

**106.1 0 Case Study No. 1 0  
Flashless Forged  
Connecting Rod**

Component name:	Flashless Forged Connecting Rod
Forging Process:	Hot Closed Impression Die
Size, mm (in.):	21 (8.25)
Weight, kg (lb):	2.9 (6.3)
Alloy:	Steel, E4340 per Mil Spec 5000, 1 1 00 series
Tensile strength, MPa (psi):	1240 (180,000)
Yield strength ' MPa (psi):	1095 (159,000)
Hardness, minimum, HRC:	40
Secondary Operations:	Cracking, finish machining
Heat treatment:	Anneal for finish machining or controlled cooling
Surface treatment:	None required
Alternate process:	Powder Metal Forging
Annual Production:	2,000,000

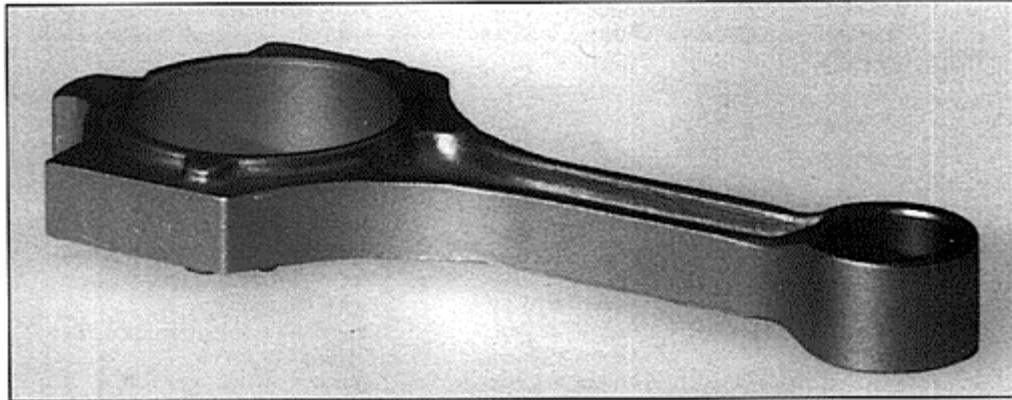
The closed die forged connecting rod shown in Figure 6-1 0 is the latest step in the evolution of manufacturing processes for connecting rods. Conventional impression die forging, which was the standard for high performance connecting rods, has given way to powder forging in many applications because it offers two distinct advantages:

- 1 . Closer dimensional precision, and overall cost reduction by reducing the number of machining operations, as evidenced by elimination of the balancing boss on the small end of the rod.
2. "Cracking" capability, allowing the cap to be separated from the rod by a precision breaking process, which does not remove metal and thus does not affect the dimensional precision of the large end of the rod.

The flashless forged closed impression die process produces rods equivalent to powder forged rods in terms of dimensional precision, elimination of trimming operations, and cracking capability. It offers two additional benefits.

1. Lower cost of materials and manufacturing operations. Forging bar stock is less costly than powdered metal, and the intermediate pressing and sintering operations associated with powder forging are eliminated.
2. Higher strength due to the development of optimum grain flow and inherent full density. The powder forging operation concentrates on increasing density, and induces very little advantageous grain flow.

Current designs duplicate the shape of powder forged rods so that the precision forged rods are interchangeable with them in finishing operations. The higher strength potentially allows for redesign to reduce rod weight, which will reduce inertial loads and permit secondary weight reductions in other engine components.



**Figure 6-10 Flashless forged connecting rod.**

