Individual can design by die-shaping – a process to expand and form can bodies

The initial product for the industrial manufacture of three-piece cans is a round cylinder with a welded longitudinal seam. By necking, flanging, beading and seaming these cylindrical bodies are converted to the well-known cylindrical cans for beverages, foodstuffs, milk, aerosol or chemical products. Due to their smooth cylindrical shape all cans look more or less the same.
Many fillers now demand individually shaped cans to distinguish themselves from their competitors.
At present, mechanical expansion or widening is the most popular technique to shape cylindrical bodies, with radially moving segments expanding and shaping the cylindrical bodies. Disadvantages of this technique are cylindrical bodies that become polygonal, locally extremely stretched body material and irregular shortening of the bodies along their circumference so that expansion up to the end of the body is not feasible because it is no longer possible to form sufficiently accurate flanges.
Other techniques use hollow shaping dies (molds) into which the bodies are pressed. The pressure medium is highly compressed air or a jet of water. These techniques are expensive, slow and inflexible.
Spin-flow shaping is a rolling and pressing process that does not expand the body, but reduces its diameter at the point to be shaped. This process only allows the forming of simple, rotationally symmetrical shapes.
The newly developed die-shaping process presented here (patent pending) now offers an alternative.
For this process, the bodies are welded to the "necking diameter" or to the smallest diameter of the shaped profile. A shaping tool entering from both sides then expands the body (as in pipe expanding) to the final diameter at the points outside the shaped profile.
During "necking“ the body is only expanded at one ends whereas shaping expands it at both ends. The den of the mandrel ends and the mandrel itself determine the neck or shape profile and the surface shape of the can.

Expansion by mandrels offers the following advantages over spreading:

- Provided the mandrel has been designed accordingly, the expanded body will be perfectly round instead of polygonal.
- Elongation of the material along the circumference is regular. This allows for a wider expansion at the same material elongation. There are no pronounced variations in height, although the body is shortened noticeably. The bodies can be shaped right up to their ends.
- The desired uniform reduction in sheet gauge (down gauging) of 5 % can be achieved in the cylindrical portions while the original sheet gauge remains at the shaped or necked portions which are subject to stress. The body is shortened by several millimeters by the expansion process.
- The tools are simple, robust and easy to adjust.

Fig. 1 shows the process sequence in four steps.

The open body, with or without conical edge, as required, is transported between the upper and lower stripper and positioned relative to the axis of the tooling. At this point the upper mandrel is at its upper dead centre while the lower mandrel is at the lower dead centre.

The upper mandrel then moves vertically downward and the lower mandrel vertically upward. The mandrels enter the body and expand it, with the profiled end of the mandrel defining its shape.

When the two mandrels have reached their end positions, the shape or "neck" has been fully formed. The mandrels then return to their initial positions. During this sequence they strip the shaped body off at the strippers and the fully shaped body leaves the station.

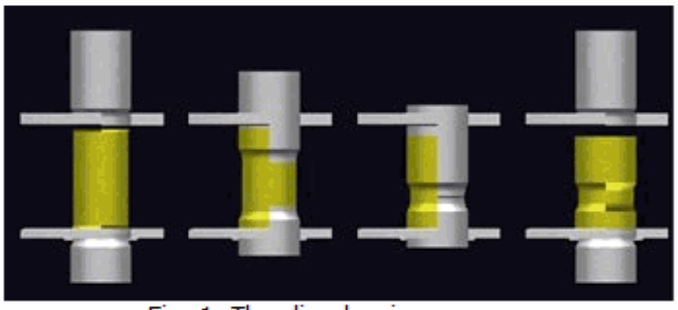

Fig. 1: The die-shaping process

The shaped body is then processed as usual and converted into a finished empty can by dienecking, flanging, beading and seaming.

The achievable expansion depends on the elongation and forming properties of the can material.

Typical expansions range from 8 to 13 % (e.g. 45 mm to 49 mm for aerosol cans, 57,5 mm (206) to 65 mm (211) for beverage cans, 65 mm (211) to 73 mm (300) or 73mm (300) to 83 mm (307) for food cans).

The actually required elongation limit of the material remains below the expansion percentages because the height of the can provides a large part of the material. Friction between mandrel and body, affected by inside lacquering and side striping, also has a major influence.

Figures for panelling or axial resistance that would allow a comparison with spin-flow necked cans have not yet been established.

At present, there is insufficient experience to make general statements on material properties and lacquering in relation to the degree of shaping and to specify general application limits of the process. A test equipment is available, however, and die-shaping samples can easily be manufactured at any time.

The following shows examples of different neck- and shape dens:

Fig. 2 shows a can expanded at one end, with a necked shape.

Fig. 3 shows an expanded can with a rotationally symmetric decorative shape.

Fig. 4 shows an expanded can with a shape that serves as protective bead.

Fig.5 shows an expanded can with an asymmetric decorative shape.

The shaped bodies shown here are just example. Apart from the suitability of material or lacquer there are only few limits to the den of the neck or shape. Undercut shapes are not possible, however.