Technical Information

System
Trumpf

PASS STANZTECHNIK AG

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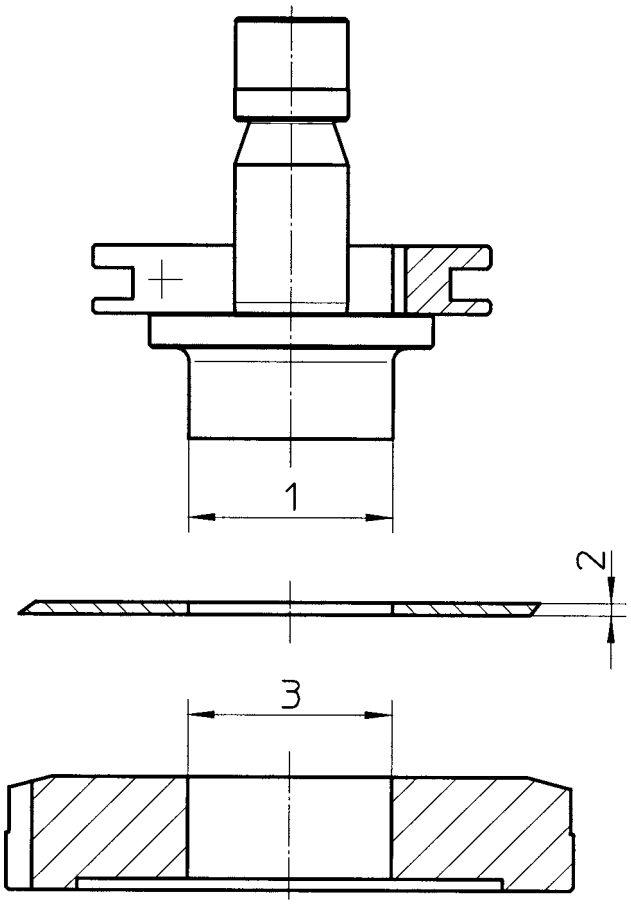
Determining Die Clearance

Die clearance D_{Ma}

$D_{punch} + F \times S_{sheet\ thickness} = D_{Die}$

1 = D_{punch}
2 = $S_{sheet\ thickness}$
3 = D_{Die}



F = multiplier for sheet type

Spring steel:	F = 0,30 mm (.012")
Stainless steel:	F = 0,25 mm (.010")
Cold rolled steel:	F = 0,20 mm (.008")
Aluminium:	F = 0,15 mm (.006")

All units of measure must be the same type (all inches or all metric)

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PASS-Punches with shear

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1. PASS-punches with shear are used for punching up to 10 mm (.394") sheet thickness.

2. PASS-punches with shear have a 5 degree shear for shape sizes 10.51 mm (.414") - 35 mm (1.378"). For 35 mm (1.378") and bigger they have a constant shear height of 3 mm (.118"). This means the shear angle is depended on the shape diameter.

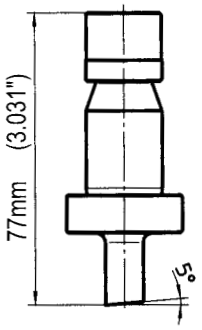
3. PASS-punches have a single shear up to a shape diameter of 72 mm (2.835"). > 72 mm (size II) have a double shear. Simple regrinding is possible.

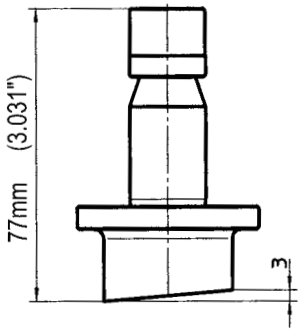
4. PASS-punches for the machine groups A-H have a length of 74 mm (2.913"), for machine group I it is 77,5 mm (3.051"). PASS-punches with a shear are generally 77 mm long (3.031").

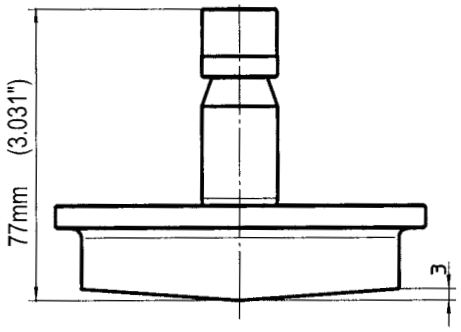
5. Punching noise can be reduced 3-4 dB for sheets up to 3 mm (.118") by using PU-strippers. For punches up to Ø 48 mm (1.890").

