

# Copyright.

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Purchasing this Manual entitles the purchaser to build a single Rorty No.2 Tube Bender. Furthermore, Rorty Design reserves the sole right to make any and every financial gain, from this Manual and any resulting device or derivative.

# Rorty No.2 Tube Bender.

## Materials List.

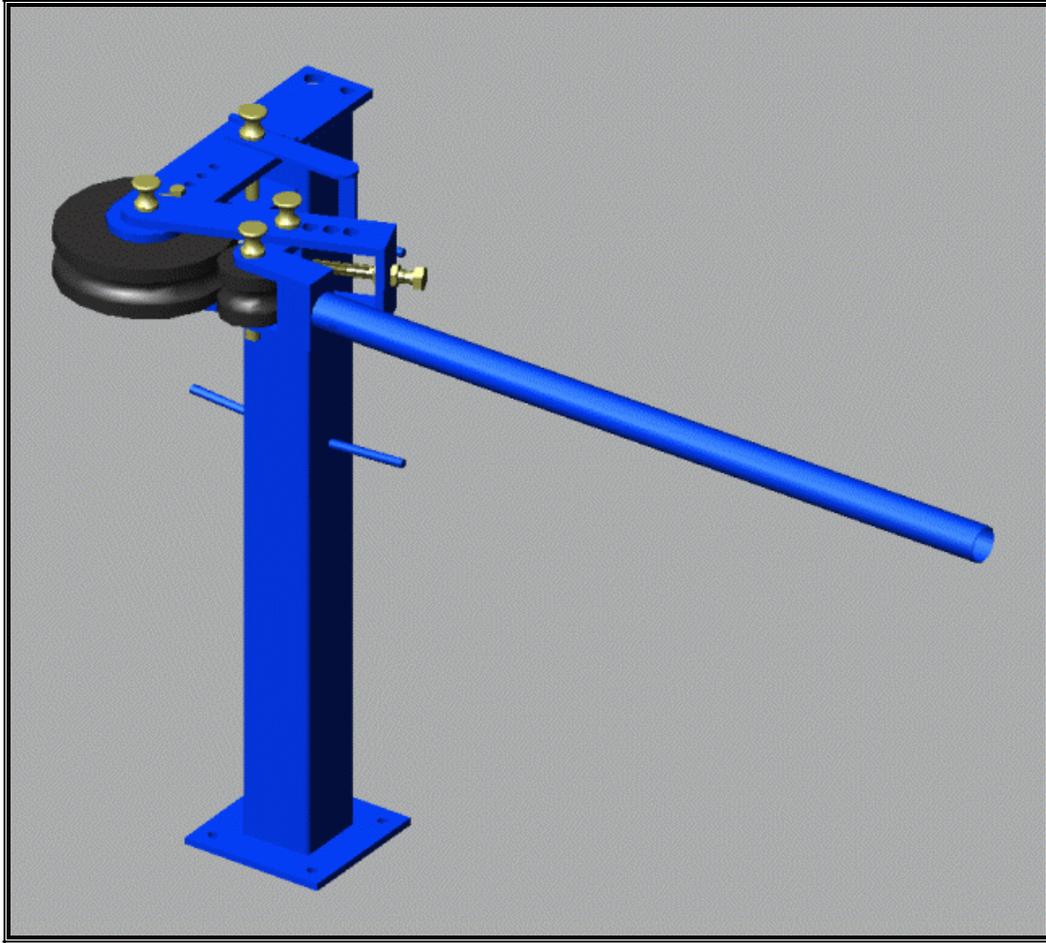
1. Base Plate:  
1# 200mm off 200mm x 8mm flat bar.
2. Column:  
1# 1015mm off 100mm x 100mm x 3mm SHS.
3. Die Arms:  
1# 464mm off 100mm x 12mm flat bar.  
1# 406.5mm off 65 x 12mm flat bar.  
1# 100mm off 8mm x 8mm square bar.
4. Tool Holders:  
4# 110mm off Ø12mm round bar.
5. Pivot Pins:  
500mm off Ø38mm 4140 round bar.
6. Primary Lever:  
2# 335mm off 50mm x 12mm flat bar.  
1# 94.5mm off 50mm x 12mm flat bar.
7. Secondary Lever:  
2# 116mm off 50mm x 12mm flat bar.  
2# 81.2mm off 50mm x 12mm flat bar.  
1# 100mm off 70mm x 50mm steel plate/bar.  
1# 70mm off 25mm x 12mm flat bar.
8. Lever Handle:  
1# 1000mm off DN40 x 3.2mm wall CHS (black pipe).
9. 31.8mm (1¼") Die Set:  
2# 186.6mm off 25mm x 6mm flat bar.  
1# 84mm off 25mm x 6mm flat bar.  
1# Ø240mm circle x 70mm medium carbon steel, 5083 aluminium or Delrin.  
1# Ø90mm circle x 70mm medium carbon steel, 5083 aluminium or Delrin.
10. 38.1mm (1½") Die Set:  
2# 220.1mm off 25mm x 6mm flat bar.  
1# 84mm off 25mm x 6mm flat bar.  
1# Ø292.1mm circle x 70mm medium carbon steel, 5083 aluminium or Delrin.  
1# Ø90mm circle x 70mm medium carbon steel, 5083 aluminium or Delrin.
11. 44.45mm (1¾") Die Set:  
2# 251.9mm off 25mm x 6mm flat bar.  
1# 84mm off 25mm x 6mm flat bar.  
1# Ø349.3mm circle x 70mm medium carbon steel, 5083 aluminium or Delrin.  
1# Ø90mm circle x 70mm medium carbon steel, 5083 aluminium or Delrin.
12. 50.8mm (2") Die Set:  
2# 280.8mm off 25mm x 6mm flat bar.  
1# 84mm off 25mm x 6mm flat bar.  
1# Ø400.8mm circle x 70mm medium carbon steel, 5083 aluminium or Delrin.  
1# Ø90mm circle x 70mm medium carbon steel, 5083 aluminium or Delrin.

# Rorty No.2 Tube Bender.

## Fastener List.

1. Anchor bolts:  
4# Ø12mm x 100mm masonry bolts or rag bolts.
2. Primary lever:  
1# M18 x 1.5 x 130mm Class 10.9 hex screw.  
2# M18 x 1.5 jam (half/lock) nuts.
3. Die bolts:  
2# M12 x 1.75 x 110 Class 10.9 hex bolts.  
2# M12 x 1.75 Nyloc nuts.  
4# Ø12mm flat washers.

## No.2 Tube Bender Construction.



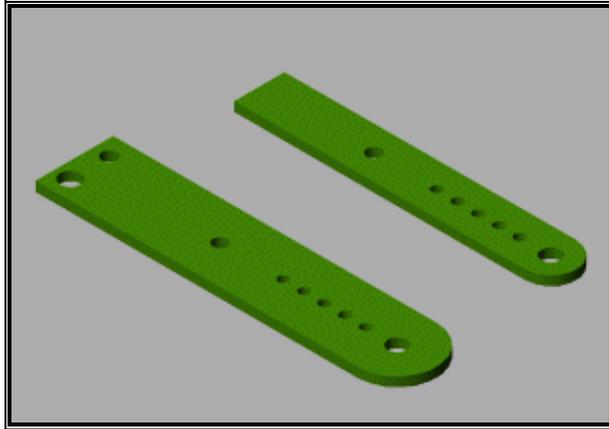
This bender is capable of bending structural tube of the following diameters:  $\text{Ø}31.8\text{mm}$  ( $1\frac{1}{4}$ " ),  $\text{Ø}38.1\text{mm}$  ( $1\frac{1}{2}$ " ),  $\text{Ø}44.45\text{mm}$  ( $1\frac{3}{4}$ " ) and  $\text{Ø}50.08\text{mm}$  (2" ). Do not attempt to bend pipe with this machine, as damage to it or you will most likely occur!

The bender is ideally suited to anyone wanting to bend light mechanical tube for occasional projects, yet does not want the complexity or expense of a large commercial set-up. The bender can be quickly de-mounted and stored away when not in use.

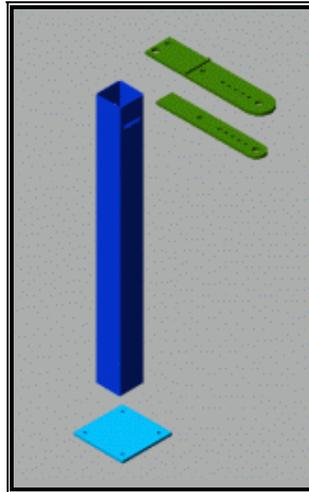
The bender is designed with the utmost simplicity of construction in mind. The stand and most of the other components can, in most instances, be made from common steel off-cuts found in the average workshop. The bending dies necessitate being turned on a lathe, but even a wood lathe can be employed to make the dies from acetal if preferred. The only other tools required are a scribe or craft knife, a tape measure, a setsquare, an adjustable bevel, a hacksaw or cut-off saw, a pedestal or hand drill,  $\text{Ø}8\text{mm}$ ,  $\text{Ø}12\text{mm}$ ,  $\text{Ø}19\text{mm}$ ,  $\text{Ø}20\text{mm}$ ,  $\text{Ø}24\text{mm}$  drill bits, a welder, and an angle grinder or file for finishing.

