Unsurpassed Expertise

Advancing technology has been the cornerstone of our success for over 50 years. When Camcar developed the Raycarl® process, it was considered the most significant breakthrough in cold forming technology in over 100 years. Today, we continue to lead the industry though continuing research and investment in new technology, unsurpassed expertise and strict attention to detail. STANLEY Engineered Fastening manufactures the high-quality, cost-efficient components your applications demand.

Cold forming, or cold heading, forms shapes without causing scrap material. Since raw material can be the most expensive aspect of a part, cold forming is often a lower cost alternative to screw machining and other manufacturing methods. Expanding cold forming technology is allowing increasingly complex components to be manufactured at very high production rates.

Quality
• Improved strength and reliability through work hardening and an uninterrupted grain flow
• Improved surface finish over screw machined components

Reduced Costs
• Reduced scrap rates
• High production rates
• Ability to form parts to a net or near-net shape, which requires fewer secondary operations to achieve finished form
• Allows multi-piece assemblies to be manufactured as a single component
• Cold forming often uses significantly less raw material for the same component

Design Flexibility
• Unique and diverse shapes, including parts with multiple diameters, extrusions, blind holes and through holes
• Eccentric or asymmetrical bodies possible
• Large head to shank ratios without secondary machining
Cold forming uses forces greater than a metal’s elastic limit to form shapes without causing scrap material. First the material, in wire form, is drawn into the header, and is cut off at the desired length. Next, a series of engineered dies and punches are used to form shapes by upsetting or extruding the cut-off.

**One Die, Two-Blow Process**
The two-blow cold forming process allows upsets and extrusions to be achieved on the same component. The first blow provides the rough shape, while the second blow forms the final shape.

**Advancing Technology**
The Raycarl® process was developed by Camcar to manufacture shapes which exceed the upset or extrusion limits of conventional one- and two-blow cold forming.

Today, cold forming technology has advanced far beyond this innovative process.

**Two Die, Three-Blow Process**
With its additional impact/extrusion die, the two die, three-blow process can provide up to 4-1/2 diameters of upset, larger head ratios and more diverse shapes than a one die process.

Multi-die forming, which uses several impact/extrusion dies on one header, allows even greater capabilities (see following page).

**Upsets**
Upsetting allows heads or shapes larger than the wire diameter to be formed by exerting force on one end of the blank. The portion of the blank to be upset is measured by wire diameters of upset.

**Extrusions**
Extruding is done by two methods: forward and backward. With forward extrusions, the metal blank is forced into a die opening smaller than the wire diameter, achieving a decrease in blank diameter and an increase in length. With backward extrusions, a punch smaller in diameter than the blank is forced into the blank, causing the material to flow backward around the punch, forming cylindrical holes.
Cold Forming Processes & Capabilities

Multiple-Die Forming
Through multiple-die forming, the final shape is achieved in stages. Multiple-die headers have more dies and punches on each machine to allow for:

- increased areas of reduction
- forming unique shapes such as multiple diameters on one component
- large head to shank ratios
- possible elimination of secondary operations such as drilling, turning and trimming

Current technology includes off line set-up, computer-controlled tool loading, and trimming capabilities within the header.

Multiple-Die Progression
Through multiple-die forming, the final shape is achieved in stages. The six stage process shown here, from cut-off to finished blank, often takes less than 1/2 second.

Progression Dimensions
Cut-off (Stage 1): Length – 2.46" (62.55mm)
Diameter: 0.72" (18.28mm)
Finished Blank (Stage 6): Length – 3.86" (98.06mm)
Smallest Diameter: 0.374" (9.488mm)
Largest Diameter: 1.85" (46.91mm)

Multiple-Die Headers
STANLEY Engineered Fastening has a wide range of multiple-die headers and other equipment to manufacture components to your specific requirements.

