

STANLEY[®]
Engineered Fastening



Cold Formed Specials

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 through 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

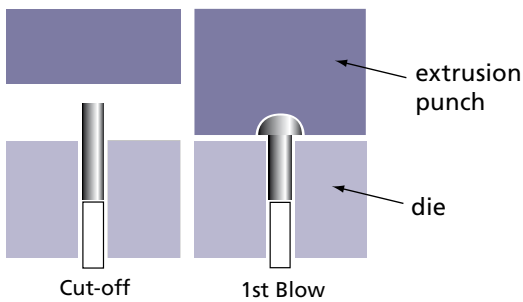
Design Flexibility

- 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 Processes & Capabilities

Dies and Punches



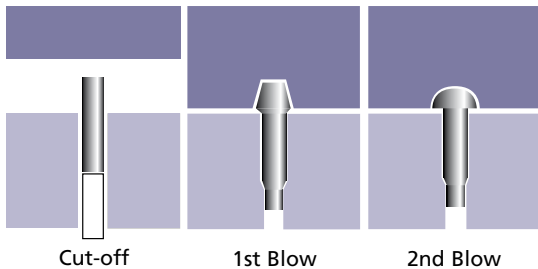
Cold forming uses forces greater than a metal's elastic limit to form shapes without causing scrap material.

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.

One Die, Two-Blow Process

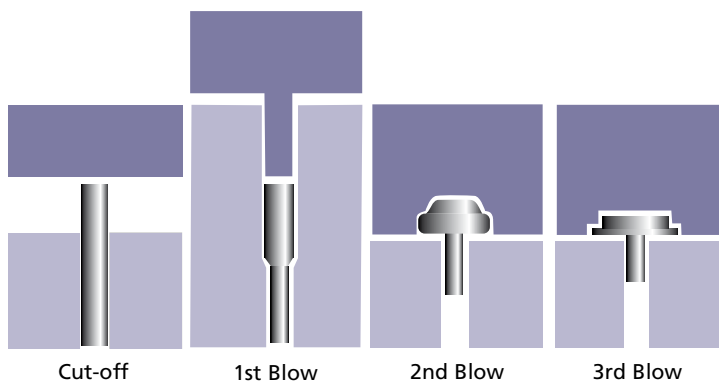


Advancing Technology

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



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.



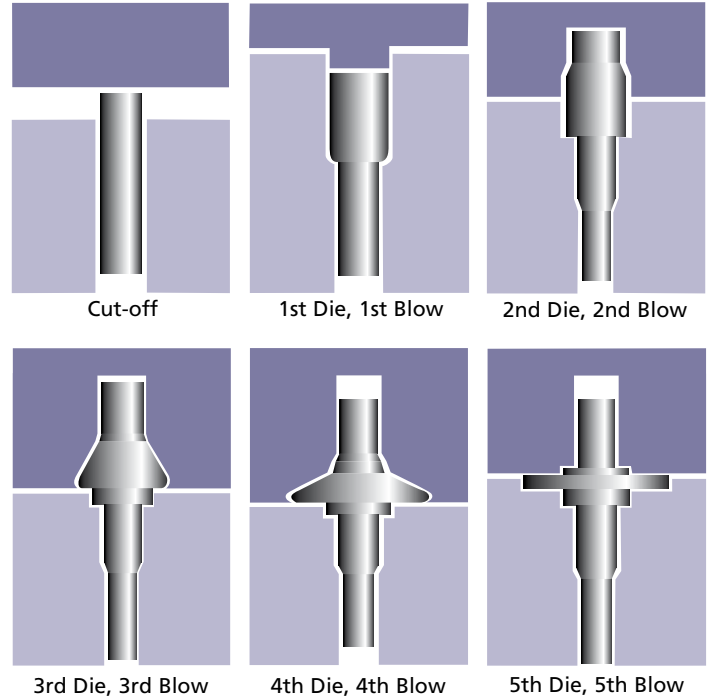
Cold Forming Processes & Capabilities

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)

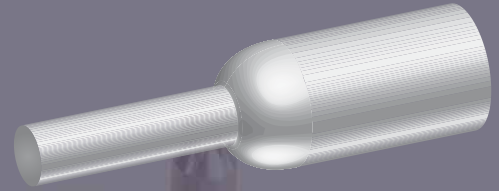
Lengths:

- 14" (355mm) under the head with diameters to 1.5" (38mm)
- 17" (432mm) under the head with diameters to .875" (22mm)

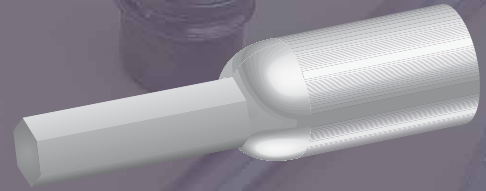
Actual sizes are dependent on the complexity of the component. Please contact an STANLEY Engineered Fastening applications engineer for more information.



