1. There is no need to produce a drawing for 90° bends, but the following will need to be considered:
   - The pipe will be fitted in pipe clips, so an allowance has to be made.
   - A fixed point will need to be identified to determine the position of the mark on the pipe. The fixed point could be at the end of the pipe, a fitting or a pipe clip, this eliminates the need to use long measurements. The fixed point is a pipe clip in the example.

2. When copper pipe is to be bent, it is normal practice that all the marking out for the making of the bend is done to the outside edge.

3. Measure the distance from the fixed point to the outside edge. A piece of scrap pipe can be used to determine where to mark the outside edge. Transfer this to the pipe to be bent and mark as shown (yellow line).

4. Place the pipe in the bender, ensuring the fixed point is behind the backstop. Use a scrap piece of pipe and a square to ensure the mark on the pipe is aligned with the outside edge of the scrap pipe. Pull the bend to the correct angle.

5. Check with either a square or an angle finder that the bend is 90°. Remember that the copper pipe will spring back a little due to its elasticity so release the pressure before checking the angle or your bend will not be accurate.

6. The pipe should fit in the clips without straining. Note: do not make manual adjustments if the bend is not accurate as this will cause damage to the bend.

Tip: It is much easier when starting out to bend accurately if you have your hands free to hold the squares etc. So consider mounting your bender either in a vice or a portable workbench for best results.
Copper Skills - Producing an offset

1. These bends are often found in two or three pipes that run parallel in an installation: consistent, accurate bending is the key to aesthetics (looking good). It is best practice to set out to ensure consistency of offset quality, to keep the pipes aligned (identical / straight)

2. To set out, start as above then strike an arc from the centre of the pipe at 4 times the diameter as the radius, as shown: For 22mm 4 X dia = 88mm For 15mm 4 X dia = 60mm

3. Draw a circle as shown, and draw a line from the tangent of the circle at the required angle of the offset. To obtain the outside edge, draw a line parallel to the first line at a distance that matches the diameter of the tube used. That completes the setting out.

4. Use the drawing as a template, and decide on a fixed point, which can be a pipe clip, a fitting or something else. The pipe should be marked for bending on the outside of the first bend as shown:

5. Place the pipe in the bender and using the square and a piece scrap of pipe, line up the mark as shown - Remember to keep the fixed point behind the machine.

6. Place the pipe in the machine and if it has been set out correctly, the pipe will sit in the bending machine as shown. It can be checked for accuracy by ensuring the two legs of the bend are in line, as shown by the blue line, to give the correct offset distance.

7. The pipe can now be returned to the drawing and should fit perfectly without any adjustment by pulling etc. which will distort the bend and detract from the quality of the finished product. Use the drawing as a template to mark out the second bend, in line the outside edge as shown.

8. The pipe should now fit the drawing without any tweaking, as shown.

Given Measurement 'A'

Given Measurement 'A'

9. To check that the offset is in-line and parallel use a long steel rule. Then return to the drawing and it should match 100%. Check that the clearance is correct - The accepted industry tolerance is ± 2mm.

10. The pipe should now be returned to the drawing and should fit perfectly without any adjustment by pulling etc. which will distort the bend and detract from the quality of the finished product. Use the drawing as a template to mark out the second bend, in line the outside edge as shown.

6. Pull the bend to the required angle and using a split rule set at the angle, or an angle finder, check that the bend is accurate before removing from the bending machine. Remember to allow for the 'spring back' when releasing the pressure on the arm.
Copper Skills - Producing a passover

1. This can be achieved by drawing the passover out. In this diagram, the object to be passed over and the clearance can be seen - This is the start of our setting out.

2. Strike an arc at a radius of 4 times the diameter of the inner edge, so 77mm for 22mm pipe and 52.5mm for 15mm pipe.

3. Striking through the two arcs - one at 52.5mm and 67.5mm if using 15mm pipe, or 77mm and 99mm for 22mm pipe as shown.

4. Using squares or angle finder set at (in this case) 135°, draw a line from the tangent of each of the arcs as shown.

5. The final set out drawing should look like the drawing shown. That completes the setting out.

6. Use the drawing as a template, decide on a fixed point, which can be a pipe clip, a fitting or something else. The pipe should be marked on the outside edge of the first bend (yellow line).

7. Place the pipe in the bender and, using the square and a piece of scrap pipe, line up your mark as shown - remembering to keep the fixed point behind the machine.

8. Pull the bend to the required angle. Using a split rule set at the angle (or an angle finder), check that your bend is accurate before removing from the bending machine. Remember to allow for the spring back when releasing the pressure on the arm.

9. The pipe can now be returned to the drawing and should fit perfectly without any adjustment by pulling etc., which will distort the bend and detract from the quality of the finished job. The second bend can be marked in line with the outside edge using the drawing as a template. In the diagram the 135° (45°) bend will mean that this bend is a straightforward 90° bend.

10. Return the pipe to the bending machine with the use of a square and a scrap piece of pipe, as shown. Remember the fixed point still needs to be inserted behind the bending machine. Tip: Before bending look across the pipe bender to ensure that the pipe is not twisted in the machine.

11. Pull the bend to the required angle and check with a square to confirm it is correct, before removing from the bending machine.

12. The pipe should now fit the drawing without any tweaking, as shown. The last bend can now be marked out on the outside edge.

13. Now place the pipe in the machine and if it has been set out correctly it will look like it does in the diagram. Accuracy can be checked by ensuring the two legs of the bend are aligned, as shown by the blue line.

14. When checking, use a long steel rule to ensure that the passover is in line. Then return to the drawing and it should match 100%. Check that the clearance is correct - remember that the industry accepted tolerance is ±2mm. Then fit to pipe clips and it should fit without the need for adjustment or forcing it to fit.