

# Operating, Servicing, and Safety Manual

## Model # 2500 180° Hydraulic Bender



***CAUTION: Read and Understand***

These Operating, Servicing, and  
Safety Instructions, Before Using  
This Machine.

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# SAFETY

**The purpose of the safety section of this manual is to inform operators and maintenance personnel of the precautions to be taken while operating or servicing the machine. The following are a few basic guidelines to follow, but as with any type of machinery good judgment and a safe attitude should be applied at all times.**

1. Always disconnect power, lock-out and tag-out machine per OSHA regulations before attempting to service this machine.
2. Always wear safety glasses or other approved eye protection while operating or servicing the machine.
3. Keep all body parts and any foreign objects away from moving parts. Do not reach into the machine without first disconnecting all power sources.
4. Do not attempt to override any safety device on the machine.
5. Do not operate the machine if it has been damaged or is not operating properly.
6. Do not wear jewelry (watches, rings, necklaces, etc.), or loose fitting clothing while operating or servicing the machine.
7. The machine should only be operated or serviced by properly trained, authorized personnel.
8. Replacement parts should have the same specification and operation as the original parts on the machine.
9. All guards and covers must be in place before operating the machine.
10. Before starting the machine be sure it is set up properly.
11. Make sure the machine is properly grounded.
12. The machine and work area should be kept neat and clean.
13. Do not operate or service any machine while under the influence of drugs or alcohol.

**NOTE: THESE SAFETY RULES ARE FOR YOUR BENEFIT TO HELP PREVENT INJURY TO YOURSELF AND/OR YOUR CO-WORKERS. REVIEW ALL SETUP AND OPERATING PROCEDURES, WHETHER COVERED OR NOT, IN THIS MANUAL TO HELP INSURE **SAFE OPERATION** OF THE MACHINE.**

## **HYDRAULIC SAFETY PRECAUTIONS**

### **WARNING**

#### ***General Operation***

- All WARNING statements must be carefully observed to help prevent personal injury.
- Before operating the pump, all hose connections must be tightened with the proper tools. Do not over tighten. Connections should only be tightened securely and leak-free. Over tightening can cause premature thread failure or high pressure fittings to split at pressures lower than their rated capacities.
- Should a hydraulic hose ever rupture, burst, or need to be disconnected, immediately shut off the pump and release all pressure. Never attempt to grasp a leaking pressurized hose with your hands. The force of escaping hydraulic fluid could cause serious injury.
- Do not subject the hose to potential hazard such as fire, sharp surfaces, extreme heat or cold or heavy impact. Do not allow the hose to be altered or kink, twist, curl, crush, cut, or bend so tightly that the fluid flow within the hose is blocked or reduced. Periodically inspect the hose for wear, because any of these condition's can damage the hose and possibly result in personal injury.
- Do not use the hose to move attached equipment. Stress can damage hose and possibly cause personal injury.
- Hose material and coupler seals must be compatible with the hydraulic fluid used. Hoses also must not come in contact with corrosive materials such as creosote-impregnated objects and some paints. Consult the manufacturer before painting a hose. Hose deterioration due to corrosive materials can result in personal injury. Never paint the couplers.
- Inspect machine for wear, damage, and correct function before each use. Do not use machinery that is not in proper working order, but repair or replace it as necessary.
- Replace worn or damaged safety decals.
- Modification of a product requires written Power Team authorization.
- Use only components with the same pressure rating when assembling a system or machine.

#### ***Pump***

- Do not exceed the hydraulic pressure rating noted on the pump data plate or tamper with the internal high pressure relief valve. Creating pressure beyond the rated pressure can result in personal injury.
- Before replenishing the fluid level, retract the system to prevent overfilling the pump reservoir. An overfill can cause personal injury due to excess reservoir pressure create when cylinders are retracted.

#### ***Air Supply***

- Shut off and disconnect the air supply when the pump is not in use or before breaking any connections in the system.

## ***PREPARATION & SET-UP***

#### ***Air Supply Hook-Up***

Remove the thread protector from the air inlet of the pump. Select and install the threaded fittings which are compatible with your air supply fittings. The air supply should be 20 CFM (.57 M3/min.) and 100 PSI (7 BAR) at the pump to obtain the rated hydraulic pressure. Air pressure should be regulated to a maximum of 140 PSI (9 BAR). Secure your pump fitting to the air supply.

**WARNING:** If improperly used, pressurized equipment can be potentially hazardous. Therefore:

- Hydraulic connections must be securely fastened before building pressure in the system.
- Release all system pressure before loosening any hydraulic connection in the system.

