

# 060 Super Bender<sup>®</sup>

Rotary Draw Bender for Pipe, Tube and Profile Bending

## Operator's Manual



**WARNING!**

BEFORE USE, BE SURE EVERYONE USING THIS MACHINE READS AND THOROUGHLY UNDERSTANDS ALL SAFETY AND OPERATING INSTRUCTIONS IN THIS MANUAL

Model 060A \_\_\_\_\_

Serial # \_\_\_\_\_

# 060 Super Bender® Rotary Bender

Pipe, tube and profile bending machine

Congratulations on your purchase of an Ercolina® bending machine from CML USA Ercolina®. Ercolina® machines are designed and manufactured to deliver years of trouble-free bending performance. Please take a moment to complete and mail your warranty registration card. Doing so validates the machine warranty period and ensures prompt service if needed. Thank you for selecting products from CML USA Ercolina®.

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CML USA Ercolina® reserves the right to make improvements and modifications to design without prior notice.

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# Important Safety Instructions



## WARNING!

When using electric tools, basic safety precautions should always be followed to reduce the risk of fire, shock and personal injury.

- 1. Keep Work Area Clean**  
Cluttered areas and benches invite injuries.
- 2. Consider Work Area Environment**  
Do not expose power tools to rain.  
Do not use the power tools in damp or wet locations.  
Keep work area well lit.  
Do not use a tool in presence of flammable liquids or gases.
- 3. Guard Against Electric Shock**  
Prevent body contact with grounded surfaces. For example; pipes radiators, ranges, refrigerator enclosures.
- 4. Keep Children Away**  
Do not let visitors contact tool or extension cord.  
All visitors should be kept away from work area.
- 5. Store Idle Tools**  
When not in use, tools should be stored in a dry and high or locked-up place out of reach of children.
- 6. Do Not Force Tool**  
It will do the job better and safer at the rate for which it was intended.
- 7. Use The Right Tool**  
Do not force small tool or attachment to do the job of a heavy-duty tool.  
Do not use the tool for purpose not intended, for example; do not use a circular saw for cutting tree limbs or logs.
- 8. Dress Properly**  
Do not wear loose clothing or jewelry; they can be caught in moving parts.  
Rubber gloves and non-skid footwear are recommended.
- 9. Use Safety Glasses**  
Also use face mask or dust mask if operation is dusty.
- 10. Do Not Abuse Electric Cord**  
Never yank electrical cord.  
Keep electric cord from heat, oil and sharp edges.
- 11. Do Not Overreach**  
Maintain proper footing and balance at all times.
- 12. Maintain Tools With Care**  
Keep clean for better and safer performance.  
Follow instructions for lubricating and changing accessories.  
Inspect tool cords periodically and if damaged, have repaired by authorized service facility.  
Inspect electrical cords periodically and replace if damaged.  
Keep handles dry and clean and free from oil and grease

**13. Disconnect Tools**

Disconnect machine from power source when not in use, before servicing and changing accessories.

**14. Remove Adjusting Keys and Wrenches**

Form a habit of checking to see that keys and adjusting wrenches are removed from machine before turning it on.

**15. Avoid Unintentional Starting**

Always disconnect from power source before moving.

**16. Stay Alert**

Watch what you are doing. Use common sense, do not operate tool when you are tired. (Do not use when taking medications that may cause drowsiness.)

**17. Check Damaged Parts**

Before further use of the machine, guard or other part that is damaged should be carefully checked to determine that it would operate and perform its intended function.

Check alignment of moving parts, binding of parts, breakage of parts mounting and any other conditions that may affect its operation. A guard or other part that is damaged should be properly repaired or replaced by an authorized service center. Do not use this machine if switches do not turn it on and off. Have defective switches replaced by authorized service center.

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## **Special Instructions**

1. Read and follow operators manual thoroughly. If you require an additional manual please contact CML USA Ercolina® at **563-391-7700** or email **info@ercolina-usa.com**.
2. Due to size and weight, it is recommended that qualified professionals transport, position and install the bending machine. Use proper equipment for installation including lift truck safety straps, chains binders and bars. Machine must be balanced evenly at all times.
3. Never place hands, finger gloves or clothing near rotation machine parts.
4. Always disconnect machine from power source before changing accessories.
5. Always use eye and hearing protection.
6. Never wear loose clothing, gloves or jewelry when working near machine.
7. Stand in a safe position when operating machine.
8. Always wear safety approved steel toe footwear.
9. Make provision for safe handling of heavy and/or awkward materials.
10. Use only proper tooling, keep tooling securely fastened.
11. Keep machine and tooling free and clear of chips and debris.
12. Keep all safety features functioning and working properly.
13. Do not alter or modify machine. Use only OEM approved parts and accessories.

## Before you Begin

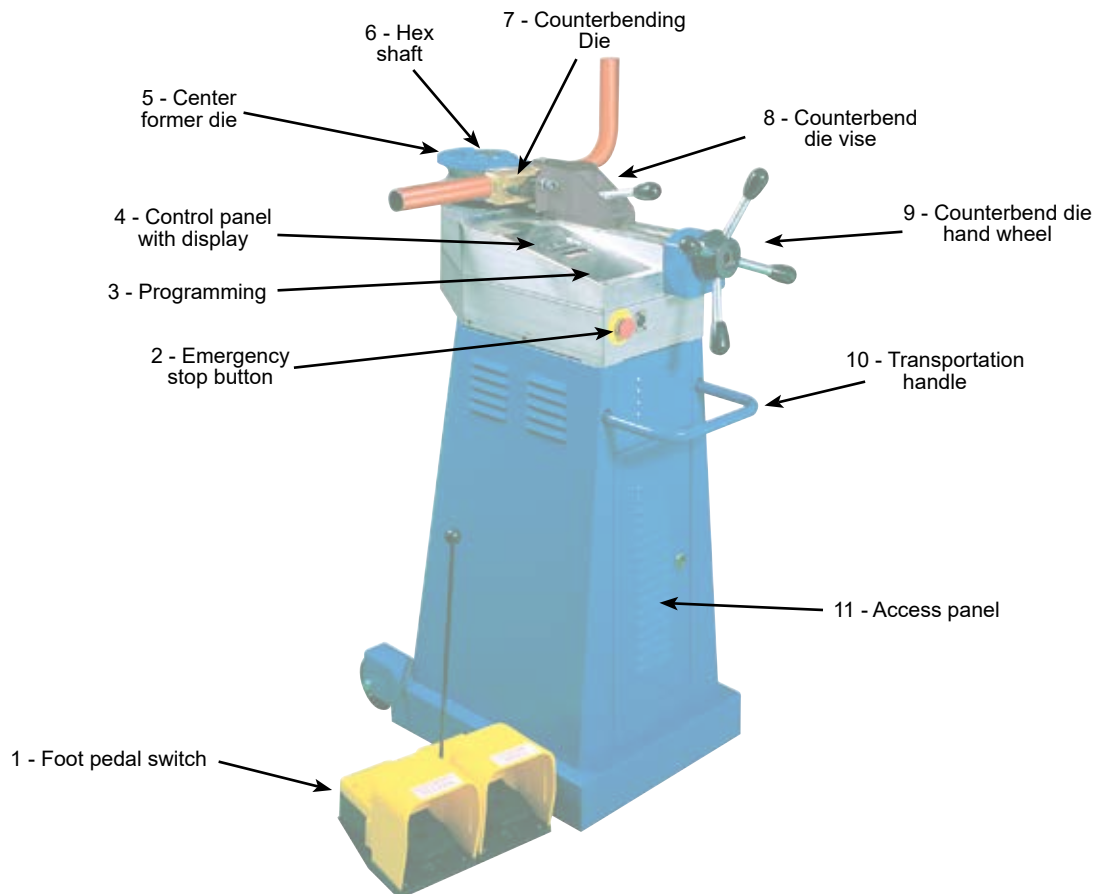
Inspect machine to be sure following equipment arrived and no damage occurred during shipment.