## General Construction.

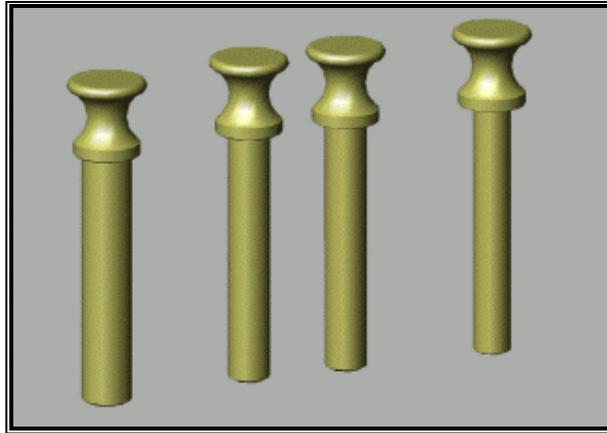
1. Refer to drawing 1. Cut and dress the base plate, and drill the four anchor holes where indicated.
2. Refer to drawing 2. Cut the SHS column to length ensuring the ends are accurate and square.
3. Measure down from the top of the column, and, on two opposite sides, mark the two slots for the bottom die arm. Drill out the waste then finish the slots by filing to shape.
4. Refer to drawing 3. Cut and dress the two die arms, and drill the various holes where indicated.



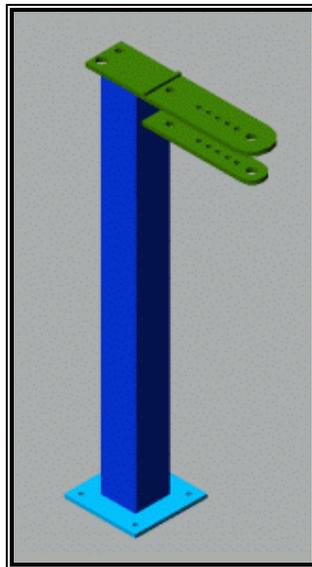
5. Centre the column on the base plate, and tack weld together. To prevent the base plate turning up at the corners, make only short 20mm welds at each corner of the column.



6. Refer to drawing 4. Turn the four pivot pins from the 4130 steel bar to the dimensions given. Hardening and tempering the pins will give longer service. Alternatively, just weld some large rings or washers to lengths of pre-finished tool-steel rod.

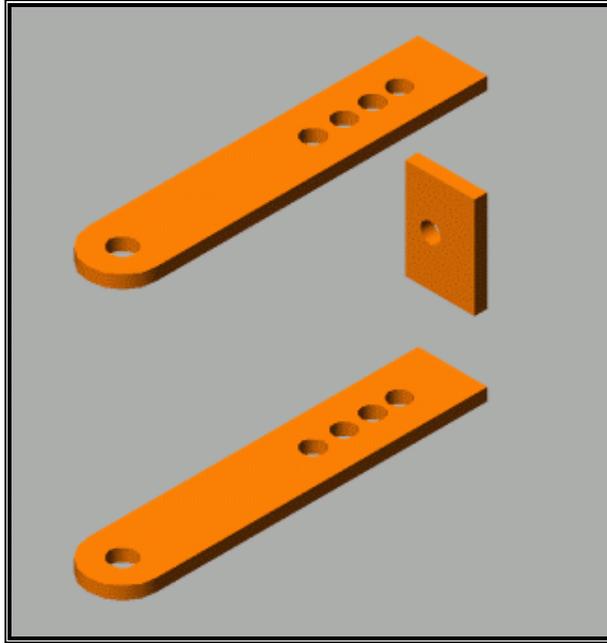


7. Stand the column upright again, and insert the bottom die arm into the slots in the column. Align the back edge of the die arm flush with the back of the column. Position the top die arm on top of the column, and align it with the sides of the column. Drop the  $\text{\O}24\text{mm}$  pivot pin through the large holes in the ends of the die arms, and when satisfied the two arms are perfectly aligned, carefully tack weld the arms to the column. You can now go ahead and finish welding the two die arms to the column.

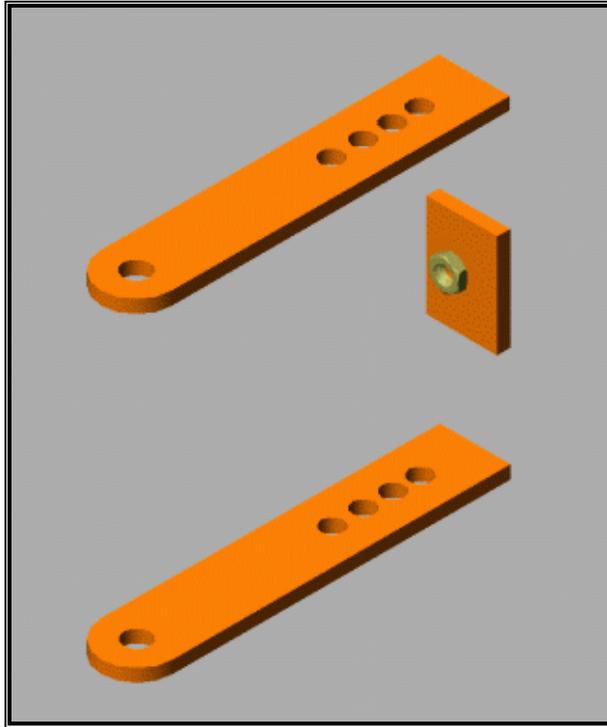


8. Refer to drawing 5. Cut and dress the four tool holders from  $\text{\O}12\text{mm}$  round bar. Mark their positions on the side of the column, and weld in place at about  $4^\circ$  above the horizontal.

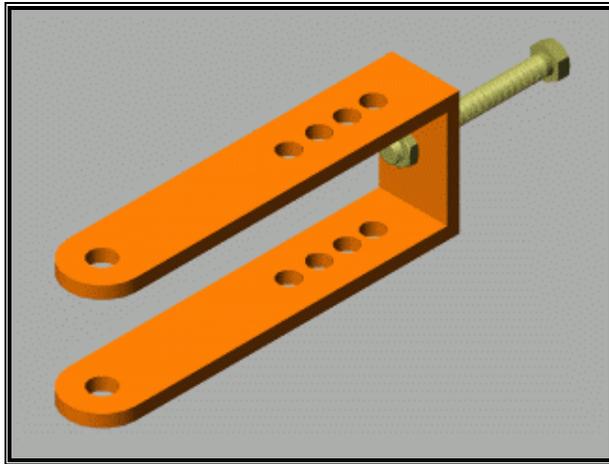
9. Refer to drawing 6. Cut and dress the three parts of the primary lever, drilling the holes where indicated. Clamping the two main pieces together and drilling through both simultaneously is a good method of preserving accuracy.



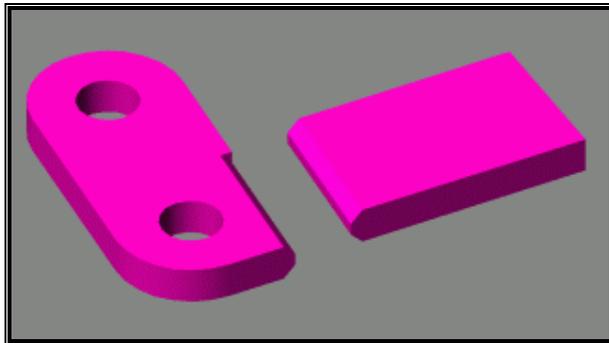
10. Run one of the M18 jam nuts part way down the thread of the hex screw. Insert the screw into the hole in the 12mm thick end piece. Run the second jam nut onto the screw and tighten. Tack this second jam nut in place, and remove the screw immediately. Fully weld the jam nut in place, and then immediately quench the end piece in some old engine oil to retain the jam nut's hardness. When cool, clean the oil residue off.



- Using the die arms as a jig, clamp the two main parts of the primary lever over the die arms, and insert the  $\text{\O}24\text{mm}$  pivot pin through the pivot holes to keep it all aligned. Place the end piece in position with the welded-on nut facing inwards and to the right side. Tack, and then weld the end piece in place.

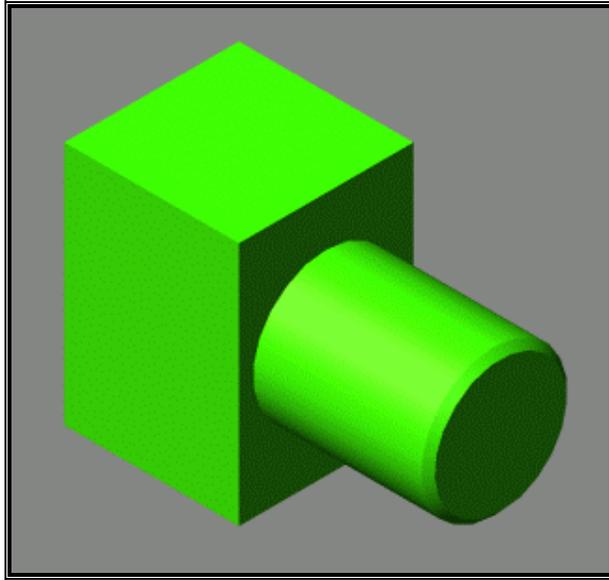


- Refer to drawing 7. Cut and dress the pieces of 12mm flat bar for the secondary lever. Clamp the sides together and drill the holes where indicated. Grind the mating edges of the pieces where they will be welded to form a deep V.



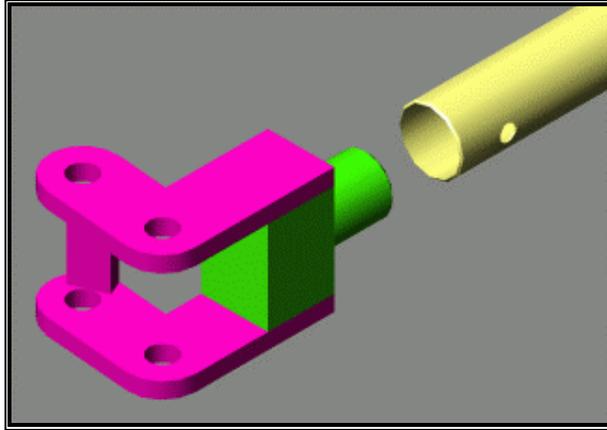
- Tack and then fully weld the two angled arms, and then grind (only) the two inside welds flush (otherwise they will interfere with the roller dies when assembled).

