

FITOK

Hand Tube Bender Manual



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Introduction

- 1. FITOK Hand Tube Bender is used for tube bending and provides high quality performance in tube bending solutions.
- 2. Read this operation manual carefully before using FITOK Hand Tube Bender.
- 3. Ordering information

Dimensions, in.		
Ordering Number	Tube O.D.	Bend Radius
HTB-4S	1/4"	0.56"
HTB-4	1/4"	0.75"
HTB-5	5/16"	0.94"
HTB-6	3/8"	
HTB-8	1/2"	1.5"
HTB-6M	6 mm	15 mm
HTB-8M	8 mm	24 mm
HTB-10M	10 mm	
HTB-12M	12 mm	38 mm

The hand tube bender can not be used for SAF 2507 tubing over 1/4" O.D. or for medium-pressure tubing.

Tubeing Data

- ©FITOK Hand Tube Bender is available for bending tube of OD1/4, 5/16, 3/8 and 1/2 in. and 6, 8, 10 and 12 mm in a variety of wall thicknesses.
- ©Tubing should be free of scratches and appropriate for bending.

Fractional Tubing

High-quality, cold-drawn, seamless carbon steel hydraulic tubing ASTM A179 or equivalent, with hardness equal to or less than 72 HRB (130 HV).

High-quality, seamless and austenitic stainless steel tubing ASTM A269/A213 (304, 316, etc.) or equivalent, with hardness 90 HRB (200 HV or less).

Dimensions, in.			
Tube O.D.	Bend Radius	Wall Thickness for Carbon Steel Min/Max	Wall Thickness for Stainless Steel Min/Max
1/4	9/16	0.028/0.065	
	3/4	0.028/0.065	
5/16	15/16	0.035/0.065	
3/8	15/16	0.035/0.065	0.035/0.083
1/2	1 1/2	0.035/0.083	

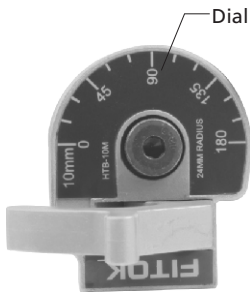
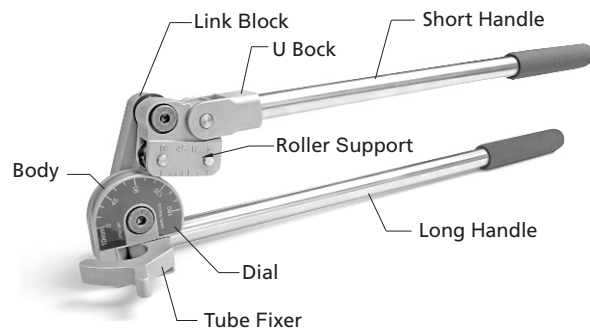
Metric Tubing

High quality, cold drawn, carbon steel hydraulic tubing DIN 2391 or equivalent, with hardness equal to or less than (72 HRB)130 HV.

High quality, seamless and welded Austenitic stainless steel tubing EN ISO 1127 (304, 316, etc.) or equivalent, with hardness equal to or less than (90 HRB)200 HV.

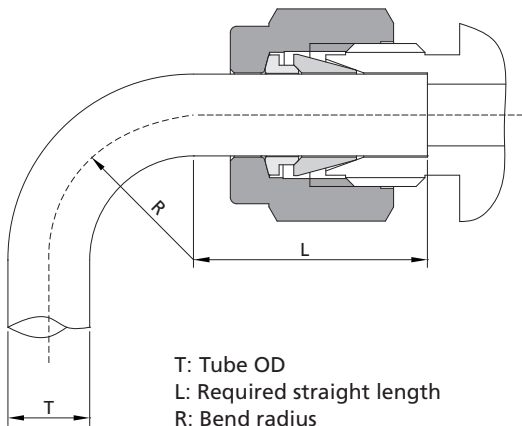
Dimensions, mm			
Tube O.D.	Bend Radius	Wall Thickness for Carbon Steel Min/Max	Wall Thickness for Stainless Steel Min/Max
6	15	0.8/1.5	
8	24	1.0/1.5	
10	24	1.0/1.5	1.0/2.0
12	38	1.0/2.2	1.0/2.0

Picture of HTB



Tubing Installation

Properly selected tubing, combined with quality FITOK tube fittings to provide leak-tight systems. When installing fittings near tube bends, there should be a sufficient length of straight tubing to allow the tube to be bottomed in the FITOK tube fitting.

