Rusch Machine & Design, Inc.

OPERATING MANUAL
FOR THE MODEL #325 PROGRAMABLE
ELECTRIC TUBE \ PIPE BENDER

SERVICE BULLETIN FOR ALL RMD TUBE BENDERS
4-MAR-04

When bending with tooling larger than 4" center line radius and any material larger than 1-1/4" pipe, it is very important that the forming die which fits on the spindle is bolted down using the supplied bolt down holes in the dies.

Failure to do so can result in the tooling lifting off of the spindle applying an excess load to the drive pins resulting in pin failure , voiding the warranty.

If you have questions or concerns please contact the factory.

1) IMPORTANT INFORMATION AND CONTACTS

Machine Information

Model #325
220VAC, 1 Phase + Neutral, 20 Amp 60Hz
800 lbs/ 363 kg
Maximum Sound level < 70 db

Distributed By:
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2) INTRODUCTION

i) You have made a practical choice in purchasing an RMD, INC. Model #325 Fully Programmable Bending Machine. It has been carefully built of high quality materials and designed to give many years of efficient service. The simplicity of design and minimum effort required to operate the machine contributes towards meeting schedules and producing greater profits.

ii) The Model #325 is an electric powered “Rotary Draw” bending machine. To bend material, a bending die and counter die are required. The material is hooked by the bending dies’ hook arm and is powerfully rotated in the clockwise direction. As the bending die rotates, the counter die remains stationary, forcing the material to conform to the radius and shape of the bending die.

iii) The Model #325 Bending Machine you have purchased is built of solid steel ensuring maximum rigidity. Tongue and groove design with grade 8 bolts throughout provides very high rigidity and stability.

iv) In the next chapter of this manual, there are safety-related descriptions for attention. These matters for attention contain the essential information to the operators while operating, and maintaining. Failure to follow these instructions may result in great damage to the machine or the operator.

3) SAFETY

a) Safety Guide

i) Read this manual before operating the machine. Carefully read the safety guide for doing safety work.

ii) Keep this manual handy for answers to any questions you may have. Store it near the machine to be usable in the future.

iii) Operators and maintenance workers shall not depend on only the safety equipment. They shall familiarize and understand the machine before operating and maintaining the machine.

b) Safety Precautions

i) Before being engaged in operating this machine, please read and understand the entire instruction manual, and follow all the warning signs labeled on the machine. Do not disfigure or remove.

ii) During operation, please do not expose any of your body parts near to the moving parts of the machine.

iii) Never touch workpiece, tooling or spindle unless the spindle stops completely.

iv) Before operation, make sure all the guards are in place.

v) Before starting the machine, make sure that all workpiece and die tooling are properly installed to avoid accidents.

vi) Operators should wear safety glasses, and remove rings, watches, jewelry and loose fitting clothing for their own protection while operating the machine.

vii) Never touch switches or controls with wet hands.

viii) Cut off the power immediately if there is electricity power breakdown.

ix) Before proceeding with the daily operation, the machine should be warmed up for approximately one minute.

x) There must be no obstacles to obstruct the operator while in the working area

xi) If machine is going to be left unattended, the operator should turn power off until the beginning of the next task.

xii) Please do not put any tools or measuring devices on the moving parts of the machine, or on the control panel.

xiii) Identify and make sure of the function of the switches or buttons on the control panel, and then proceed to operate them.

4) UNPACKING

i) After receiving machine, visually inspect for damage. Any damage should be reported immediately to RMD, Inc. before power is applied to machine.

ii) The machine weight is approximately 800 pounds. Extreme care should be taken when unloading from skid. A forklift is the best way to remove machine from the skid.

5) INSTALLING

- **i)** Once unloaded and wheels and casters attached, the machine can be wheeled to the operator's desired location.
- **ii)** Be sure to rest machine on a flat surface
- **iii)** The electrical connection must be inspected by a certified electrician, and the incoming voltage must be verified to be correct before the machine is turned on. Have a certified electrician verify that the power source is correct for the machine's specifications, and that the plug is correct and properly grounded to an earth ground. The warranty is void if incorrect power is supplied to the machine.
- **iv)** The machine is supplied with a lockable disconnect switch, the machine must be locked out for any maintenance work.

6) POWER REQUIREMENTS

AC Voltage	20 Amps	220V (208-240)	(Single Phase)
AC Voltage		480v	(3 phase)
AC Voltage		575v	(3 phase)

Frequency 60 Hz

The power source cable should be protected by fuse or breaker, and dedicated to this machine only.

7) MAINTAINANCE

- **i)** The gearbox oil should be checked monthly, and changed every three years with 80 W90 gear lube.
- **ii)** Check periodically for leaks. If a leak is detected, consult RMD, Inc.
- **iii)** On very hot days, gear oil may drip from the breather; this is normal expansion of the oil.
- **iv)** Be sure to keep the slide ways and lead screws lubricated with light hydraulic oil or equivalent.
- **v)** The only grease zerk on the machine feeds the main spindle bearing. Grease this zerk every six months with only one pump from a standard grease gun.
- **vi)** Check for any worn or damaged parts and replace immediately.

8) OPERATION

a) Programmer Overview

i) The Model 325 utilizes a fully programmable touch screen operator interface. The unique operator interface allows you to write and save 140 programs with 10 bends per program. Operation is extremely simple to learn. Simple foot pedal controls allow you to easily produce fast and accurate bends. The following instructions will walk you through the basic functions.

ii) Be sure to follow the dry running instructions to familiarize yourself with all the functions of the control before any actual bending of material is performed.

b) Machine start-up and Homing

i) Turn the main power switch to the "ON" position

ii) It takes about 1 Min for the programmer to boot up. The machine has been homed from the factory and does not need to be re-homed unless the encoder or drive motor needs servicing.

iii) The programmer will display the **"RMD MAIN SCREEN"** see Fig.1 & 2

iv) At this point, the screen in Fig1 or Fig 2 will be displayed, Fig 1 allows only one bend direction, and Fig 2 allows you to choose the bend direction. If the non standard bend direction is chosen, a Warning screen is displayed Fig 2.2, this I to ensure the proper tooling is chosen for a given bend direction.

v) On the **RMD MAIN SCREEN**, you can chose **"MANUAL MODE"** or **"RUN, VIEW OR EDIT A PROGRAM"**

c) Programmer Display and Key Functions

i) The touch screen control is very self explanatory; by touching the labeled boxes will select that parameter. The exit box will return you to the previous screen and get you back to the **RMD MAIN SCREEN**. When entering names and degrees, a keypad will be displayed Fig 6

ii) RMD MAIN MENU CHOICES

(1) **"RUN, VIEW OR EDIT A PROGRAM"** Select this Feature if you want to do any of those functions.

(a) Up to 140 programs with 10 bends per program can be created using any alphanumeric characters.

(b) To edit a program, choose the program you wish to edit my entering a number or by using the up down arrow keys Fig 7. After selecting the program touch the **VIEW/EDIT** button and the program parameters will be displayed Fig9 make changes as necessary, press the **<F1>** key to save any changes.