14. To make the spigot bar to accept the handle, take the piece of 100mm x 70mm x 50mm steel and machine to the dimensions in drawing 7.



15. Try a dry fit of the spigot into the end of the pipe handle. It will be necessary to grind or file a flat on the spigot to clear the pipe's internal weld seam. Using the spigot bar and the two  $\text{\O}20\text{mm}$  pivot pins as guides, clamp the whole secondary pivot assembly together. Place the piece of 25 x 12mm flat bar in a vertical position as illustrated. Its outer corner should line up with the points on the two sides of the lever where the radii start. Check the angle of the piece of 25 x 12mm bar, and when satisfied, tack the three pieces together and then fully weld (but take care not to weld over any of the rear pivot hole).

16. Refer to drawing 8. Cut the pipe handle to length and drill a  $\text{\O}12\text{mm}$  hole right through it, 35mm from one end.



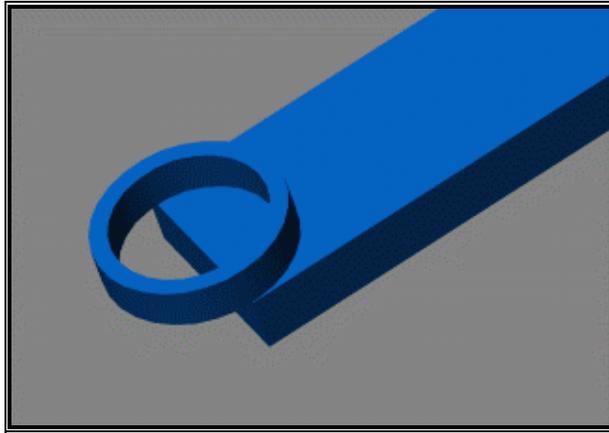
17. Push the secondary lever spigot into the pipe handle, making sure the holes through the pipe are horizontal. Make a continuous weld around the junction of the pipe and lever, and then rose-weld the holes in the pipe through to the spigot.

## The Die Sets.

The dies would be best turned from any good medium-carbon steel, or 5083 or 6061 aluminium. If using medium carbon steel, you can case harden the finished dies for better performance and wear resistance. In the absence of a suitably sized metal lathe or cheap steel/aluminium stock, the dies could also be made from acetal which is a very hard, self-lubricating plastic widely used in engineering. It can be purchased under the trade name of Delrin. Local plastics stockists can advise on supplying the die blanks from round bar or 70mm sheet.

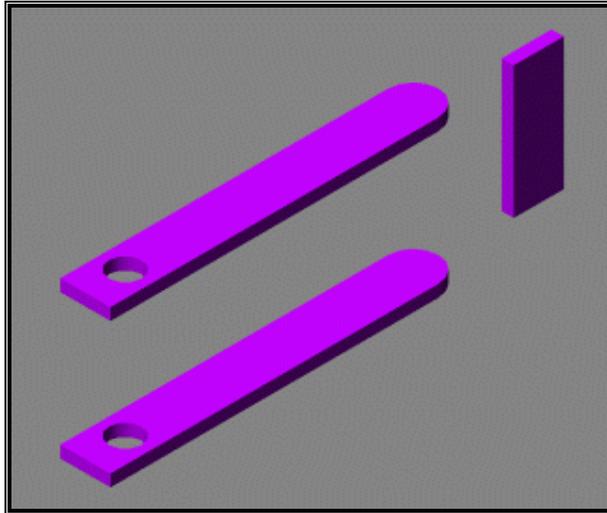
Refer to drawings 9, 10, 11 and 12. The dies are fairly straightforward as illustrated. The overall diameters, centreline radii and tube radii differ, as do some of the bolt-down holes. The rollers though, are all  $\text{Ø}90\text{mm}$ , but obviously, their tube radii differ from one tube size to another.

If you are turning the dies and rollers from acetal on a wood lathe, handy cutters can be made by turning a short piece of tool steel or alloy tube to the same diameter as the intended tube's diameter, then tack welding a 6mm cross section of it to the face of the end of a length of 50mm x 12mm flat bar.

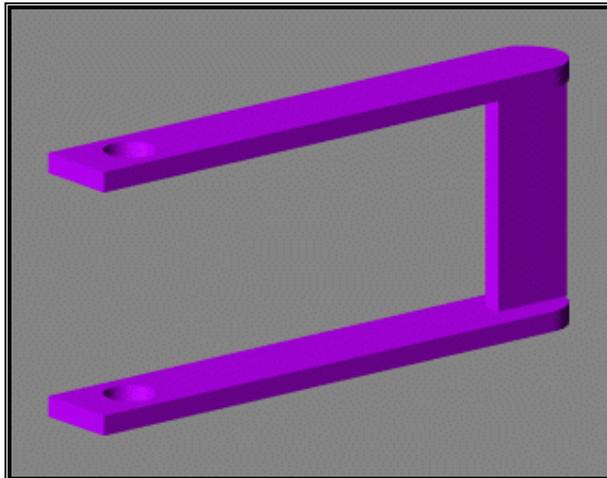


The stop arms are very simple devices and are matched to their respective dies and tube sizes. The following is a guide to their construction.

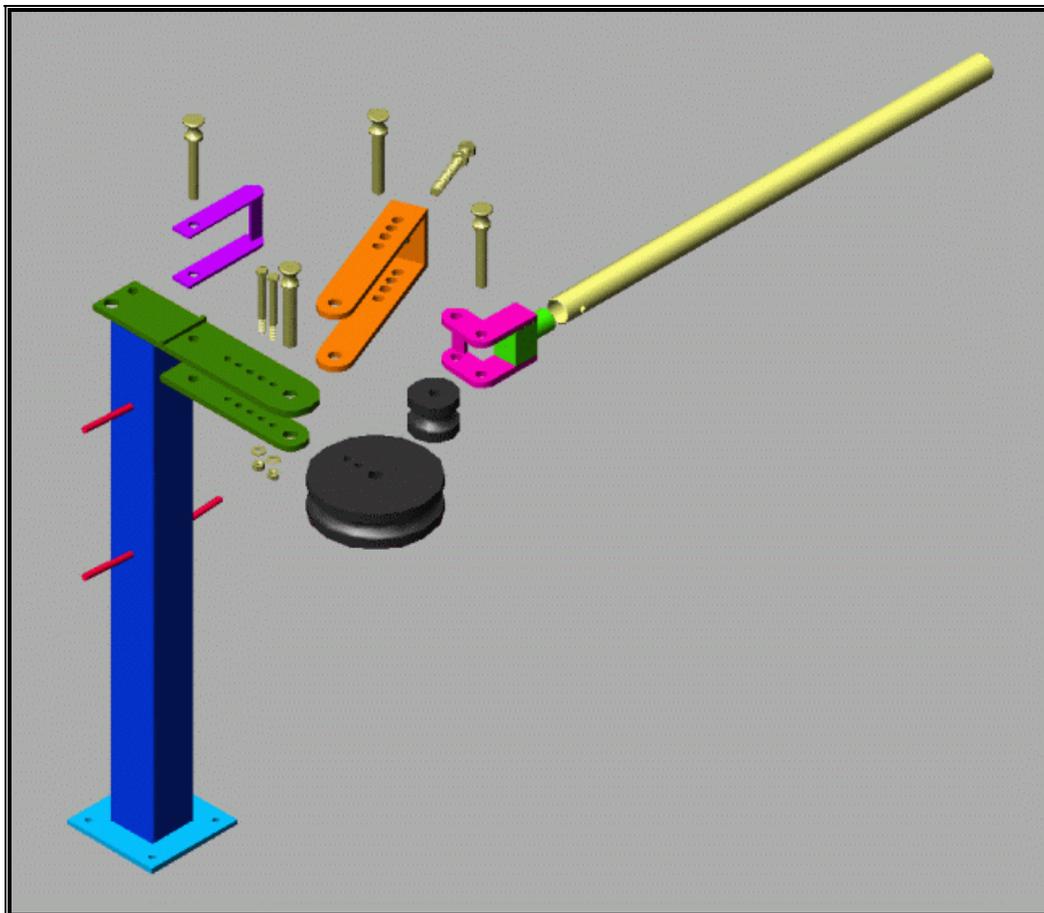
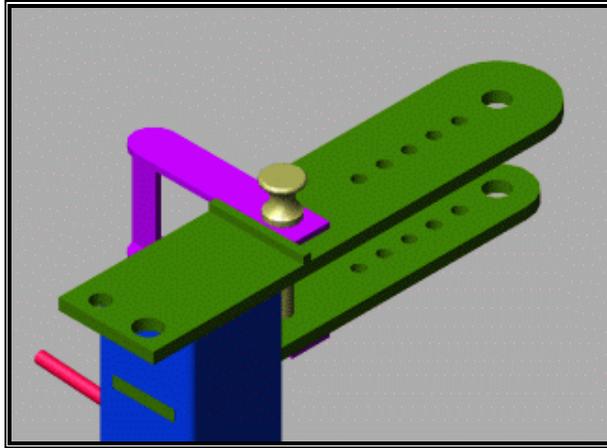
1. Cut and dress the two main pieces to the dimensions in the pertinent drawing and clearly mark the hole and end piece positions with a scribe or craft knife. Drill the holes where indicated. Cut and dress the end piece to length.



2. Using the  $\text{Ø}18\text{mm}$  pivot pin as a guide, clamp the two main pieces of the stop arm in their position on the die arms. Place the end piece in position, and align very carefully with the scribe mark. Tack into position and then fully weld the stop arm together.