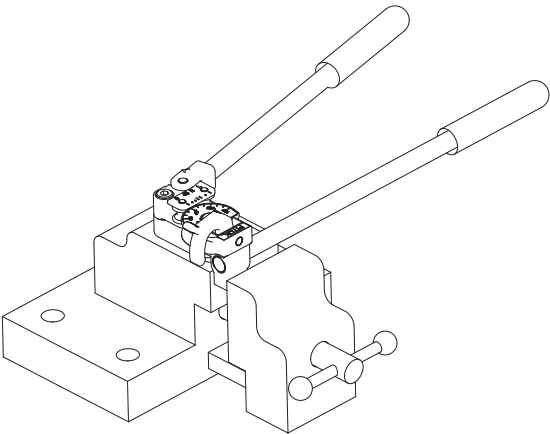


Fractional Dimensions, in.		
T Tube O.D.	R Bend Radius	L
1/4	9/16	13/16
	3/4	
5/16	15/16	7/8
3/8	15/16	15/16
1/2	1 1/2	1 3/16

Metric Dimensions, mm		
T Tube O.D.	R Bend Radius	L
6	15	21
8	24	23
10	24	25
12	38	31

Vise Clamp Block

The FITOK hand tube bender features a vise clamp block which allows the HTB to be clamped in a vise. It is convenient when bending tube of hard materials or heavy-wall thickness, or long pieces of tubing that need to be supported.



Bend Layout

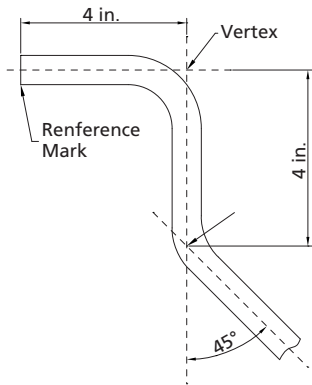
FITOK HTB can be used to form single, offset and other bends. Measure and mark the tube prior to bending.

The Measure-Bend Method

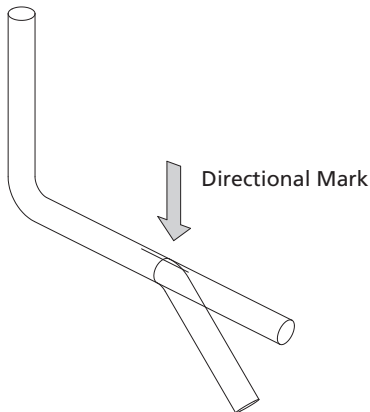
1. Add the length of all sections together to estimate the overall length of tubing required.
2. Mark at the end of the tube from which you begin the measurement.
3. Measure from the reference mark and make a bend mark on the tube at a distance equal to the desired bend length. This mark indicates the vertex of the bend.
4. Bend the tube as described in **FITOK HTB Instruction**, page 8.
5. If additional bend is needed, take the vertex mark made previously as reference mark, repeat step 3 and step 4. (The vertex is where the center lines of the two legs of the angle intersect.)

Example of the Method

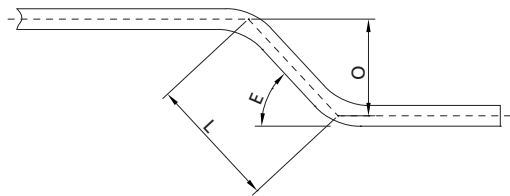
A 90° bend 4 inches from the reference mark followed by a 45° bend with 4 inches between bends.



1. Mark at the end of the tube from which you begin the measurements;
2. Measure 4 in. from the mark made in step 1. Place a bend mark to indicate the first desired bend length;
3. Bend the tube 90° as described in **FITOK HTB Instruction** on page 8.
4. Measure 4 in. from the vertex of 90° bend. Place a second bend mark.
5. Place a directional mark over the second bend mark to ensure the bend is made in the intended direction.
6. Bend the tube 45° as described in **FITOK HTB Instruction** on page 8.



Offset Bending Formula



In order to change the center line of the fluid, typically to avoid an obstruction, we choose an offset bend. To determine the length of offset bend, select the offset angle (E) first. Then, multiply the offset dimension (O) by the offset bend allowance (A).

