Fine Blanked Parts

Fine blanking process

Fine blanking process works on the principle of press techniques and employs special press, precision tool and dies. Through this process, parts are produced in almost completed form and ready for assembly operation. Apart from this, parts are produced with cleanly sheared surfaces over the entire material thickness. The sheared surface obtained by this process is of good quality and high dimensional accuracy.

To produce fine-blanked parts, a precise die with punch and die clearance of approximately 0.5 percent of material thickness is required along with a triple-action press to clamp the material during the shearing operation. The three actions in the press provide:

- Shearing pressure
- V-ring pressure
- Counter pressure

These must be held constant throughout the stroke to ensure good-quality parts. It is recommended that the press must provide fast approach stroke and a slow shearing speed of 4-15 mm/s. Press capacities ranging between 40 to 1400 tons are now available for usage. The press cycle is shown in the Figure M4.3.1.

It shows the sequence of operations taking place during one cycle of the fine-blanking press. Various steps involved in the process are

1. Feeding of the material into the die.
2. Lifting of lower table and die set, in turn raising the material to the die face.
3. Embedding the V ring in the material. Clamping the material between the V-ring (or "stinger") plate and the die plate outside the shear periphery. Clamping the material against the blanking-punch face inside the shear periphery through the counter punch (under pressure).
4. Continuing up stroking of the punch (when the V-ring pressure and the counter pressure are kept constant), shearing of the part into the die and the inner-form slug into the punch. At the top dead-center position, all pressures are shut off.
5. Opening of the die after the ram retracts.

6. Re-applying V-ring pressure immediately after the tool opening thereby striping the punch from the skeleton material and pushing the inner-form slugs up out of the punch. Feeding of the material is done again.
7. Re-imposing the counter pressure after ejection of the part from the die.
8. Removing of the part and slugs from the die area either by an air blast or by a removal arm.
9. This completes the cycle.