- Cut-off diameters up to 1.6" (31mm)
- 50 to 200 pieces per minute
- Reduced set-up time
- Highly conducive to short runs
- Offers tight part tolerances to eliminate many secondary operations
Candidates for Cold Forming

Any one of the following criteria make a part a strong candidate for cold forming:

- Large head to shank ratio
- Part is longer than 1-1/2 times its largest diameter
- Part has multiple diameters
- High production quantities needed
- Raw material is a large portion of part’s total cost
- Part has fine surface finish requirements
- Strength, hardness and ductility must meet certain requirements
- Part requires a geometrical shape, a drive system or an extrusion

Size Ranges
Diameters: .020" to 1.6" (1.27mm to 41mm)
Lengths:
- 14" (355mm) under the head with diameters to 1.5" (38mm)
- 17" (432mm) under the head with diameters to .875" (22mm)

Actual sizes are dependent on the complexity of the component. Please contact an STANLEY Engineered Fastening applications engineer for more information.
Cold Formed Equipment & Capabilities

Materials

Through continual development and modification of manufacturing techniques, STANLEY Engineered Fastening can cold form many unusual materials. This allows easy conversion from screw machining and other manufacturing methods.

<table>
<thead>
<tr>
<th>Material</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Carbon Steel</td>
<td>offers relative ease of formability; relative low cost as compared to other materials</td>
</tr>
<tr>
<td>1005 1008</td>
<td></td>
</tr>
<tr>
<td>1010 1018</td>
<td></td>
</tr>
<tr>
<td>1022</td>
<td></td>
</tr>
<tr>
<td>Medium Carbon Steel</td>
<td>for high strength applications; good formability; heat treatable</td>
</tr>
<tr>
<td>1030 1035</td>
<td></td>
</tr>
<tr>
<td>1038 1040</td>
<td></td>
</tr>
<tr>
<td>1045 1050</td>
<td></td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>for high strength applications (Class 10.9/Grade 8 and above); offers highest hardenability and toughness; heat treatable</td>
</tr>
<tr>
<td>1541 4037</td>
<td></td>
</tr>
<tr>
<td>4130 4140</td>
<td></td>
</tr>
<tr>
<td>4340 8620</td>
<td></td>
</tr>
<tr>
<td>8640 8740</td>
<td></td>
</tr>
<tr>
<td>Tool Steel</td>
<td>for high strength applications; good wear resistance</td>
</tr>
<tr>
<td>52100 M2</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td></td>
</tr>
<tr>
<td>CDA102 ETP110</td>
<td>for corrosion resistance; good formability; offer excellent soldering, welding and brazing properties</td>
</tr>
<tr>
<td>Brass</td>
<td></td>
</tr>
<tr>
<td>CDA220 CDA230</td>
<td></td>
</tr>
<tr>
<td>CDA260 CDA270</td>
<td></td>
</tr>
<tr>
<td>Bronze</td>
<td></td>
</tr>
<tr>
<td>Silicon</td>
<td></td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td></td>
</tr>
<tr>
<td>2017 2024</td>
<td>for corrosion resistance; lightweight; excellent formability</td>
</tr>
<tr>
<td>6061 5056</td>
<td></td>
</tr>
<tr>
<td>Stainless Steel</td>
<td>for superior corrosion resistance; allows for work hardening from cold forming, which is especially important for non-heat-treatable grades; good heat resistance; some offer desired magnetic or non-magnetic properties</td>
</tr>
<tr>
<td>302HQ 316L</td>
<td></td>
</tr>
<tr>
<td>321 405</td>
<td></td>
</tr>
<tr>
<td>410 420</td>
<td></td>
</tr>
<tr>
<td>430F 431</td>
<td></td>
</tr>
<tr>
<td>17-4PH Camtronic®</td>
<td></td>
</tr>
<tr>
<td>A286</td>
<td></td>
</tr>
</tbody>
</table>

Heat Treat

Several types of heat treatment are available to meet desired hardness, strength, and ductility characteristics, including:

- Through hardening: entire part is hardened and tempered to desired strength level
- Case hardening: surface hardness is raised to a level higher than the core hardness and the material the component will be in contact with (not recommended for structural applications)
- Annealing: softens part that is work hardened to enhance certain secondary processing or meet functional application requirements
- Selective hardening/selective induction hardening: only a portion of a component is hardened
- Carbonitriding: carbon and nitrogen content of the surface is raised to a level higher than the core for improved surface hardness

Platings

In selecting plating, several aspects must be considered, including desired corrosion resistance, lubricity and appearance, as well as concerns over cost and toxicity. STANLEY Engineered Fastening has a wide array of platings available to meet the specific needs of your application.