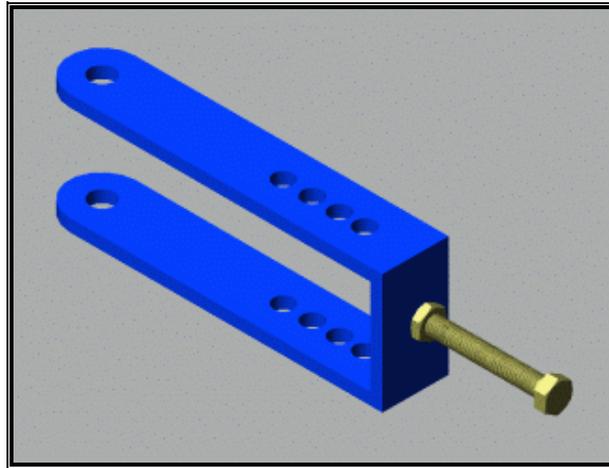


3. With the stop arm and  $\text{\O}18\text{mm}$  pivot pin in position on the die arms, use a setsquare to perfectly square the stop arm with the top die arm, and then clamp it in position. Take the 100mm piece of 8mm x 8mm square bar and place it on the top die arm, tight against the stop arm. From behind, tack weld the piece of bar to the die arm.

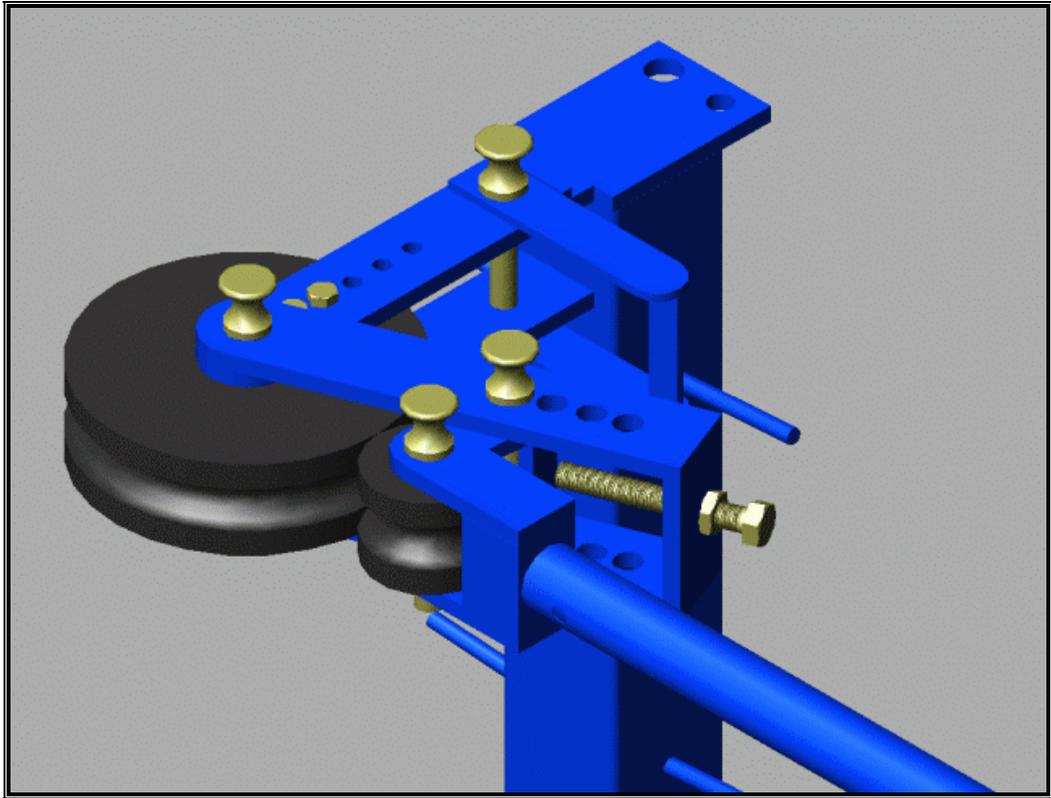


## Finishing, Assembly And Directions for Use.

1. Thoroughly clean the machine with thinners or turps to remove all traces of oil and anti-spatter fluid. Spray all the metal work with a good quality polyurethane paint, and leave until the paint has hardened.
2. Put a small amount of molybdenum disulphide grease on the end of the M18 hex screw and insert through the hole and into the welded nut in the primary lever. Do not tighten the lock nut yet.



3. Choose whichever size of die set you want to use and put the stop strap over the die arms, and retain it with the  $\text{\O}18\text{mm}$  pivot pin.
4. Put the bending die in position in the die arms, and secure with the two M12 bolts,  $\text{\O}12\text{mm}$  washers and M12 nuts.
5. Place the primary lever over the die arms, and wipe a finger full of moly grease around the inside of the holes in the end of the primary lever and die. Wipe some more grease around the  $\text{\O}24\text{mm}$  pivot pin and drop it into the hole.
6. Similarly, grease the remaining pivot holes and pins, and mount the secondary lever into the primary lever, securing with one of the  $\text{\O}20\text{mm}$  pivot pins.
7. Place the die roller in the fork of the secondary lever and push its greased pin into position.
8. In use, the die roller should barely come into contact with the die. With the pressures involved, the die components rolling against each other, whether steel, aluminium or acetal, could eventually distort their edges resulting in poor quality bends. Drag caused by the huge pressures would also increase the amount of effort required to pull the handle around.  
In practice, the aim is to use the hex screw and lock nut in the primary lever to adjust the position of the secondary lever to maintain a virtually unperceivable gap between the roller and die.
9. With the bender now assembled, rotate the die roller a couple of times to distribute the grease.
10. Swing the handle back and insert an appropriate length of tube through the stop arm. The distance from the face of the end piece in the stop arm to the bending die centreline is 225mm, and can therefore be useful as a marker to set up the bend from.
11. It is recommended to make a few trial bends using tube off cuts to familiarise yourself with each size of die set. In each case, check the proximity of the die roller with the die and adjust where necessary.



## Useful Information.

CLR = Centre Line Radius

DOB = Degree Of Bend

Length of tube in a bend = CLR X DOB X 0.1745

or, to put it another way:

$L = (R \times .01745) \times Z,$

L is the length, in inches,

R is radius of the pipe bend,

Z is the angle of the bend.

Setback = radius X tangent  $\frac{1}{2}$  angle of bend.

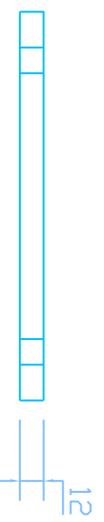
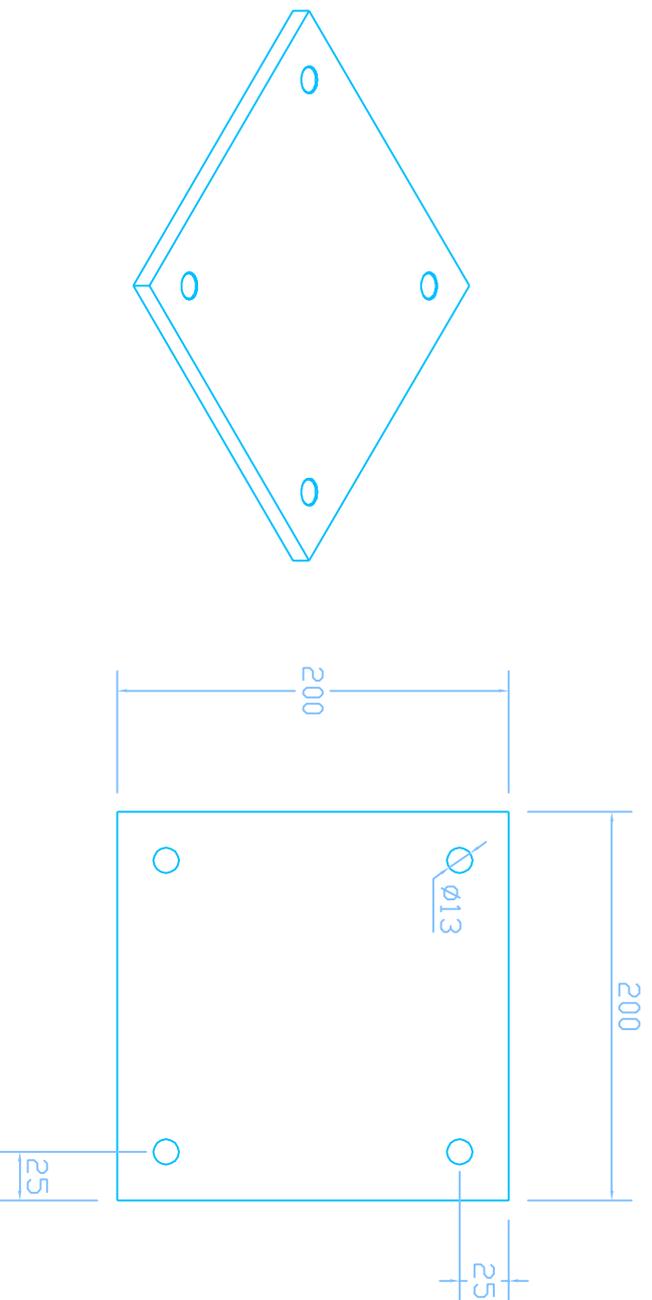
Circumference = 3.1416 X diameter.

