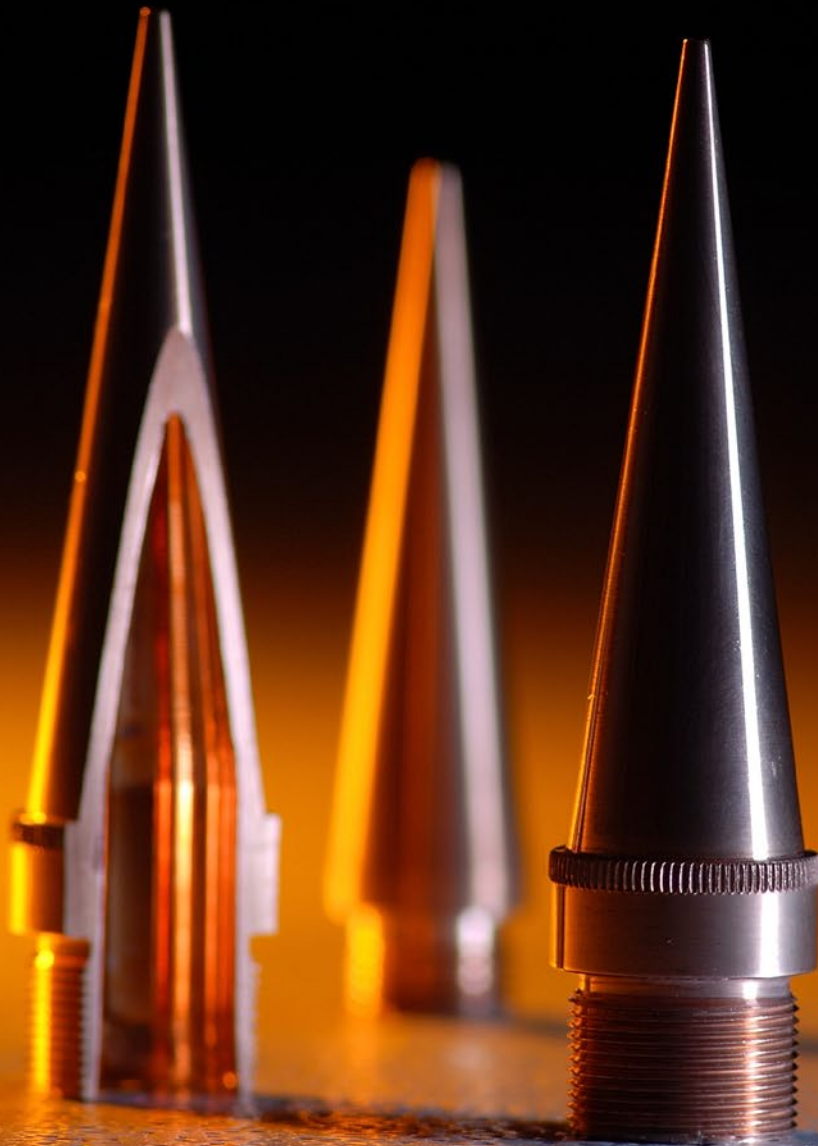




**Dawson
Shanahan**

**Precision Engineering
& Cold Forming**



The right climate for cold forming

A White Paper from Dawson Shanahan

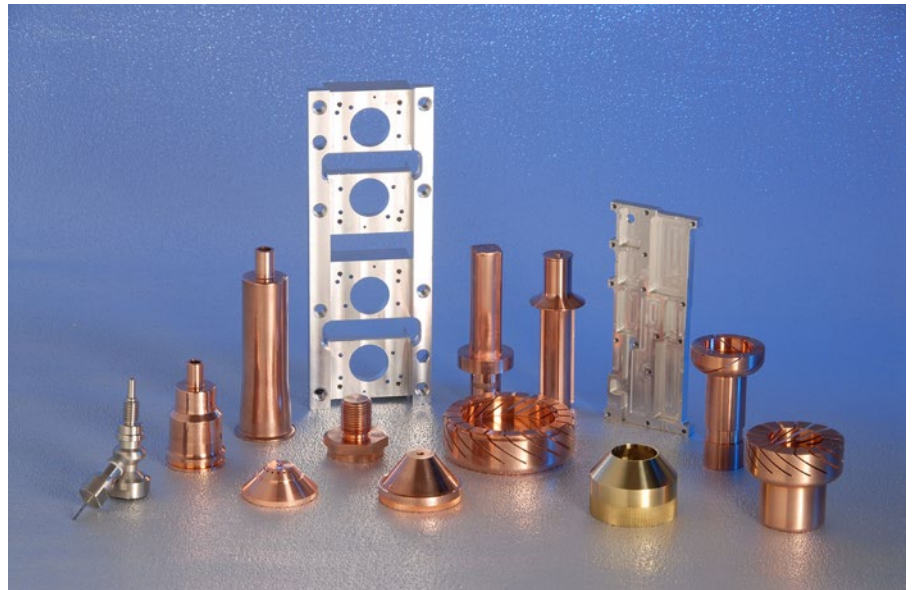
The right climate for cold forming

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Cold forming is a fast, economical way to produce robust, complex components in a wide range of materials. Surprisingly, however, this process is often ignored in favour of conventional machining methods. The reason for this may be simply that because cold forming originated as a method for producing fasteners during the 19th century it is still seen as a means of producing simple, high volume components. Today, however, the process is capable of delivering precision engineered parts with up to 80% less scrap than machine processes, which, given the current economic climate, is a statistic that ought to attract the attention of any component buyer. Coupled with faster lead times, better surface finish and improved mechanical characteristics, cold forming offers an opportunity for manufacturers across industry to take advantage of enhanced component quality while also reducing costs.

A closer look at cold forming

As it is performed at ambient temperatures, cold forming is a far quicker process than more conventional options, allowing manufacturers to achieve much shorter production processes. This in