### 060 Super Bender® and Standard accessories

060A	Super Bender® model 060
050A	40mm hex shaft
050B	50mm hex shaft (mounted on machine)
050D	Support bracket for counterbending die
050G	Hand wheel
050H	Foot pedal switch

### General Identification of Parts

1. Foot pedal switch
2. Emergency stop
3. Programming
4. Control panel with display
5. Center former die
6. Hex shaft
7. Counterbending die
8. Counterbend die vise
9. Counterbend die hand wheel
10. Transportation handle
11. Access Panel



## 060 Super Bender® Features

- Bends material to ¼" to 2½" diameters
- Heavy-duty gear case with maximum 8⅞" CLR
- Patented tooling system achieves CLR two times diameter without mandrel
- Low voltage 24V controls
- Programmable springback settings ensure bend accuracy for a wide variety of material
- Programmable bend angles 0 to 180°
- Remote foot pedal for hands free operation
- Patented swing away vise system and hex mounted tooling increase productivity
- Overload protection controls
- Standard multiple language capability
- Transportation wheels and lift handle built into base cabinet
- Tool free tooling changes with multiple CLR available for each diameter
- Accepts Ercolina® two axis A40/P positioner table
- No hydraulics
- Comprehensive (1) one-year warranty

### Machine Capacities

Material	Maximum Diameter	Maximum Thickness
Pipe	1.5" ID	Schedule 40
Mild steel tube	2"	.140
Soft brass	1⅞"	.125
Stainless steel	1⅞"	.109
Welded furniture tube	2⅞"	.125
ST 35 hydraulic steel	2"	.156
304L hydraulic stainless	2"	.125
Hard copper and aluminum	2½"	.156
Round solids	1¼"	—
Rectangular solids	5⁄16" x 1⅞"	—
Rectangular tube	13⁄16" x 9⁄16"	.125
Square tube	1⅞" x 1⅞"	.125
Square solids	1⅜" x 1⅜"	—
Mild steel T	1⅞" x 1⅞"	.187
Mild steel C channel	1¼" x 5⁄8"	.187

All capacities based on mild grade material using machine at low bending speed;  
Heavy wall and high tensile materials reduce machine capacity.

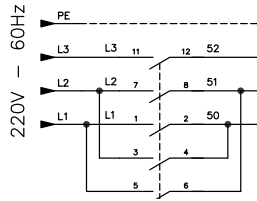
### Dimensions and Specifications

Height x Length x Width	36" x 24" x 10"
Bending speed	Two speed 1.7
Motor	120 volt single phase 50/60 cycle
Minimum and Maximum CLR	⅜" - 8⅞"
Bending angle range	0 to 180°
Weight	189 lbs.

# Wiring Instructions and Connections

**Attention!** 060 Super Bender® machines ship 120V single phase. Have a qualified electrician connect your machine according to the following instructions. **Note:** CML USA Ercolina® is not responsible for damage that may occur from improper installation.

1. Determine location of machine installation.
2. Measure incoming line voltage at power source.
3. Confirm incoming line voltage matches machine's voltage rating.
4. 060's are equipped with two multi-tap transformers (TR1 and TR2).  
Voltage taps on (TR1) and (TR2) transformers must be set to match incoming line voltage.
5. Access front panel to make necessary adjustments to electrical controls.
6. Complete wiring installation, close and lock cabinet door.  
(**Note to electrician:** When connecting machine to WYE power supply, connect highleg to wire #52 at machine. See diagram.)



7. Release emergency stop switch and rotate main power switch to "ON" position.  
If panel displays "rotation error", turn machine power "OFF", rotate power switch in opposite direction to automatically change phasing.

## General Assembly and Setup

### - Connecting foot pedal -

Insert male end of DIN plug connector into female socket on front of base cabinet.

### - Changing hex shafts -

The 060 Super Bender® ships with 50mm hex shaft installed. Smaller tooling requires using 40mm hex shaft.

To interchange shafts:

1. Remove (8) 8 x 1.25 x 25mm SHCS securing hex shaft to machine
2. Remove existing hex shaft - install desired shaft (**Note:** Only one fitting position is possible)
3. Replace and securely tighten (8) SHCS

### - Hand wheel installation -

Place hand wheel on hex head of lead screw. Hand wheel is used for positioning (X) axis and setting counterbend die pressure.

## Bending Terminology

**OD:** Outside diameter of pipe or tube

**ID:** Inside diameter of pipe or tube

**Wall thickness:** Pipe wall thickness is measured in terms of schedule (i.e. 5, 10, 40). Tube wall thickness is measured in terms of gauge (i.e. 16 gauge = .065).

**Center Line Radius (CLR):** Exact measured distance from centerline of tooling to centerline of material's neutral axis

**Degree of bend:** Number of degrees required in a bend - right angle requires 90° of bend

**Springback:** A material's tendency to return to its original shape after bending

**Ovality:** Amount of distortion created in the cross section of pipe or tube from a normal round shape

**Tangent Points:** The two points at which bend starts and ends

**Distance between bends:** Straight section between two tangent points of bends

**Tensile strength:** Point at which material is stretched beyond yield strength

# Material Selection

Before bending any material you should know the following:

1. Outside and inside physical dimensions
2. Wall thickness
3. ASTM specifications
4. Desired CLR radius
5. Degree of bend
6. Minimum distance between bends

## - Proper tooling selection -

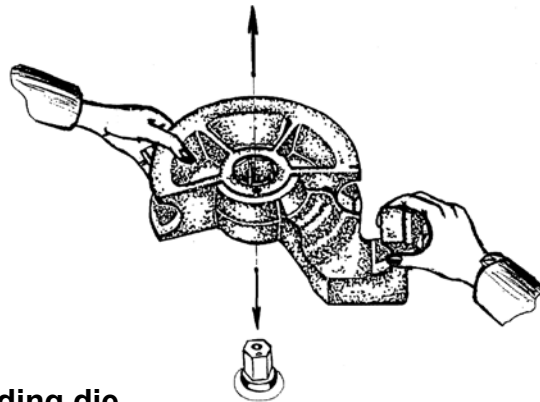
Refer to CML USA Ercolina® master catalog for recommended centerline bend radius for the material to be bent. If your application requires a CLR or profile that is not shown CML USA Ercolina® can quote special tooling on request. As a general guide when bending tubing and pipe, the heavier the wall thickness the tighter the centerline radius can be without distortion. Therefore when bending thin wall tube select the largest possible radius for best bend quality. Material requiring CLR smaller than two times the diameter should be bent with a mandrel support, consult CML USA Ercolina® for more details. The standard counterbending dies are brass to accommodate a variety of material without conflict. Counterbending dies are also available in steel for heavy usage or polymer for applications in which the workpiece finish is a factor. **Note:** When bending heavy wall material or solids a special roller style counterbending die is recommended.