#### ***Venting the Reservoir***

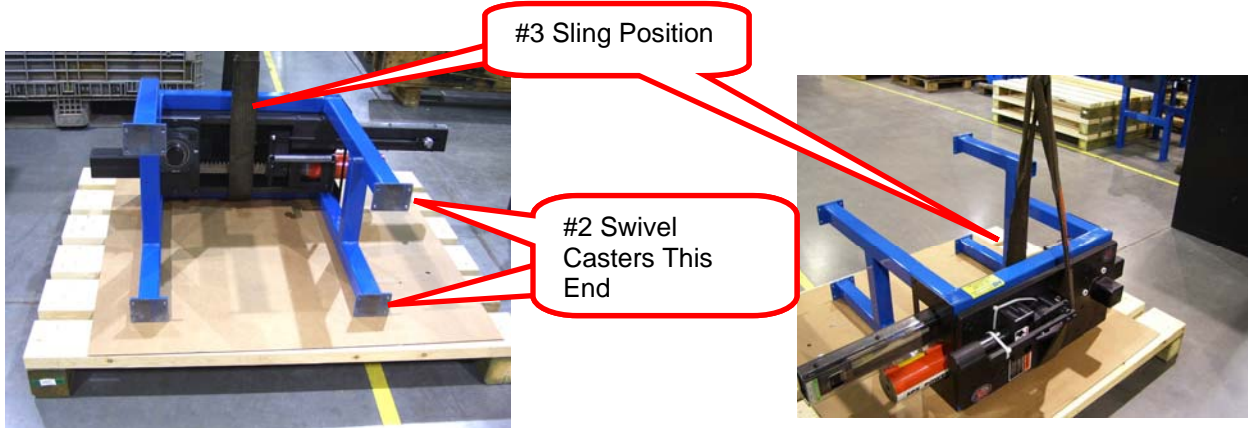
To improve hydraulic fluid delivery and increase useable hydraulic fluid capacity, remove shipping plug and install filler/vent cap before using the pump.

## **#2500 BENDER CONTENTS**

- 1ea Main bender assembly mounted to stand
- 1ea Swivel work table
- 1ea Rectangle shaped shelf
- 1ea Angle shaped shelf
- 2ea Rigid casters
- 2ea Swivel Casters, Locking
- 16ea 5/16-18 x 3/4 Hex Bolt (for mounting casters)
- 16ea 5/16-18 Hex Nut (for mounting casters)
- 16ea 5/16 Lock washer (for mounting casters)
- 16ea 5/16 Flat washer (for mounting casters)
- 5ea “U” spacers for pressure roller shaft, 1” thick
- 1ea #2500-300 Small adjustable Saddle
- 1ea #2500-301 Medium adjustable Saddle
- 1ea Operating, Servicing, and Safety Manual

# UNCRATE & SETUP

1. Remove shrink wrap and upper crating structure. Remove the two black shelves and work table from the skid. Locate the box that contains the casters.
2. Attach the casters to the mounting plates using the supplied hardware. The swivel casters should be mounted on the same end of the machine as the hydraulic cylinder and digital readout.



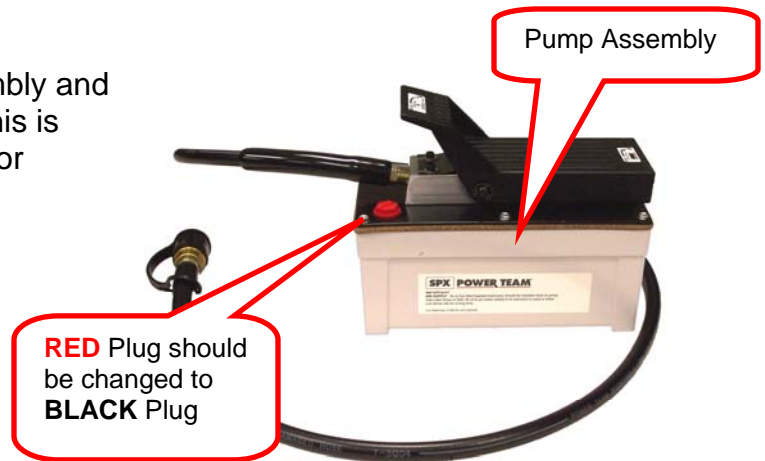
3. Once the casters are installed, use a sling positioned as shown above, to lift the machine onto the casters. **CAUTION: MACHINE IS HEAVY AND MAY CAUSE DAMAGE OR INJURY IF CARE IS NOT USED.**
4. Install the bottom shelf (with angled side) onto the bottom of the frame. It will rest on the caster mounting plates. The bent sides point up. Install the upper shelf (rectangle shaped) next. This one also should have the bent sides pointing up. You will have to tilt the shelves to fit in between the legs and then lay them flat.



