

Blanking developments

Part I: Fineblanking process and tool design

Editor's Note: This is Part I of a three-part series on blanking developments. Part II, which will appear in the August issue, will focus on part and process design guidelines. Part III, which will appear in the September issue, will cover high-speed blanking and finite element methods.

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Blanking is one of the most frequently used operations in sheet metal forming. Fineblanking, a recent development, produces sheet metal components with smooth edges in a single press stroke.

What Is Fineblanking?

A conventional blanking tool's main elements are a die, guide plate, and punch. The shearing process and a surface's shear quality are influenced by tool geometry and workpiece properties.

Die clearance, cutting-edge radius, and tool wear are the main tool parameters, while blank thickness, mechanical property, chemical composition, microstructure, and sheet material grain size influence material parameters. Die clearance determines the quality and shape of a blanked edge. As die clearance increases, the edges become rougher and the deformation zone becomes larger, which causes the material to pull in and bend.

In fineblanking, in addition to the same tool components needed for blanking, an ejector or counterpunch and a V-ring (4 and 2, respectively, in **Figure 1**) are used. The main purpose of these tool components is to generate compressive stresses and hold the material against horizontal movement. Three forces—V-ring force (F_R), coun-

terforce (F_G), and blanking force (F_S)—act on the blank. These forces are generated, as shown in **Figure 1**, by the V-ring (2), the ejector (4), the punch (3), and the die plate (1). F_R and F_G are applied by hydraulic cylinders.

In general, this operation is carried out on triple-action hydraulic presses on which the punch, guide plate, and die movements are controlled individually. Forces in fineblanking have great influence on a part's quality. During the beginning of the process, F_R and F_G are applied. These forces provide a firm clamp on the material before blanking begins. F_S acts when the press moves down and completes the blanking operation.

Figure 2 illustrates a complete fineblanking cycle. In (A) the tool is open and the blank is pushed into position. At (B) the main piston is activated, and cutting begins at (C). Once cutting ends (D), hydraulic pressures are released and the tool opens (E). At stages (F), (G), and (H), the strip moves forward. The part and scrap are removed from the tool. Suggested die clearance in fineblanking is 0.5 percent of the blank thickness. In fineblanking presses, the slide always works from the bottom upward. The slide stroke is divided into a rapid closing, touching, blanking, and rapid return travel.

Tool Design

In fineblanking technology, different die types are divided into *moving punch* and *fixed punch* systems. A moving punch system is used mainly for blanking dies that produce small to medium-sized parts with few inner forms. The fixed punch system is suitable for all die types, including thick and large parts. The fixed punch system also can be used for progressive blanking dies, compound progressive dies, and transfer

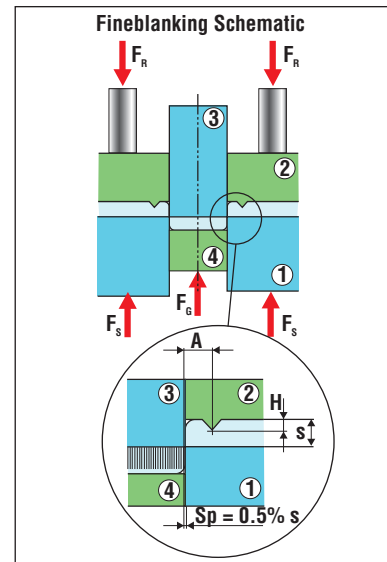


Figure 1

The main purpose of the ejector or counterpunch and V-ring is to generate compressive stresses and hold the material against horizontal movement.¹

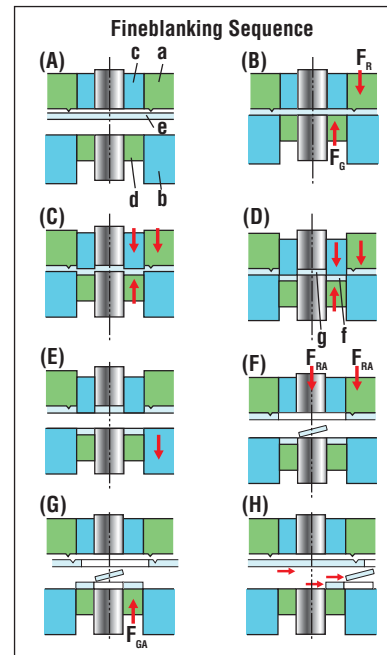


Figure 2

dies. **Figure 3** and **Figure 4** show a schematic view of these systems.²

Fineblanking die design is based on a part's shape, size, type, and the required sheet metal thickness. These parameters determine the type of die

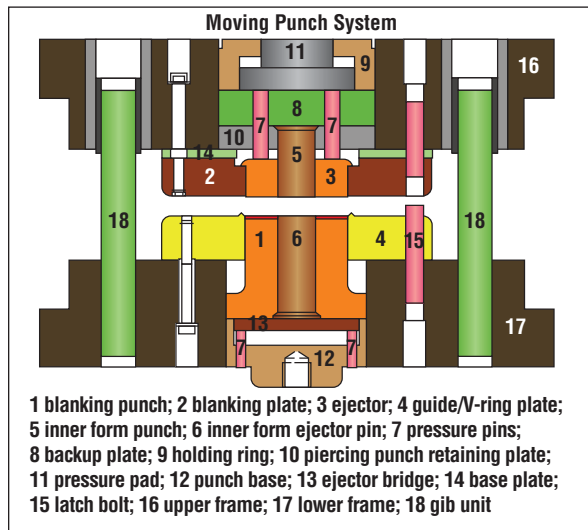


Figure 3

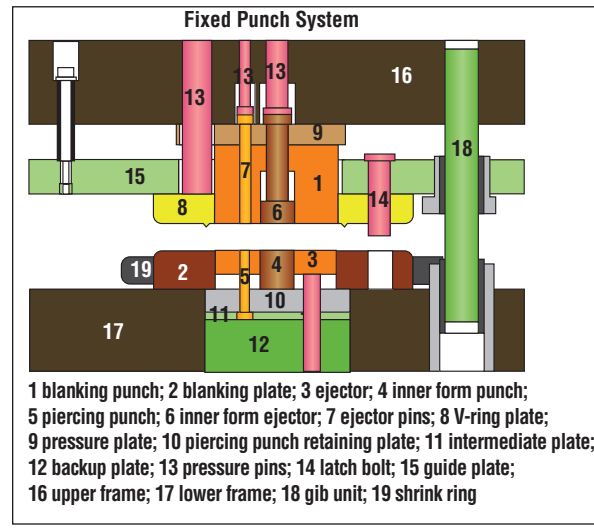



Figure 4

and the die system used.

Cut Surface, Die Roll

A fineblanked part's cut surface is sheared smoothly over the entire workpiece thickness (100 percent of s). However, tearing and fracture may occur. While tearing depends on a material's microstructure, fracture behavior is influenced by the magnitude of the blanking clearance.

The die roll depends on blank and material factors such as angle and radius of inward and outward pointing corners, material and microstructure, strength, and sheet metal thickness. In addition to the V-ring, edge preparation of the blanking plate and the punch influence the amount of die roll.

Burr-free fineblanking is not possible. The blanking burr is located opposite the die roll. As a result of tooling wear, burr height and width increase with the number of blanking operations. Burr can be removed by belt or flat grinding. 

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Notes

1. F. Birzer, *Forming and Blanking*, 2nd ed. (Feintool, 1999).
2. Springer-Verlag, *Metal Forming Handbook* (Schuler GmbH).