turn means that components can be made to order extremely quickly, cutting lead times and the need to store high volumes of spare parts onsite. Aside from tangible cost savings, cold forming makes for superior quality products by plasticising metals along their grain boundaries, rather than cutting across. Parts are produced with extremely low levels of stress deformation and high levels of mechanical integrity, resulting in far greater performance and reliability. Furthermore, cold forming offers outstanding levels of definition, even on parts with complex contours. Typically, dimensional tolerances can be to within plus or minus two microns, with the added benefit of extremely fine surface finishes, which in many cases, require no further machining or polishing.

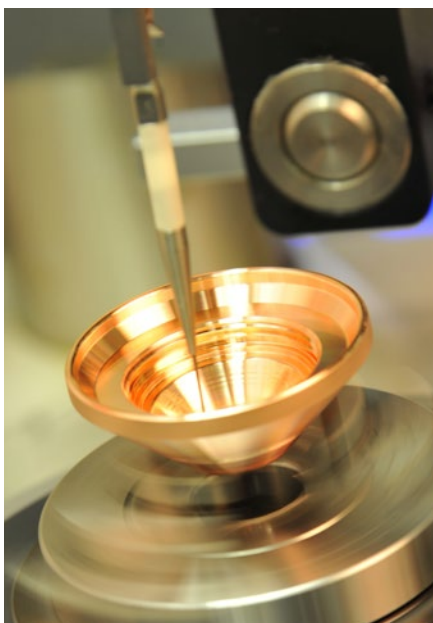
Additionally, parts undergo work hardening during the cold forming process, improving their machinability and durability still further. Work hardening dislocates the structure of the metal in a way that prevents further dislocations, resulting in a stronger component. As this increase in strength is comparable to that of heat treating, it can be more cost effective to cold work a less costly and

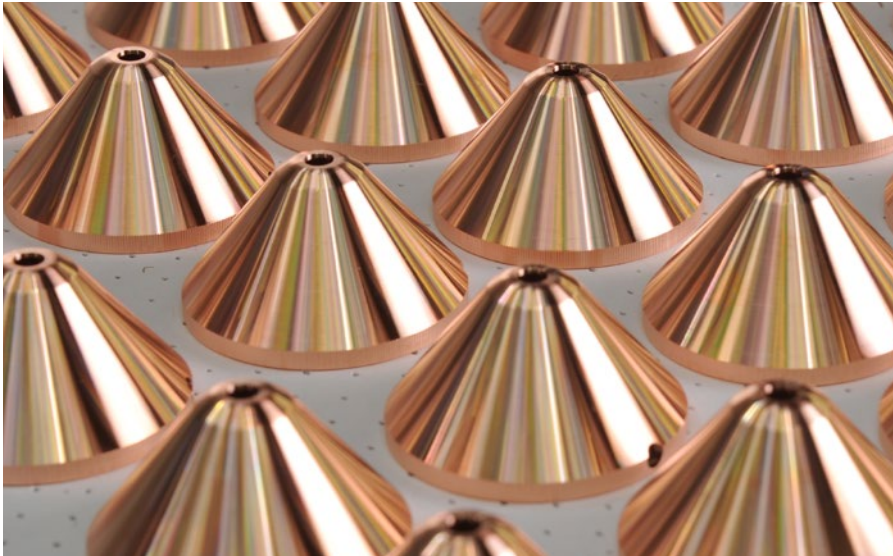
weaker metal than to hot work a more expensive metal, particularly where a precision finish is required.

