

# **\$AVE MONEY WHEN ORDERING BENDS**

SMALL CHANGES IN YOUR SPECIFICATIONS COULD REDUCE PROJECT COSTS



#### **By Brad Frank**

**B** ending tube and pipe has become increasingly popular throughout the metal fabrication industry. Bending inherently saves money over other fabrication methods, such as the cutting and welding of standard fittings or the use of cast elbows.

However, fabricators can reduce costs further by following simple procedures while designing or ordering bends.

## Design: Use Common Pipe and Tube Materials

Use common sizes, wall thicknesses, and grades of material. Tube and pipe charts available from any tube and pipe supplier show all sizes that can be made. Many of those sizes are available only at a premium because they are so seldom produced. If you are not aware of the sizes and grades commonly produced, check with a tube or pipe supply house to see if Even for the largest sizes, using pipe and tube with standard diameters will lower the cost of a project.

the product you have in mind is normally available.

Examples of tube and pipe sizes found on charts that cost more because of their rare usage include 4½inch pipe (measures 5 inches outside diameter [OD]), 11-inch-OD tubing, 9-inch pipe, or 7- by 4-inch rectangular tubing. The use of odd-sized materials can double your material cost and easily double bending cost because your supplier may have to build or modify tooling to perform the odd job.

## Design: Use Bending Tangents Wisely

To bend tube and pipe, almost all bending machines require more material than the usable arc in the finished bend. These bending tangents, or the straight piece of the tube on each end of the bent arc (see **Figure 1**), are required by the bending machine to apply leverage to the material during bending.

These required tangents vary but range from two to four times the tube and pipe's OD on each end. Let these required bending tangents work for you and not against you.

If the bent part will be attached to more straight material in service, design the bend so that these bending tangents remain on the bend and are not removed by the bender. This reduces labor at the bender and the amount of straight material needed at the next fabrication step.

This also reduces the cost to attach the bend, in terms of labor and welding, to the rest of the fabrication because this extended end of the bending tangent is inherently less distorted by the bending pressures and will mate with tube and pipe of the original size with little or no roundup or rework.

Another reason to consider tangents when designing bends regards the standard tube and pipe lengths commonly available. Before designing bends, determine the common lengths available that will work for your project, then design with these lengths in mind to avoid higher than necessary material costs.

To get the maximum bent arc from the available lengths, subtract the required bending tangents from the available length to determine the maximum economical bent arc per piece. Otherwise, additional material must be welded to the material to be bent to allow for these required bending tangents. This additional material cost will be minimal compared to the welding stub cost. Experience has shown that the wise use of bending tangents generally can save from 10 percent to 50 percent on your next bending job.

#### **Design: Use a Common Radius**

Today's modern bending techniques allow almost any tube or pipe to be formed to almost any desired bending radius. However, designing bends to some radii will cost more than to others. Some radii require custombuilt dies or expensive machinery and labor to achieve the bend. Many bending applications have some flexibility in the radius they can use.

When possible, use a common bending radius and adjust the tangents on each end of the bend to yield the overall required dimensions. Small, tight radius bends should use the largest radius possible. Typically, the bigger the radius, the easier the bend is to make without serious deformation, such as ovality or wrinkles in the material.

If the radius can be big enough, design it in increments of feet, i.e., 12inch radius, 24-inch radius, 36-inch radius. If your project does not allow such a big radius, design the radius as a multiple of the nominal outside diameter of your material, such as 3R, 5R, or 10R, where R stands for the radius factor.

In other words, if you are designing bends in 2-inch pipe (2.375-inch OD), a 3R bend would be 2-inch (pipe)  $\times$  3 (radius factor) = 6-inch radius; a 5R would produce a 10-inch radius; and a 10R would produce a 20-inch radius.

Designing bend radii around the common dies available through most bending operations will also reduce the cost of your bending project.

## Design: Consider Welded Material

When designing bends with seamless tube or pipe, consider using material with a longitudinal weld seam or welded material over seamless material. Welded material generally costs less than seamless material.