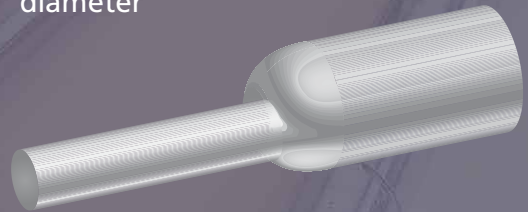
Round or concentric extrusions, for shafts or threading; multiple diameters are possible



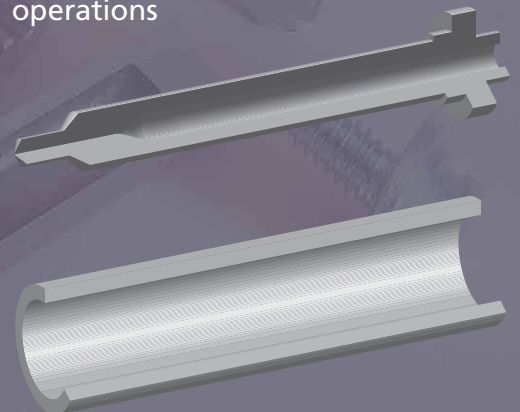
External shapes, such as splines, squares, flats and drive systems



Eccentric or asymmetrical bodies that are within the initial wire diameter



Blind or through holes, which eliminate secondary drilling operations



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.

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

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.

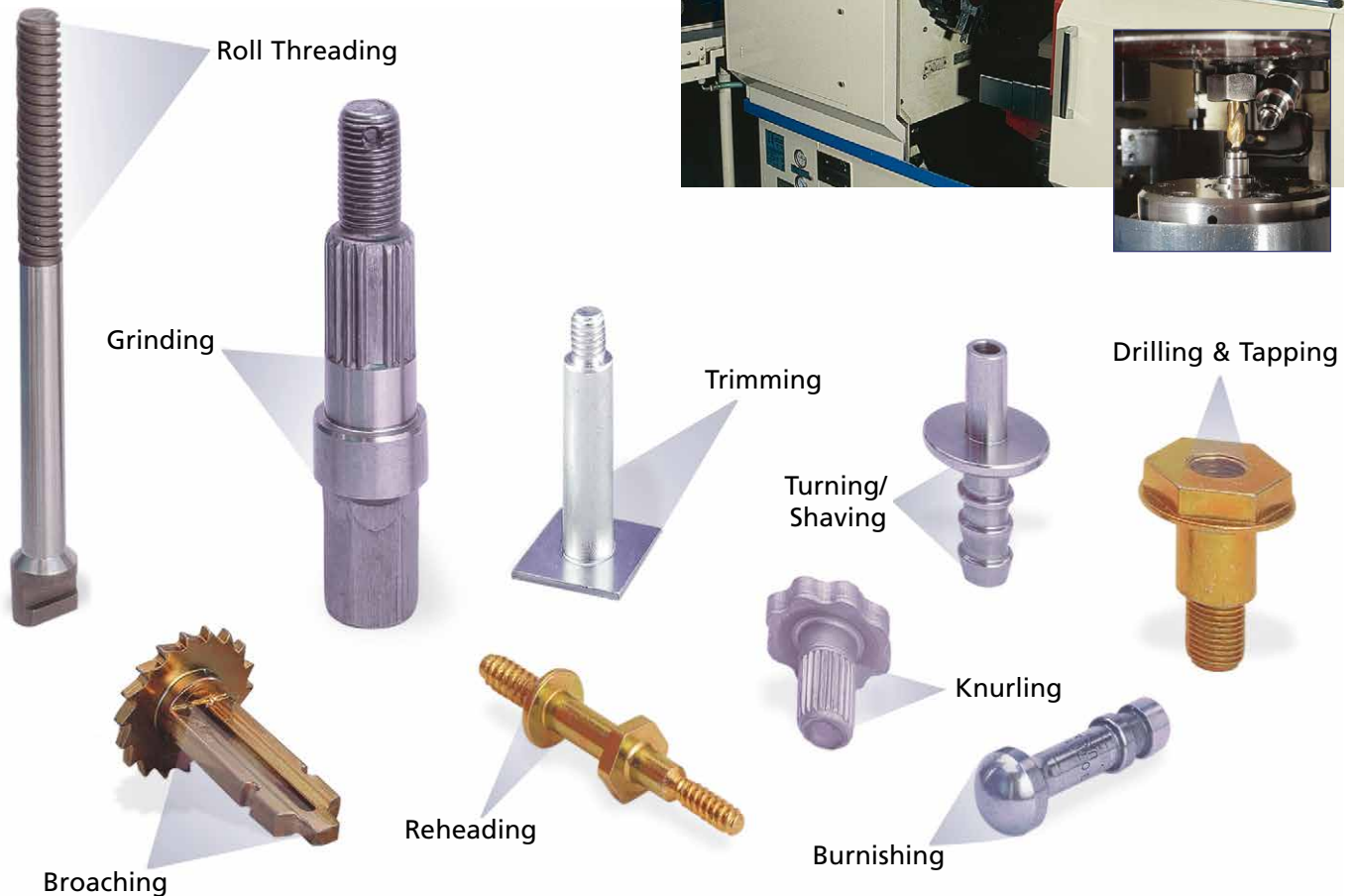
Capabilities Include:

