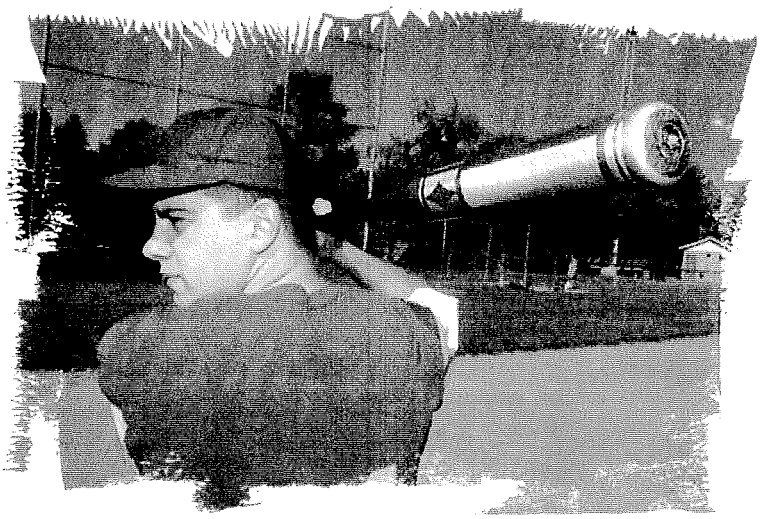
Batter up!

Turning an aluminum tube into a baseball bat

By Kevin Cole and Eric Lundin
Associate Editors of TPJ - The Tube and Pipe Journal



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The roar of the crowd, the shouts of the umpire, the crack of the bat hitting the ball—these are the unmistakable sounds of a baseball game. Over the last few decades, however, one of those sounds has changed; now the bat tends to make a ping that resonates when it hits the ball. It's the sound of aluminum rather than wood making contact with the ball.

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Hillerich & Bradsby Co. (H&B), Louisville, Ky., the manufacturer of the venerable Louisville Slugger® wooden baseball bat, has not ignored this trend. Rather, the company embraced it when in 1978 it purchased Alcoa Sport Products, Santa Fe Springs, Calif., from the Aluminum Company of America (Alcoa). Formerly known as LeFiell Sport Products, the inventor of the aluminum golf club shaft, the company manufactured aluminum golf clubs, ski poles, police officer's nightsticks, and baseball bats. It also developed other products such as aluminum tennis racket frames and experimental aluminum bicycle parts. It started to produce bats for H&B in 1979.

After H&B purchased Alcoa Sport Products, it discontinued most products to concentrate solely on aluminum bats for adult- and junior-league softball and baseball. Now located in Ontario, Calif., the facility is capable of producing 2,000,000 bats per year.

The raw material for manufacturing a bat is a simple tube. The manufacturing process, however, is anything but simple. An aluminum bat is a complex product that requires many modern manufacturing processes, including taper drawing, swaging, heat treating, and shot peening.

Sprinting Toward First Base (Processing Raw Tube Stock)

Because H&B manufactures bats in a variety of sizes and shapes, it purchases extruded and drawn 7000-series aluminum tubing in diameters between 2 and 3 inches. They are cut to lengths from 24 to 35 in.

The first forming process is a taper drawing operation, also known as ironing. This process involves sliding the cut tube over a tapered mandrel and using hydraulic pressure to force the tube through a die. The result is that the outside diameter of the ironed tube is constant, but the inside diameter varies. This process controls the wall thickness in the barrel, reduces the wall thickness in the tapered portion, and reduces the amount of metal needed to form the handle. Because the ironing operation performs an extensive amount of cold work, and thereby hardens the metal, it is necessary to anneal, or soften, the tube before further processing.

After annealing, the tube goes through a swaging process. Two opposing dies rotate around the tube at 850 revolutions per minute and perform 5,100 impacts per minute, reducing the diameter of the bat. As the tube proceeds farther into the die, the reduction progresses until the final handle size is achieved.