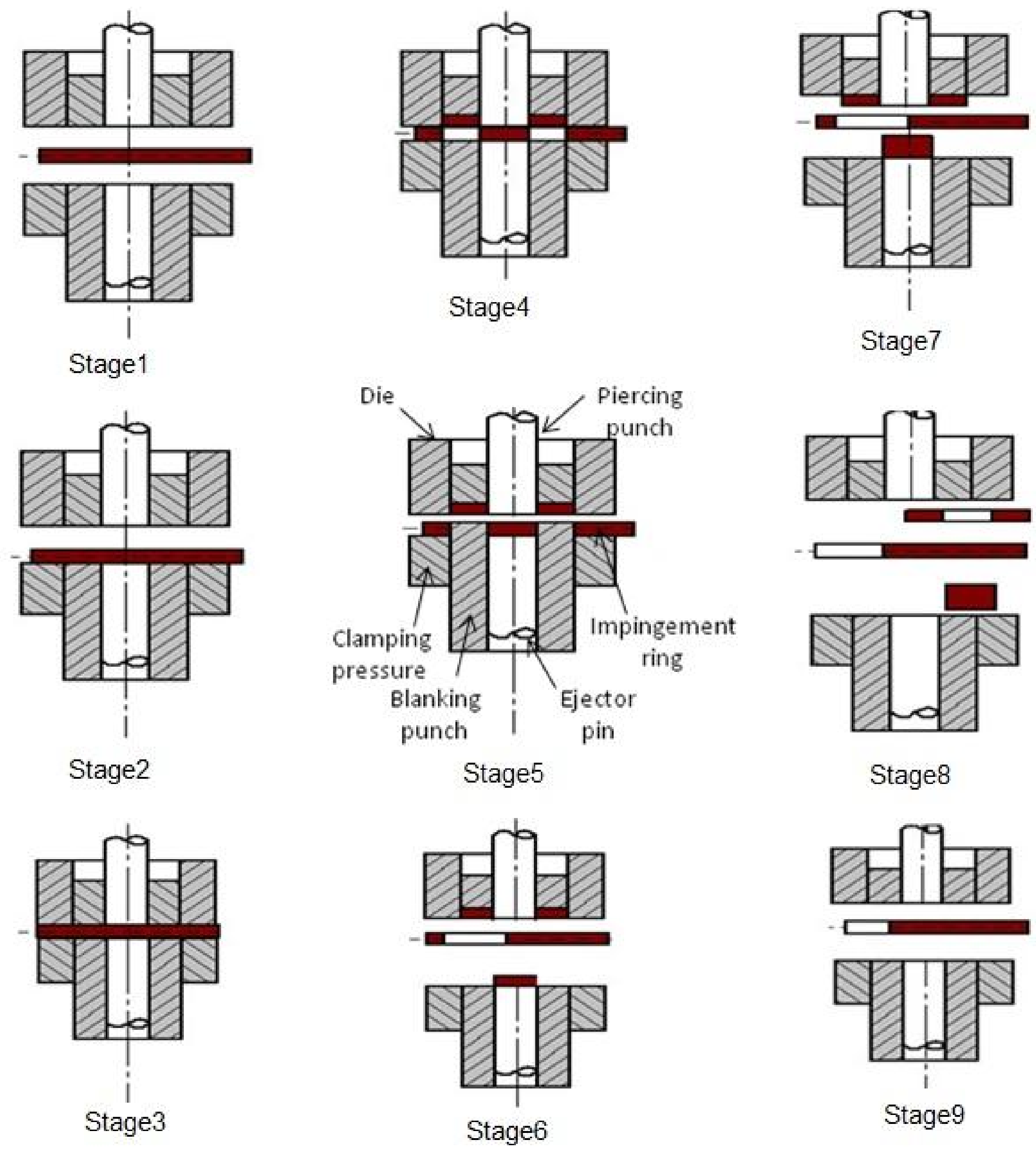

Figure M4.3.1: One cycle of fine blanking press

Tooling

If possible, it is generally attempted to produce a fine-blanked part with a compound die so that production will be complete in a single operation.

Typical characteristics and application

Fine blanking operation provides several advantages over other conventional stamping methods such as - products yield better surface finish, produces squared sheared edges, provides higher dimensional accuracy and better flatness or appearance.

Various applications include gears, gear segment, ratchets and racks etc. Average expected surface finish for parts produced through fine blanked process is 0.45μm. The ranges of the size of such products cover a broad range. For example, very small parts like parts of watch of 2.5 mm length and parts like machinery plates of 760 mm are also produced by this method. Most of the parts lies in the range of 25 by 25 mm to 250 by 250 mm. The thickness of such parts also covers a broad range varying between 0.13 mm to 13 mm.

Material suitable for fine blanked parts

Fine blank parts are generally made with materials in a relatively hard condition to obtain a good shear break characteristics. On contrary, fine blanking process requires materials that exhibit a good cold forming quality.

Fine blank parts available are approximately 90 % produced from steel. Apart from hardness and cold-forming characteristics, the steel has certain other material structure characteristics to become a suitable material for fine blanking. A good dispersion of small cementite spheres within a soft ferrite mass (spheroidize-annealed) helps the cutting elements to shear the part cleanly rather than induce a shear-break characteristic in the unevenly dispersed structure of a nonannealed material. Steel with a tensile strength of approximately 260 to 520 MPa and a carbon content of 0.08 to 0.35 % is considered to be the most suitable material for the above. In fact, nonferrous materials like brass, copper, and aluminium can also be used for fine-blanking. If brass is used for fine blanking, there should not be any lead content as it will cause tearing on the sheared surfaces of the parts.

Design recommendations for piece parts

Corner radii: Corners for fine blanked parts must be rounded. If the radius is too small, the edge near the corner will show tears in the material over the shear zones. The minimum radius is determined based on the three factors: corner angle, material thickness and type of material. These are the recommended values need to be applied.

Obtuse angles: radius 5 to 10 % of material thickness

Right angles: radius 10 to 15 % of material thickness

Acute angles: radius 25 to 30 % of material thickness

Recommended corner radius has been shown in Figure M4.3.2 for fine blanked part where T is the material thickness.