## - Installing counterbending die vise -

Place vise assembly on tool post of counterbending die axis, vise assembly should pivot counterclockwise when mounted.

## - Mounting center former -

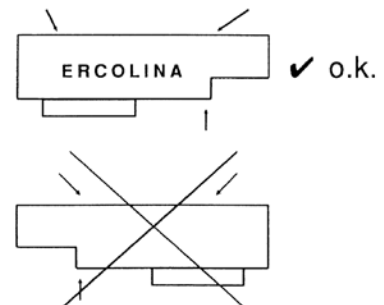
Ercolina® center formers are manufactured with an offset hex design ensuring proper installation. When mounted, the center former's gripper arm should face right side of machine.



## - Mounting counterbending die -

Ercolina® counterbending dies are designed for quick installation and removal. Insert male dovetail located on back of counterbend die into slot on counterbending die vise. Hold die firmly against vise, depress and rotate black knob clockwise securing die onto vise bracket. Installed properly, the "Ercolina®" logo will be facing the operator (see figure). **Note:** When bending heavy wall profiles and solids, standard counterbend die and vise must be removed and replaced with a roller counterbend die. **Attention: Failure to use roller style die on heavy profiles may result in machine damage.** (See Mounting "roller" counterbending die instructions.)

**Note:** Counterbending dies are wear items - Replace as necessary to ensure bend quality. Counterbending die should never contact center former when material is in former and tooling is in starting position.





### - Mounting “roller” counterbending die -

When bending heavy wall profiles or solid materials a roller counterbending die must be used. Remove counterbend die vise assembly and place roller die onto tool post. With material in center former advance roller die inward until material rests firmly between former and roller. Retract roller die approximately 1½” to 2” from material. **Warning:** Never use roller die flush against material.

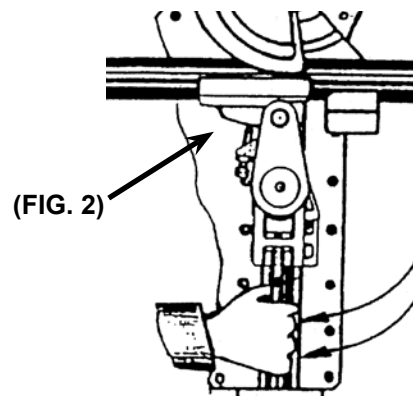
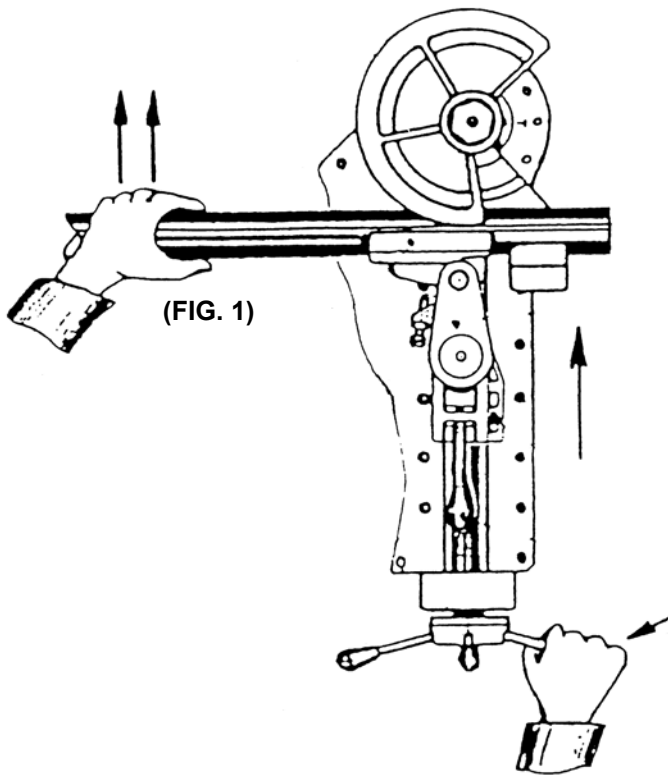
### - Counterbending die lubrication -

For best results counterbending dies should be kept lubricated with Ercolina® spray grease - Part # 810. Proper lubrication extends counterbend die life and improves bend quality.

### - Loading workpiece -

1. Slide workpiece into gripper arm and groove of center former
2. Using hand wheel advance counterbending die forward until material rests securely between former and die (see FIG. 1).
3. Properly adjusted vise and counterbending die assembly should be perpendicular to workpiece and swing freely counterclockwise to release workpiece (see FIG. 2).

**Note:** If vise assembly pivots away from material at beginning of bend, reduce pressure on vise. Proper counterbending die adjustment ensures satisfactory bends.





# ERCOLINA® ROTARY DRAW TIE BAR ACCESSORY

Mega Bender® 030, TB60, 050PLUS, SB48, and SB48PLUS



**Hex Drive Center Pivot**



**Securing Centerformer  
Pivot Shaft**



**Saddle Block Mounting Screw**



**Securing Saddle Block**



**Installing Tie Bar**



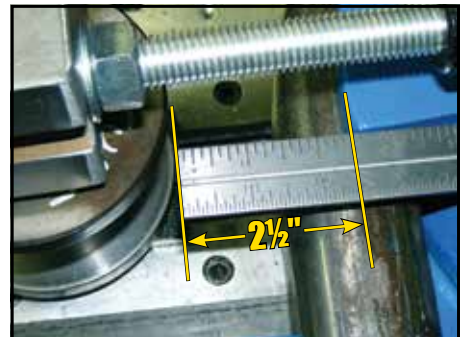
**Side Loading Tie Bar**



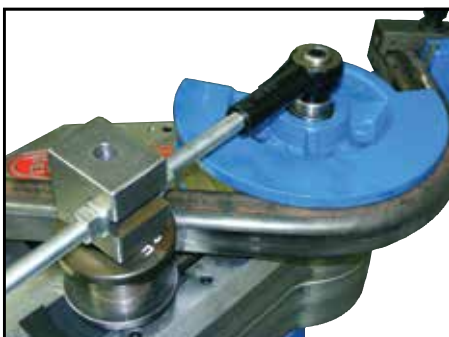
**Tie Bar Nuts**



**Tie Bar Assembly Mounted**



**Minimum Distance (FIG. 1)**



**Tie Bar Assembly**

### - Mounting “roller” counterbending die -

When bending heavy wall profiles or solid materials a roller counterbending die must be used. Remove counterbend die vise assembly and place roller die onto machine tool post. With material in center former advance roller die inward until material rests firmly between former and roller. Retract roller die approximately 2½” from material (refer to FIG. 1 on page 10). **Warning: Never use roller die flush against material – doing so will damage machine.**

## Special Application Tooling – Part# 030TIEBAR

- Never bend material exceeding machine specifications (i.e. high tensile, stainless, heavy profile or solid). Contact factory for machine capacity before bending.
- Always use lowest rpm setting. Reset tool shaft position – “C” axis 10° above “0” home – to avoid center former interference with machine case.
- Always use roller-style counterbending die.
- Mounting the roller-style counterbending die (Heavy Profiles or Solids). Heavy wall profiles and solid materials require a roller counterbending die. Remove the standard counterbend die vise assembly and slide roller onto vise mounting post. With material in former move roller die inward until material rests firmly between former and roller. **Back roller die off approximately 2½”.**



**Warning: Never use roller die firmly against the material.**

- Always use tie bar. Refer to mounting instructions. Tighten hex nuts neutrally, neither pushing nor pulling against tie bar assembly. Rotate hand wheel counter clockwise to remove play from counterbending vise screw.
- Always use lubrication on roller-style counterbending die and tool post.