Rotary swaging is a fast way to shape the tube, but its main disadvantage is that as it reduces the diameter, it increases the wall thickness. H&B's patented swaging method prevents wall thickening by using a mandrel inside the tube. The mandrel controls the inside diameter, and thereby the wall thickness, from the barrel to the handle.

Passing Second Base (Cleaning, Heat Treating, and Aging)

Aqueous cleaning removes the lubricants from the swaging and ironing operations in preparation for heat treating and further processing.

Heat Treating

The method used by H&B to harden the aluminum involves a molten salt bath solution. The metal is heated to nearly 900 degrees and held at this temperature for 20 minutes. This high temperature causes the various elements that make up the alloy to become soluble and to go into solution, similar to salt dissolving in water. After all of the elements have gone into solution, the bats then are quenched

Continued on page 14

in a water tank. The quenching creates a supersaturated solution that prepares the bats for precipitation aging.

Precipitation Aging

To complete the hardening process, the bats then are heated in an aging furnace for about 12 hours at about 300 degree F. This causes some of the alloying elements to precipitate out of solution. These precipitates form grains in a particular size and shape, thereby producing a harder and stronger material. Some models go through an additional 24 hours in the aging furnace for increased strength.

Rounding Third (Capping, Polishing, and Silk Screening)

The bat is nearly finished. At this stage the body and handle have the distinctive bat shape, and the material is the proper hardness. However, it is still a tube—that is, its ends still are open. To close the larger end of the bat, H&B uses one of two processes: spinning or capping.

An end-spinning machine rotates the bat at approximately 1,600 to 1,800 revolutions per minute (RPM) while it is heated to 400 degrees. While the bat is rotating, a forming tool is set against the heated and softened metal near the end of bat, forcing the material over to seal and close the bat end permanently.

The other way to close a bat is with an end cap. Bats that are to be closed with end caps are grooved internally so the caps fit precisely.

The polishing operation is done on a centerless feed-through machine that causes the bat to rotate while being polished. Various grits are used to apply different finishing characteristics. A shot peen finish is used to further enhance some bat models. Shot peening adds compressive stresses, strengthens the metal, and adds a decorative look to the bat.

The bats are then silkscreen-printed. The inks provide an abrasion-resistant marking that will not come off on the ball and is a relatively permanent identification. Anodized bats are silkscreen-printed on freshly anodized surfaces, then dyed with a multitude of colors. The inks used in the silkscreen process contain chemicals that prevent the background dye from covering the graphics. The bat finish is then finished with a sealant to lock in the dyed colors.

Safe at Home! (Final Assembly and Packaging)

Some bats then are placed into a machine that automatically mixes a polyurethane foam and injects it into the bats. The foam is created by mixing liquid resin, catalysts, and blowing agents that are hydraulically shot into the barrel end of the bat through the handle end. A chemical reaction takes place that converts these liquids into a flexible urethane foam.

TPS® bats with the Power-End® feature have a polyurethane elastomer cast inside, with specific weights used for various models. All bats are checked for finished weight on an electronic scale.

The bats are sent down a conveyor line where the handle is cleaned just before welding. Bats proceed into the automatic welding booth, where an automated gas metal arc welding (GMAW) machine is used to attach the knob to the bat handle. The shielding gas is argon.

The bats have one of two types of grip: rubber or wrap. Rubber grips are applied by air pressure. Wrap grips are applied by hand. The bats are sent into the final assembly and packaging area where the labels and protective film are applied before the bats are placed into a shipping carton.

Take Me Out to the Ball Game

It's one of this country's favorite professional sports, our national pastime, and a staple of summertime recreation. It has created some of our country's most well-known popular heroes, and it stirs up excitement every year when seven crucial games decide which team is the best.

And it's a source of dreams for youngsters who long to knock a ball into the stands and round the bases for a home run—dreams that start with summertime junior league games and the thrill that follows a distinctive resonating ping.

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Hillerich & Bradsby Co. Inc., 800 W. Main St., Louisville, KY 40202-2637, 502-585-5226, fax 502-585-1179, www.slugger.com. Hillerich & Bradsby manufactures bats for adult- and youth-league baseball and softball.