

# BENDING GUIDE

## SOLUTIONS FOR POORLY BENT TUBES

### 1st BEND DIE

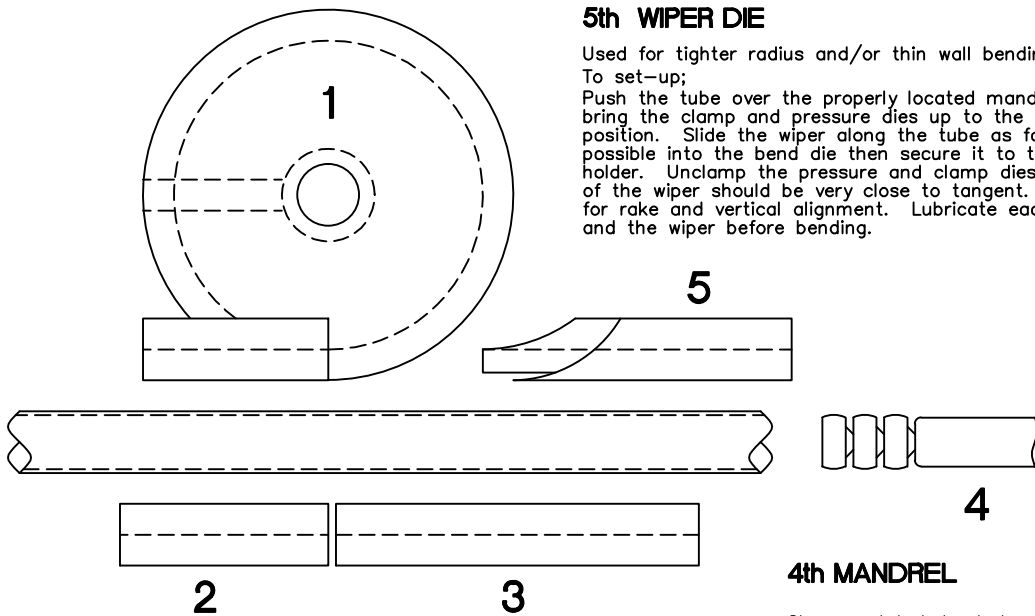
Hardened tool steel or alloy steel, heat-treated and nitride. The drive key must be parallel to the clamp insert. The bore should have a slip fit over the centering ring or spindle.

NOTE: Bend dies may have special tube grooves with captive lip or heart shaped.

### 5th WIPER DIE

Used for tighter radius and/or thin wall bending.

To set-up; Push the tube over the properly located mandrel and bring the clamp and pressure dies up to the bending position. Slide the wiper along the tube as far as possible into the bend die then secure it to the holder. Unclamp the pressure and clamp dies, the tip of the wiper should be very close to tangent. Adjust for rake and vertical alignment. Lubricate each tube and the wiper before bending.



### 2nd CLAMP DIE

Hardened tool steel or alloy steel, heat-treated and nitride. Preferable length is 3-1/2" TOD. The tube groove is grit blasted or may be serrated if it is less than the preferred length.

To set-up; With the tube held in the bend die, advance the clamp die and adjust it for vertical alignment. Adjust for parallel contact with the entire length of the clamp. Adjust for pressure.

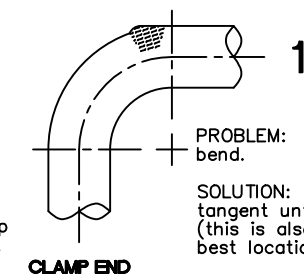
### 3rd PRESSURE DIE

Alloy steel and nitride. The tube groove must be parallel to the back of the die. If a static pressure die system is used, the length equals 3-1/2" TOD; if a follower type is used, the length equals 180'+2 TOD. If a boosted system is used, the groove should be grit blasted.

To set-up; With the tube clamped to the bend die, advance the pressure die and adjust it for vertical alignment. Adjust it for minimum pressure and increase as required in small increments.

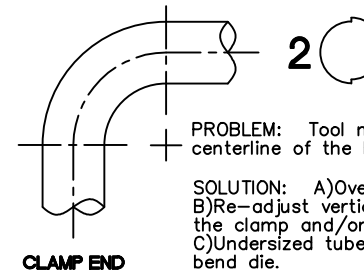
### 4th MANDREL

Chrome plated, heat-treated Steel or Bronze. Use Chrome plated mandrel when bending ferrous material such as Brass, Copper, etc. Use Bronze for non-ferrous material such as Stainless Steel, Titanium, etc. The mandrel fits inside the tube and supports the wall to prevent flattening during the bending process.