5. Slip the swivel work table into the open end of the square tube leg.

## HYDRAULIC SYSTEM

1. Remove the **RED Plug** in the pump assembly and replace with the supplied **BLACK plug**. This is the reservoir venting system and damage or inoperability may result if not changed out.



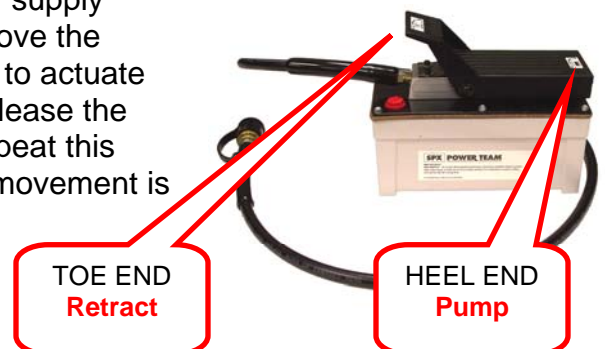
2. Attach the hydraulic hose to the pump. Attach an air line fitting for your shop air to other end of the pump. Be sure to use a quality thread sealer on both connections



3. Push the pump foot pedal to the release position (TOE END) to relieve all internal pressure. Push the MALE hose end, from the pump, into the FEMALE Cylinder fitting & then thread the retainer collar hand tight. This procedure will insure that the male & female fittings positively seat against each other, eliminating any possibility of air locking. Failing to follow this procedure may cause the cylinder to not retract and / or leak.

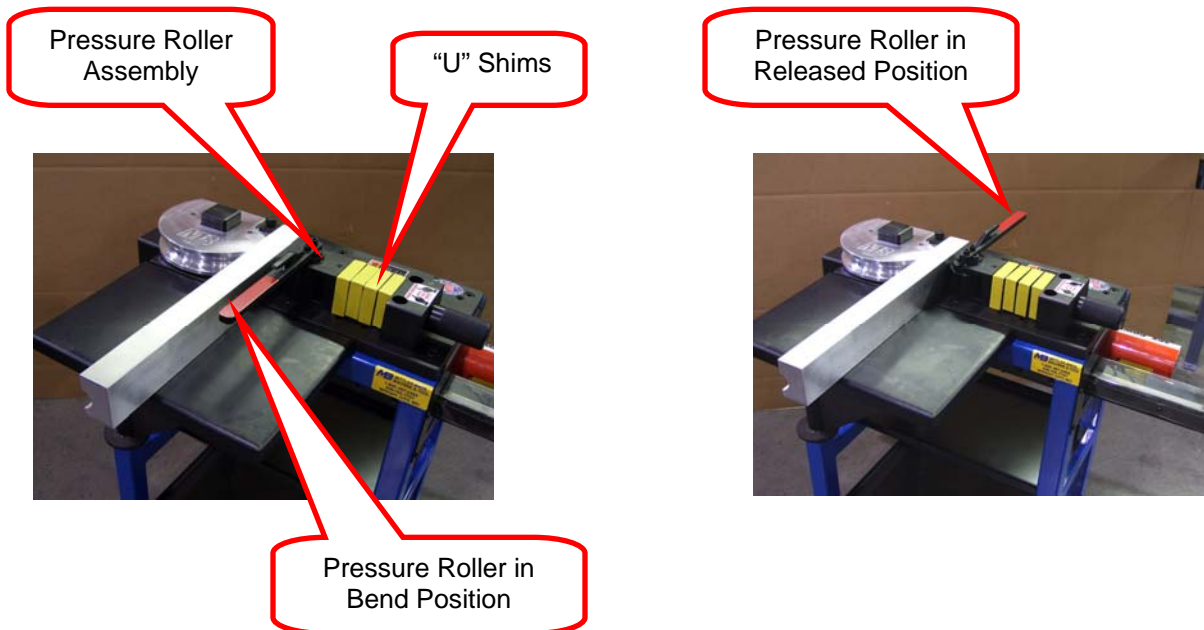
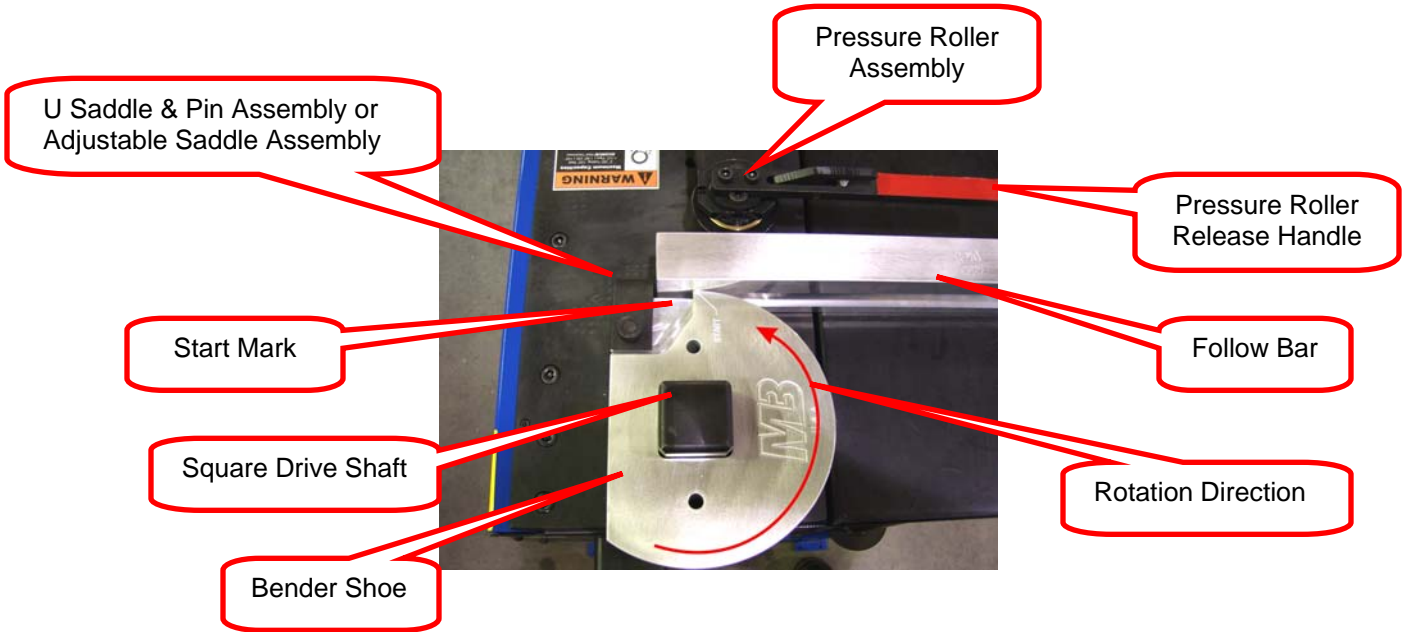


