
</tr>
<tr>
<td>153 112</td>
<td>Three-Phase Electrical Connector Assembly</td>
</tr>
<tr>
<td>57. 150 221</td>
<td>Dual Foot Pedal</td>
</tr>
<tr>
<td>58. 150 202</td>
<td>Solenoid Valve Assembly</td>
</tr>
<tr>
<td>59. 150 204</td>
<td>Solenoid Coil</td>
</tr>
<tr>
<td>60. 150 203</td>
<td>Solenoid Subplate</td>
</tr>
<tr>
<td>61. 150 205</td>
<td>U-Clamp</td>
</tr>
<tr>
<td>62. 100 131</td>
<td>Rigid Caster</td>
</tr>
<tr>
<td>63. 100 192</td>
<td>Sight Gauge Hose</td>
</tr>
<tr>
<td>64. 100 191</td>
<td>Breather Cap</td>
</tr>
<tr>
<td>65. 100 175</td>
<td>4-Way Power-Beyond Valve</td>
</tr>
</tbody>
</table>
WEEKLY MAINTENANCE
1. Grease.
2. Grease.
3. Check and clean.
4. Check chain tension.
5. Check Depth-of-Bend accuracy.

MONTHLY MAINTENANCE
1. Grease.
2. Grease.
3. Check and fill as required.
4. Check all fittings for leaks and tighten as required.
5. Spray lube.
Table 3. Key to Hydraulic Schematics

<table>
<thead>
<tr>
<th>ITEM</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reservoir</td>
</tr>
<tr>
<td>2</td>
<td>Suction Filter</td>
</tr>
<tr>
<td>3</td>
<td>Hydraulic Pump</td>
</tr>
<tr>
<td>4</td>
<td>Pump Mounting Bracket</td>
</tr>
<tr>
<td>5</td>
<td>Pump/Motor Coupling</td>
</tr>
<tr>
<td>6</td>
<td>Coupling Guard</td>
</tr>
<tr>
<td>7</td>
<td>Open Drip-Proof Electric Motor</td>
</tr>
<tr>
<td>8</td>
<td>Top Cylinder</td>
</tr>
<tr>
<td>9</td>
<td>Flow Control Valve</td>
</tr>
<tr>
<td>10</td>
<td>Sequence Valve</td>
</tr>
<tr>
<td>11</td>
<td>Pressure Gauge</td>
</tr>
<tr>
<td>12</td>
<td>Bottom Cylinder</td>
</tr>
<tr>
<td>13</td>
<td>4-Way Valve</td>
</tr>
<tr>
<td>14</td>
<td>4-Way Power-Beyond Valve</td>
</tr>
<tr>
<td>15</td>
<td>Expander Cylinder</td>
</tr>
<tr>
<td>16</td>
<td>2-Way Solenoid Valve</td>
</tr>
<tr>
<td>17</td>
<td>2-Way Subplate</td>
</tr>
<tr>
<td>18</td>
<td>4-Way Solenoid Valve</td>
</tr>
<tr>
<td>19</td>
<td>4-Way Subplate</td>
</tr>
<tr>
<td>20</td>
<td>Relief Valve</td>
</tr>
</tbody>
</table>

HOSE NUMBER CONNECTS THESE PARTS

1. Suction Filter ........................................ Pump Inlet
2. Bending Control Valve, “A” Port ............... Top Cylinder, Blind End
3. Bending Control Valve, “B” Port ............... Sequence Valve, Inlet Port
4. Expander Control Valve, “A” Port ............. Expander Cylinder, Blind End
5. Expander Control Valve, “B” Port ............. Expander Cylinder, Rod End
6. Bottom Cylinder, Blind End .................. Reservoir Tank
7. Pump Outlet ........................................ 1st Valve in System
8. Bottom Cylinder, Rod End ..................... Sequence Valve, Cylinder Port
9. Flow Control Valve ............................... Sequence Valve, Inlet Port
10. Power-Beyond Valve, Tank Port ............... Reservoir Tank
11. Power-Beyond Valve, Power-Beyond Port ...... Bending Control Valve, Inlet Port or Swager Control Valve, Tank Port
12. Bending Control Valve, Tank Port ............ Reservoir Tank
13. Power-Beyond Valve, Power Beyond Port ...... Swager Control Valve, Inlet Port
14. 2-Way Solenoid Valve, Inlet Port ............ Top Cylinder, Blind End
15. 2-Way Solenoid Valve, Tank Port .............. Reservoir Tank
16. Bending Control Valve, “A” Port ............ Top Cylinder, Blind End (Semi-Automatic Models Only)
17. Relief Valve ........................................ Bending Control Valve, Inlet Port
Figure 23. Hydraulic Schematics
Automatic Models

MODELS
150 MSA
153 MSA

MODELS
110 MSA
120 MSA
130 MSA

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Figure 24. Hydraulic Schematics

MODELS
150 MS, 150 ML
153 MS, 153 ML

MODELS
110 MS, 110 ML
120 MS, 120 ML
130 MS, 130 ML
214 MS

MODELS
100 MS, 100 ML

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Figure 25. Hydraulic Schematics
Semi-Automatic Models

MODELS
150 SA, 150 SAL
153 SA, 153 SAL

MODELS
110 SA, 110 SAL
120 SA, 120 SAL
130 SA, 130 SAL

MODELS
100 SA, 100 SAL
\(\text{Figure 26. Electrical Schematic}\\\text{Automatic Models}\)

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