# Bender Programming

## - Control panel functions -

Display and Switches	Function
Left two switches and display	Springback setting
Middle three switches and display	Bend angle adjustable 0-180 degrees
Right one switch and display	Slow down setting

### - Enter bend angle -

Rotate the bend angle selector switch to desired bend angle.

### - Determining springback setting -

With all previous steps completed, material and tooling in the bending position, begin bend cycle by holding bend switch or depressing foot pedal until the material begins to flex and stop. Observe the degree reading on the display.

### - Entering springback value -

Rotate the springback selector switch to desired setting. Adjust as necessary to achieve desired bend angle. When programming angles less than the springback value adjust this setting to zero and increase the bend angle as necessary.

### - Entering slow down setting -

Adjust end of bend slow down setting as follows:

Tube Diameter..... .250" – 1.000" .....3  
Tube Diameter..... 1.000" – 1.375" .....2  
Tube Diameter..... 1.375" – 1.625" .....1  
Tube Diameter..... 1.625" – 2.000" .....0

### - Adjusting countering bending die support screw -

Use provided T-handle Allen wrench, and turn adjustment screw until it contacts the backside of the vise. Secure screw with locking jam nut. This adjustment screw affects the quality of the bend and must be set each time the material profile and or size are changed.

### - Finishing bend -

Hold bend switch or depress the foot pedal and hold, the Super Bender© will automatically stop at programmed angle.

### - Return center former to zero position -

Hold bend switch or depress foot pedal and hold until bender stops at the zero position.

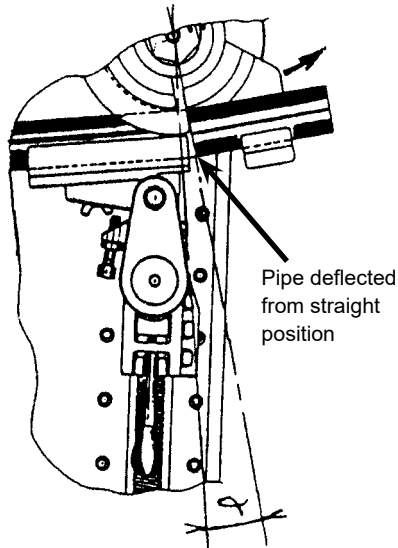
### - Editing bend angle and springback values -

The bend angle and springback settings can be edited at any time during the forward bending cycle by rotating the selector switches to the desired setting.

### - Initial springback setup -

1. With previous steps completed -
2. Initiate bend cycle by depressing foot pedal switch
3. Stop bend cycle when material begins to deflect (see FIG. 1)
4. Observe degree reading on control panel.
5. Rotate springback selector switch to input springback value into program (**Note:** Springback value can be edited later if needed). Springback must be set for each angle.

(FIG. 1)



**- Adjusting counterbending die support screw -**

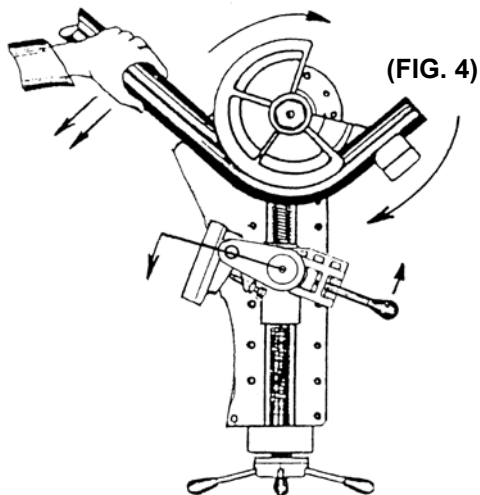
Using Allen wrench, turn adjustment screw until contacting back side of vise. Secure screw with locking jam nut (see FIG. 2). Adjustment screw affects quality of bend and must be set for each material.

**- Finishing bend -**

Hold bend switch or depress and hold foot pedal completing bend cycle (see FIG. 3).

**- Return center former to "0" position -**

Hold bend switch or depress return foot pedal until bender returns to "0" home position (see FIG. 4).

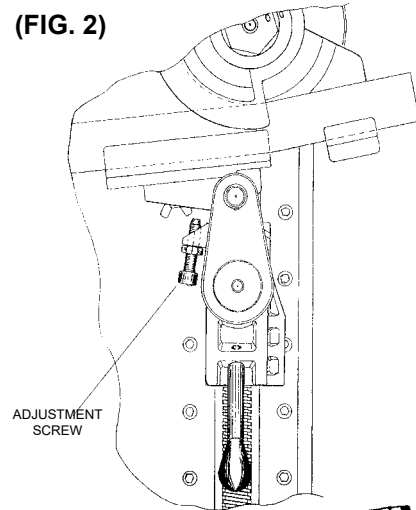


**- Editing bend angles and springback values -**

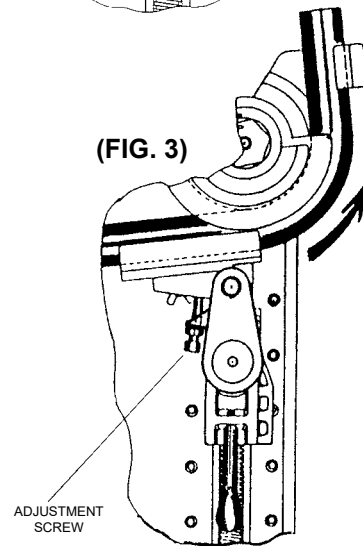
Bend angles and springback values can be edited at any time during a bend cycle using rotary switches on control board.

HOW TO USE THE ADJUSTMENT SCREW

(FIG. 2)

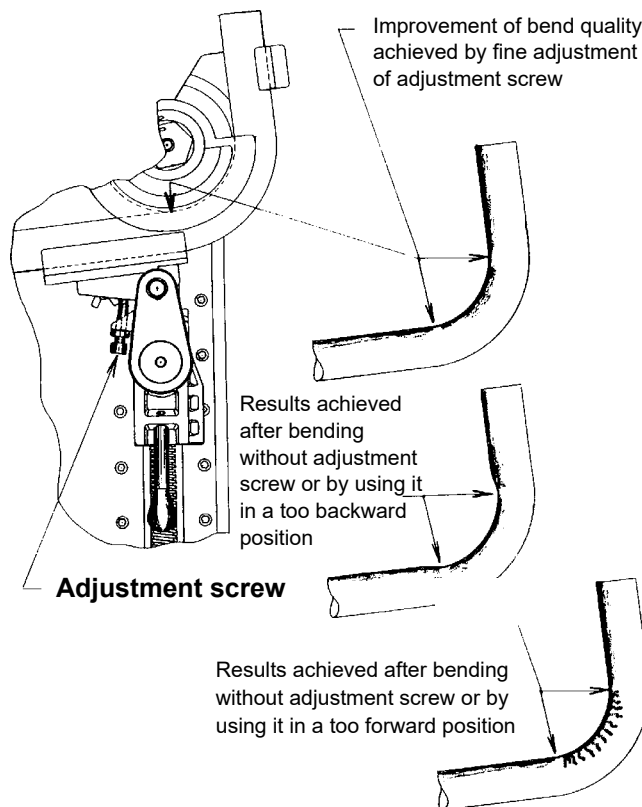


(FIG. 3)