(2) DELETE PROGRAM

(a) Follow the above steps to get to the edit screen Fig 9 and press and hold the **CLEAR PROGRAM** button to erase all of the bend data for the selected program.

(3) RUN PROGRAM

(a) Select this feature if you want to run an existing program.

(b) To edit a program, choose the program you wish to edit my entering a number or by using the up down arrow keys Fig 7. After selecting the program touch the **RUN** button and the program parameters will be displayed Fig 11

(c) At this point, pressing the forward foot pedal will start the bending process, the machine will rotate in the selected direction at the chosen speed to the desired degree totaling the bend angle plus the spring back degrees.

(d) When at the final position, the control will prompt you to **PRESS REV PEDAL TO HOME** Fig 12

(4) MANUAL BEND

(a) Select this feature to bend manually without the need to create a program. The actual degree will be displayed while in this mode. This mode also allows you to enter in one bend angle and on spring back value Fig 3 & 4

(b) With the arrow keys a bend speed from 1-6 can be selected

d) OEM MENU & HOMING (FIG OEM 1 THRU 7)

(a) To set the home position, you must access the **OEM** screens, consult factory for the password, once in the **OEM MENU** press the **HOMING ROUTINE** button, and follow the directions on the screen to set the home position. The Home position is saved forever even if the power is shut down. You may lose the home position if power is lost to the machine during a move or if wiring or electronics are disconnected inside the electrical cabinet.

(b) Activation of bi directional option should only be done at the factory, consult RMD

(c) Any other parameters in the OEM MENU should only be done after consulting RMD, changing these parameters without consulting RMD will void the warranty.

e) Creating a Program

i) Choose **"RUN, VIEW OR EDIT A PROGRAM"** from the **RMD MAIN SCREEN** Fig1

ii) Select a program number from 1 to 140 Fig7

iii) When you reach the desired program number, press, **VIEW EDIT** Fig 8

iv) On the edit screen enter the desired **PROGRAM NAME** by touching that field

v) Enter the bend **ANGLE** Fig 9

vi) Enter the **SPRING BACK** Fig 9

vii) Enter the **SPEED** from 1-6

viii) Enter a **COUNTERDIE POSITION** (just a reference number taken from the leadscrew counter)

ix) Enter a **MATERIAL ROTATION** if desired.

x) Repeat above steps for Bends #2 to #10.

xi) Press the **<F1>** key to save all data. (Note: if escape key is pressed, data will be lost)

f) Running a Program

i) Choose **"RUN, VIEW OR EDIT A PROGRAM"** from the **RMD MAIN SCREEN** Fig1

ii) To edit a program, choose the program you wish to edit my entering a number or by using the up down arrow keys Fig 7. After selecting the program touch the **RUN** button and the program parameters will be displayed Fig 11

iii) Bend data will be displayed Fig 11.

iv) Press and hold the **Forward foot pedal** down to produce the sample bend.

v) When at the final position, the screen will read, **"PRESS REVERSE PEDAL TO HOME** Fig12

vi) Press and hold the reverse foot pedal until the spindle reaches “0” degrees.

vii) If a second bend was programmed, this will be the next bend and so on all the way to the last programmed bend up to bend 10

viii) If no data was entered after bend 1, bend 1 will be repeated until escape is pressed.

g) Dry Running

i) Once you are familiar with the machine and programming unit, it is important to dry run a few programs.

ii) Follow the previous steps to produce a generic bend and dry run without material.

iii) Repeat this process as many times as needed to fully understand the functions and controls.

iv) DO NOT ATTEMT TO OPERATE IF YOU ARE NOT CONFIDENT, OR DON’T UNDERSTAND THE CONTROLS.

v) Feel free to consult the factory with any questions.

k) Bending More than 180 degrees

i) This machine is capable of bending more than 180 degrees; contact Rusch Machine & Design about your application.

l) Die Selection and Installation

Damaged or worn tooling should be replaced before attempting to bend material. This will ensure that bends are correct and provide a longer life to machine components.

Before any bending can take place, the proper die set must be chosen to match the material being bent. (EX) 1-1/2" diameter tubing requires a die set marked 1-1/2" tube.

Note: Pipe and Tube are not the same, see chart in appendix c for nominal pipe sizes. All RMD dies are color coded to avoid confusion between tube and pipe.

Material	Color
Pipe	Green
Tube	Blue
Metric	Red
Square or Rectangle	Gray

Caution: When installing large dies use either a mechanical lift or a fork lift to prevent serious personal injury.

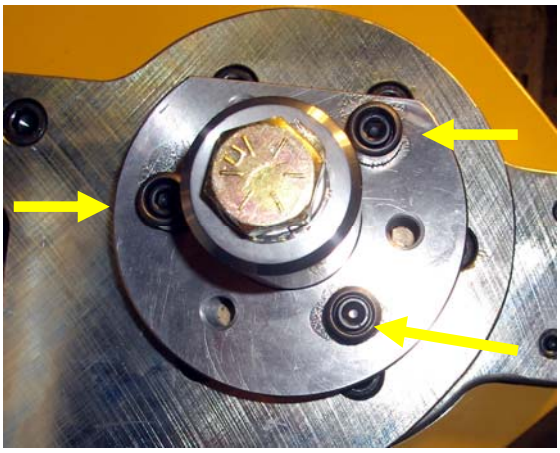


Figure 1 Spindle drive pins and hold down bolts

i) To install the die, slip the die over the centering pin until the three unequally spaced drive pins engage the receiving holes formed in the die (Note: The die will only fit one way). When the drive pins line up the die will drop all the way down to the spindle. If bolt holes are provided in the die ensure that the die is bolted to the spindle with the ½-13 bolts and lock washers provided with the die.

Figure 2 Hold down bolts on the die

FAILURE TO PROPERLY BOLT DOWN DIE WILL RESULT IN DAMAGE TO MACHINE.

To install the counter die, Remove the hitch pin & insert the counter die in the opening in the counter die mount until the ¾" holes line up. Now insert the hitch pin through all the holes, reinstall clip on the hitch pin with the engraved side of the counter die facing up.

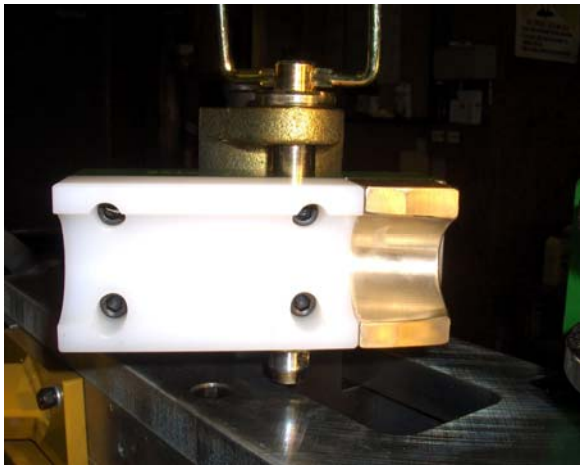


Figure 3 Installing counter die

IMPORTANT: Be sure the long end of the counter die points away from the hook arm, or to the right of machine.

m) Material Insertion

i) At the start page, choose “RUN PROGRAM” and choose program to run following screen instructions.

ii) Once the die set is properly installed and the desired program is loaded and performs as needed, the correct size material can now be inserted.