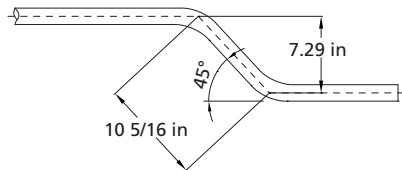
$$L=O\times A$$

Use this formula to calculate the distance between the bend marks described in **Bend Layout**.

Offset Angle (E)	Offset Bend Allowance (A)
22 1/2°	2.263
30°	2.000
45°	1.414
60°	1.154

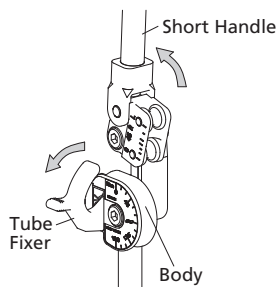
Example:
Offset angle (E) 45°
Offset dimension (O) 7.29 in.

$$7.29\times 1.414 = 10.31 \text{ in.}, \text{ or approximately } 10 \frac{5}{16} \text{ in.}$$

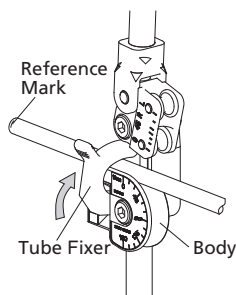


FITOK HTB Instruction

1. Swing the short handle up to the position above the body.
2. Release the tube fixer.

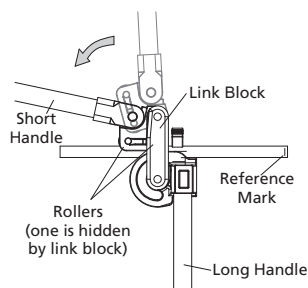


3. Place the tube in the groove of body with the reference mark to the left of the tube fixer.
4. Close the tube fixer over the tube just enough to hold the tube in place. This restricts movement of the tube during initial positioning but still allows for additional alignment.

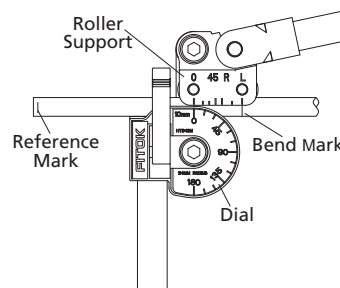


5. Swing down the short handle carefully until rollers rest gently on the tube while keeping the link block parallel to the long handle.

Note: Non-parallel between link block and the long handle should lead to premature bending.

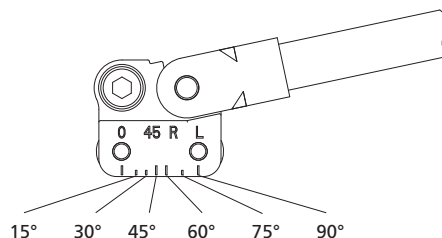


6. Align the zero on the roller support with the zero on the dial.



Alignment for A 90° bend

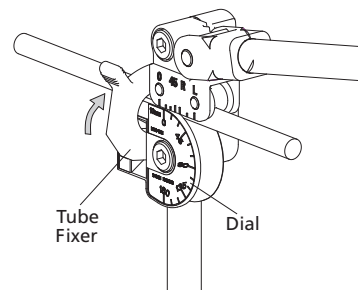
7. Align the bend mark with the mark on the roller support corresponding to the bend angle.



Note: View marks on the dial as a 0 to 90° scale when bending other angles.

8. Push the tube fixer firmly over the tube to secure the tube in the groove of body.

Note: Excessive pressure on the tube fixer may damage soft tubing.

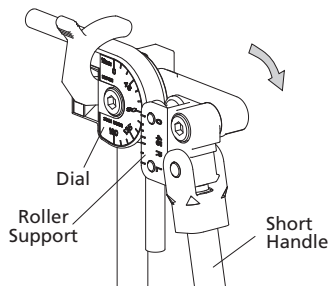


Bending

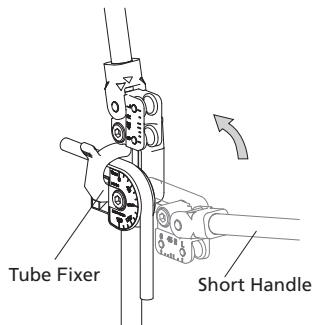
Bends 90° or less

1. Slowly swing the short handle down until the zero on the roller support reaches the desired angle on the dial.

Note: Be aware of springback, described on page 13.