4. **BLEED THE CYLINDER**; Connect a compressed air supply (90PSI) to the pump. Elevate the pump and hose above the cylinder. Push the hydraulic pump pedal **HEEL END** to actuate the cylinder. Run the cylinder out about half way. Release the pump by pressing on the **TOE END** of the pedal. Repeat this process three or four times or until the ram cylinder movement is smooth.





## GETTING READY TO BEND



1. Slide the main **Bender Shoe** over the **Square Drive Shaft**. Be sure that the **MB** and **START** are facing up and that they are positioned as shown above. The **START** engraving should be closest to the **Pressure Roller Assembly**.
2. Position the **Pressure Roller Assembly** to the correct position by adding or subtracting "U" shims until the follow bar is almost touching the bender shoe, **Be Sure the Pressure Release Handle Is in the Bend Position as Shown**.

3. Move the **Pressure Release Handle** to the RELEASED position and place the tubing (which has already been marked with the bend start points) into the **Bender Shoe** with the first bend start mark aligned with the **START** arrow on the **Bender Shoe**. Slip the **“U” Saddle** or **Adjustable Saddle** over the tubing and the **Bender Shoe**. Align the holes and install the pin, if using the adjustable saddle, tighten down the clamp knob.  
**CAUTION: THE PIN MUST BE COMPLETELY THROUGH BOTH SIDES OF THE “U” SADDLE! FAILURE TO HAVE PIN COMPLETELY INSTALLED MAY RESULT IN EQUIPMENT DAMAGE AND / OR PERSONEL INJURY!**
4. Align the front edge of the **Follow Bar** with the **START** arrow on the **Bender Shoe**. Be sure the start mark on the tubing is still lined up with the **START** arrow as well. Run the **Pressure Roller Adjusting Shaft** up to the Follow Bar.
5. **PRESSURE ROLLER ADJUSTMENT:** Move the Pressure Roller Release Handle into the BEND position being sure that it locks into place.
6. Start bending by stepping on the foot pedal. Go slowly and stop as soon as all of the slack in the shoe, follow bar & pressure roller is taken up.