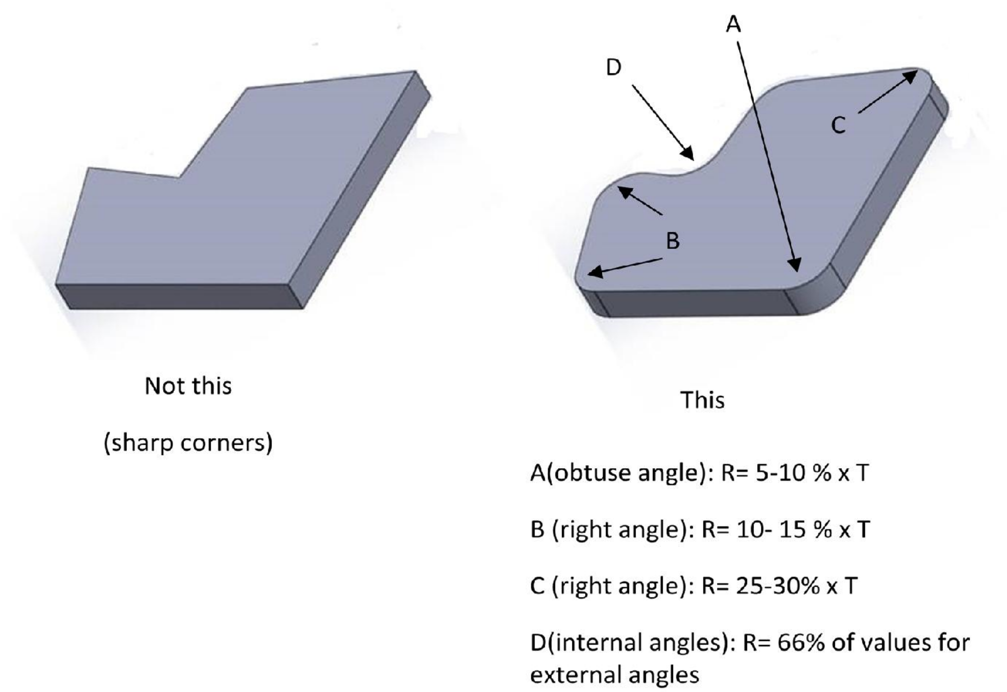

Figure M4.3.2: Recommended corner radii for fine-blanked parts.

Holes and slots: Hole diameter should be approximately 60 to 65% of the material thickness. When material thickness increases the specific shear pressure becomes higher in such areas. Further, the heat up rate of cutting element also increases. Recommended design rules for slots have been shown in Figure M4.3.3.

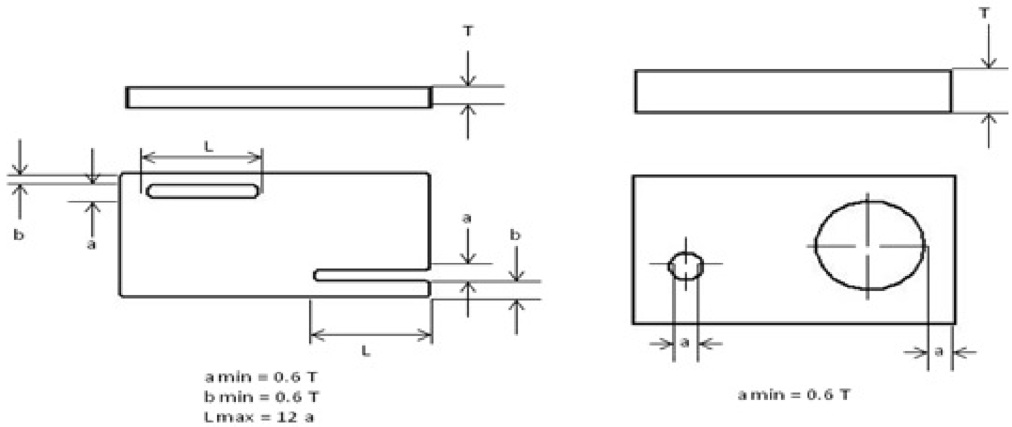

Figure M4.3.3: Design rules for slots in fine-blanked parts.