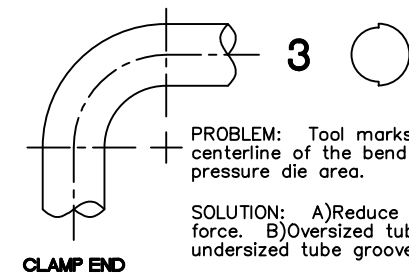
PROBLEM: A hump at the end of the bend.

SOLUTION: Relocate mandrel back from tangent until the hump is barely visible (this is also a good system to find the best location for the mandrel).



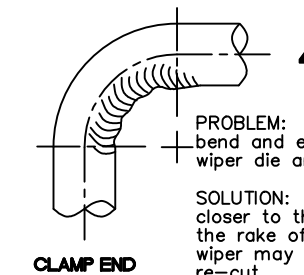
PROBLEM: Tool marks on the centerline of the bend.

SOLUTION: A) Oversized tube. B) Re-adjust vertical alignment of the clamp and/or pressure die. C) Undersized tube groove in the bend die.



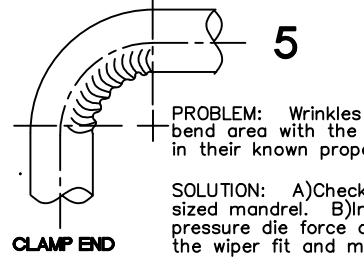
PROBLEM: Tool marks on the centerline of the bend in clamp and pressure die area.

SOLUTION: A) Reduce pressure die force. B) Oversized tube or undersized tube groove.



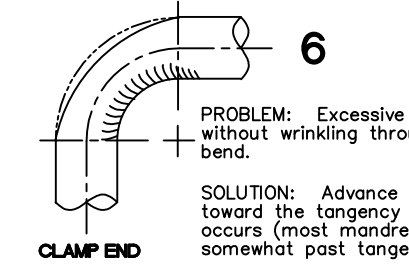
PROBLEM: Wrinkling throughout the bend and even extending into the wiper die area.

SOLUTION: A) Advance wiper die closer to the tangent. B) Decrease the rake of the wiper die. C) The wiper may be worn out--have it re-cut.



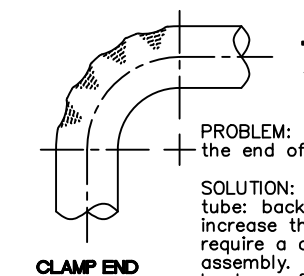
PROBLEM: Wrinkles throughout the bend area with the wiper and mandrel in their known proper position.

SOLUTION: A) Check for an undersized mandrel. B) Increase the pressure die force only after checking the wiper fit and mandrel location.



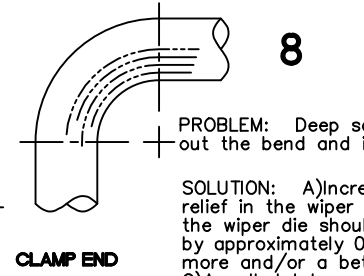
PROBLEM: Excessive collapse with or without wrinkling throughout the entire bend.

SOLUTION: Advance the mandrel toward the tangency until a slight hump occurs (most mandrels must advance somewhat past tangent).



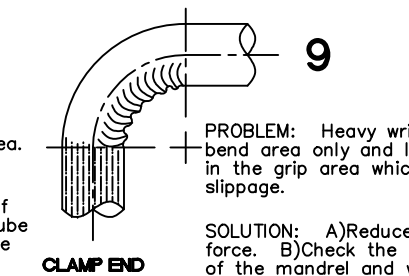
PROBLEM: Mandrel ball humps at the end of the bend.

SOLUTION: A) Too much drag on the tube: back off the pressure die force--increase the wiper die rake. B) May require a closer pitch mandrel ball assembly. C) Tubing material may be too soft.



PROBLEM: Deep scratches throughout the bend and in the wiper die area.

SOLUTION: A) Increase the rake or relief in the wiper die (the flat end of the wiper die should not touch the tube by approximately 0.030-0.060). B) Use more and/or a better lubricant. C) A galled tube groove--needs re-cut.



PROBLEM: Heavy wrinkles through the bend area only and linear scratches in the grip area which indicates clamp slippage.

SOLUTION: A) Reduce the pressure die force. B) Check the location (and lube) of the mandrel and wiper die. C) Increase pressure on the clamp die. D) Use serrated or carbide spray in the tube groove of the clamp die.