# Bending Troubleshooting

Problem	Probable Cause	Solution
Material wrinkles or deforms	Counterbend die pressure incorrect Radii too small for profile	Increase counter die pressure Increase CLR of tooling
Tube slips	Poor quality tubing Counterbend die pressure is too low	Confirm tubing measurements and replace with quality material Increase die pressure tension
Material cracks or breaks	Material quality poor	Confirm material composition with mill certifications
Poor bend quality	Material quality poor CLR too small for profile Improper tooling adjustment	Replace material Increase tooling CLR Reset counterbend die pressure
Workpiece ends are oval or deformed	Too much pressure on die	Decrease die pressure, change adjustment screw setting (see fig. below)
Machine overloads	Material exceeds machine's capacity	Reduce material size or wall thickness
Counterbend die wears prematurely	Excessive pressure on counterbend die Lack of lubrication Material dirty or rusted	Decrease counterbend die pressure Use Ercolina® bending lubricant Replace material or clean surface
Tube has marks	Poor tube quality Tooling not ordered for material	Replace material Consult factory



# Troubleshooting

Problem	Probable Cause	Solution
Machine doesn't turn on	Electrical connections Emergency switch depressed Fuse blown	Check power source and plug end Release emergency switch Replace fuse
Stops and display flashes	Overload, refer to machine capacity chart	Turn machine off, depress the blue reset button, turn machine on
Depress foot pedal and machine will not start	No bend angle stored	Program machine
Counter miscounts	Encoder or star wheel dirty or defective	Clean with CRC electrical cleaner

## - Routine Maintenance -

Keep machine clean and free of grease and debris

Using supplied grease gun, lubricate gearbox at zirts every 40 hours of use (see figure)

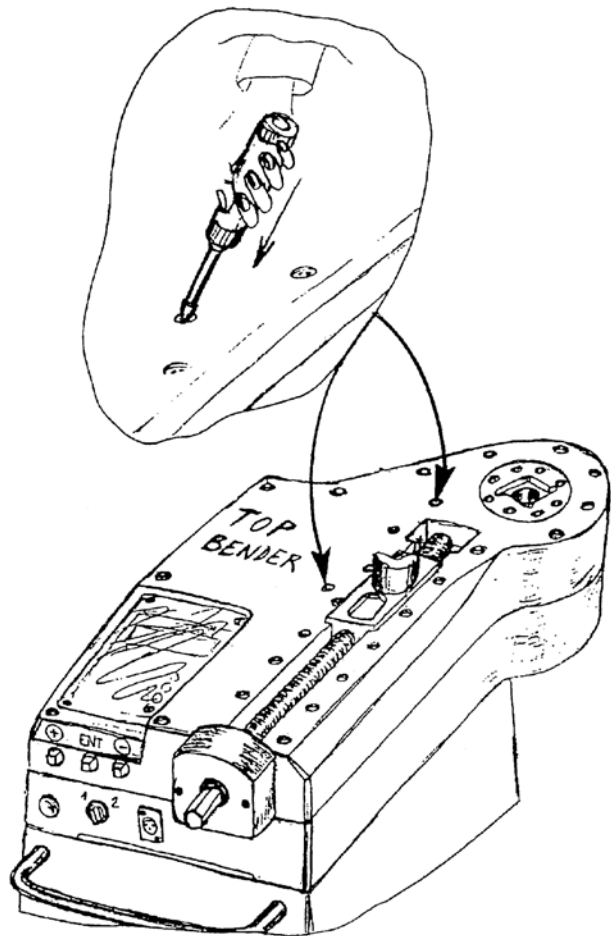
Replace worn power cords or broken switches

Clean encoder with electrical contact cleaner or canned air spray

Any repair or replacement of internal or external parts of machine must be made only by personnel trained/authorized by Ercolina®

Replace worn tooling

Ercolina® reserves the right not to supply accessories or spare parts if machine has been modified



## - 060 Super Bender® Accessories -

**A40/P** - Two axis positioning table

Polymer counterbending die

**O50M** - Mechanical tube and pipe positioner

**051** - Folding/Bending attachment

**O50E** - Counterbending die support bracket for radii 225mm

**O50I** - 3/8" - 2 1/2"

**O50J** - 2 1/2" - 3"

**810** - One 12-oz can of Ercolina® Spray Grease

**811** - 9pc case of Ercolina® Spray Grease



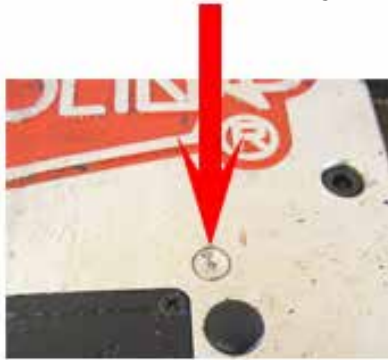
## Don't Forget The Grease!

Grease fittings are permanently installed by a threaded connection leaving a connection that a grease gun attaches to. To prolong the life of your Ercolina bending machine it is important to grease the zerks (fittings) every 40 work hours or 1,000 bends. WD-40 and other penetrating oils actually break down the grease and can cause damage to your machine.