Please contact a STANLEY Engineered Fastening application engineer for more information on what type of heat treatment and plating is appropriate for your application.
Cold Forming Equipment & Capabilities

Secondary Operations
Cold forming allows products to be manufactured to net or near net shape. STANLEY Engineered Fastening also offers a full line of precision secondary operations to meet more specific requirements.

Capabilities Include:
- Roll forming
- Roll threading
- Tapping
- Broaching
- Grinding
- Turning/Shaving
- Slotting/Sawing
- Reheading
- Knurling
- Finishing
- Burnishing
- Assembly
- Trimming
- Drilling
- Milling
- Flattening

Precision Machining
STANLEY Engineered Fastening has a wide array of equipment that allows multiple secondary operations with extremely tight tolerances to be performed. A single machine can perform up to 12 operations per part, including turning, grooving and drilling.

Utilizing this precision equipment can be less expensive than other secondary machining methods because several operations can be done on one machine at very high speeds. These machines also offer continuously high quality, holding diameter tolerances to .001" (0.025mm) and length tolerances to .005" (0.127mm).
From Screw Machining To Cold Forming

Our wide array of cold forming processes allow even the most complex screw machined components to be converted to cold formed components. There are many reasons to switch:

Cold forming provides stronger and more reliable parts. The cold forming process causes the raw material to work harden as it conforms to the desired shape, providing an uninterrupted grain flow that follows the contour of the part.

• provides improved yield and ultimate tensile strength
• provides greater fatigue strength, especially at critically-stressed corners

Although these characteristics can eliminate the need for heat treating, the hardness of cold formed components can be enhanced with these treatments, with the added benefits of improved ductility and fatigue strength.

Cold forming components provide better wear resistance. Cold forming produces a surface finish of 63 micro inches, which is superior to the finish typically produced on machined surfaces. If a smoother surface is required, STANLEY Engineered Fastening can utilize secondary operations to achieve a finish as low as 6 micro inches.

• provides a higher wear resistance
• since machining is eliminated or kept to a minimum, the possibility of machining notches, which can cause premature failure, is also reduced

Cold forming provides higher production rates. Multi-die cold form headers can produce up to 200 parts per minute, because they progressively form multiple parts with each machine cycle. Screw machining, whether single or multiple spindle, typically averages less than 50 pieces per minute.
From Screw Machining To Cold Forming

Cold forming can reduce scrap by 80% and more. Screw machining only removes material, so it requires bar stock to be as large as the largest diameter of the finished component, resulting in excessive scrap.

Cold forming moves material, so the original wire stock can be significantly smaller.

- requires less material
- generates minimal scrap
- minimizes scrap handling and removal costs

This is especially important with expensive raw materials.

From Assemblies to Single-Piece Parts

Assemblies consisting of two or more components can be cold formed into strong, reliable single-piece parts. This can lower costs in a number of areas through:

- elimination of assembly or welding operations
- increased production rates
- minimized part handling
- parts consolidation and reduced inventory management

The cold formed cut-off (right) is often significantly smaller than the screw machined blank (left) required to form the same part (shown in the middle).

Cold formed cut-off: 326 lbs./1000 pcs.
Screw machined blank: 3,000 lbs/1000 pcs.
Raw material savings: 2,674 lbs/1000 pcs.