Figure 4Lubricating counterdie

Figure 5 inserting material to start bending

With the die head at home or “0” position, insert material past the hook arm aligning the “0” mark on the die with where the bend will start on the material.

IMPORTANT: Liberally apply lubricant along the material and counter die with a WD-40 style lubricant or equivalent. Do not lubricate the die. Lubricating the die will encourage slipping of material in the die.

iii) Tighten the counter die assembly applying moderate pressure on the material.

iv) With the counter die tight, document the number displayed on the leadscrew counter, you will want to return to the same exact number every time to ensure exact counter die positioning and repeatable bends.

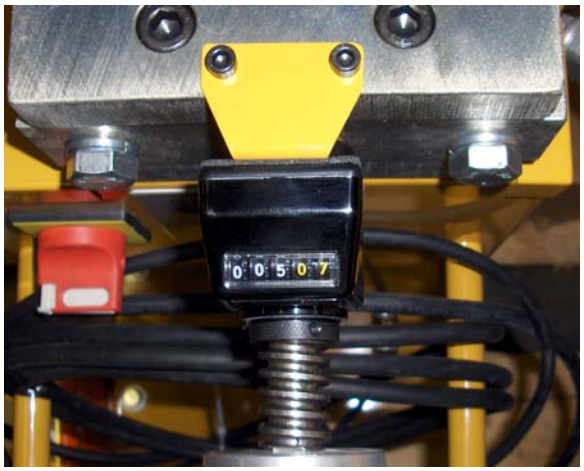


Figure 6 Leadscrew counter

v) Be sure there are no obstructions along the draw side of the material.

vi) Be sure to leave enough material past the plastic slide to produce the desired bend.

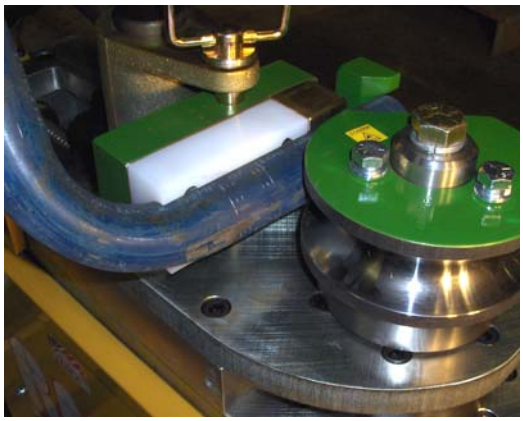


Figure 7 Not enough material to complete the bend

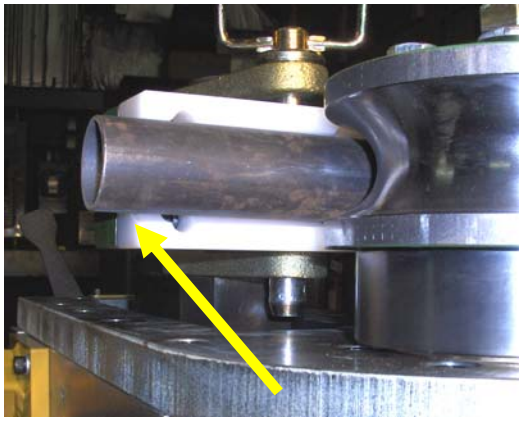


Figure 8 Correct amount of material left

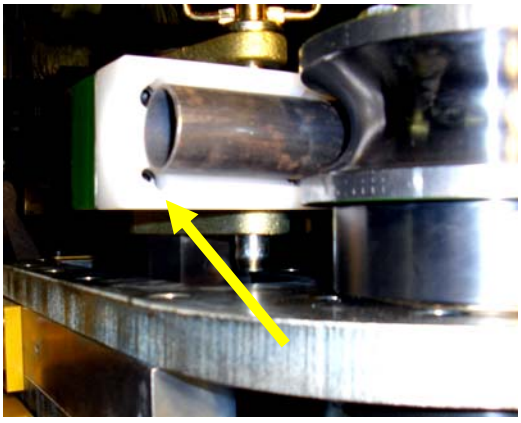


Figure 9 **Maximum amount material can be pulled through the counterdie**

n) Material Removal/Advancement

i) After the die stops at the desired angle, the material needs to be removed or advanced if using an Index Table (See section 11).

ii) Activate the reverse foot pedal momentarily to relieve pressure.

CAUTION: DO NOT REVERSE OR HOME ALL THE WAY WITH THE COUNTER DIE UP TIGHT

iii) Open the counter die assembly using the three legged hand wheel allowing the removal or advancement of the material from the die and hook arm.

iv) Once the material is removed, activate the Reverse foot pedal and hold until the die reaches its home or "O" position. If you are using an index table, open the counter die and then reverse machine, holding material in place. Be careful when reversing with material still in die, not to catch it on the hook arm of the die.

v) Repeat previous steps for next bend in line.

9) MATERIAL LAYOUT

In order to create accurate parts, you will have to layout the material in flat form. First you will need to determine how much material is used per degree of bend. Use the multiplier table on Table #1 to determine the arc lengths for the die in use. Or use the following formula:

Alternate arc length formula $\left(\frac{(clr \times 2) \times pi}{360} \right) \times$ degree of bend

a) Once the arc lengths are determined you can begin layout of the material using Diagram #1 as a reference.

b) Diagram #1 shows a simple part bent on the same plane in the same direction

c) Diagram #2 shows bending based off of a centerline in two directions

d) For symmetrical bends, centerline bending is easiest.

e) For non-symmetrical bends, continuous one direction bending is best.

10) BENDING SUGGESTIONS

a) ALUMINUM: If bending aluminum, lubrication is very important, if the results are less than desirable with WD-40 other lubricants can be used such as:

i) Johnson Paste Wax (seems to work the best)

ii) High Pressure grease

iii) Highly rich dish soap

iv) The bronze counter die must be polished and have no aluminum deposits or it will continue to pick up metal.

v) If using RMD's standard counterdie is not producing desired results, roller counter dies are also available.

vi) Some aluminum will crack as it is being bent, 6061-T6 is very hard and may need to be annealed or ordered in the "T-0" condition.

b) HEAVY WALL DOM TUBING: If heavy wall materials are bent to a tight radius, they can tend to slip in the hook arm causing a poor bend result, below are some suggestions

i) Use a vise clamp on the outside of the hook arm to "lock" the material in place.

ii) Use a piece of two sided coarse emery cloth in between the hook arm and the material, this works very well.

iii) In only this application, high pressure grease applied to the DIE GROOVE also helps.

c) Bending with square dies

i.) Die parts

1) Main bending die
2) Die cap
3) Quick release handles
4) Hookarm
5) Hookarm clamp
6) Plastic slide
7) Slide mount

ii.) Square Tooling Setup

1) Install the bending die (1) on to the spindle. Be careful not to pinch your fingers as you lower the die on to the spindle. The die will only fit on the spindle one way. Bolt the die to the spindle using the holes in the die.