- 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.

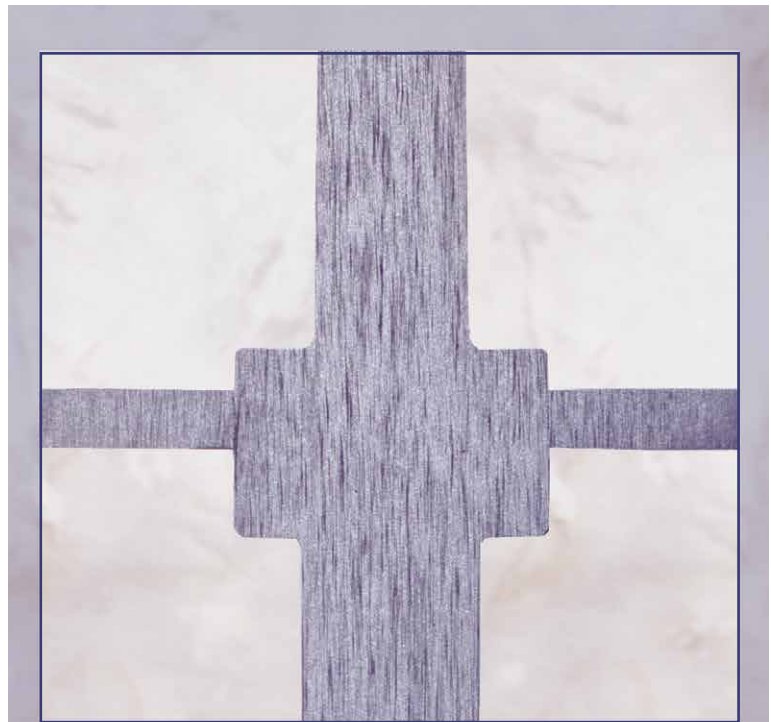
- provides improved yield and ultimate tensile strength
- provides greater fatigue strength, especially at critically-stressed corners

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.

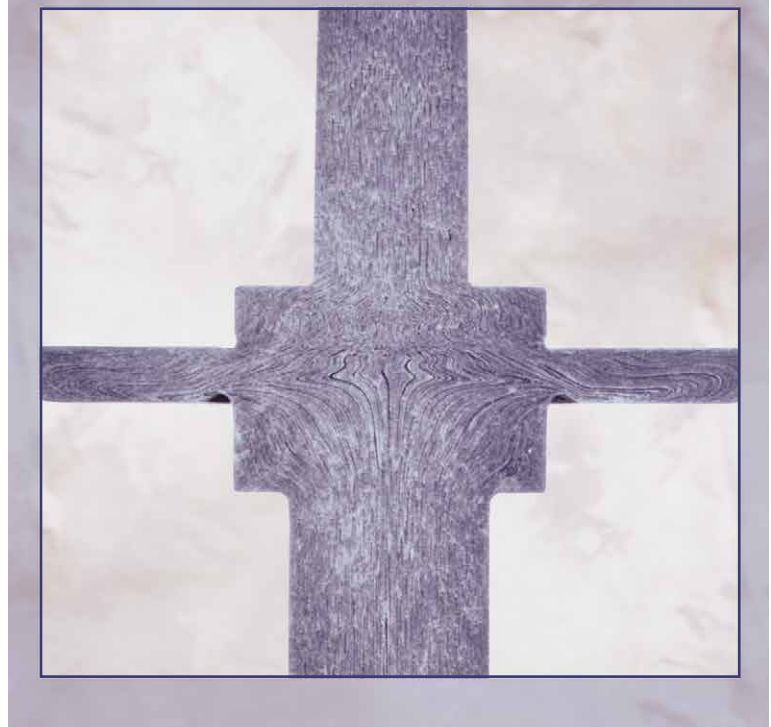
Cold forming components provide better wear resistance. Cold forming produces a surface finish of 63 micro inches, which is superior to the finish typically produced on machined surfaces. If a smoother surface is required, STANLEY Engineered Fastening can utilize secondary operations to achieve a finish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