2. Swing up the short handle away from the tube after completing the bend.

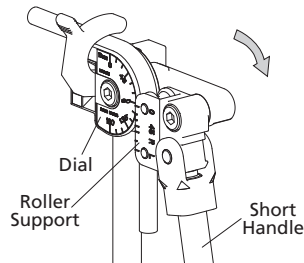


3. Release the tube fixer and remove the tube from the HTB groove.

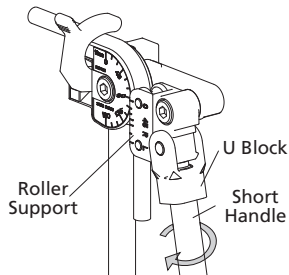
Bends greater than 90°

The right-angle design of the FITOK HTB offers maximum leverage when making bends. The bender's unique design allow you to use right angle leverage for bends greater than 90°.

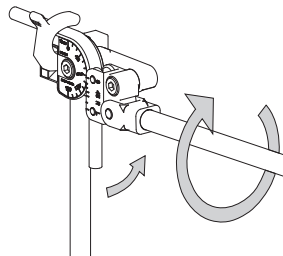
1. Slowly swing the short handle down until the zero on the roller support reaches the 90° on the dial.



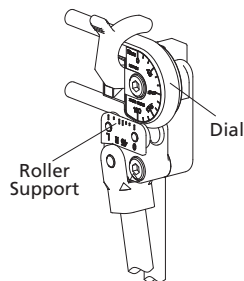
2. Loosen the short handle from U Block until the short handle could swing without moving the roller support.



3. Swing the short handle up until it is perpendicular to the long handle.
4. Tighten the short handle to provide continuous right-angle leverage for the rest of the bend.



- Continue the bend until the zero on the roller support reaches the desired angle on the dial.



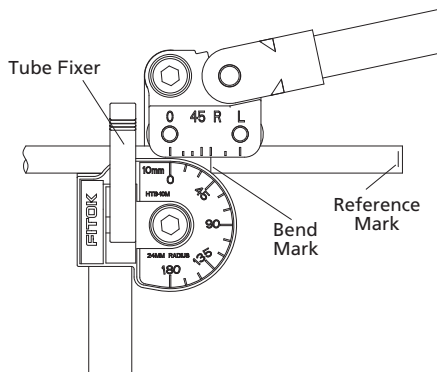
- Swing up the short handle away from the long handle after completing the bend, pausing when the zero on the roller support reaches 90° on the dial. Unscrew the short handle. Swing the short handle until it parallels with the long handle. Retighten the short handle.
- Swing up the short handle away from the tube.
- Release the tube fixer. Remove the tube from the bender.

Reverse Bending

The Measure-Bend Method

A reverse bend is made with the reference mark to the right of the hand tube fixer.

- Align the reference mark on the tube with the marks on the roller support as follows:
 - Line the bend mark up with R mark for 90° bends.
 - Treat the marks between 0 and R as an approximate 0 to 90 scale for other bend angles.



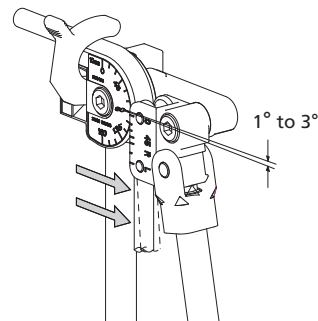
- Bend the tube as described in **Bending**, page 10.

Springback

All tubing will exhibit springback after a bend has been completed. The amount of springback depends on the bend angle, tubing material, tubing wall thickness and radius.

Experience will be helpful in predicting the springback amount. Expect to allow 1° to 3° of compensation.

Note: Verify the bend angle using a protractor, template or against a known angle to ensure the desired bend angle has been achieved.

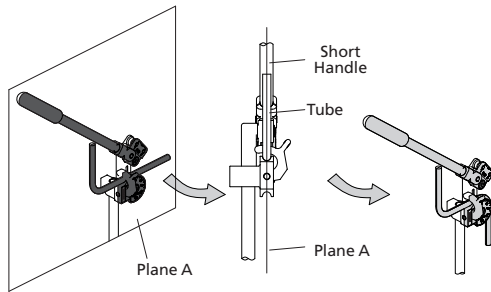


Note: When bending softer tubing such as aluminum or copper, do not bend all the way to the bend mark.