The cold forming process also makes it possible to produce component parts with a superior finish, both internally and on the surface. Accurate internal profiles and complex external profiles are possible, enabling precision parts to be manufactured that can have a significant impact on the performance of the equipment in which they are used. Furthermore, there is almost no limit to the shape, size or complexity of the metal components that can be produced using cold forming. Simple cold-headed parts or highly complex cold formed and finished machined components can be produced for a diverse range of applications.

Pioneering new techniques in drug delivery systems

To appreciate the effectiveness of cold forming in the manufacture of precision components for the medical and pharmaceutical sector we can look at one of Dawson Shanahan's latest innovations. Created in partnership with a leading pharmaceutical company, Dawson has developed components for a revolutionary needle-free syringe that is designed to





relieve the suffering of patients with Central Nervous System (CNS) and pain disorders. This ground-breaking product is a drug-device combination that enables the needle-free delivery of subcutaneous sumatriptan for the acute treatment of migraines and cluster headaches.

Dawson Shanahan used intricate cold forming processes to achieve specially engineered parts, including an aluminium chamber and steel ram, with a highly accurate profile and finish that would enable the drug to be shot into the user's body without the need for a needle. As a result, medication can be administered quickly, simply and without anxiety. The success of the design is partly due to the high quality mirror finish on the inside of the piston, while the angles in the design also played a crucial role in ensuring that the trigger mechanism works effectively.

Cold forming stainless steel

Considerable work has been dedicated to developing a solution that allows stainless steel to be cold formed. As a result, the Dawson Shanahan research and development department has been able to create and apply a unique coating and lubrication process that acts as a protective barrier, while

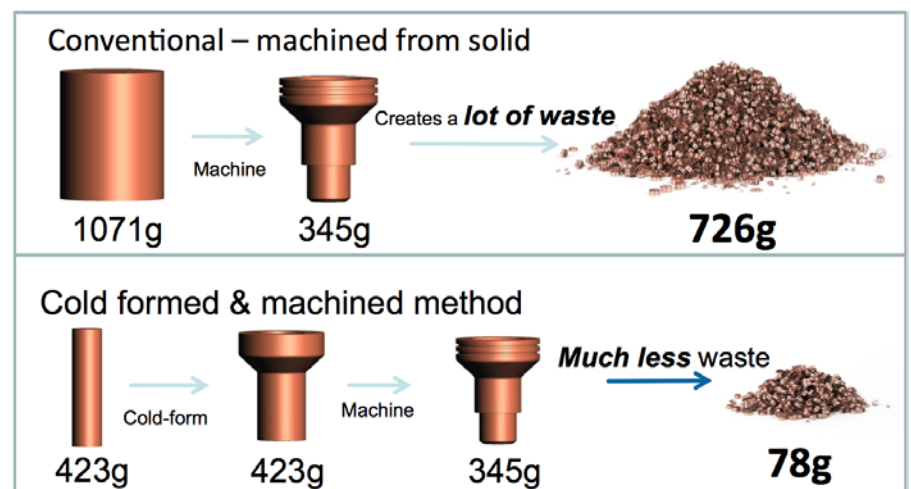
minimising friction when each part is formed. The company has had finished parts independently tested by world leading laboratories, which have confirmed that the physical and chemical properties of the stainless steel had been retained during the process. Furthermore, the specialist protective barrier prevents galling, thus retaining the desirable surface characteristics of stainless steel.

