

Cold forming with aluminium

Technical article



By cold forming aluminium manufacturers can significantly cut costs and reduce waste while maintaining or even enhancing the material properties.

Aluminium is an exceptionally well-travelled metal, circumventing the globe in the form of all manner of things, from soft drinks cans to supersonic aircraft. It is widely used because it is abundant, malleable, light, strong, naturally resistant to corrosion and, as illustrated here, highly flexible in terms of the many methods by which it can be processed. Most commonly these have been rolling, machining and forming but it is the latter of these processes that is increasingly offering engineers some powerful and economical options.



Aluminium is rolled by passing an ingot of the metal through a hot rolling mill. It is later cooled and then subjected to the same process several times until reduced to a thickness of between 4.0 and 6.0 mm. It can then be cold rolled to a thickness of as little as 0.05 mm. Thanks to decades of careful attention to the mechanics and chemistry of the rolling process, and a knowledge of the influence of the starting stock surface condition, this method has satisfied the needs of the canning industry, which sets down stringent requirements for flatness. As for other applications, rolled aluminium can be used within a range of alloys with specific physical properties that suit the needs of different applications. For example, strain-hardening alloys can be used in pressure vessels, cryogenic tanks, rail carriages and so on, while heat-treatable alloys provide material for the construction of missiles, armour plating and supersonic aircraft.

Machining is a technique that is also widely used in the aluminium industry for shaping manufactured aluminium. In this process, a cutting tool removes chips of aluminium as it shapes the part

to specific dimensions. Machining can also give the surface a particular finish within a range of given tolerance values. The aeronautical and automotive industries have made frequent use of machined aluminium.

Forming offers a third way of processing manufactured aluminium with its own unique potential. Hot forming allows more complex shapes to be forged under low pressures but the relatively high level of energy required to carry out the process has led many manufacturers to take advantage of cold forming, which can be plastically formed at room temperature (though pre-forming steps, annealing and high forming pressures may be required).

One of the many advantages of cold forming is that the surface finish can be precisely controlled, achieving results that other processes cannot produce without investing unfeasible levels of time and cost. Cold forming can offer several further benefits over die-casting or machining from solid aluminium, for instance, speed. Some parts can be completely cold-formed at

rates of up to 300 per minute, while other components are cold-formed and then machined. This is of particular advantage to manufacturers of lower cost components, offering significant savings on materials and on the time and cost of the machining process.

Even when an element of machining is required, manufacturers of lower cost components can make significant savings. Frequently, however, the need to add machining processes to cold formed parts is often unnecessary, as many secondary procedures have been eliminated by the expanded capabilities of cold-heading equipment and tooling.

In general, it is important not to consider cold-forming as a necessarily separate measure but one that can be allied to others in the interest of economy and product quality.

Engineers and designers who may not have given enough thought to cold forming need to consider the fact that, while some configurations, tolerances and/or hybrid designs will always require additional operations, many

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For example, Dawson Shanahan's recent innovations have included a revolutionary needle-free syringe, which was achieved by cold forming aluminium to high levels of specification. And as knowledge and experience has grown, the progress of cold forming has increasingly resulted from computer-aided research rather than 'experience-based' development.

In comparison with alternatives, cold forming is a simple process that can produce complex parts at low ambient temperatures, without removing any material, and it can do so as much as 15 times faster than more conventional options. As if that weren't enough, the significant reduction in energy consumption achieved by switching to cold forming helps to reduce not only plant costs but also carbon footprint. So, while rolling and machining remain well established processes with their own individual strengths, forming is now clearly an equally strong option that offers a range of benefits and one that engineers need to consider in order to ensure that they are producing the best quality components at the highest rate of efficiency.

second operation procedures have been eliminated by the expanded capabilities of cold-heading equipment and tooling. Cold forming can also produce parts of a greater strength than machined parts. During machining, bar stock grain is interrupted, while cold-headed parts have a grain that follows the configuration of the part.

The enhanced strength, surface finish and production speed enabled by cold forming aluminium is accompanied by another major benefit: reduced cost. Because cold forming is essentially the extrusion of a part from a blank, rather than the practice of chipping away that characterises the machining process, there is a correspondingly small amount of waste; cold forming results in up to 80% less scrap.

Demands on parts and labour can also be reduced by cold forming, as the process allows parts that may previously have been assembled from a number of pieces to be formed as a single component. This reduces cost in a number of ways, from improving product output to saving time on

inspections and the compilation of inventories further down the line, as there are fewer individual components both on the factory floor and in the warehouse. The ability to produce components of net or near net shape, reducing secondary operations, has greatly raised the profile of the cold forming process.

Cold forming can also result in a high quality, 'burnished' surface finish that requires little or no secondary finishing. This is because the surface finish mirrors the smooth condition and dimensions of the dies, offering powerful possibilities to end users who, for example, specify the production of containers with zero gas leakage. When manufacturing such containers it is critical that the surface remains free from scratches, which can create gas leak paths, and cold forming can yield excellent results here.

By carefully considering technical issues such as stress deformation, mechanical integrity and dimensional tolerances, engineers have pushed the boundaries of cold forming and achieved some impressive results.