Tooth forms: The recommended pitch circle radius for tooth form is 60% of material thickness.

Lettering and marking: Lettering and marking can be incorporated with no extra cost. Marking should be laid off either on the die side of the piece part or through a punch insertion on the piece part burr side. Generally the former is preferred.

Semi piercing:

Maximum depth to which semi piercing (offsets) are recommended to be pierced is 70% of material thickness. This is illustrated in Figure M4.3.4.

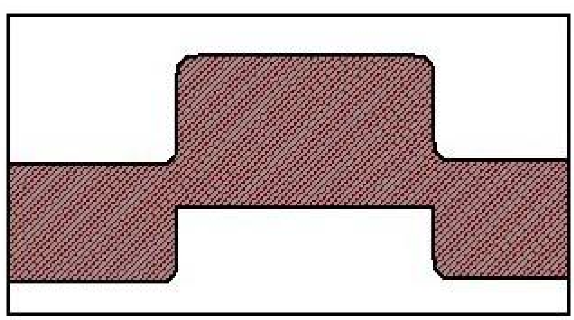

Figure M4.3.4: Semi-piercing.

Countersink and chamfers:

When the countersink lies on the die side of the part, it can be made together with the actual blanking of the part in one operation. Countersinks of 90° can be introduced to depths of one-third material thickness (up to approximately 3 mm) without disagreeable material deformation becoming noticeable. With the increase or decrease of the countersink, the volume of material to be compressed should not exceed the volume of one-third material thickness at 90°. If the countersink has to be laid on the burr side (punch side) of the piece part, it has to be created in a preceding station in the tool. Similarly, for the countersink to be located on both sides of the hole, these must be introduced in one or two preceding stations, based on the depth requirement. This is illustrated in Figure M4.3.5.

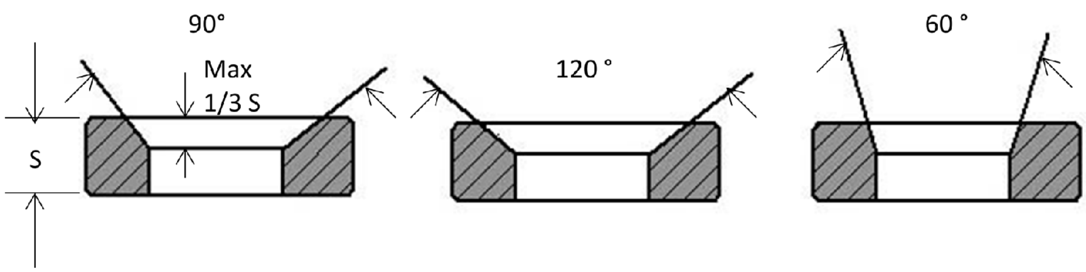

Figure M4.3.5: Countersink variations producible by fine-blanking

Dimensional factors and tolerances: The aspects which influence the piece-part quality depend upon the stock material and the accuracy of the press tool. The flatness obtained for piece-part in production varies widely with respect to part size, part configuration and quality, and thickness of material being worked. Table M4.3.1 indicates recommended tolerances for fine-blanked parts.

Table M4.3.1: Recommended Tolerances for Fine-blanked Parts (Source: Design for Manufacturability Handbook by James G Bralla, 2nd Ed)

Material thickness (mm)	**Tolerance of inner form and outer configuration and dimensions (mm)**	**Tolerance of hole spacing (mm)**
Material tensile strength to 410 MPa		
0.5–1.0	0.008/0.013	0.013
1.0–3.0	0.013	0.025
3.0–5.0	0.025	0.038
5.0–6.3	0.039	0.038
Material tensile strength over 410 MPa		
0.5–1.0	0.013/0.025	0.013
1.0–3.0	0.025	0.025
3.0–5.0	0.038	0.038
5.0–6.3	0.050	0.038