**Grease machine every 40 hours of operation  
Use 1 oz. of Hi-Temp Grease NLGI No. 2 per fitting.**

### VARIOUS TYPES AND LOCATIONS OF GREASE ZERKS

**Top Benders from  
SB48 to 030  
(Needle-tip socket style)**



**TB130**



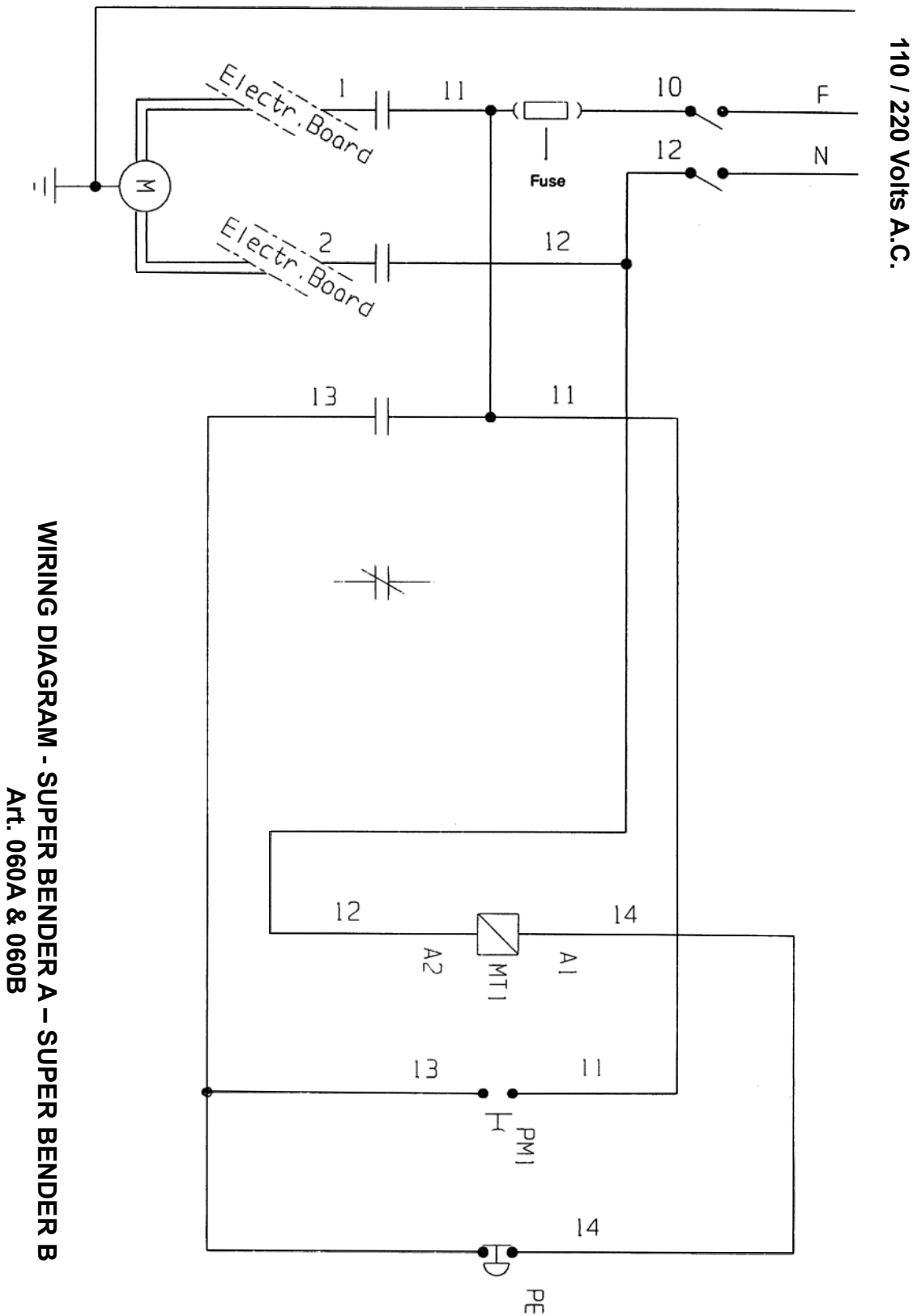
**TB100**



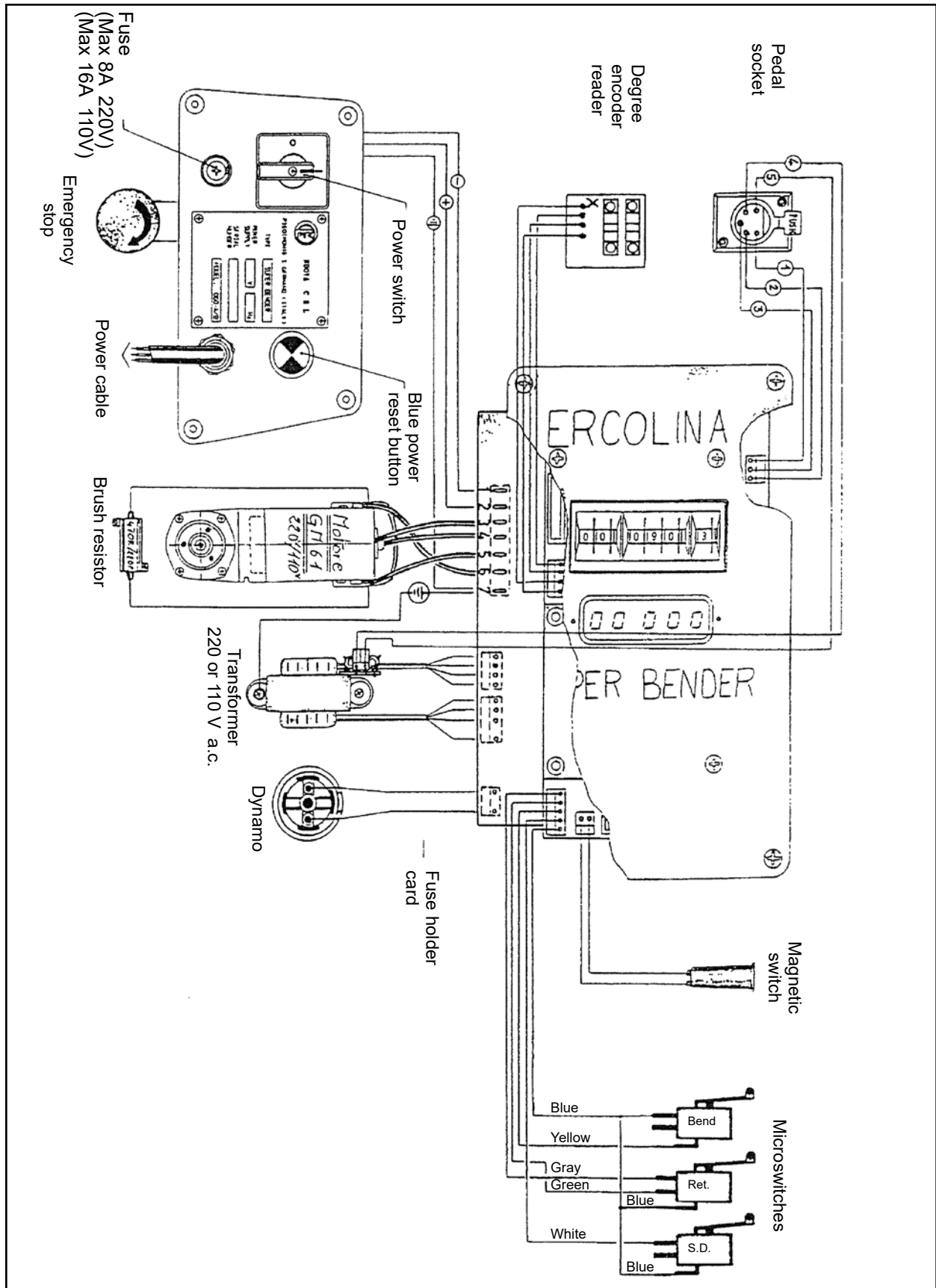
**Inadequate greasing can leave your gearcase dry,  
damaging the bushings in your machine.**



## Electrical Schematic (220V)



# Wiring Diagram



# PIPE INFORMATION

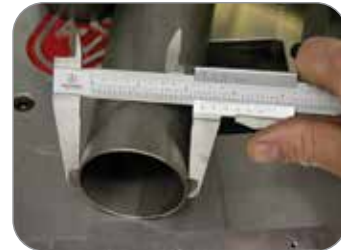
Pipe dimensions are based on I.D. of material  
(2" sch. 40 pipe measures 2.375" O.D.)



Nominal Size	O.D.	Commercial Pipe and Wall Thickness					
		Schedule					
		5	10	40	80	160	XX Strong
1/4"	.540		.065	.088	.119		
3/8"	.675		.065	.091	.126		
1/2"	.840	.065	.083	.109	.147	.188	.294
3/4"	1.050	.065	.083	.113	.154	.219	.308
1"	1.315	.065	.109	.133	.179	.250	.358
1-1/4"	1.660	.065	.109	.140	.191	.250	.382
1-1/2"	1.900	.065	.109	.145	.200	.281	.400
2"	2.375	.065	.109	.154	.218	.343	.436
2-1/2"	2.875	.083	.120	.203	.276	.375	.552
3"	3.500	.083	.120	.216	.300	.438	.600
3-1/2"	4.000	.083	.120	.226	.318		.636
4"	4.500	.083	.120	.237	.337	.531	.674

# ROUND TUBE INFORMATION

Tube dimensions are based on O.D. of material  
(2" tube measures 2.00" O.D.)