**Happy bending!**

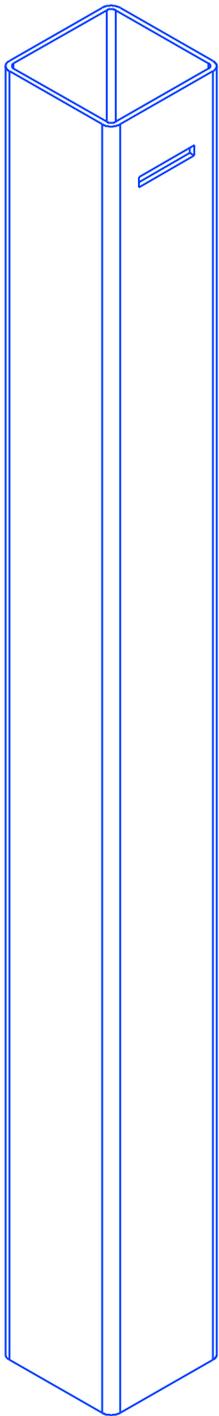
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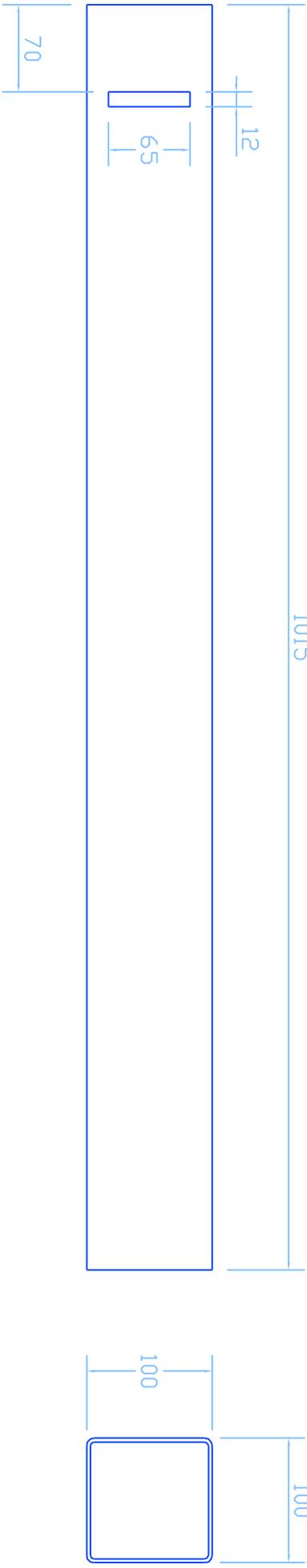
[info@rorty-design.com](mailto:info@rorty-design.com)



MATERIALS		NUMBER REQUIRED		PROPERTY OF PROPERTY DESIGN	
200 X 12 MS FLAT BAR		1		www.ror ty -design.com	
CLEAN UP ALL SHARP EDGES		DRAWN R F-S		NUMBER 2 TUBE BENDER	
		CHECKED		DATE 25.12.03	
		DATE		SHEET OF	
		SCALE 4:1		DRAWING NUMBER 1	
ALL MEASUREMENTS IN MILLIMETRES UNLESS OTHERWISE STATED		PROPERTY OF ROR TY DESIGN		BASE PLATE	

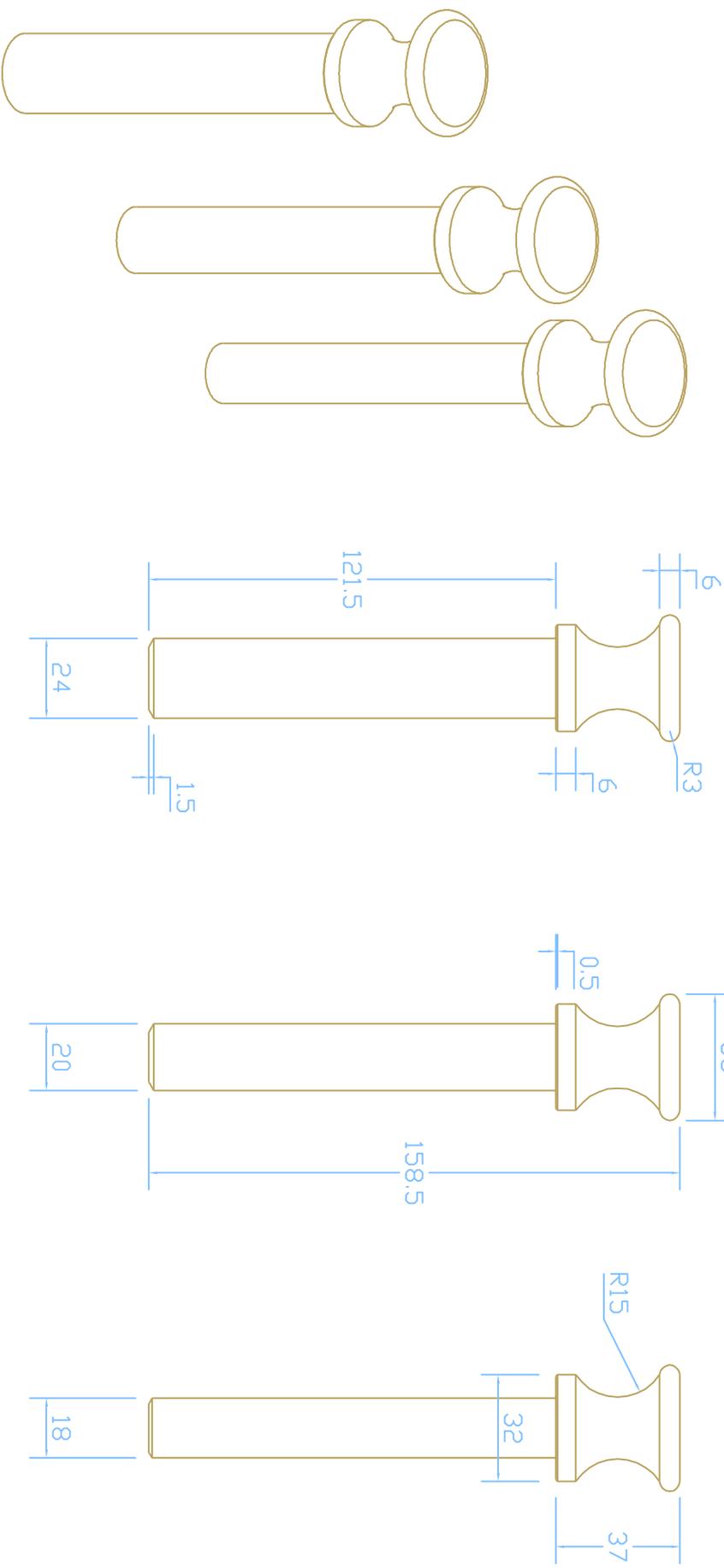


1015

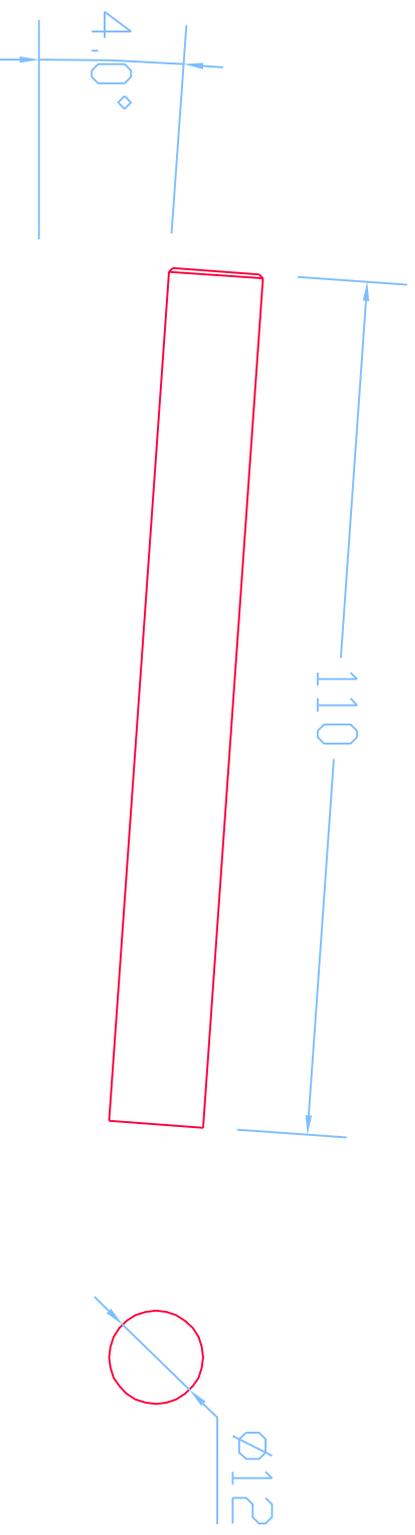
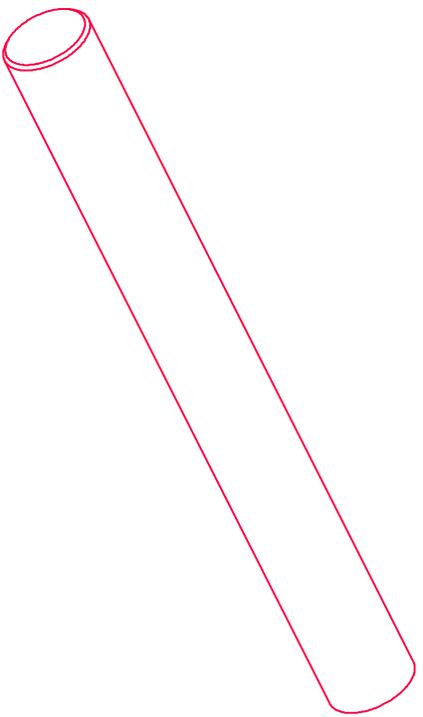


MATERIALS		NUMBER REQUIRED		1	
100 X 100 X 3 SHS		CLEAN UP ALL SHARP EDGES			
ALL MEASUREMENTS IN MILLIMETRES UNLESS OTHERWISE STATED		DRAWN		R F-S	
		CHECKED			
		DATE		25.12.03	
		SHEET		OF	
		SCALE		5:1	
		PROPERTY OF RORRY DESIGN www.ror-ty-design.com		NUMBER 2 TUBE BENDER	
				COLUMN	
				DRAWING NUMBER	
				2	