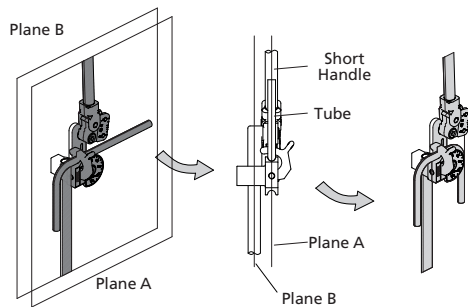
Bending on the Same Plane and Direction

Make sure the bend is made in the right direction when making multiple bends on a single piece of tube.

For bends in opposite direction of the previous bend, align the tube with the raised short handle (Plane A).



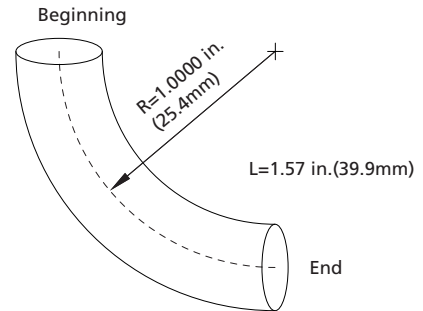
For bends in the same direction as the previous bend, parallel the tube to the long handle (Plane B).



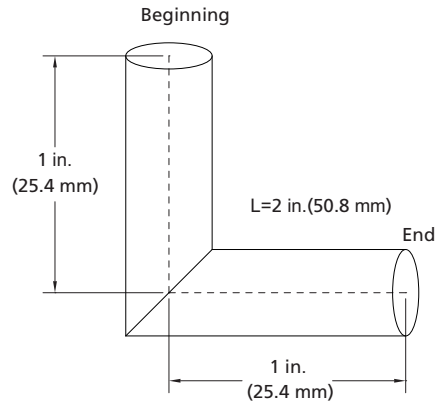
Adjustment (Gain) Calculations

Adjustment (gain) is another available method to get the desired bend.

Adjustment is the difference between the length of tubing used in the radiused bend and that in sharp bend, when measured from the beginning to the end of the bend.



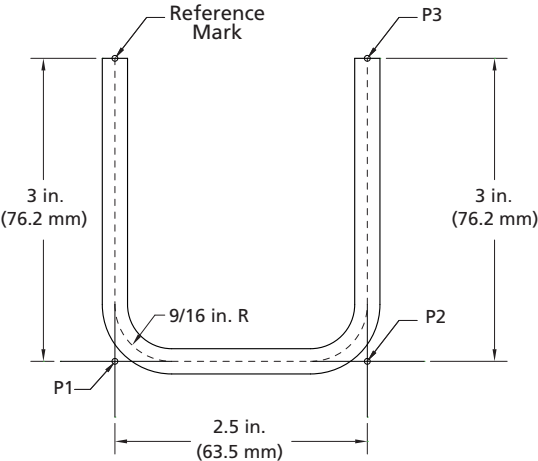
Radiused Bend



Sharp Bend

Example of the Method

1/4 in. tubing using a 1/4 in. bender with a 9/16 in. bend radius.



In order to get the desired bend, mark the tubing as follows:
 $P1 = 3 \text{ in.}$

To confirm the location of the bend mark, add the new section length to the previous bend mark position, then minus the adjustment (gain) of the previous bend.

$$P2 = P1 + 2.5 \text{ in.} - 5/16 \text{ in. (adjustment)} = 5 \text{ } 3/16 \text{ in.}$$

$$P3 = P2 + 3 \text{ in.} - 5/16 \text{ in. (adjustment)} = 7 \text{ } 7/8 \text{ in.}$$

7 7/8 in. is the total length of the tube.

$$90^\circ \text{ adjustment} = 5/16 \text{ in.}$$

Bend the tube as described in **FITOK HTB Instruction**, page 8.