Minimum Achievable "Centerline Radius" with Standard Tooling

Tube Size	Wall Thickness							
	.035 20 Ga.	.049 18 Ga.	.065 16 Ga.	.083 14 Ga.	.095 13 Ga.	.109 12 Ga.	.120 11 Ga.	.134 10 Ga.
1/4"	1.4	1.4	1.4	1.4	1.4	1.4	.78	.78
3/8"	1.4	1.4	.78	.78	.78	.78	.78	.78
1/2"	1.4	1.4	1	1	1	1	1	1
5/8"	1.8	1.8	1.8	1.4	1.4	1.4	1.4	1.4
3/4"	2.6	2.6	2.6	1.8	1.8	1.8	1.8	1.8
7/8"	2.6	2.6	2.2	1.8	1.8	1.8	1.8	1.8
1"	3.2	3.2	2.6	2.2	2.2	2.2	2.2	2.2
1-1/8"	3.2	3.2	3.2	2.6	2.2	2.2	2.2	2.2
1-1/4"	4.4	4.4	4.4	3.2	2.6	2.6	2.6	2.6
1-3/8"	4.4	4.4	4.4	3.2	3.2	3.2	3.2	3.2
1-1/2"	7.5	5.9	5.1	3.9	3.9	3.5	3.5	3.5
1-5/8"	7.5	5.9	5.1	3.9	3.9	3.5	3.5	3.5
1-3/4"			6.7	6.7	5.1	3.9	3.9	3.9
1-7/8"			7.5	5.9	5.1	3.9	3.9	3.9
2"			7.5	7.5	5.9	4.7	4.7	4.7
2-1/8"			7.5	7.5	5.9	5.1	5.1	4.7
2-1/4"				7.5	5.9	5.1	5.1	5.1
2-3/8"				7.5	5.9	5.1	5.1	5.1
2-1/2"					11.8	10.2	9.8	
3"					11.8	10.2	9.8	

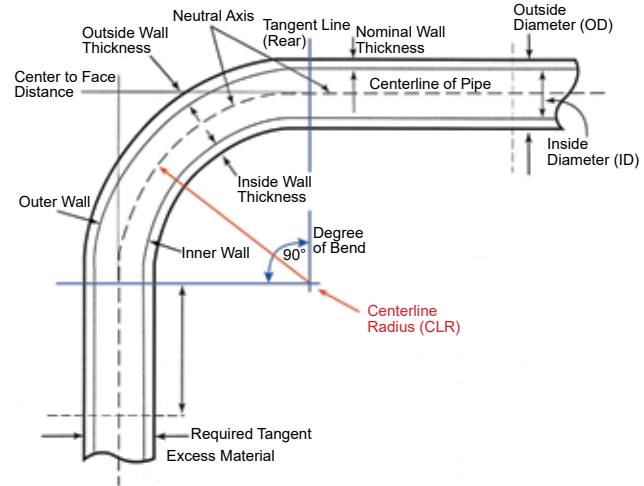


# BEND FORMULA

## Material Consumption for Bend Angle

$$\text{Radius} \times \text{Degree of Bend} \times .0175 = \text{Length}$$

To calculate total pipe length, add distance from end of pipe to the first bend, plus first bend arc length, plus distance to second bend.



## Decimals

1/64	.0156	23/64	.3593	45/64	.7031
1/32	.0312	3/8	.3750	23/32	.7187
3/64	.0468	25/64	.3906	47/64	.7343
1/16	.0625	13/32	.4062	3/4	.7500
5/64	.0781	27/64	.4218	49/64	.7656
3/32	.0937	7/16	.4375	25/32	.7812
7/64	.1093	29/64	.4531	51/64	.7968
1/8	.1250	15/32	.4687	13/16	.8125
9/64	.1406	31/64	.4843	53/64	.8281
5/32	.1562	1/2	.5000	27/32	.8437
11/64	.1718	33/64	.5156	55/64	.8593
3/16	.1875	17/32	.5312	7/8	.8750
13/64	.2031	35/64	.5468	57/64	.8906
7/32	.2187	9/16	.5625	29/32	.9062
15/64	.2343	37/64	.5781	59/64	.9218
1/4	.2500	19/32	.5937	15/16	.9375
17/64	.2656	39/64	.6093	61/64	.9531
9/32	.2812	5/8	.6250	31/32	.9687
19/64	.2968	41/64	.6406	63/64	.9843
5/16	.3125	21/32	.6562	1	1.000
21/64	.3281	43/64	.6718		
11/32	.3437	11/16	.6875		

## Millimeters

1 - .0393	26 - 1.023	51 - 2.007	76 - 2.992
2 - .0787	27 - 1.062	52 - 2.047	77 - 3.031
3 - .1181	28 - 1.102	53 - 2.086	78 - 3.070
4 - .1574	29 - 1.141	54 - 2.125	79 - 3.110
5 - .1968	30 - 1.181	55 - 2.165	80 - 3.149
6 - .2362	31 - 1.220	56 - 2.204	81 - 3.188
7 - .2755	32 - 1.259	57 - 2.244	82 - 3.228
8 - .3149	33 - 1.299	58 - 2.283	83 - 3.267
9 - .3543	34 - 1.338	59 - 2.322	84 - 3.307
10 - .3937	35 - 1.377	60 - 2.362	85 - 3.346
11 - .4330	36 - 1.417	61 - 2.401	86 - 3.385
12 - .4724	37 - 1.456	62 - 2.440	87 - 3.425
13 - .5118	38 - 1.496	63 - 2.480	88 - 3.464
14 - .5511	39 - 1.535	64 - 2.519	89 - 3.503
15 - .5905	40 - 1.574	65 - 2.559	90 - 3.543
16 - .6299	41 - 1.614	66 - 2.598	91 - 3.582
17 - .6692	42 - 1.653	67 - 2.637	92 - 3.622
18 - .7086	43 - 1.692	68 - 2.677	93 - 3.661
19 - .7480	44 - 1.732	69 - 2.716	94 - 3.700
20 - .7874	45 - 1.771	70 - 2.755	95 - 3.740
21 - .8267	46 - 1.811	71 - 2.795	96 - 3.779
22 - .8661	47 - 1.850	72 - 2.834	97 - 3.818
23 - .9055	48 - 1.889	73 - 2.874	98 - 3.858
24 - .9448	49 - 1.929	74 - 2.913	99 - 3.897
25 - .9842	50 - 1.968	75 - 2.952	100 - 3.937

# Minimum Distance Between Bends

By Center Line Radius

Radius of Center Former		Minimum Distance Between Bends	
Inches	Metric	Inches	Metric
.394	10	NA	NA
.472	12	NA	NA
.591	15	NA	NA
.630	16	NA	NA
.709	18	NA	NA
.787	20	NA	NA
.945	24	NA	NA
1.023	26	NA	NA
1.102	28	NA	NA
1.181	30	NA	NA
1.259	32	NA	NA
1.417	36	2.362	60
1.811	46	3.149	80
2.204	56	3.740	95
2.637	67	3.937	100
3.228	82	3.937	100
3.543	90	4.330	110
3.937	100	4.330	110
4.133	105	4.330	110
4.409	112	4.330	110
4.724	120	5.511	140
5.118	130	5.511	140
5.708	145	5.905	150
6.692	170	5.905	150
7.283	185	5.905	150
7.480	190	5.905	150
8.858	225	5.905	150
10.236	260	6.299	160
11.811	300	6.299	160