2) Install the plastic counter die assembly (6, 7) with the long end pointing away from the hook arm

3) Snug up the cap clamps (3). Do not over tighten! Or they will be overly difficult to loosen after the bend is complete. Note: tighten clamps without material in the die. The clamps are lift and turn, so you can position them anywhere. This allows the handles to clear the counterdie mount during bending.

4) Insert the material in to the hook arm (4) and pull in to the die. It may be a tight fit. Continue to pull until the material is fully seated in the die's groove.

5) Lube the counter die and the material that will slide along the counter die. Bring the plastic counter die assembly up to the material, leaving about 1/8” to 1/4" gap. (Note: on some thinner material it helps to keep the counter die approx 1” away from the material)

6) Important: Do not lube the bending die surfaces. This will increase the possibility for slippage.

7) Caution: make sure all the die cap clamp handles (3) are inside the die diameter. They could catch the counter die mounting assembly and break off.

8) If the material slips during the bending operation, install the hook arm clamp (5). Do not use it unless you have to.

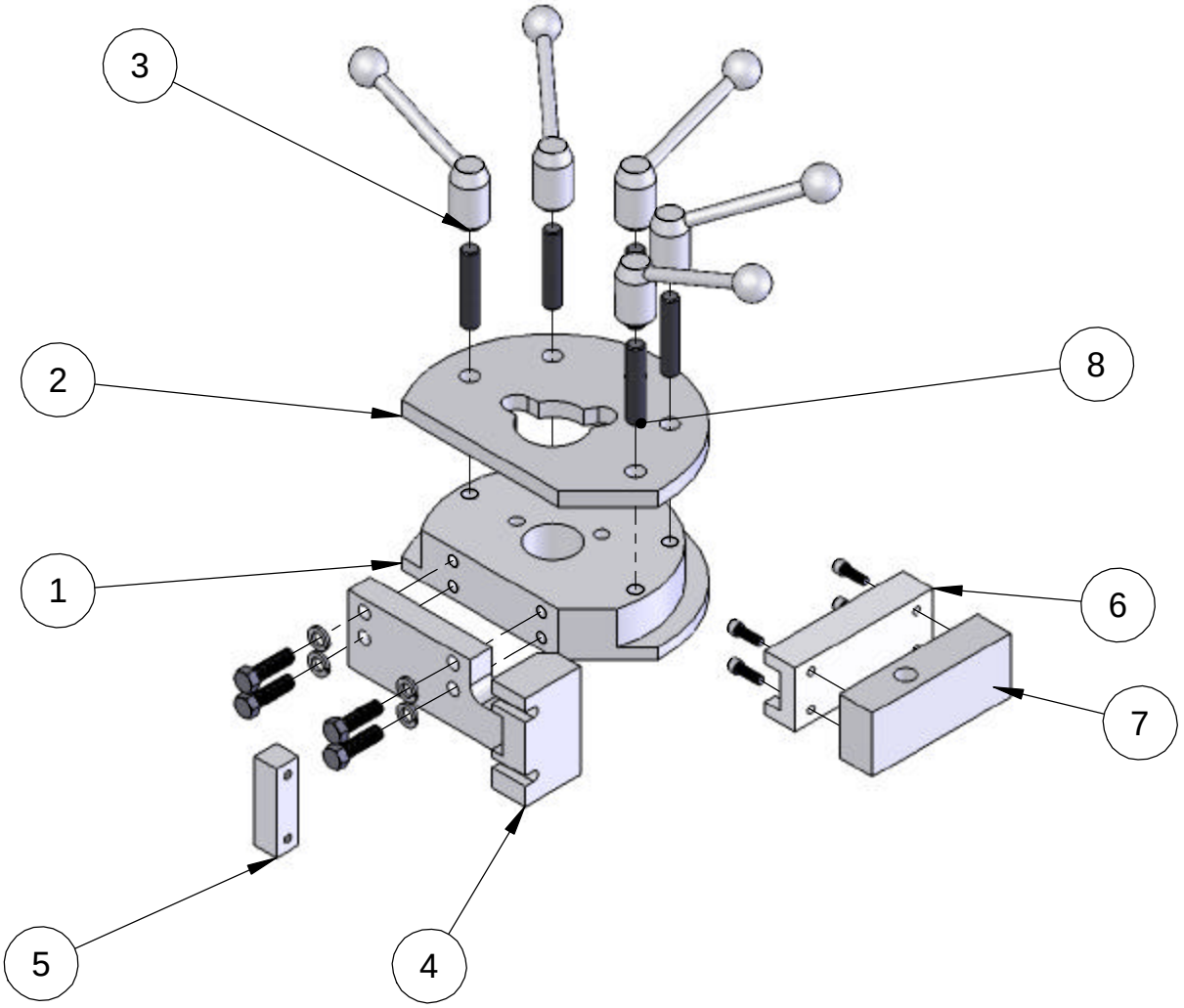
9) Activate the bender and bend to the desired angle.

10) To remove the material, open the counter die and return bender to the “home position”. Using a soft mallet, gently tap the cap clamps open and the material will spring out of the die (1). Remove the material and re-snug the cap clamps.

11) Install the next piece of material to be bent and repeat steps 1-9.

d) LARGE DIAMETER SQUARE: When bending large diameter thinner wall square tubing, the counter die position seems to work better between ½ and 1” farther away from the die. This seems do reduce side wall distortion and inner wrinkling. Although this suggestion is to help on large diameter, the same steps can be used for any square, if trying to achieve better results. If the square material slips in the hook arm, use the supplied clamp and bolts to hold in place.

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	D-1500S-R500	1.500 SQUARE DIE	1
2	DC-R500-625	5.0 RADIUS DIE CAP	1
3	.625 HANDLE	.625 HANDLE	5
4	H-1500S-R500	1.5 X 5.0 CLR HOOK ARM	1
5	HC-1500S	1.500 HOOK CLAMP	1
6	PS-1500S	1.5 SQUARE SLIDE	1
7	CDM-0016	2.5 THICK SQ C'DIE MOUNT	1
8	.625 X 3.0 STUD	.625 X 3.0 STUD	5



NEXT ASSY | USED ON

APPLICATION

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL
Material <not specified>

FINISH

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	CHRIS RUSCH	
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		

COMMENTS:

RUSCH MACHINE & DESIGN

1.5 SQUARE DIE SET ASS'Y

SIZE A | DWG. NO. DH-1500S-R500 | REV. 0

SCALE:1:8 | WEIGHT: 58.54 | SHEET 1 OF 1

11) INDEX TABLE ATTACHMENT (OPTIONAL EQUIPMENT)

a) Introduction

i) The IDX-10 Indexing table was designed to allow you too accurately and repeatedly position distances between bends, by using the adjustable stops. Also the IDX-10 can be used to hold the material being bent perfectly level while bending, or altering the angles between bends.

b) Connection to your machine

i) Remove the shaft mounting bracket [#2] (angle iron) leaving the slide shaft [#16] in place.
ii) Slide the front of the main track tube [#1] onto the slide shaft [#16].
iii) Reattach the shaft mounting bracket [#2] and tighten bolts.
iv) With the front of the main track tube attached, lift up the rear and support it with a sturdy saw horse or equal.
v) Attach the rear leg adjuster [#13] using the supplied 3/8 X 1” bolts.
vi) Align the keyways with the slide bolt and slip the caster mount [#12] onto the leg adjuster [#13].