Because of higher-quality welding and nondestructive examination techniques used in the tube mill industry today, many designs can use the less expensive welded tube and pipe in places that previously required seamless material. Again, experience has shown that generally this substitution



Ordering bends with common radii will eliminate the possibility of having to build dies just for your job. And, designing tangents so that they remain on the bend will reduce the amount of straight material needed at the next step.

can save from 25 percent to 40 percent on material cost.

#### Ordering: Know Common Bending Terms

Know the proper terms and needed information to communicate your bending needs to your bender. Lack of good communication can be costly when ordering any custom-produced product, especially tube and pipe bends. See the **Sidebar** for a list of common bending terms.

A complete description of a tube or pipe bending job includes:

- Quantity of bends.
- Material grade.

• Outside dimensions of the tube or pipe.

• Wall thickness.

• Degree of bend or arc length of bend.

• Radius of bend (specify that the radius is to the centerline, inside or outside of the tube).

• Required tangent lengths on the finished bend.

• End preparation (such as no end preparation, square cut, or beveled end).

#### Ordering: Bend End Preparation Is Important

The end preparation specified on bends, whether the ends have a specified tangent or a specified condition such as a beveled end or a square cut end, can determine a large part of the cost of the bend. If the bends will be cut by the next fabricator, ask what is the least expensive end preparation designation. This prevents you from paying for an end preparation that won't be used.

If tangents are required, specify a minimum tangent as opposed to an exact tangent. Requesting an end preparation combined with a requirement that no straight tangent be on the finished bend, known as zero tangents, is the most expensive end preparation. This requires cutting the bend after bending, rounding the ends because they have some ovality caused by the bending pressures, then applying the end preparation.

#### Ordering: Avoid Minimum Charges

Avoid minimum charges on small orders. Many bending operations have



The range of tube and pipe bends and pipe sizes is nearly unlimited, but using common configurations can help budgets.

# BENDING TERMS

Arc – The curved portion of a bend. See Figure 1.

**Bend Radius** – Distance from the center of curvature to the centerline axis of the tube or pipe. See Figure 1.

**Chord** – Straight distance between the centerline points of any two points of a bend.

**Degree of Bend** – Angle in degrees to which the bend is formed (e.g., 45 degrees, 90 degrees). See Figure 1.

**Grade** – Manufacturer's specification of material types of tube or pipe (e.g., A53B carbon steel, T304 stainless steel).

**ID** – Inside diameter of the tube or pipe.

**Minimum Tangent** – The minimum length of straight pipe on the end of a bend required by the bending machine to form the bend.

**OD** – Outside diameter of the tube or pipe.

**Ovality** – The distortion

or flattening of tube or pipe from its normal round shape caused by the bending process.

**Square Cut** – Cuts made square to the tangent of a bend after the bending process.

**Tangent** – The straight portion of material on either side of the arc of a bend. See Figure 1.

**Tangent Point** – The point at which the bend starts or ends. See Figure 1. **Wall** – The thickness of tubular material.

Wrinkles – Folds, creases, or waving formed on the inner radius of a bend during the bending process.

Arc Arc Bend Radius Degree of Bend Center of Curvature standard minimum charges, such as a setup fee for each bending machine. If you order only one bend, your unit cost for the bend can be three times or more than your unit cost if you had ordered 10 bends or more. So consider grouping orders of different bends, or if the bend is a repeat need, consider increasing the order quantity to reduce the unit cost.

# Ordering: Ask How Cost Can Be Reduced

Good suppliers will offer cost-saving ideas. However, sometimes you have to start that conversation. This applies especially to custom-produced products like tube and pipe bends, because minor changes in the bend can yield cost reductions.

Ask your bender what changes in

your bend would reduce cost. In many cases, you can avoid costs that are not adding value to the bend from your perspective.

# **Ordering: Have the Bender Arrange Shipping**

Consider having the bender arrange the shipment of the bent product from the bender's plant to its next destination. Shipping tube and pipe bends that have irregular shapes can have its difficulties. The bender's experience in shipping such items can help reduce shipping costs and save you time.

#### **Informed Decisions**

In a global manufacturing environment, fabricators must constantly look for ways to reduce cost, avoid waste, and improve effectiveness. They can achieve this if they make informed decisions. Using the information presented here and following these steps, they can reduce the cost of designing and ordering bends in their tube and pipe.

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