As cold forming retains the integrity of the metal, while also producing parts with highly polished surfaces and no

galling, the performance of a component can be improved dramatically. The derived advantages of this technological process can be of benefit in a diverse range of areas, from laser applications, where cold formed nozzles can increase cutting precision significantly, to automotive engine parts, such as diesel injectors where stainless steel can replace copper to enhance the overall reliability of engines and achieve reduced CO₂ and particulate emissions, especially where biodiesel is used.

Historically, cold forming in stainless steel has been problematic due to the hardness and unique mechanical properties of the metal. The difficulty is that many of the punch and die sets used in cold forming are also made from stainless steel, so they tended to collapse slightly when first used. However, Dawson Shanahan is developing a complex tooling design to allow for this controlled deformation.

This latest innovation opens up a world of new opportunities for the manufacture of precision parts in the healthcare sectors, including surgical instruments and equipment.



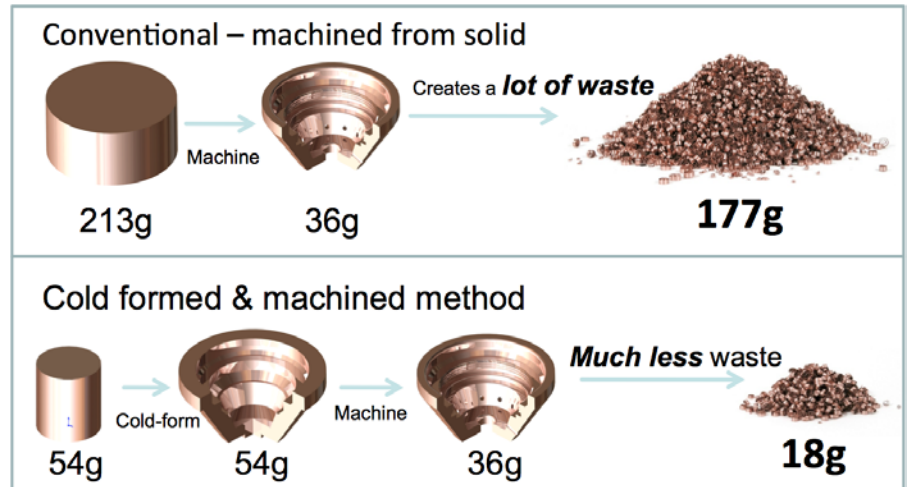
Cold forming minimises waste. For a typical power distribution component this can be by up to 90%.

The right climate for cold forming

Taking advantage of aluminium

To give a specific example of one of the ways in which cold forming can affect the physical characteristics of aluminium, consider the potential of this process for achieving a unique surface finish. Cold-formed parts have surface finishes that mirror the smooth condition and dimensions of the dies. Not only does this somewhat 'burnished' condition often eliminate the need for secondary finishing, it can also invest parts with the capacity to preserve, for example, gases with zero leakage for a number of years.

Recently, Dawson Shanahan engineered a cold-formed aluminium tube for the purpose of holding nitrogen gas. Our customer specified that a minimum pressure must be maintained within the chamber for a period of two years. A rubber seal contacting the chamber inner surface was used to prevent gas loss. It was therefore critical that the chamber surface was free from scratches, eliminating gas leak paths and, in turn, loss of pressure. Although the drawing specification required a 0.2Ra radial surface requirement, the process produced results between 0.04 and



For plasma cutting shields, cold forming cuts waste and enhances mechanical properties.

0.08Ra. This case is one of many which demonstrate that there is great potential for engineers to consider, and take advantage of, the various modern methods of processing manufactured aluminium to suit the needs of different applications.

Cold forming – the continuing story

The research and development of cold forming continues; in recent years there has been an increasing shift from experience-based development to

computer-aided research, facilitating a deeper and more analytical approach to developing the process.

Cold forming continues to present new opportunities across industry but it is important not to consider cold-forming as a necessarily separate process; it can be allied to other processes in the interest of economy and product quality. Those 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 second operation processes have been eliminated by the expanded capabilities of cold-forming equipment and tooling.

Finally, cold forming also delivers significant ecological benefits compared to processes such as hot forging, where the high level of heat, and thus energy, required comes at a price to the environment.

Consequently, cold forming can contribute to a lower carbon footprint, as well as enhancing productivity and business performance.