## ***DIGITAL READOUT OPERATION***

1. Turn **“ON”** the **Digital Readout Assembly**.
2. Press the **“in/mm”** button so that the **“mm”** scale is readable. **NOTE:** Using the **“mm”** scale will provide a one degree of bend readout for each **“mm”** of indicator travel, for example, a 45mm reading is equivalent to 45° of bend.
3. Press the **“zero”** button when you have taken all of the slack up (**step 6 above**). This will give you an accurate degree reading.



Inch / MM  
Button

ON / Zero  
Button

## ***TUBING SPRING BACK***

The tubing material, wall thickness and amount of bend angle will all influence the amount of spring-back that must be allowed for.

It is best to test a sample piece of tubing to determine the “spring-back” before making your first bend with the type tubing material, wall thickness, and bend angle. Example: Make a 90-degree bend (digital readout reading 90-degrees) and remove from the shoe. Position the bent tube on the flat table top of bender with bent angle pointing up and measure the angle of the bend. If the bend is 87-degrees, then 3-degrees of spring-back needs to be included, thus bending to 93-degrees will produce a 90-degree finished bend.

**PLEASE CONTACT US IF YOU NEED FURTHER ASSISTANCE.**

# CORRECTED MATHEMATICAL FORMULA FOR HYDRAULIC TUBING BENDER

The following formula should be used to determine the start point for each required bend.

The example will be for a Double Bevel Bend

- L1 = 26                    25 degree angle
- L2 = 15                   65 degree angle
- L3 = 39                   65 degree angle
- L4 = 15                   25 degree angle
- L5 = 26

Bend #1 Start Point:

$$\begin{aligned} &L1 - \frac{1}{2} \text{ developed length (DL25)} - \frac{1}{2} \text{ (Gain)} \\ &26'' - \frac{1}{2} (3.064'') - \frac{1}{2} (.050) \\ &26'' - 1.532'' - .025'' = 24.448 \end{aligned}$$

Bend #2 Start Point:

$$\begin{aligned} &L1 + L2 - \text{Gain 1} - \frac{1}{2} \text{ (DL65)} - \frac{1}{2} \text{ (Gain 2)} \\ &26 + 15 - .050 - \frac{1}{2} (7.941) - \frac{1}{2} (.973'') \\ &26 + 15 - .050 - 3.9705 - .48895 = 36.491 \end{aligned}$$

Bend #3 Start Point:

$$\begin{aligned} &L1 + L2 + L3 - \text{Gain 1} - \text{Gain 2} - \frac{1}{2} \text{ (DL65)} - \frac{1}{2} \text{ (Gain 3)} \\ &26 + 15 + 39 - .050'' - .978 - \frac{1}{2}(7.941) - \frac{1}{2} (.972'') \\ &26 + 15 + 39 - .050'' - .978 - 3.9705 - 0.486 = 74.515 \end{aligned}$$

Bend #4 Start Point:

$$\begin{aligned} &L1 + L2 + L3 + L4 - \text{Gain 1} - \text{Gain 2} - \text{Gain 3} - \frac{1}{2} \text{ (DL25)} - \frac{1}{2} \text{ (Gain 4)} \\ &26 + 15 + 39 + 15 - .050 - .978 - .978 - \frac{1}{2} (3.054) - \frac{1}{2} (0.497) \\ &26 + 15 + 39 + 15 - .050 - .978 - .978 - 1.527 - 0.025 = 91.442 \end{aligned}$$

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### GAIN FACTORS

Degree of Bend	Multiplier
1	.0000
2	.0000
3	.0000
4	.0000
5	.0000
6	.0001
7	.0001
8	.0003
9	.0003
10	.0005
11	.0006
12	.0008
13	.0010
14	.0013
15	.0015
16	.0018
17	.0022
18	.0026
19	.0031
20	.0036
21	.0042
22	.0048
23	.0055
24	.0062
25	.0071
26	.0079
27	.0090
28	.0100
29	.0111
30	.0126

Degree of Bend	Multiplier
31	.0136
32	.0150
33	.0165
34	.0181
35	.0197
36	.0215
37	.0234
38	.0254
39	.0276
40	.0298
41	.0322
42	.0347
43	.0373
44	.0400
45	.0430
46	.0461
47	.0493
48	.0527
49	.0562
50	.0600
51	.0637
52	.0679
53	.0721
54	.0766
55	.0812
56	.0860
57	.0911
58	.0963
59	.1018
60	.1075

