

6.6 Case Study No.6

Component name:	Cylinder Cap for Agricultural Hydraulic System
Forging Process:	Hot impression die (Hammer)
Weight, kg (lb):	1.0 (2.2)
Alloy:	Steel 1045
Secondary Operations:	Broach, turn, face, P-cut, deburr
Alternate process:	Machined from bar stock
Annual Production:	Typically 1 0,00 to 12,000

The hydraulic cylinder cap shown in Figure 6-6 is one of two that was converted for forging. The objective of the conversion was to develop higher performance, more cost effective hydraulic cylinders for agricultural equipment. Performance is critical because:

- The cap is hinged to a frame, and is used as a lifting device.
 - Hydraulic pressures exceed 21 MPa (3000 psi).
 - High stresses and shock loading occur constantly.
- The cap must also be weldable to the cylinder barrel, which is a steel tube drawn over a mandrel.

The prior design was fabricated from steel bar, using multiple operations including saw cutting, deburring, flame cutting, grinding, drilling and broaching. The result was a cap that was difficult and costly to manufacture. For example, it was difficult to maintain the necessary flatness on the surfaces through which the pin bore was drilled, then broached, because of the very tight tolerance for perpendicularity.

The OEM, working with a forger, redesigned the cap and optimized it for forging. Some of the highlights of the redesign were:

- Combining the trim operation with a hot piercing operation to produce a hole with no draft, which met requirements for perpendicularity with the reference surface and circularity.
- Reducing in-house operations from 13 to 2.
- Reducing scrap rates from approximately 25% to virtually zero.
- Achieving a cost reduction of 65.5%

The success of this program has led to conversion of other parts such as trunions, rod ends and brackets to forging at similar cost reductions.



Figure 6-6