BOURDON TUBE TYPES

Some specifications for pressure gauges unnecessarily restrict design and manufacturing methods. What should be specified of course, is the performance of the gauge. As part of the design process, Ashcroft gauges are rigorously tested for ability to maintain accuracy and pressure boundary integrity while withstanding vibration, pulsation, and other conditions encountered in the field.

Several tests are recommended in ASME B40.100 (Gauges, Pressure Indicating Dial Type – Elastic Element); a document established by a committee representing both gauge manufacturers and users. One of the more important criteria is the fatigue life of the Bourdon tube when subjected to pressure pulsations of 20-80% of scale range. A Bourdon tube for the process industry should withstand at least one million cycles without failure. All Ashcroft Duragauge tubes have successfully passed this test.

There are several requirements for making a robust Bourdon tube, starting with a low stress design, and forming without scratches, sharp corners or other stress intensifiers. There are at least four ways of making the tubing for Bourdon tubes, and good or bad material can result from any one. A brief discussion of each method follows:

Seamless – A white hot billet is extruded or pierced into a 2″ to 3″ diameter “tube shell” which must be reduced to the size needed in a long and cumbersome series of drawing and annealing operations. Each one of these steps provides an opportunity to create defects and to make eccentric tubing. The casting and extrusion operations are the most common cause of defects, but drawing and annealing present opportunities for oxidation and excessive grain growth, if proper procedures are not followed. Some specifications require use of seamless tubing, which is no guarantee of satisfactory life.

Welded and Drawn – This tubing starts by continuously forming strip into a round tube, which is then welded under inert shielding gas. It is then given a few drawing and annealing operations which homogenize the weld so that it is virtually indistinguishable from the parent metal. Since the tube starts with a strip of consistent thickness, the resulting tube is more concentric than the seamless tube. Strip material is inherently less prone to defects than tubing, and also, both strip surfaces are visible for inspection before forming into the tube.

As-Welded – This tubing is made from annealed strip, similar to welded and drawn, but is not subjected to any further operations – the welded tubing is formed directly into the finished Bourdon tube. The weld is oriented on the lowest stressed area of the Bourdon tube cross-section on the flat, instead of on the edges. Ashcroft holds a patent on this method of manufacture. Strip for the Ashcroft Duragauge, is purchased to stringent specifications, including the tightest thickness tolerance in the industry. The result is the most consistent and concentric tubing available. This tubing is made in our own plant where it is subjected to rigorous quality control testing.

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Bored – Starting from a cut piece of bar stock, a hole is gun-drilled through the length of the bar, producing a tube. Holding I.D. tolerance, concentricity, and good finish is very difficult and expensive. This method is no longer used by Ashcroft or other major manufacturers.

Regardless of which manufacturing method is used, it is important that the tubing be dimensionally consistent and free of defects. Ashcroft quality control procedures assure conformance to design requirements, from raw material to finished product.

We purchase tubing and strip for Ashcroft Bourdon tubes from reliable domestic mills to our own stringent specifications. Our Purchasing and Quality Assurance departments have visited these plants and audited their procedures. Tubing made by Ashcroft is carefully monitored during welding using recognized, deformation tests. Welding parameters are monitored and logged throughout the production run. Statistical process controls are employed at key points during Bourdon tube forming to assure consistent results.

As mentioned above, one of the basic requirements for good gauge performance is a Bourdon tube with long life. Ashcroft Bourdon tubes and gauges are continually being tested in our laboratories. In one ongoing test, no failures have occurred in 400 psi as-welded stainless steel Bourdon tube gauges after 70 million cycles at 20-80% of scale range.

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