Degree of Bend	Multiplier
61	.1134
62	.1196
63	.1260
64	.1327
65	.1397
66	.1469
67	.1544
68	.1622
69	.1703
70	.1787
71	.1874
72	.1964
73	.2058
74	.2156
75	.2257
76	.2361
77	.2470
78	.2582
79	.2699
80	.2891
81	.2944
82	.3074
83	.3208
84	.3347
85	.3491
86	.3640
87	.3795
88	.3955
89	.4121
90	.4292

GAIN = GAIN FACTOR FOR DEGREE OF BEND X RADIUS

EXAMPLE:

FIND THE GAIN FOR AN 85 DEGREE BEND  
USING A 7 INCH RADIUS

$$\text{GAIN} = .3491 \times 7 = 2.4437 \text{ OR } 2 \frac{7}{16}$$

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**TABLE FOR OFFSET MULTIPLIER**

Degree of Bend	Multiplier
1	57.30
2	28.65
3	19.11
4	14.33
5	11.47
6	9.57
7	8.21
8	7.18
9	6.39
10	5.76
11	5.24
12	4.81
13	4.45
14	4.13
15	3.86
16	3.63
17	3.42
18	3.24
19	3.07
20	2.92
21	2.79
22	2.67
23	2.56
24	2.46

Degree of Bend	Multiplier
25	2.37
26	2.28
27	2.20
28	2.13
29	2.06
30	2.00
31	1.94
32	1.89
33	1.84
34	1.79
35	1.74
36	1.70
37	1.66
38	1.62
39	1.59
40	1.56
41	1.52
42	1.49
43	1.46
44	1.44
45	1.41
46	1.39
47	1.37
48	1.35

**DISTANCE BETWEEN BENDS = OFFSET MULTIPLIER FOR DEGREE x OFFSET HEIGHT**

**EXAMPLE:**

**FIND THE DISTANCE BETWEEN BENDS FOR A  
15 INCH OFFSET USING 25 DEGREE BENDS.**

**DISTANCE BETWEEN BENDS = 2.37 X 15 = 35.55 OR 35 9/16**

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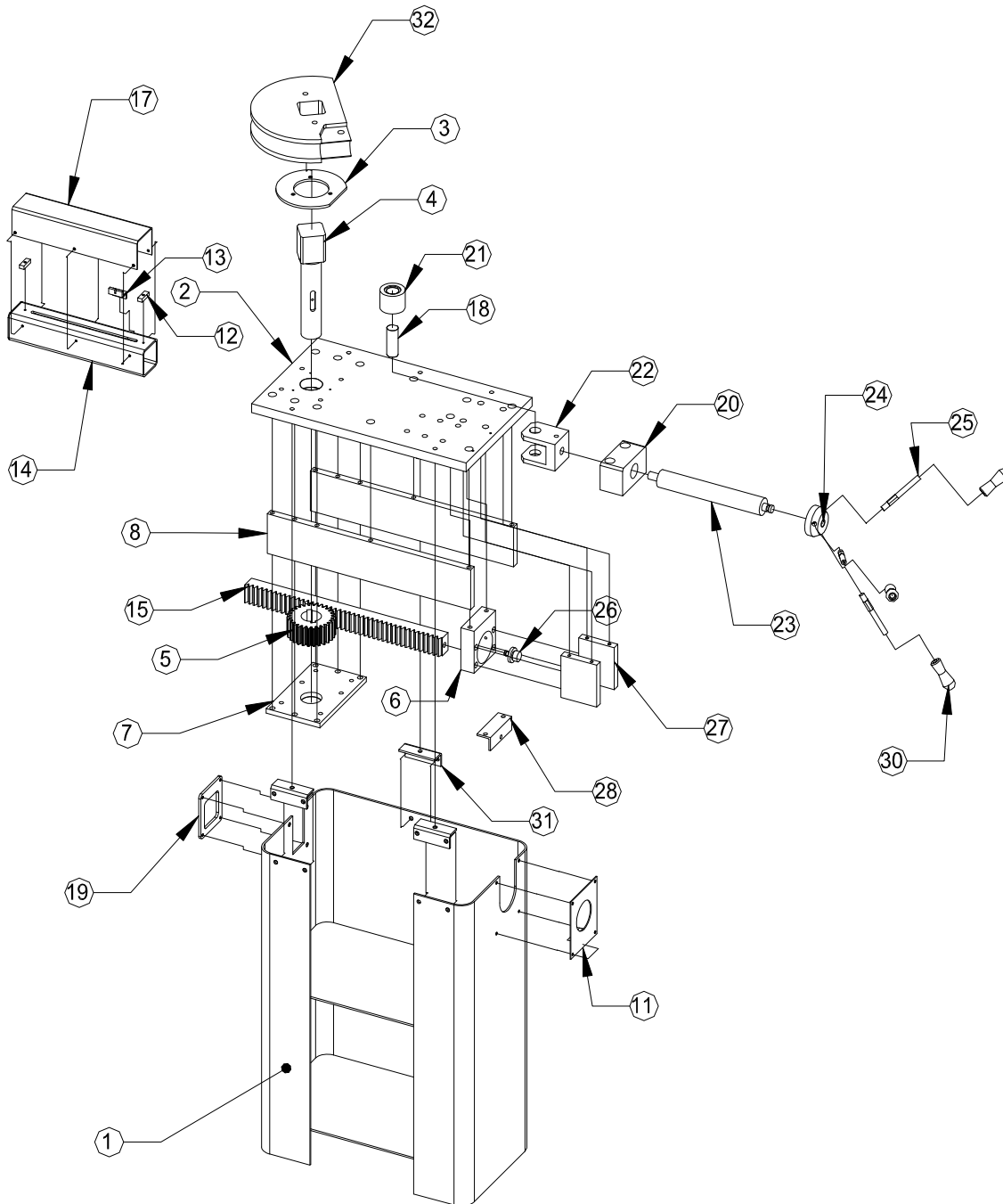
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**Drawing Is Not Current But Should Provide a Reference if Replacement Parts Are Needed.**