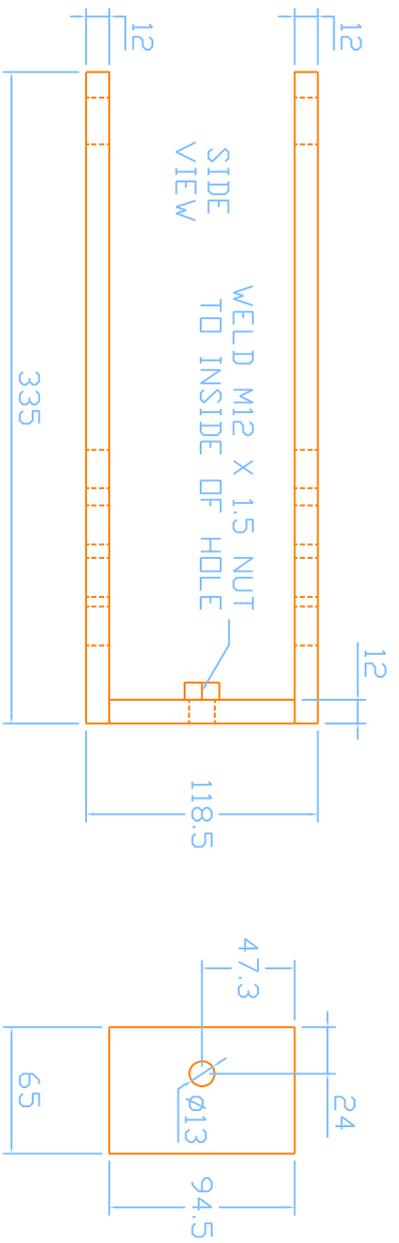
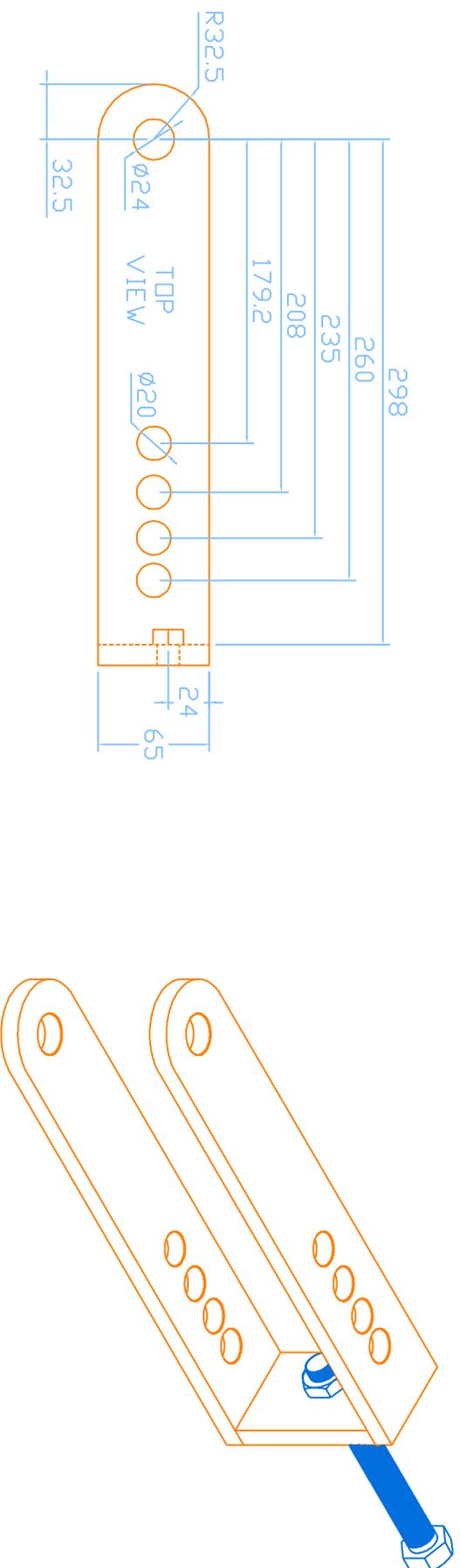




MATERIALS		NUMBER REQUIRED		PROPERTY OF PROPERTY DESIGN	
ø38 4140 ROUND BAR		CLEAN UP ALL SHARP EDGES		www.ror ty-design.com	
		1 ø24, 2 ø20, 1 ø18		DRAWN R F-S	
		ALL MEASUREMENTS IN MILLIMETRES UNLESS OTHERWISE STATED		CHECKED	
				DATE 25.12.03	
				SHEET OF	
				SCALE 2:1	
				DRAWING NUMBER 4	
				NUMBER 2 TUBE BENDER	
				PIVOT PINS	



MATERIALS		NUMBER REQUIRED		4	
Ø12MM MS ROUND BAR		CLEAN UP ALL SHARP EDGES			
ALL MEASUREMENTS IN MILLIMETRES UNLESS OTHERWISE STATED		DRAWN	R F-S	PROPERTY OF RORRY DESIGN	
		CHECKED		www.ror-ty-design.com	
		DATE	25.12.03	NUMBER 2 TUBE BENDER	
		SHEET	OF	TODL HOLDER	
		SCALE	1:1	DRAWING NUMBER	5



MATERIALS

65 X 12 MS FLAT BAR

NUMBER REQUIRED

1

CLEAN UP ALL SHARP EDGES

PROPERTY OF RORRY DESIGN

www.ror-ty-design.com

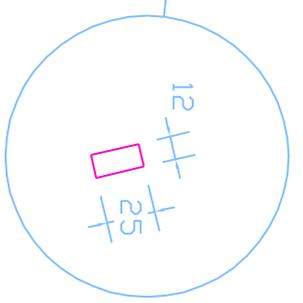
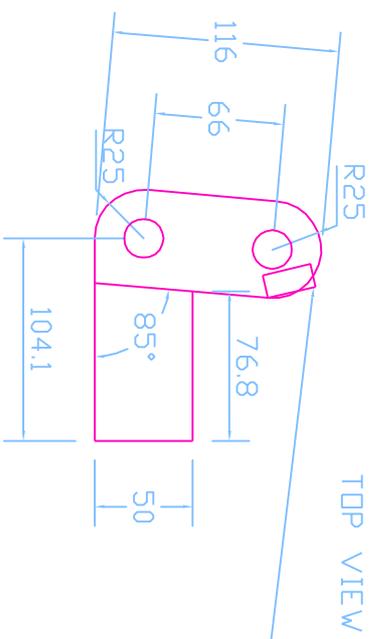
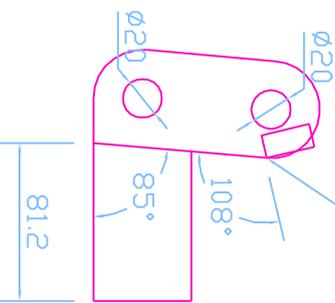
NUMBER 2 TUBE BENDER

PRIMARY LEVER

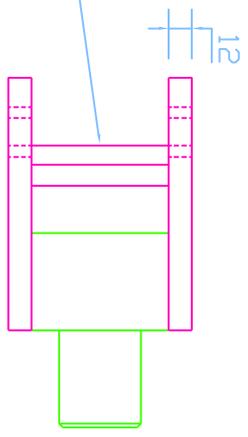
ALL MEASUREMENTS IN MILLIMETRES  
UNLESS OTHERWISE STATED

DRAWN	R F-S	NUMBER 2 TUBE BENDER
CHECKED		
DATE	25.12.03	PRIMARY LEVER
SHEET	OF	
SCALE	4:1	DRAWING NUMBER
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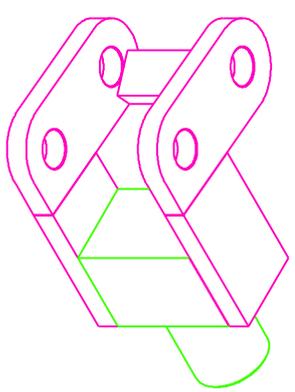
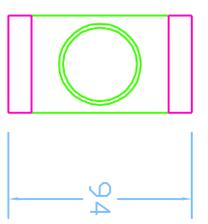
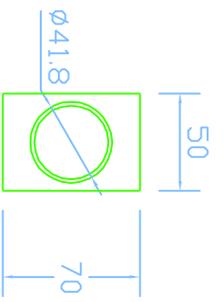
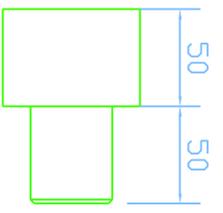
ALIGN CORNER OF SMALL BAR WITH BEGINNING OF ARC