The section of a screw machined component (above) demonstrates how the grain of the material is interrupted by this process. The section of a cold formed component (below) demonstrates how the material flows around critical corners, increasing strength.



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.



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.

From Assemblies to Single-Piece Parts



▲ This single component, a shaft for a drive fork, was once a 3-piece assembly.

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

◀ 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.

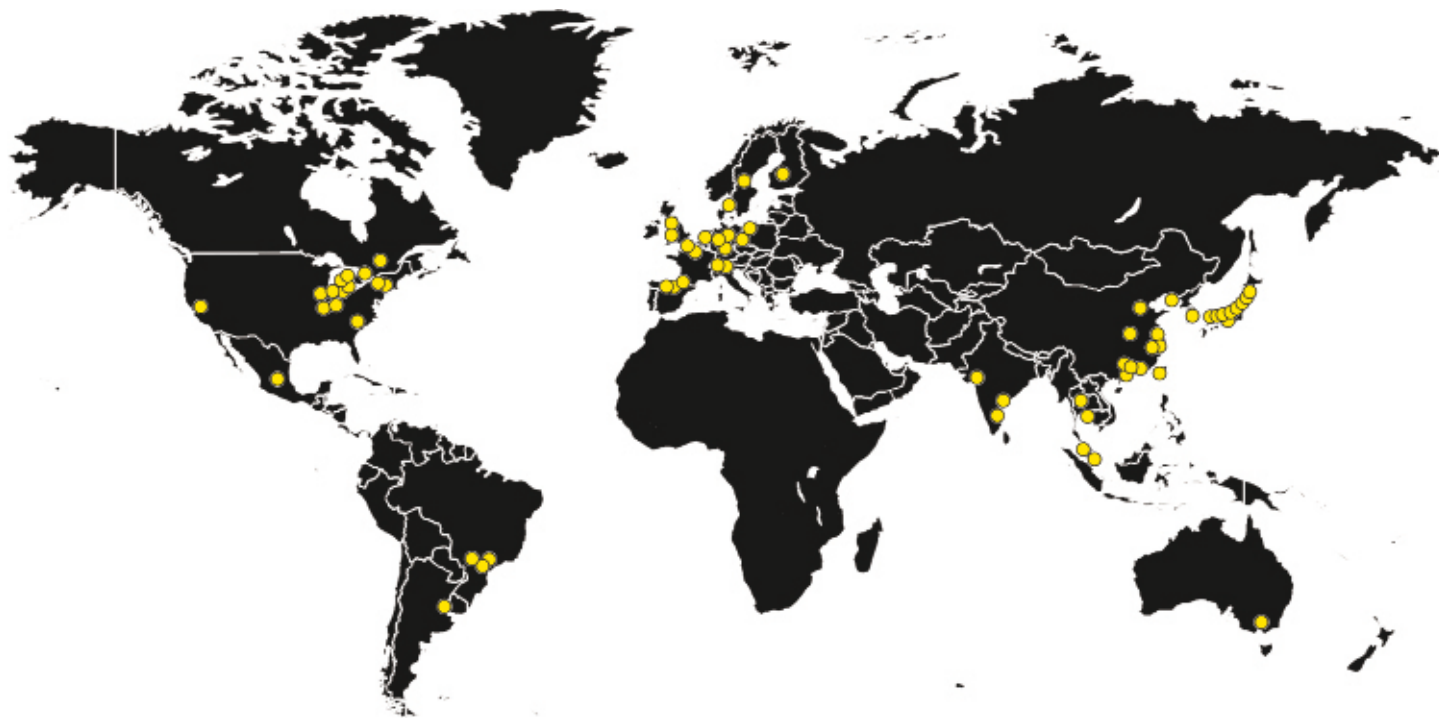
Customer Benefits:

- Stronger parts
- Elimination of brazing process
- Lower material and product costs



STANLEY®

Engineered Fastening



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