Scrap lifting during press operations is caused by factors such as product defects or damage to the dies, and can become a serious problem. It is said that scrap lifting is particularly likely when punching small holes in thin sheetor during side cuts when there is little restraining force with the die.

Causes of scrap lifting

The causes of scrap lifting are thought to include adhesion due to vacuum, adhesion to the punch tip, adhesion due to oil, magnetic force of the punch, and lifting-up by the die compressed air.
Also, with ordinary clearances, because the sizes of punching scrap are smaller than the diameter of the die holes, scrap lifting occurs easily.

General countermeasures to scrap lifting

The primary means of preventing scrap lifting is to ensure that
Force of adhesion onto the punch < (Die friction force + Punch scrap weight). For this purpose, a variety of steps have been taken, including the following.

1) **Punch countermeasures**···· Machining of the tip end (shear angle, projections), air blows, use of a jector punch, etc.
2) **Die countermeasures**······· Sucking scrap out with a vacuum, increasing the surface roughness of the blade inner surface, fine chamfering of the blade, etc.
3) **Other countermeasures** ···· Profile shape changes, reducing clearances, increasing the punch and die penetration depth, etc.

Generally, the use of suction generated by a vacuum is the method most often used. However this method requires that structural considerations be incorporated beginning from the time of die design, and involves troublesome adjustments for factors such as variation in installation work or suction force. The use of a jector punch requires processing of the jector pin when regrinding of the punch occurs, and changing the surface roughness of the blade inside surface also involves troublesome reprocessing after regrinding is completed. MISUMI scrap retention dies resolve these problems through the use of special machined grooves.

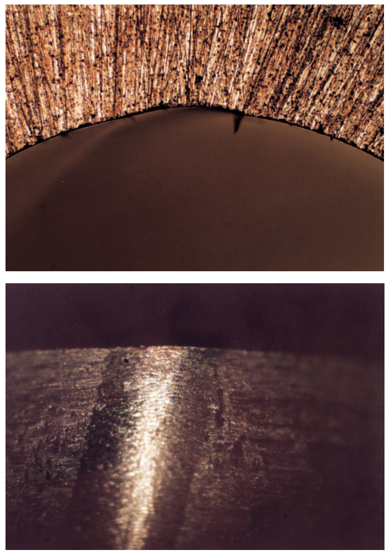

Fig. 1 Groove shape of dies with countermeasures for scrap retention

Principles and characteristics of scrap retention dies

1) **Principle of dies with scrap retention**
Two or more slanted grooves are machined in the inside surface of the die in opposite directions as viewed from the center. The scrap initially punched out during the punching process forms small projections along the slanted grooves in the die. When these are pushed still farther down to the bottom by the downward stroke of the punch, these projections become compressed by the sides of the die (“ironing” effect), increasing the friction force and preventing scrap lifting from occurring. Because the slanted grooves are machined in opposite directions rather than in a spiral pattern, there is no risk of scrap lifting caused by rotation during the punch upward stroke.

2) **Hole shapes and die types**
The use of scrap retention dies is possible and effective not only with round and shaped die holes (where scrap lifting is more likely to occur), but also with notched shapes (side cuts) where there is little binding force with the die.

3) **Easy handling and lower total costs**
Because the scrap retention effects can be achieved simply by incorporating scrap retention countermeasures into an existing die, these dies can be used with existing dies, eliminating any need for troublesome steps at regrinding or reprocessing after regrinding. Although the cost is somewhat higher than conventional dies, the cost difference is approximately the same as the difference between an ordinary punch and a jector punch. When the benefits of these dies and maintenance costs are considered, the added value of these dies is extremely high.

Effects of the cut cross-section shape

Scrap retention dies are effective because of the slanted grooves (approx. 0.005 mm~0.1 mm) that are machined on the inner surface of the dies. As a result, clearance increases at the specific parts of the workpiece which correspond to locations where these special grooves are machined. This causes slight changes in the cut cross section, as shown in Figure 2. What this means is that relative to the parts where the grooves were not machined, the shear droop (R), fracture surface length (H), fracture surface dimensional difference (C), and burr height (B) are larger, and the shear surface (S) is smaller.
As a result, please use caution in cases when many shear surfaces are required, such as during shaping work, and when fracture surface dimensional difference are a problem.