70MM DF 25 X 12 FB



SIDE VIEW



MATERIALS

- 100 X 70 X 50 MS PLATE
- 50 X 12 MS FLAT BAR
- 25 X 12 MS FLAT BAR

NUMBER REQUIRED

1

CLEAN UP ALL SHARP EDGES

PROPERTY OF RORRY DESIGN

www.ror-ry-design.com

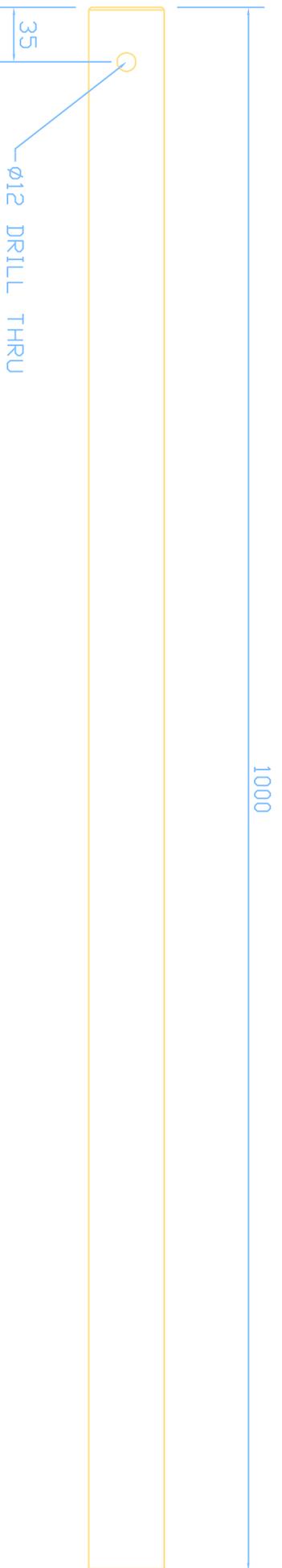
DRAWN R F-S NUMBER 2 TUBE BENDER

CHECKED DATE 25.12.03 SECONDARY LEVER

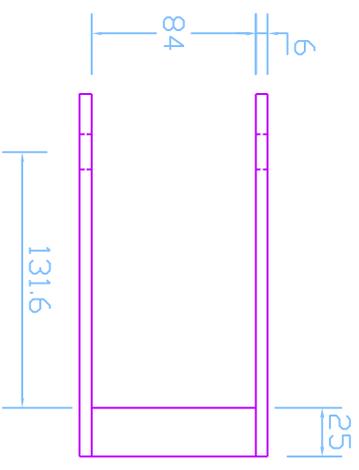
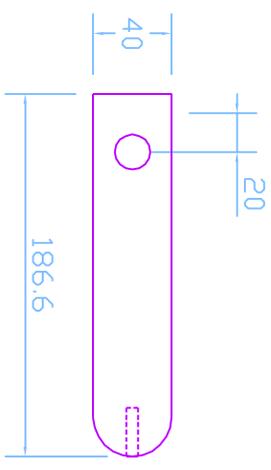
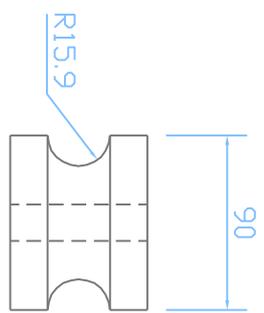
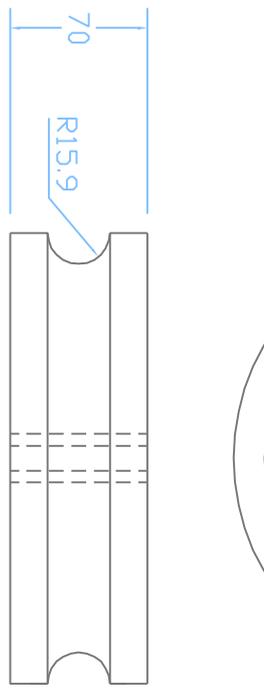
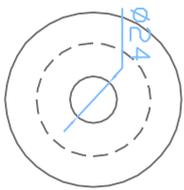
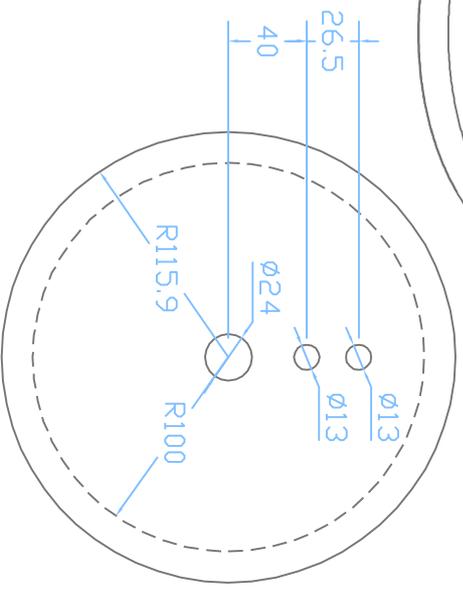
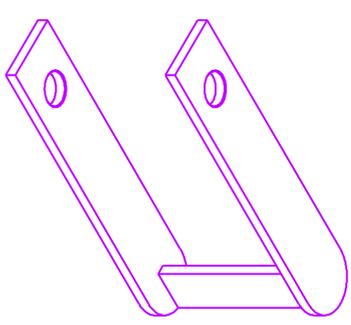
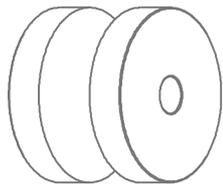
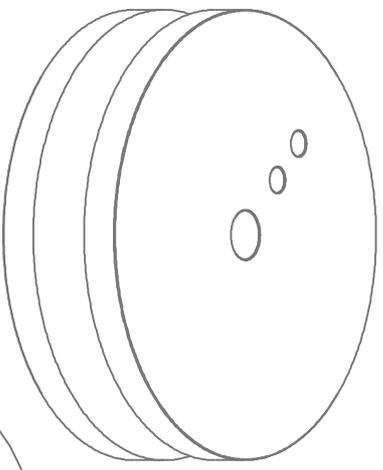
SHEET OF

ALL MEASUREMENTS IN MILLIMETRES UNLESS OTHERWISE STATED

SCALE 4:1 DRAWING NUMBER 7



MATERIALS		NUMBER REQUIRED		1	
40 NOMINAL BORE X 3.2 WALL CHS		CLEAN UP ALL SHARP EDGES			
ALL MEASUREMENTS IN MILLIMETRES UNLESS OTHERWISE STATED		DRAWN		R F-S	
		CHECKED			
		DATE		25.12.03	
		SHEET		OF	
		SCALE		4:1	
		PROPERTY OF RORRY DESIGN		NUMBER 2 TUBE BENDER	
		www.ror-ty-design.com		LEVER HANDLE	
		DRAWING NUMBER		8	



MATERIALS

70MM 5083 DR DELRIN PLATE  
40 X 6 MS FLAT BAR

NUMBER REQUIRED ONE OF EACH

CLEAN UP ALL SHARP EDGES

PROPERTY OF RORTY DESIGN

www.rorty-design.com

DRAWN R F-S

NUMBER 2 TUBE BENDER

CHECKED

DATE 25.12.03

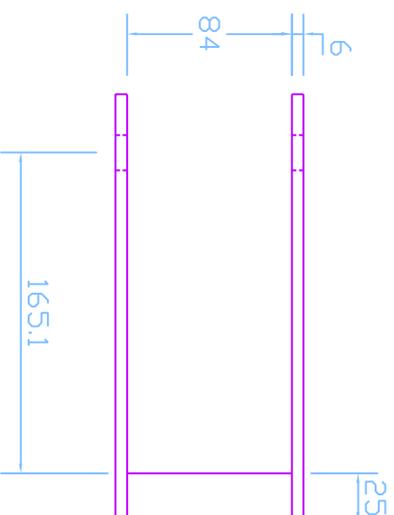
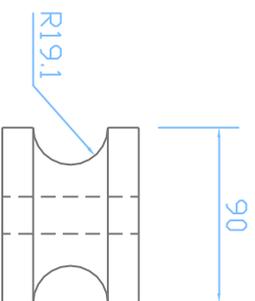
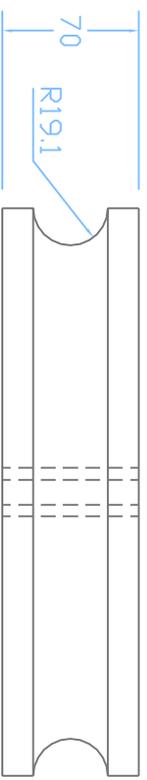
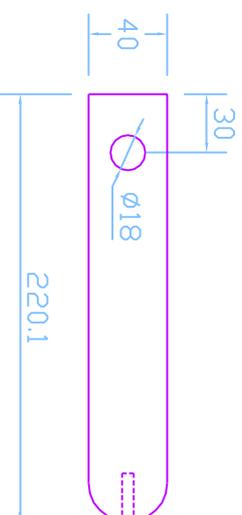
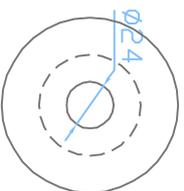
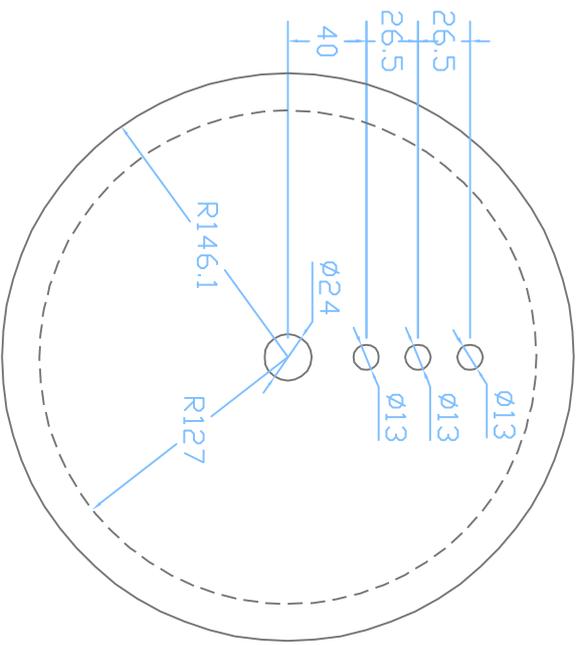
318 (1 1/4") DIE SET