c) Height Adjustment and Leveling

i) Level your machine on a flat hard surface. (The index table must be allowed to pivot and rotate with the casters.)
ii) With the machine level, choose the desired die set.
iii) The thickness of the die determines the height of the index table. Using the chart shown below find the correct number of turns required for your die.
iv) Rotate the height adjustment screw [#21] clockwise until it stops. This is the lowest the table will go. (EXAMPLE 1-1/2 die)
v) Rotate the adjustment screw [#21] counter clockwise the exact number of turns that were chosen from the chart.
vi) Using a 2 ft level placed on the main track tube, rotate the large nut [#35] until the main track tube is level.
vii) Position the front of the main track tube so the center line of the track tube matches the center (radius) line of the die.
viii) The Chuck/Gearbox assembly is designed to pivot on its mount, tension is adjusted with spring washers beneath the (2) ½-13 mounting bolts.

d) Material layout

i) Before you can use the IDX table, your first piece of material needs to be laid out. Using Diagram1 and Table1 you can determine all of the bend start points, these points should be transferred to the material using a fine point sharpie marker. This diagram is a generic two bend scenario, for more complex parts the steps are generally the same. Use section 10 for further reference.

e) Operation

i) After the connection to your machine is complete, and the height and center line positions are verified, the IDX-10 can be used.

ii) Your first part should now be clearly marked. These marks will be used to position the tubing perfectly with the “0” mark on the die, and to set your IDX stops. Only your first part needs to be marked, after that the IDX stops will be used.

iii) Insert a piece of material through the hook arm of the die being used and insert through the chuck. (note: If multiple parts are being produced, the material should be marked so the chuck position can be repeated) position the material so the start of bend mark lines up with the “0” mark on the die, now set your first stop on the index table and produce the first bend. **NOTE:** The complete table will swing, be sure not to interfere with the motion.

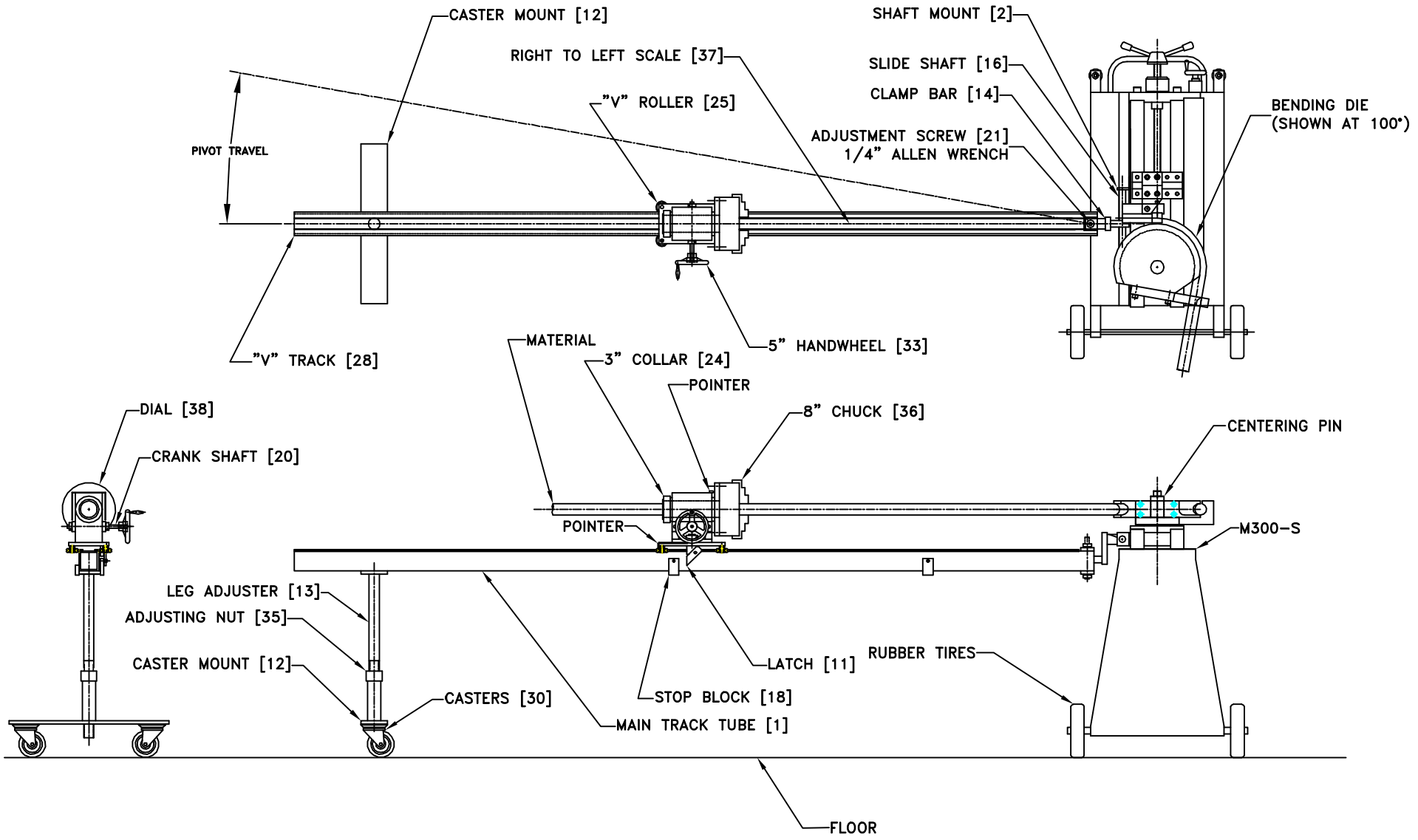
iv) After the bend is complete, the die must return to home. Once the die is home, the material can be advanced and rotated (if required) to the next “0” mark. The next stop can now be set. Repeat as required, your IDX table comes standard with (4) stops.

CAUTION! Make sure the hook arm of the die does not catch the tubing when returning.

v) The previous steps are just examples how to set stops and produce various bends; it is up to the user to define exactly how his/her IDX will be set up. RMD will be glad to offer any suggestions for your application.

Rusch Machine & Design, Inc.

HEIGHT ADJUSTMENT	
CCW TO RAISE	
TURNS CCW	DIE THICKNESS
0.0	1.50
2.5	2.00
5.0	2.50
7.5	3.00
10.0	3.50



Rusch Machine & Design, Inc. Two Rivers Wisconsin	TITLE M300-S FLOOR PLAN WITH INDEX TABLE	DRAWN BY: C. RUSCH	DATE 24-JUL-00	DRAWING NUMBER FP-0006

12) WARRANTY

a) Coverage

(1) Rusch Machine & Design, Inc. warrants to the original purchaser for use that the products sold by RMD, Inc. will be free from defects in workmanship and material for a period of one year from the date of purchase provided such goods are installed, operated, maintained and used in accordance with RMD, Inc.'s written instructions.

b) Exclusions

(1) Ordinary wear and tear, and damage from abuse, neglect or alterations are not covered by this warranty. THIS WARRANTY IS NULL AND VOID IF INSTRUCTIONS AND OPERATING PROCEDURES ARE NOT FOLLOWED.

