Interplex

Cold Forging

Tech Bulletin

Cold Forging Improves Production Efficiency for Automotive Drivetrain Components

Greater Strength, Reduced Cost and Higher Production Yields

This Tech Bulletin provides information on how Cold Forging processes are being leveraged to enhance production efficiency, product quality, manufacturing yields, and product cost for the creation of drivetrain components.

What is Cold Forging?

Cold Forging is an "impact forming" process that deforms a billet of raw material plastically, under high compressive force, between a punch and a die using a Horizontal or Vertical Cold Forging press. Some basic Cold Forging techniques include Extrusion, Coining, Upsetting, and Swaging. These techniques may take place in the same punch stroke for a single die Vertical operation, or in sequential succession through a series of dies in a Horizontal operation. The process, Vertical or Horizontal, depends on the specific application and complexity of the product produced.

Cold Forging, efficiently forms all the existing material into the desired shape thereby maximizing material utilization; whereas Volume-In (billet) = Volume-Out (product). It also greatly increases production throughput rates compared to other manufacturing methods – this can be over 100 times faster in some instances.

Figure 1 - Automotive Drivetrain Components

The following sections look specifically at the advantages that Cold Forging provides for makers of various critical high-strength components used throughout automotive drivetrains.

Why Cold Forging for Drivetrain Components?
Automotive drivetrain components are a vital element in the global vehicle manufacturing industry and are also undergoing an accelerated pace of design changes as the industry develops new hybrid, electric and more fuel-efficient alternatives. Regardless of the power generation methods, drivetrains continue to play the critical role of efficiently and reliably transferring that power to the wheels.

Global competitive pressures are forcing companies to engineer and produce powertrain systems that over time are more economical to manufacture, higher in product quality and reliability, higher in performance, more fuel efficient, and have longer life expectancy.

Figure 2- Planetary Drive Assembly

Drivetrain components must endure very high forces (torque, coupling, internal pressures, etc.) and handle instantaneous changes in force over the lifetime of the vehicle. Also, the ever-increasing complexity of the drivetrain component design, is creating new manufacturing challenges.

For creating automotive drivetrain components, Cold Forging offers the following advantages:

- Improved Strength and Component Integrity
- Higher Material Utilization Rates
- Cost-Efficient High-Volume Production

Improved Strength and Component Integrity
One of the many advantages of Cold Forging, is the significant improvement to the strength and integrity of the finished product. Forging, by nature of the operation itself, yields a much stronger finished product when compared to other manufacturing processes such as casting, weldments, powder metal, and conventional (CNC) machining.

The high compression process used in Cold Forging displaces and rearranges the grain of the base material such that any inherent weaknesses are eliminated. This can be particularly important for product designs, such as drivetrain components; whereas the required shape could experience weak points along the existing grain of the base material.

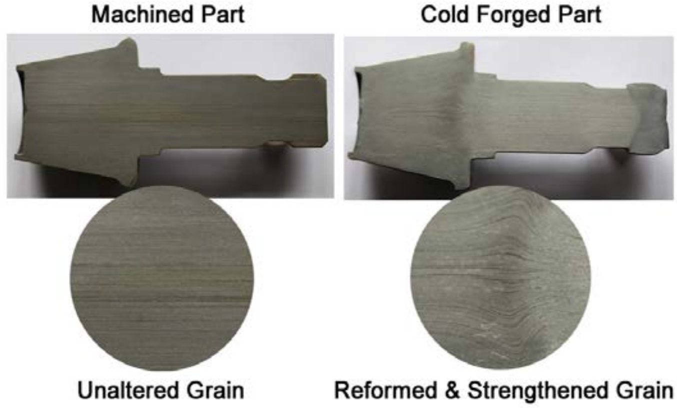

Figure 3 - Improved Grain Strength

Drivetrains include many of the types of designs where grain flow strength is critical, such as components with long protrusions that cut across the grain or complex components with narrow points that could be prone to breakage under stress.

Using a Cold Forging process inherently overcomes these problems by eliminating the need for design and production engineers to worry about any potential issues with the underlying grain of the raw material.

Higher Material Utilization Rates

A primary advantage of Cold Forging is the elimination of wasted material. Instead of removing a significant amount of the raw material as in conventional machining, a Cold Forging process makes use of it all. Input to the Cold Forging process is in the form of “billets” of material, which are cut from the raw stock bulk material (coil, beam, sheet, etc.). Each billet is the exact amount of material needed for the final component so there is no waste or loss of material.

To accommodate the removal of material, machining processes typically must start with a significantly larger amount of raw material than is needed in the finished component, which results in much lower material utilization rates. Cold Forging can provide material savings of up to 70 percent versus machining. This waste-free process can offer a significant benefit in high volume production of drivetrain components where the waste-per-component can become a key cost consideration.

Cold Forging also provides consistent higher quality as the surface finish will mirror the smooth condition and dimensions of the dies; usually eliminating any need for secondary finishing.

Figure 4 - Drive Shaft - Cold Forged with Near-100% Material Utilization

Cost-Efficient High-Volume Production

Because Cold Forging can produce near-net-shape products in a single pass using a minimum of material, the production process efficiency is greatly improved. Cold Forging enables creation of close tolerance products at rates of dozens or even hundreds per minute.

Cold Forging thereby provides significant production yield improvements and cost reduction by producing 50-300 pieces per minute as compared to other machining technologies; such as CNC Turning, CNC Milling, and Screw Machining - that can take several minutes per part.

Summary

Cold Forging offers the potential to convert multi part units to a single Cold Forged component; therefore, saving on parts, labor, inspection, tolerance issues, purchases, inventory coordination and assembly time, all while improving strength and product output.

Compared with other technologies, such as machining, die casting, plastic injection molding, weldments, and metal injection molding (MIM); Cold Forging creates products with a higher impact strength, a higher structural integrity, better accuracy, increased material efficiency, and the most competitive manufacturing cost.

More information on Cold Forging can be found on the web at http://www.interplex.com/services/cold-forging