Shear droop	R1 < R2
Shear surface length	S1 > S2
Fracture surface length	H1 < H2
Fracture surface dimensional difference	C1 < C2
Burr height	B1 < B2

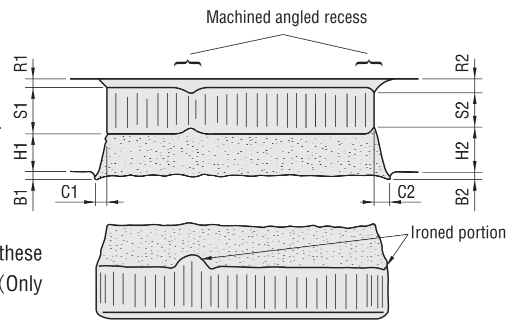

Fig. 2 Shear plane shape due to die with countermeasures for scrap retention

Applicable range

1. **Hole diameter: ϕ0.8 mm~ϕ48 mm**
Smaller holes are believed to involve greater risk of scrap retention, however these dies can be used beginning from a minimum hole diameter of ϕ0.8 mm. (Only the precision grade can be used with diameters smaller than ϕ1.0 mm.)
2. **Workpiece material: Can be used up to tensile strength of 1177 N/mm^2 (120kgf/mm^2).**
Scrap lifting is believed more likely to occur with materials that are harder and less ductile. The scrap retention dies can be used with tensile strengths up to 1177 N/mm^2 (120 kgf/mm^2), which covers nearly all of the broad range of workpiece materials.
With workpiece materials that have a tensile strength exceeding 1177 N/mm^2 (120 kgf/mm^2), the intended effects of the dies may not be achieved.
3. **Workpiece material thickness: Can be used with materials of minimum thickness 0.1 mm**
Due to factors such as oil— and vacuum—adhesion, scrap lifting is more likely to occur with thinner sheet thicknesses, resulting in trouble. Scrap retention dies can be used with sheets with thickness 0.1 mm or larger. (For materials with thickness of less than 0.15 mm, only precision grade dies can be used.)
4. **Die material: Die materials can be selected from D2 (and equivalents), M2, powdered high-speed steel (HAP40), carbide V40 and super-fine carbide.**

Precautions

1. The special grooves are machined so as to deliver the best results and minimize the effects on the products, however there may be variation in the scrap retention effects due to a variety of conditions.
2. Punch and die penetration: Approximately 1 mm
In order to achieve the full benefits of the scrap retention die functions (increasing the force of friction with the die by the “ironing” effects), approximately 1 mm of penetration is required. Therefore, please consider this requirement during die design and at the time of regrinding.
3. Amount of regrinding: Approximately 1 mm (or to BC—1 mm when BC is used)
In order to achieve the full effects of the scrap retention die, regrinding to approximately 1 mm should be performed before use. (In order to achieve the scrap retention effects, the straight portion of the blade edge must be a minimum of 1 mm.)

Ordering

In order to machine the slanted grooves which will provide the greatest scrap retention effect, and to minimize the effect on the product, in addition to the ordinary die dimensions, we also require the values for workpiece material thickness and clearance (one side).

- Workpiece material thickness: MT : minimum 0.15mm (Indicate in units of 0.01mm.)
- Clearance C : minimum 0.01mm (Indicate in units of 0.005 mm.)

Precision grade material thickness MT : minimum 0.10mm (Indicate in units of 0.01 mm.)
Precision grade clearance C : minimum 0.005mm (Indicate in units of 0.001mm.)

Order

Catalog No.	—	L	—	P	—	W	—	R (Ⓡ (only)	—	MT	—	C
SR—MHD13	—	30	—	P7.00					—	MT1.50	—	C0.105