(2) Die sets are excluded from warranty.

(3) Machine maintenance, adjustments, setups or downtime costs are excluded from warranty.

Rusch Machine & Design, Inc. will in no event be liable for incidental or consequential damages.

c) Conditions

(1) All warranty work must be approved by RMD, Inc.

(2) All defective items must be returned to RMD, Inc. for inspection.

(3) Customer pays freight, travel and all other associated costs other than parts and labor

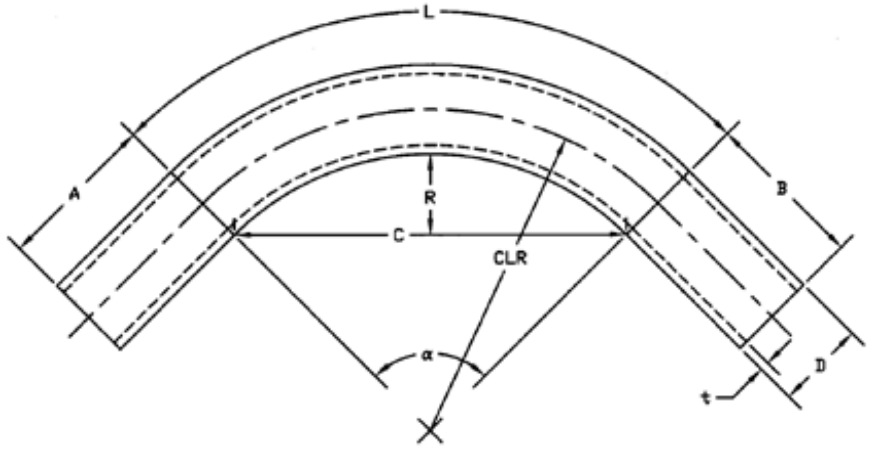
d) Extended Parts Warranty

All electrical components and gearboxes carry a one-year replacement warranty from manufacturer.
Replacement labor not included. Customer pays freight costs.

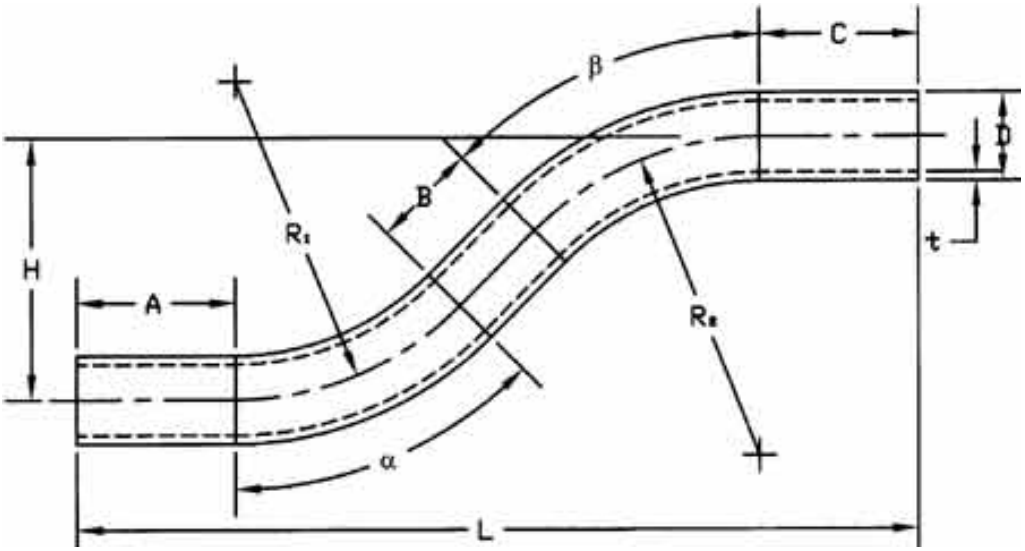
Any questions pertaining to this limited warranty should be addressed to:

Rusch Machine & Design, Inc.
P.O. Box 375
Two Rivers, WI 54241

Appendix A. Pipe bending and Tube bending Diagrams



Legend
L = Arc length (outside)
R = Rise (inside)
D = Tube outside diameter
t = Tube wall thickness



a= First bend arc angle
b= Second bend arc angle
A= First tangent
B= Straight between bends
C= Second tangent
D= Tube outside diameter
H= Height of offset
L = Length of offset
R1= First radius
R2= Second radius
t= Tube Wall Thickness

Appendix B. Glossary of Commonly Used Terms

Arc Length – The length of material along the centerline of the tubing

Centerline Radius (CLR) - Distance in inches from the center of curvature to the centerline axis of the tube bending or pipe bending bends. Abbreviated as CLR. See Tube Bending and Pipe Bending Diagram

Degree - Angle in degrees to which the tube/pipe bends are formed (i.e. 45 degrees, 90 degrees, 180 degrees, etc.)

Easy Way (EW) - Bending of a rectangular tube with its short side in the plane of the tube or pipe bend

Hard Way (HW) - Bending of a rectangular tube with its long side in the plane of the tube or pipe bend

I.D. - Inside diameter of the tube or pipe bends

Minimum Tangent - The minimum straight on the end of pipe bends required by the bending machine to form the bend

Neutral Axis - That portion of the pipe or tube that is neither in compression or tension.

O.D. - Outside diameter in inches of the tube or pipe

Out of Plane - The deviation of the horizontal plane of a single pipe bend between its tangent points, based on the theoretical center-line of the pipe bend

Ovality - The distortion or flattening of pipe or tube from its normal, round shape caused by the pipe bending process

Springback – Amount of degrees material will return after bending pressure is released

Tangent - The straight portion of material on either side of arc of bending bends. See Tube Bending and Pipe Bending Diagrams.

Tangent Point - The point at which the bend starts or ends. See Tube Bending and Pipe Bending Diagrams.

Wall - The thickness in inches of tubular pipe bending material.

Wrinkles - Waving or corrugation of pipe bending bends in the inner radius.