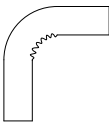
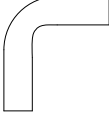
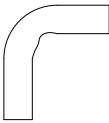
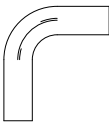
Fractional Adjustment Calculations

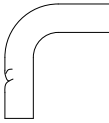
Bend Angle	Tube O.D., in.				
	1/4	1/4	5/16	3/8	1/2
	Bend Radius, in				
	9/16	3/4	15/16	15/16	1 1/2
30°	0	0	0	0	1/16
45°	1/16	1/16	1/16	1/16	1/16
50°	1/16	1/16	1/16	1/16	1/8
55°	1/16	1/16	1/8	1/8	1/8
60°	1/16	1/16	1/8	1/8	3/16
65°	1/8	1/8	3/16	3/16	1/4
70°	1/8	1/8	3/16	3/16	5/16
75°	3/16	3/16	1/4	1/4	3/8
80°	3/16	3/16	5/16	5/16	7/16
85°	1/4	1/4	3/8	3/8	9/16
90°	5/16	5/16	7/16	7/16	11/16

Metric Adjustment Calculations

Bend Angle	Tube O.D., mm			
	6	8	10	12
	Bend Radius, mm			
	15	24	24	38
30°	1	1	1	1
45°	1	2	2	3
50°	2	2	2	3
55°	2	3	3	4
60°	3	3	4	5
65°	3	4	4	7
70°	4	5	5	8
75°	5	6	7	10
80°	6	8	8	12
85°	7	10	10	15
90°	8	12	12	18

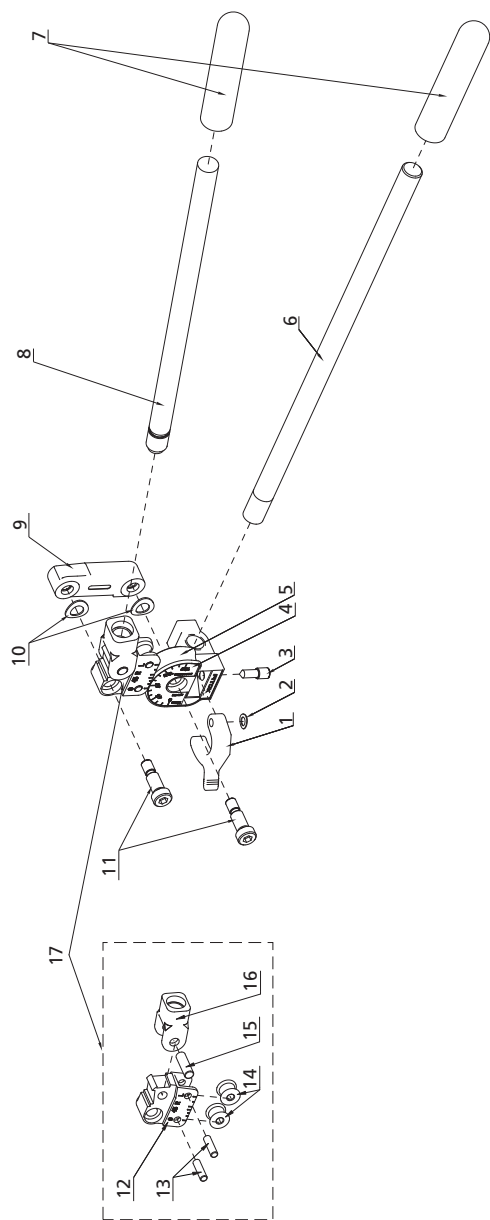
Troubleshooting

Defect	Cause	Solution
	Undersized bend radius	Increase bend radius
	Tube wall thickness too thin	Increase wall thickness
	Bender is intended for use with a larger tubing O.D.	Choose the correct size bender
	Tubing is collapsing during bending	Increase wall thickness
	Bend die flattens the tubing during bending	Use a bender equipped with rollers
	Bender is intended for use with a larger tubing O.D.	Choose the correct size bender
	Link block is not parallel to the long handle prior to bending	Make sure the link block is parallel to the long handle before bending
	Bender is intended for use with a smaller tubing O.D.	Choose the correct size bender
	Tube groove of body is damaged	Repair or replace body
	Foreign matter in body or roller	Clean bender or roller
	Rollers freezed	Replace damaged roller or bender

Defect	Cause	Solution
	Improper alignment	Make sure that the bender is properly aligned prior to bending
	Excessive pressure on the fixing block (generally visible on softer tubing only)	Reduce pressure

Replacement Parts

Hand Tube Bender Components



Item	Components
1	Tube Fixer
2	Curved Spring Washers
3	Cone Screw
4	Dial
5	Body
6	Long Handle
7	Sleeve
8	Short Handle
9	Link Block
10	Curved Spring Washers
11	Shoulder Screws
12	Roller Support
13	Pin 1
14	Roller
15	Pin 2
16	U Block
17	Roller Assembly