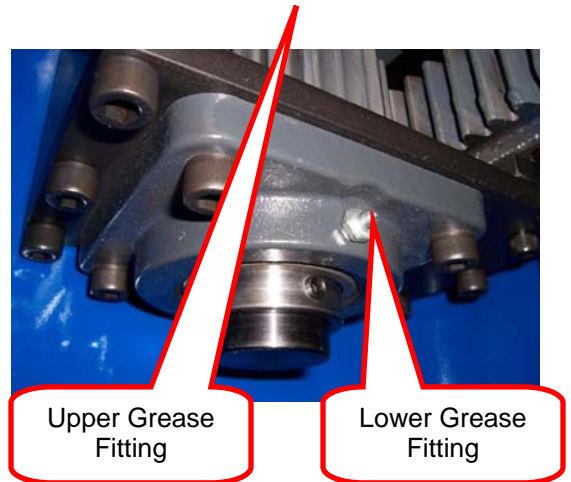
ITEM NO.	PART NUMBER	QTY.
1	2500-507 Stand for Bender (Optional)	1
2	2500-004 Main Base Plate	1
3	2500-011 Delrin Spacer Plate	1
4	2500-014 Square Drive Shaft	1
5	2500-510 2 Pt. Gear	1
6	2500-010 Mounting Block	1
7	2500-012 Bottom Support Plate	1
8	2500-013 Stiffening Bars	2
9	2500-015 Gear Rack Support Block	1
10	2500-506 Lamina, 3/8 x 2 x 48	1
11	2500-019 Cover Plate (Hydra. Cyl.)	1
12	2500-024 Mnt Pcs For Digital Scale	2
13	2500-020 Adjustable Bracket	1
14	2500-021 Gear Rack Cover	1
15	2500-504 Gear Rack	1
16	2500-023 Cap (Gear Box Tube)	1
17	2500-025 Lexan Cover Guard	1
18	2500-005 Shaft for Cam Follower	1
19	2500-022 Mounting Plate	1
20	2500-001 Acme Screw Mounting Block	1
21	2500-512 Cam Follower Bearing	1
22	2500-006 Roller Clevis	1
23	2500-502 Acme Screw	1
24	2500-017 Alum. Knob	1
25	2500-018 Hex Rods For Alum. Handles	3
26	2500-008 Connector	1
27	2500-009 Gusset (Hydra. Cyl. Block)	2
28	2500-003 Spring Return Bracket - Long	1
29	2500-002 Spring Return Bracket - Short	1
30	2500-027 Alum. Handle	3
31	2500-026 Angle Iron, 1.5 x 1.5 x 4	3
32	2500.S Pipe Shoe	1

# MAINTANANCE

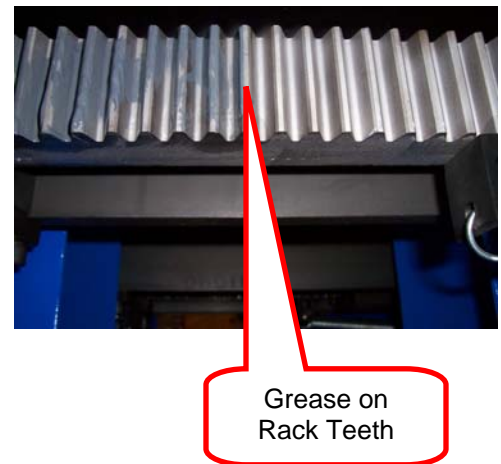
## WARNING

Be sure the cylinder is completely retracted and that the hydraulic pump is disconnected before servicing this machine.