Appendix C. Pipe OD and Wall Thickness Chart

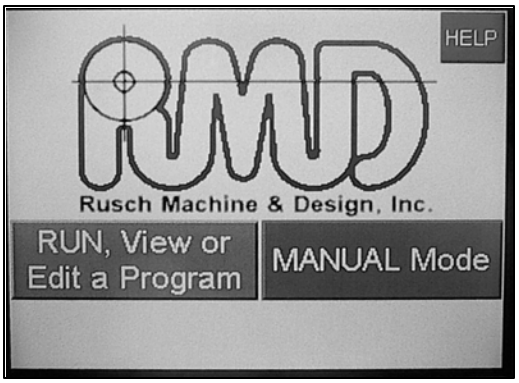
Pipe Sizes	O.D.	Pipe Schedules and Wall Thickness									
		5s	5	10s	10	40s & Std	40	80s & E.H.	80	160	Dbl. E.H.
1/8	0.405	-	0.040	0.050	0.050	0.068	0.070	0.095	0.100	-	-
1/4	0.540	-	0.050	0.070	0.070	0.088	0.090	0.119	0.120	-	-
3/8	0.675	-	0.050	0.070	0.070	0.091	0.090	0.126	0.130	-	-
1/2	0.840	0.070	0.070	0.080	0.080	0.109	0.110	0.147	0.150	0.190	0.294
3/4	1.050	0.070	0.070	0.080	0.080	0.113	0.110	0.154	0.150	0.220	0.308
1	1.315	0.070	0.070	0.110	0.110	0.133	0.130	0.179	0.180	0.250	0.358
1 1/4	1.660	0.070	0.070	0.110	0.110	0.140	0.140	0.191	0.190	0.250	0.382
1 1/2	1.900	0.070	0.070	0.110	0.110	0.145	0.150	0.200	0.200	0.280	0.400
2	2.375	0.070	0.070	0.110	0.110	0.154	0.150	0.218	0.220	0.340	0.436
2 1/2	2.875	0.080	0.080	0.120	0.120	0.203	0.203	0.276	0.280	0.380	0.552

All sizes are in inches

Appendix D. Troubleshooting

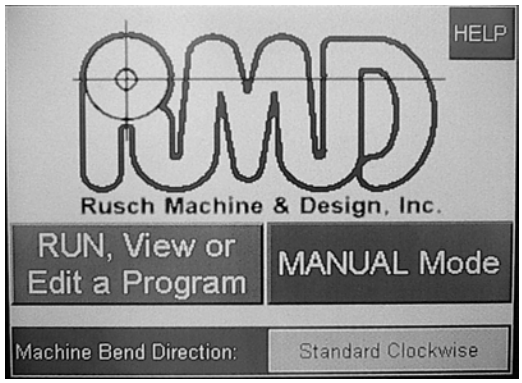
Problem	Solution
Machine does not power up	Check circuit breakers
	Wrong Power, Check for Proper voltage
Oil leaking from Breather	Oil will expand when the gearbox gets hot, causing oil to purge from the breather, this is normal
Home Position is not correct	Go through the homing sequence in section
Material slips in the hookarm	Too much lube on material and is transferring to the bend die clean the bend die with degreaser.
	The counter die should be lubed only
	The material may need to be clamped
	Wrong material for the die set
Spindle drive pins are damaged	If the bend dies are not bolted down properly the drive pins will get damaged. Replace drive pins.
Poor Bend Results	Check proper tooling for material IE Pipe Vs Tube. Green for pipe, Blue for tube, Red for metric and Gray for square or rectangle tubing. See pipe sizing chart
	Wall thickness is too thin

SCREEN SHOTS

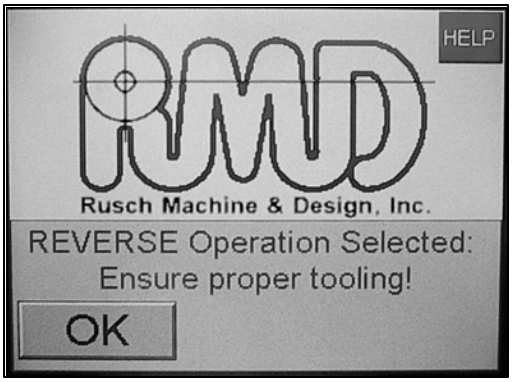


OEM SCREEN FIGURE #1

OEM SCREEN FIGURE #2



OEM SCREEN FIGURE #2.1



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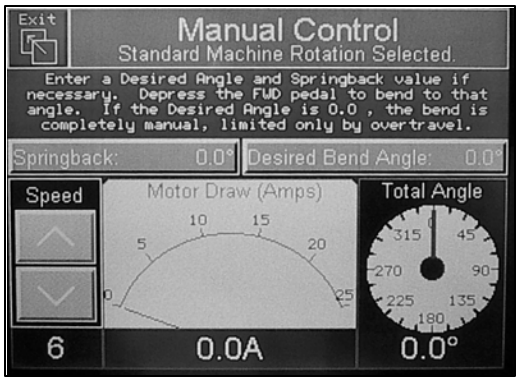
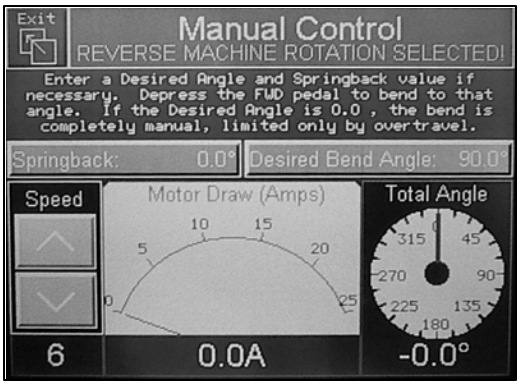


OEM SCREEN FIGURE #3



OEM SCREEN FIGURE #4

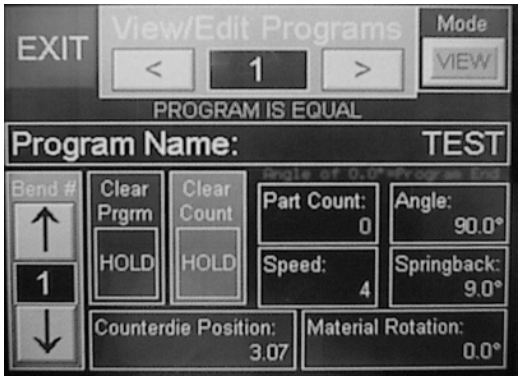
OEM SCREEN FIGURE #5

OEM SCREEN FIGURE #6

SCREEN SHOTS

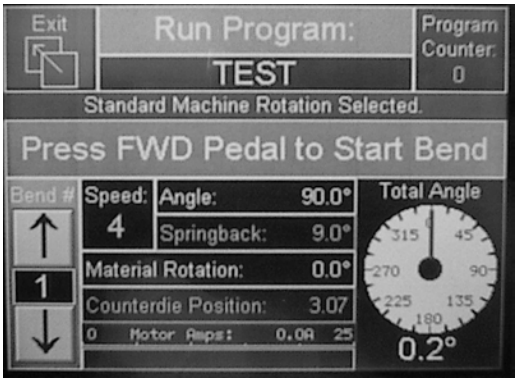
OEM SCREEN FIGURE #7

OEM SCREEN FIGURE #8



OEM SCREEN FIGURE #9

OEM SCREEN FIGURE #10



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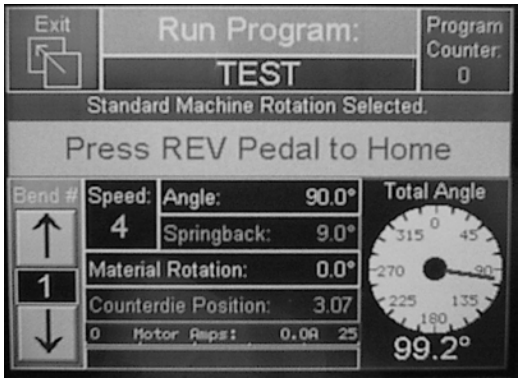
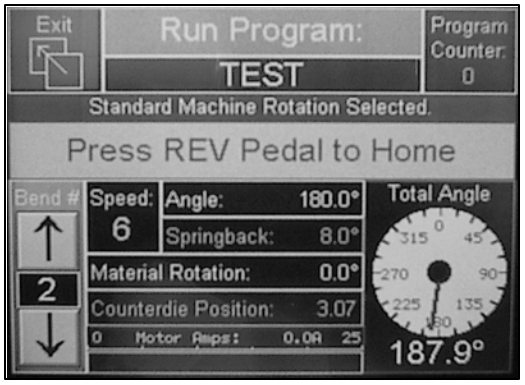


