Flexible Solutions
DURAFLEX™ INC.
for Rigid Applications

EXHAUST APPLICATIONS

WHITE PAPER
Written by:
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WHY BELLOWS VS. HOSE

BELLOWS / HOSE FABRICATION

To understand the differences in performance, one must first understand the differences in the forming processes. Bellows and/or Hose can be fabricated from a variety of processes:

- Hydroforming
- Metal Pi Die Method
- Elastomer Compression Forming
- Metal Contact Spinning Process

Each of the processes utilizes multi-ply technology different from hose forming which can typically only use single ply construction. The advantages of multi-ply versus single ply construction is highlighted in the Duraflex (EJMA) Multi-Ply Advantages data sheet.

HYDROFORMING BELLOWS —PREFERRED BELLOWS FORMING PROCESS

Hydroforming is becoming the most popular low cost/highly repeatable processes for forming multi-ply or single ply seamless or welded metal tubing into bellows. During hydroforming, a predetermined section of dies are positioned parallel and adjacent to one another. The dies are precision matched to the final required net shape and quantity of the convolutions. The seamless or welded metal tube is inserted into openings of the dies and is held in position. Pressurized water is forced through the interior of the tube and water pressure that is forced against the tube inside diameter expands the walls of the tube outwardly into the die cavities. Simultaneously, the dies apply pressure against the outer diameter of the tube at specific locations along the length of the tube so that the metal that is free to elongate and move is expanded between adjacent dies. At the same time, the dies are compressed together by the hydraulic ram until they reach solid height and the desired net shape of the bellows.

Duraflex utilizes a unique and proprietary die design which is like no other in the industry. Most competitors dies are machined specifically for each diameter of tubing that will create a final net ID size of bellows. As a result, only certain die sets can be utilized for each bellows ID. Also, the set-up is long and arduous, as each die plate (upper and lower) must be established and “locked” in place for each convolution profile. The Duraflex technique is unique in the following areas:

- Dies are “layered” allowing a single die set to produce ID bellows from 1” to 8” in size.
- Plates (upper and lower) can be added or subtracted to accomplish any bellows length within the limitation of the arbor.
- Die inserts are not hardened as is the common practice, but are “chuckered” each and every time a new set-up is introduced.
- Any end fitting configuration that is formable within the elongation properties of the material can be added to the die set, including any transitional spacing die required to make the transition between bellows and end fitting.
- Position CNC technology is utilized to geometrically “set” the die. Errors can not occur because the CNC program assures each and every location to be exact in identification and position. A simulation is run through the forming computer each and every time to ensure that each parameter is in place and recognized.

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METAL PI DIE METHOD—STANDARD BELLOWS PROCESS

This is a single convolution forming method where the segmented die is internal to the tube and when an arbor is pushed against the die actuator, the metal segments of the die expand to create convolutions. The end product is better in its engineered definition to a hose, but it still lacks the consistency and repeatability of a hydroformed bellows.

HOSE FORMING—ELASTOMER COMPRESSION FORMING

This is a single convolution bellows forming process where a single or multi-ply tube (seamless or welded) is inserted around a mandrel that when compressed forces a neoprene donut to compress and expand to produce a convolution in the tube directly in contact with the expansion. Convolution height, spacing and shape is controlled by the element used and the operator performing the operation. As a hose the product is no where near the consistent and predictable engineering properties of a hydroformed bellows.

HOSE FORMING—METAL CONTACT SPINNING PROCESS

Intended to be a "finishing" operation to the non-hydroformed bellows forming methods, it can be used as a continuous process for hose forming. With multiple anneals and operations, it can also be used as a rudimentary bellows forming operation. Basically, a metal tube is formed against a mandrel with a shaped metal donut applying pressure by an operator while the tube is spinning with an internal mandrel for support. The operation is entirely at the discretion of the operator for all aspects of the bellows geometry.

ADVANTAGES—HYDROFORMED BELLOWS VS. HOSE

- Bellows are designed for axial movement in that the convolutions are mathematically derived, hose is not.
- Bellows manufacturing and design standards are governed by EJMA and ASME. Hose is not governed by any Engineering body of manufacturing or design standards.
- Bellows properties are 100% predictable and guaranteed. Hose application properties related to fatigue (cycle life) and vibration are not predictable.
- Bellows can be made as Multi-Ply; hose can not.
- Bellows is an engineered product; hose is a commodity product.
- Bellows are difficult to produce; hose is easily produced by third world countries with limited technology.
- Bellows are designed for concurrent motions and forces such as axial, lateral, rotational, pressure surges, vacuum; hoses are not.
- Hose was designed for long length lateral flexibilities involved in conveyance of product such as offloading trucks. Unfortunately, distributors and fabricating distributors of these products who routinely weld end fittings to them flexible element started cutting them down for a "poor man's bellows".
- Using hose is a dangerous practice as there are no real standards in place for this type of product. It was never designed to replace bellows or expansion joints.
- Bellows today with the advent of high production hydroforming can and do, compete on a price level with industrial cut to length hose.

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