Super Bender® with pipe kit					Super Bender® with tube kit				
Size	CLR	Min. Wall	Former part #	Counterbend #	Size	CLR	Min. Wall	Former part #	Counterbend #
½"	1.8	.109	153R046P0500	155P0500	¾"	2.6	.039	153R067T0750	154T0750
¾"	2.2	.113	153R056P0750	155P0750	⅞"	2.6	.039	153R067T0875	154T0875
1"	2.6	.133	153R067P1000	155P1000	1"	3.2	.039	153R082T1000	154T1000
1¼"	3.5	.140	153R090P1250	155P1250	1¼"	4.4	.039	153R112T1250	154T1250
1½"	3.9	.145	153R100P1500	155P1500	1½"	5.9	.047	153R150T1500	154T1500
					1¾"	6.7	.059	153R170T1750	154T1750

Pipe kit only # PIPEKIT2

Tube kit only # TUBEKIT2

## TERMS AND CONDITIONS OF WARRANTY

**1. Definitions.** CML USA, Inc. ("CML") hereunder; the term "End-User" means the ultimate user of the Goods; the term "Dealer" means an independent contractor of CML whom purchased the Goods from CML to sell to the End-User; and the term "Goods" means the goods, equipment, products, parts, services, labor, or other items or work provided.

**2. Warranty.** CML hereby disclaims any warranty regarding speed of production or output or economics of operation with respect to the Goods. If such matters are set forth or described in the specifications applicable to the Goods such statement or description shall be deemed to be an estimate only. Any warranties of CML with respect to the Goods shall be null, void and without effect if such Goods have been altered or repaired by persons or entities other than CML, unless otherwise agreed to (in writing) by CML. Notwithstanding any contrary provision contained herein, the warranties of CML hereunder shall become effective and valid only for one year from the date of the bill of lading issued by the carrier at the designated FOB point. **THE WARRANTIES ATTACHED TO THIS ARE CML'S CURRENT EXCLUSIVE WARRANTIES AND CML EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES (WHETHER WRITTEN, ORAL, IMPLIED OR STATUTORY), INCLUDING (BUT NOT LIMITED TO) ANY WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.** Any claim for breach of CML's warranties must be demonstrated to CML's satisfaction to have existed at the time of delivery of the Goods and shall be deemed waived by the End-User unless written notice of such claim is actually received by CML within twelve (12) months after CML has shipped the Goods (FOB, CML's Factory) to which such claim relates. CML's liability shall be expressly limited (at CML's option) to the replacement or repair of non-conforming or defective Goods or to the credit for the purchase price of non-conforming Goods. Prior to said repair, replacement, or credit, CML has the right to inspect the Goods claimed to be defective or non-conforming, and, if requested by CML, End-User shall return such Goods to CML at CML's direction and expense. No Goods are to be returned to CML without CML's prior written authorization. THE REMEDIES SET FORTH HEREUNDER SHALL CONSTITUTE THE EXCLUSIVE REMEDIES AVAILABLE TO THE END-USER AND ARE IN LIEU OF ALL OTHER REMEDIES.

**3. End-User's Materials.** All materials required by CML to test the operation of the Goods shall be furnished by the End-User (at its sole cost and expense). All materials and equipment furnished by the End-User for the construction, remodeling, or testing of Goods (or for any other purpose) shall be delivered to CML at no cost to CML, FOB CML's warehouse floor. The End-User shall bear the risk and cost of returning all such materials and equipment to the End-User. The End-User shall pay all applicable crating and delivery costs and expenses for samples and parts delivered to the End-User and, except as may be required for testing purposes, the End-User shall pay all costs and expenses pertaining to producing parts or samples requested by the End-User.

**4. Tolerance and Variations.** Except as specified by the End-User and expressly agreed to by CML (in writing), the Goods shall be produced in accordance with CML's standard business practices. All Goods (including, but not limited to, Goods produced to meet an exact specification) shall be subject to tolerances and variations consistent with good manufacturing practice in respect to dimensions, weight, section, chemistry and mechanical properties, the normal variations in surface and internal conditions and in quality, and to deviations from tolerances and variations consistent with practical testing and inspection methods.

**5. Limitation of Liability.** IN NO EVENT SHALL CML BE LIABLE FOR INCIDENTAL, INDIRECT, SPECIAL OR CONSEQUENTIAL DAMAGES RESULTING FROM THE FURNISHING, PERFORMANCE, OR USE OF THE GOODS SOLD HEREUNDER (IF AT ALL), WHETHER AS A RESULT OF BREACH OF CONTRACT, BREACH OF WARRANTY, THE NEGLIGENCE OF CML OR OTHERWISE. CML's liability under no circumstances will exceed the purchase price for the Goods for which liability is claimed.

**6. Indemnification; Assumption of Risk.** To the extent permitted by law, the End-User agrees to indemnify and hold CML (and its respective agents and employees) harmless from and against any and all liabilities, damages, losses, actions, causes of action, claims (including, but not limited to, claims of patent infringements), expenses, costs (including, but not limited to, attorney's fees), fines, penalties and any other expenses directly or indirectly arising from End-User's actual use or intended use of the Goods. The End-User agrees to assume all risk of loss or damage to person or property while on the premises of CML or of CML's related corporations. To the extent permitted by law, the End-User (on behalf of itself and all of its agents and employees) hereby releases and forever discharges CML (and its respective employees and agents) from any and all claims, demands, causes of action, liabilities, losses or damages resulting or arising from the End-User's presence (or the presence of the End-User's employees and agents) on the premises of CML. The End-User warrants to CML that the End-User has the authority to grant this release on behalf of the End-User's agents and employees.

**7. Non-Waiver.** No waiver, alteration or modification of any of the provisions hereof shall be binding on CML unless such waiver is expressed in writing by CML. Waiver by CML of any breach or default by End-User hereunder shall not be deemed a waiver by CML of any default or breach by End-User which may thereafter occur.

**8. Assignment.** CML reserves the right to subcontract all or any part of the work to be performed hereunder, without obtaining the consent of the End-User. No notice to the End-User of any subcontracting by CML is required. The rights and obligations of the End-User hereunder may not be assigned without the prior written consent of CML.

**9. Governing Law; Jurisdiction; Venue.** The laws of the State of Iowa shall govern all disputes, controversies, interpretive matters and litigation arising under this warranty. PROPER AND EXCLUSIVE JURISDICTION AND VENUE for all disputes, controversies, interpretive matters and litigation arising hereunder (or otherwise between the parties) lies with the Iowa District Court located in Scott County, Iowa or the United States District Court for the Southern District of Iowa, Davenport Division. The End- User hereby submits to the personal jurisdiction of such courts.

**10. Limitations for Suits.** Any cause of action or claim arising out of or relating to CML's performance or failure to perform hereunder or the furnishing, performance, or use of the Goods hereunder must be commenced within one (1) year after the claim or cause of action has accrued.



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