



MATERIAL OVERVIEW COMMON TUBE AND PIPE

Pipe and tube are manufactured from a variety of metals are suitable for bending. However, different pipe materials have different physical properties which influence the bend. For example, copper is malleable and ready to bend at room temperature, whereas stainless steel requires a much greater effort to bend. Not only does pipe material influence the ease of bending, but it also influences how readily a pipe will take the desired shape or be damaged during the bending process. Most buyers don't even ask the question is this material suited for bending. Always start with the material and confirm it is acceptable for bending.

Carbon steel

The term carbon steel is often used to indicate steel that is not stainless steel, and is one of the most commonly bent materials. It is a strong, reliable component for construction (Figure 2) and OEM (original equipment manufacturer) applications. Carbon steel is available in different grades, offering various options in machining, bending, and wear resistance.

Mild steel

Mild steel is a commercial term that means low-carbon steel. It contains 0.04 - 0.3% carbon and therefore is more malleable and ductile. Ductility decreases as the carbon percentage in the steel increases. All machines are rated on mild steel capacity, bending higher tensile materials must be factored in sizing the machine model. Higher tensile strength materials require larger machines.

Alloy steel

Typical pipe material tensile strengths:

Grade A 48000 PSI (Machine rated for Grade A)

Grade B 60000 PSI

Grade C 70000 PSI

Two popular steel alloys are AISI 1018 and AISI 4140. The last two digits of each number indicate the percentage of carbon in the alloy: 1018 has 0.18% carbon and 4140 has 0.40% carbon. This means that 1018 is a mild steel and 4140 is a medium-grade carbon steel. AISI 1080 can be cold bended and AISI 4140 should be heat treated before bending.

Stainless steel

Material tensile strengths:

304 SS 73200 PSI

Different grades of stainless-steel range in carbon content from low-grade to high-grade (approximately 1% carbon content), but are differentiated from carbon steel by their high chromium content (minimum 10.5%). This high chromium content is what protects stainless steel from corrosion and rust. Of the different types of stainless steel, 300-series, specifically 304 stainless steel is the most popular for bending due to its ductility. However, at large diameters, stainless steel is very difficult to bend manually. A mandrel bending machine is typically used in this case.

Aluminum

Aluminum is lightweight, and the material requires specialized skills and forming processes to prevent material cracking. However, the bending properties vary according to the different grades of aluminum used. 6061 aluminum material is hard to bend, and cracking is pretty common. Cold bending always weakens the material. Proper bending can be by using T0 temper material that is new from mill, or annealing aluminum first. 3003 aluminum is the best for bending due to its midrange strength and high elongation. It can be cold bent, and has a high difference between tensile strength and yield strength. This means it can be permanently deformed, in other words bent, a great deal before breaking. 5052 aluminum is almost as good for bending as 3003 aluminum, but has slightly less elongation. However, when heated, its formability improves past that of 3003 aluminum. Aluminum is commonly used in transportation and storage tanks. Always use the largest radius possible when bending aluminum to avoid breaking the material.

Copper Tube

Both annealed tube and hard drawn tube can be bent with the appropriate machine and tooling. Material grade, wall thickness and minimum CLR must all be considered before bending.