SHEET OF

SCALE 4:1

DRAWING NUMBER 9

ALL MEASUREMENTS IN MILLIMETRES  
UNLESS OTHERWISE STATED



MATERIALS

70MM 5083 DR DELRIN PLATE  
40 X 6 MS FLAT BAR

NUMBER REQUIRED ONE OF EACH

CLEAN UP ALL SHARP EDGES

PROPERTY OF RORRY DESIGN

www.ror-ry-design.com

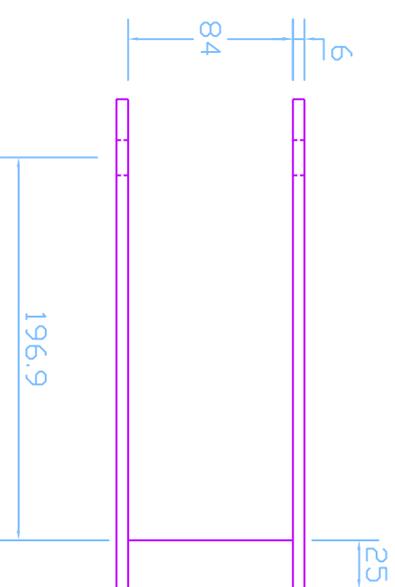
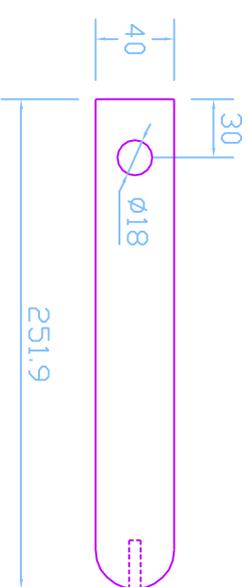
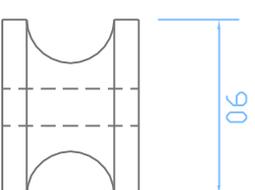
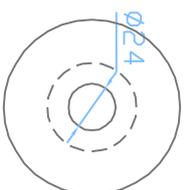
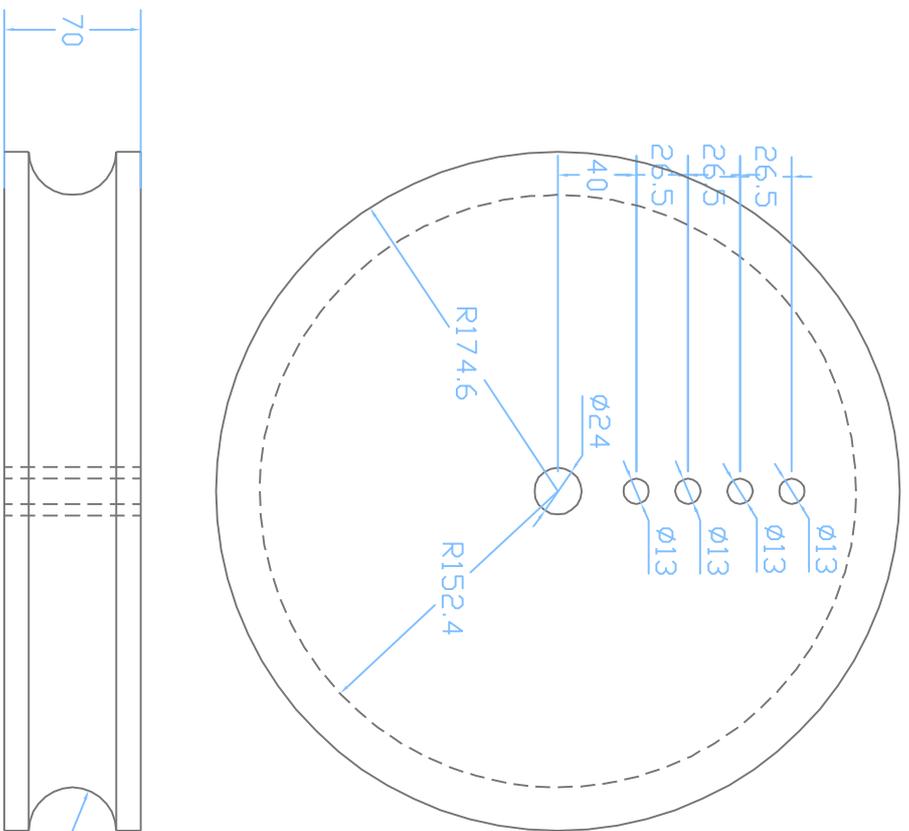
DRAWN R F-S NUMBER 2 TUBE BENDER

CHECKED DATE 25.12.03 38.1 (1 1/2") DIE SET

SHEET OF

SCALE 4:1 DRAWING NUMBER 10

ALL MEASUREMENTS IN MILLIMETRES  
UNLESS OTHERWISE STATED



MATERIALS

70MM 5083 DR DELRIN PLATE  
40 X 6 MS FLAT BAR

NUMBER REQUIRED ONE OF EACH

CLEAN UP ALL SHARP EDGES

ALL MEASUREMENTS IN MILLIMETRES  
UNLESS OTHERWISE STATED

PROPERTY OF RORRY DESIGN

www.ror-ty-design.com

DRAWN

R F-S

NUMBER 2 TUBE BENDER

CHECKED

DATE

25.12.03

44.45MM (1 3/4") DIE SET

SHEET

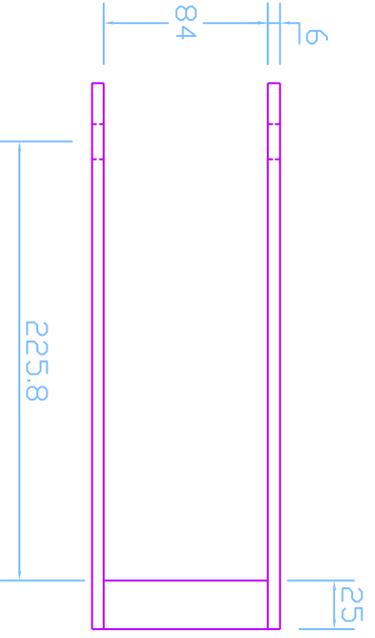
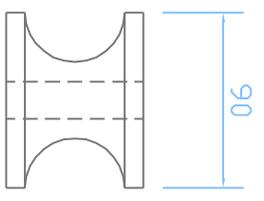
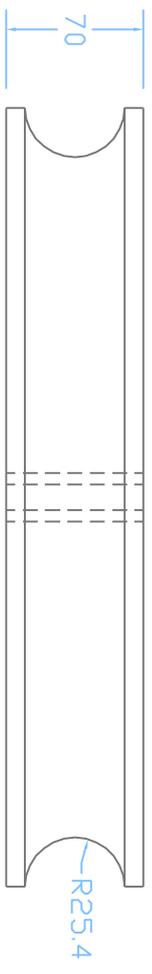
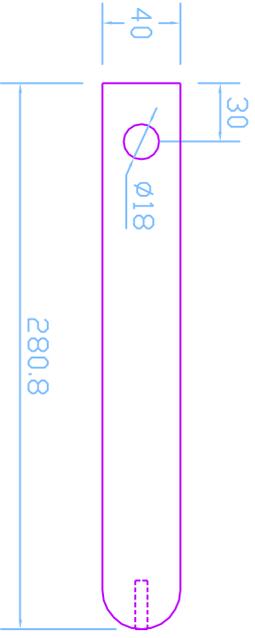
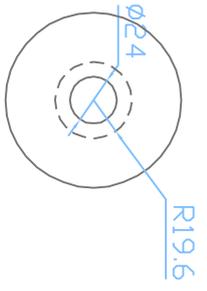
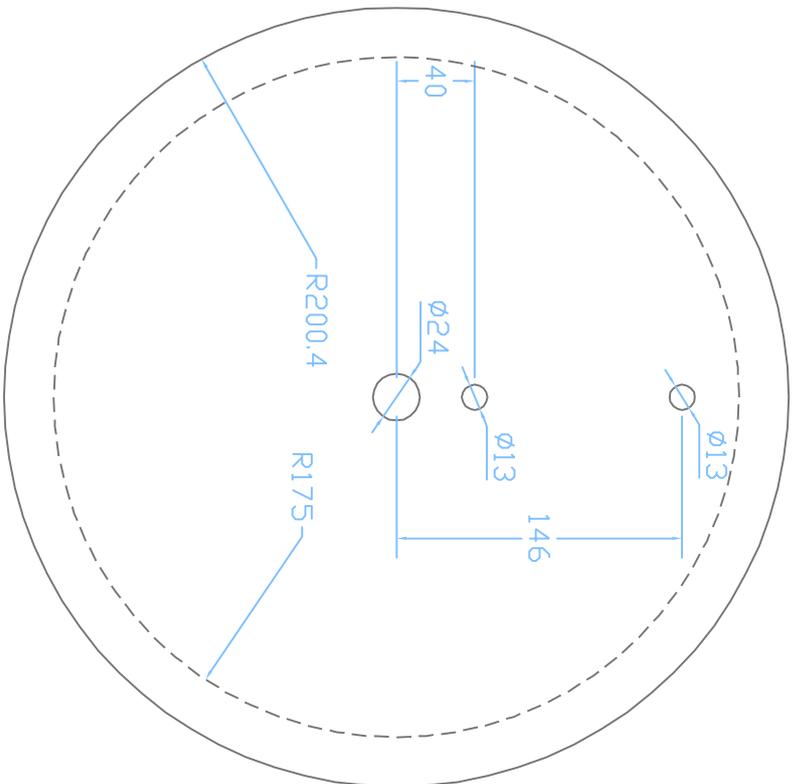
OF

SCALE

4:1

DRAWING NUMBER

11



MATERIALS

70MM 5083 DR DELRIN PLATE  
40 X 6 MS FLAT BAR

NUMBER REQUIRED ONE OF EACH

CLEAN UP ALL SHARP EDGES

PROPERTY OF RORTY DESIGN

www.rorty-design.com

NUMBER 2 TUBE BENDER

DRAWN		R F-S		PROPERTY OF RORTY DESIGN	
CHECKED				www.rorty-design.com	
DATE		25.12.03		NUMBER 2 TUBE BENDER	
SHEET		OF		50.8MM (2") DIE SET	
SCALE		4:1		DRAWING NUMBER	
				12	

ALL MEASUREMENTS IN MILLIMETRES  
UNLESS OTHERWISE STATED