This component, used on a wheelchair lift, was originally a screw machined shaft welded to a washer. Today, the shaft and washer are cold formed as a single unit, with an uninterrupted grain flow. Secondary operations are used for drilling and tapping the shaft and broaching the flats. Even with these secondary operations, the resulting part is stronger and less expensive than the original assembly.
Success With Cold Formed Components

Material Capabilities Fulfill Requirements
Application: Airbag mount assembly
Component: Attachment pin
Original process considered: Die-casting
Needs/Problems: During prototyping, it was determined that the die-cast material could not meet the mechanical performance requirements of the application.
STANLEY Engineered Fastening Solution: Cold forming 10B21 material, followed by secondary machining
Customer Benefits:
• Provides a strong, reliable component

Reduced Material Costs
Application: Automotive brake assembly
Component: Piston rod
Original process used: Screw machining
Needs/Problems: Screw machining required use of bar stock of the largest diameter
STANLEY Engineered Fastening Solution: Cold forming followed by a shave operation
Customer Benefits:
• Material cost savings of $0.60 to 0.80 per component

Decreased Costs and Increased Strength With Cold Forming
Application: Door lock
Component: Dead bolt
Original process used: Powdered metal forming
Needs/Problems: Powdered metal components had high costs and could not meet durability requirements
STANLEY Engineered Fastening Solution: Both external and internal shapes were completely cold formed, including blind hole; no secondary operations were necessary
Customer Benefits:
• High strength, durable components
• Lower costs

Stronger Parts Through Cold Forming
Application: Steering system
Component: Shaft with involute spline
Original process used: Screw machining
Needs/Problems: Machined splines did not meet strength requirements
STANLEY Engineered Fastening Solution: Cold formed 1035 alloy shaft and rolled threads; involute spline created in second cold-forming operation to minimize damage. Secondary operations included grinding of round diameters and cross-drill.
Customer Benefits:
• Stronger, more reliable part
• Reduced overall costs
Success With Cold Formed Components

Internal Rolled Threads Provide High Precision Fit
Application: Motorcycle wheel assembly
Component: Internally-threaded fastener for attachment of wheel spokes to tire rim
Original process used: Cold formed part with cut-tapped hole
Needs/Problems: Cut-tapped hole could not meet automation requirements
STANLEY Engineered Fastening Solution: Cold formed blank with squared end, TORX PLUS® Drive recess, and hole. Internal threads were rolled instead of cut.
Customer Benefits:
• Increased thread quality
• Decreased assembly line rework due to threading issues

Special Thread Requirements Met Easily
Application: Automotive engine assembly
Component: Pipe plug housing requiring smooth threads to accept O-ring assembly; also, bottom of cup must be flat to .05" and first step in cup must be smooth
Original process considered: Screw machining
Needs/Problems: Required tapered threads, which can not be screw machined
STANLEY Engineered Fastening Solution: Cold formed component with rolled threads. Secondary operation used to meet tight tolerance requirements on inside diameters.
Customer Benefits:
• Material savings
• Tapered threads and tight tolerances met

From Two-Piece Assembly into a Single Component
Application: Commercial air conditioner
Component: Valve stem
Original process used: Two-piece screw machined, 302 stainless steel parts brazed together
Needs/Problems: Two-piece part was not meeting strength requirements of application
STANLEY Engineered Fastening Solution: 3/8" x 3" one-piece cold formed 302 stainless steel part with TORX® recess and squared end. CNC turning, burnishing and grinding were used to achieve 32 micro inch finish and desired concentricity.
Customer Benefits:
• Stronger parts
• Elimination of brazing process
• Lower material and product costs
STANLEY Engineered Fastening, a Stanley Black & Decker Inc. Company has been revolutionizing fastening and assembly technologies for a variety of industries for more than 40 years.

For more information, please visit our website www.StanleyEngineeredFastening.com

Quick Links:

- Our locations
  http://www.stanleyengineeredfastening.com/contact/global-locations

- Request Information
  http://www.stanleyengineeredfastening.com/econtact/request-information

- Resource Center
  http://www.stanleyengineeredfastening.com/resource-center

© 2015 Stanley Black & Decker, Inc., PTF CFS, Rev. 07.2015

Camtronic® is a registered trademark of Infastech Intellectual Properties Pte Ltd. Raycarl®, TORX®, and TORX PLUS® are registered trademarks of Acument® Intellectual Properties, LLC.
Data shown is subject to change without prior notice as a result of continuous product development and improvement policy. The information in this catalog is not to be considered a specification. Your local STANLEY Engineered Fastening representative is at your disposal should you need to confirm latest information.