- There are two bearing blocks that are greaseable. These can be accessed from under the top by looking in from the opening. The lower fitting is visible and the upper fitting is up between the frame rails of the bender. A few pumps of high quality grease every month is recommended for average use. If you are using the bender on a more aggressive schedule, shorten the intervals between greasing.



- Using the same grease that you use for the bearings brush a small amount on the rack teeth when ever the bearings are greased. If the rack teeth seem dirty or gritty clean them before applying the grease.



Recommended Hydraulic Oil: **AW46** with Foam Suppressant



Digital Read Out Assembly Battery: **SR44 1.5 Volt**





## **OPTIONAL EQUIPMENT**

### **180 DEGREE BENDER SHOE LIST**

<b>ROUND TUBE SIZE</b>	<b>C/L RADIUS</b>	<b>PART #</b>
3/4"	4"	2500-S09
1"	4"	2500-S08
1-1/8"	4"	2500-S07
1-1/4"	5"	2500-S06
1-3/8"	5"	2500-S05
1-1/2"	6"	2500-S04
1-5/8"	7"	2500-S03
1-3/4"	7"	2500-S02
1-3/4"	8"	2500-S01
2"	8"	2500-S00
<b>SQUARE TUBE SIZE</b>		
3/4"	4"	2500-S11
1"	4"	2500-S10
1-1/8"	4"	2500-S12
1-1/4"	5"	2500-S13
1-1/2"	6"	2500-S14
1-3/4"	7"	2500-S15
1-3/4"	8"	2500-S16
2"	8"	2500-S18
<b>PIPE SIZE</b>		
1"	5"	2500-S30
1-1/4"	6"	2500-S31
1-1/2"	8"	2500-S32

# Adjustable Saddles For 2500 180° Hydraulic Bender

5/8" TO 1-3/8" OD. Adjustable Saddle.....2500-300

1-1/2" TO 1-3/4" OD. Adjustable Saddle...2500-301



This new style saddle eliminates the clutter of a saddle for every size. Two saddles cover all sizes of **round** & **square** tube from 5/8" to 1-3/4". The adjustable locking block allows you to securely snug the tubing to the shoe and give you consistent compound and multi plane bends. This new design also eliminates the stuck saddle syndrome. This is where the tubing has wedged the saddle and pin and makes it hard to release the tubing from the saddle after bending.

## Bend Aligner

End material waste and slow trial & error fabrication. Excellent addition if you have our **BEND CALCULATOR PRO** software. This great accessory assures precise axial alignment of notches and bends. Add the finishing touch to your *Ultimate Notcher* and your *Bender!*

Notch & Bend Aligner Complete w/ SmartTool.....1800-STA

Bend Aligner Mount Only.....1800-A



## Bend Calculator Software

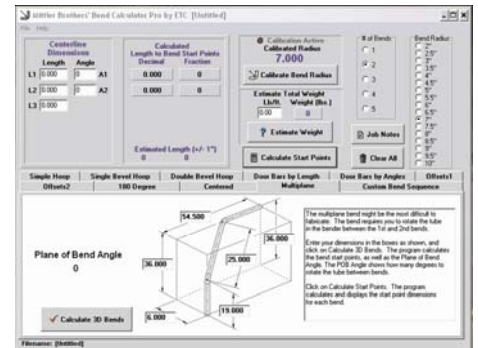
Point and Click simplicity allows you to calculate bend information for door bars, hoops & support tubes. You will be able to locate the bend start locations as well as calculate the cut lengths. *A high-light of the PRO version is the ability to calculate multi-plane bends as shown to the right.*

*This easy to use Windows based software is a fabricators dream!*

Calculate pipe and tube bends like the Pros. Choose a bend radius from 2" to 10", in 1/2" increments. You also have the ability to fine tune the radius to exactly what your bender creates.

**Don't waste your time and material guessing where and how much to bend! DO IT RIGHT THE FIRST TIME.**

Easy to follow screens and a comprehensive help file make BEND CALCULATOR PRO the most powerful and simplest to use bending program available.



**Bend Calculator Pro Software.....900-501-2**



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