OEM SCREEN FIGURE #12

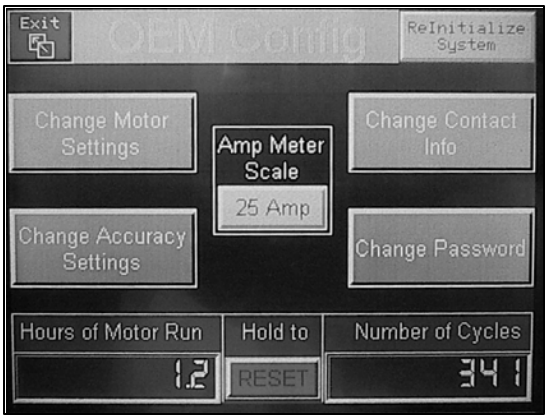
OEM SCREEN FIGURE #13



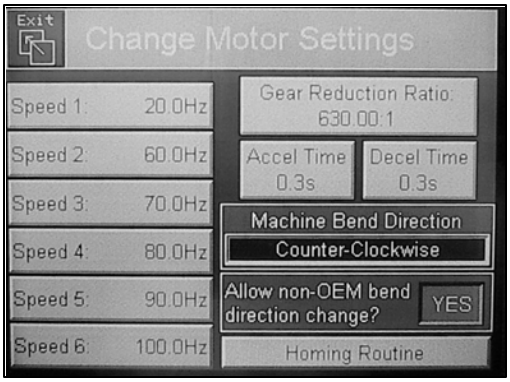
OEM SCREEN FIGURE #14

SCREEN SHOTS

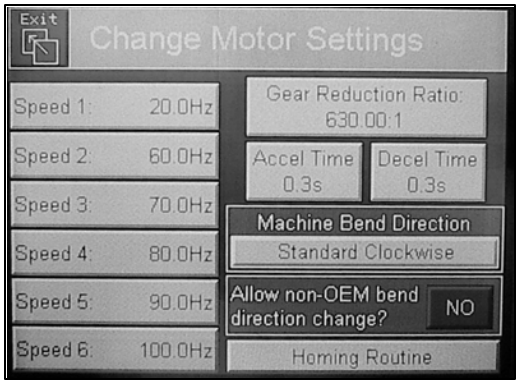
OEM SCREEN FIGURE #13



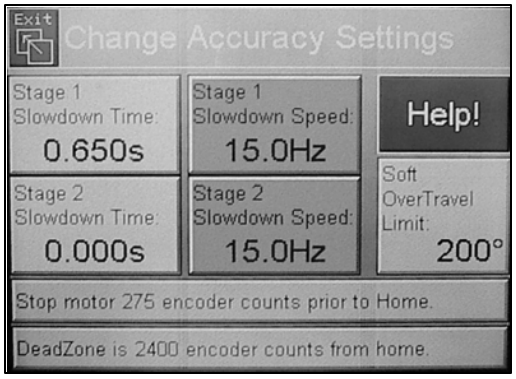
OEM SCREEN FIGURE #2



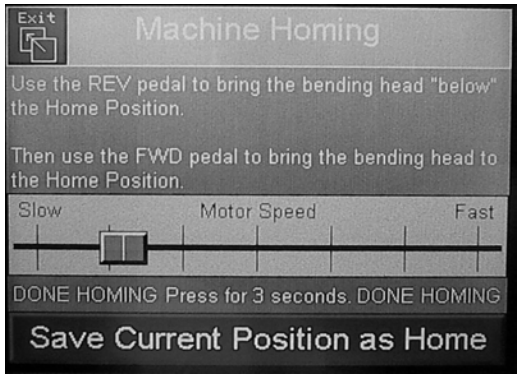
OEM SCREEN FIGURE #3



OEM SCREEN FIGURE #4



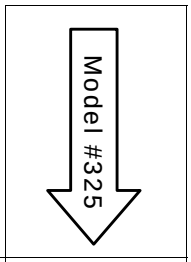
OEM SCREEN FIGURE #5



OEM SCREEN FIGURE #6

OEM SCREEN FIGURE #7

Capacity Chart For Model #325



MAXIMUM CAPACITIES	CROSS-SECTION	MATERIAL	MAX DIA. X THICKNESS (inches & mm)
	○	GAS PIPE (ROUND)	2" PIPE X .218 60 X 5.5 (mm)
	○	MILD STEEL (ROUND)	3" X .140 76 X 3.5 (mm)
	○	STAINLESS STEEL (ROUND)	2.5" X .120 63.5 X 3 (mm)
	○	ALUMINUM (ROUND)	3" X .210 76 X 5.3 (mm)
	●	MILD STEEL (SOLID ROUND)	1-1/2" 45 (mm)
	□	MILD STEEL (SQUARE)	3" X 3" X.093 76 X 76 X 3 (mm)
	◆	MILD STEEL (SOLID SQUARE)	1-1/2" X 1-1/2" 38 X 38 (mm)

NOTE: MINIMUM BEND RADIUS OF 2 TIMES THE TUBE DIAMETER CAN USUALLY BE ACHIEVED WITHOUT A MANDREL, DEPENDING ON MATERIAL TYPE AND WALL THICKNESS
EXAMPLE: 2 X 1.5 (1-1/2" DIA. TUBE)=3"CLR

COMMON PIPE SIZES (FOR REFERENCE)	NOMINAL PIPE SIZE	OUTSIDE DIAMETER	WALL THICKNESS			
			SCHEDULE 5	SCHEDULE 10	SCHEDULE 40 (STD)	SCHEDULE 80
	1/2 PIPE	0.840	0.065	0.083	0.109	0.147
	3/4 PIPE	1.050	0.065	0.083	0.113	0.154
	1" PIPE	1.315	0.065	0.109	0.133	0.179
	1-1/4" PIPE	1.660	0.065	0.109	0.140	0.191
	1-1/2" PIPE	1.900	0.065	0.109	1.145	0.200
	2" PIPE	2.375	0.066	0.109	0.164	0.218
	2-1/2" PIPE	2.875	N/A	N/A	0.203	0.276
	3" PIPE	3.500	N/A	N/A	0.216	0.300
	3-1/2" PIPE	4.000	N/A	N/A	0.226	0.318
	4" PIPE	4.500	N/A	N/A	0.237	0.337

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