6. Maximum punching diameters can be calculated using the machine instructions or the shear formula.

7. Possible shear versions for PASS punches can be found on the next page.







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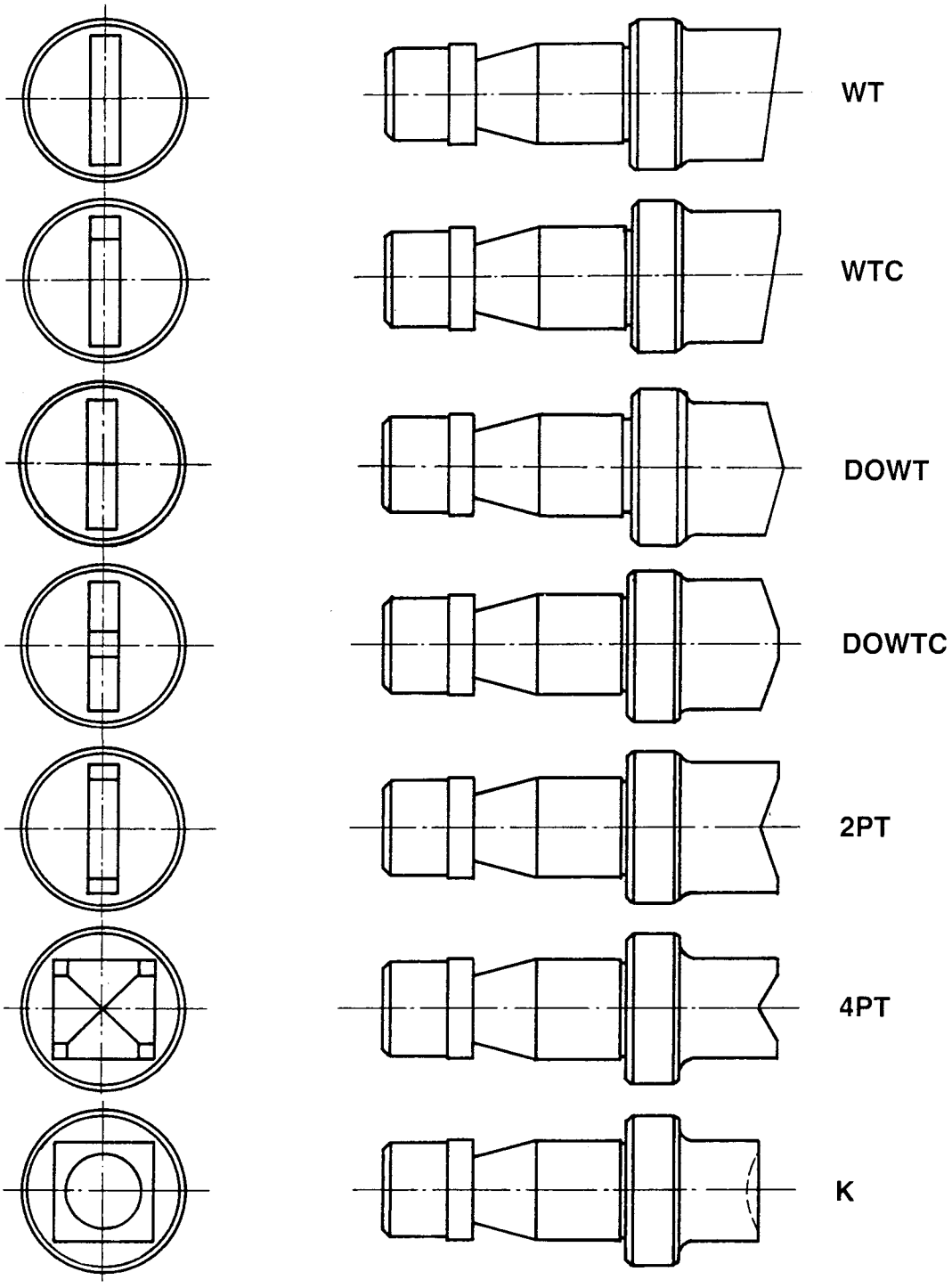
PASS-punches with shear

Shear variations for PASS-punches



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Suggestions to increase tool life

Using reinforced tools
If smaller punches (size I) and dies (size II) are breaking, when high punching power is encountered (typically when working with thick or high tensile steels), reinforced tools are recommended.

Improving tool steel or hardness
Best results are generally attained with good HSS tool steel. However, if tools break or break at the cutting edges due to high punching powers (typically when working with thick or high tensile steels), tool life can be increased by surface treating or coating the tools.

Tools with chamfered profiled edges
If edges are breaking, a chamfered profile edge is recommended.

Using coated tools
If cutting edges are galling too fast when working with abrasive materials or tools break due to high punch pull-out forces, then a TIN or TICN coating is recommended.

Hardness of TIN coating is 2,400 HV and 3,000 HV for TICN. Coated tools attain a very high tool life. However they are very sensitive to contamination on the sheet such as dirt, scale, etc. (on surface or as inclusions). Once the coating is destroyed, the tools are no longer usable.

Grinding of coated tools is possible.
You can find PASS TIN and TICN coating options on page 55 of our catalog.

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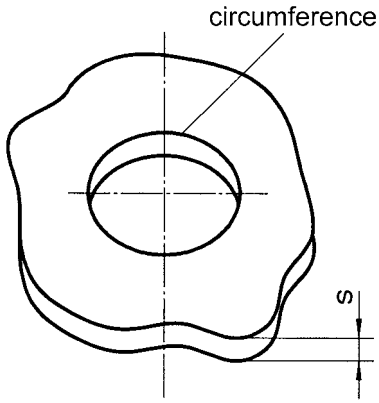
Calculation of punching force

Please find below the formula to calculate punching forces:



$$F \text{ (in kN)} = \frac{U \times s \times Rm \times 0{,}9 \times f}{1000}$$

F = punch force in Kilonewton
(10 kN = 1 metric ton)

U = circumference or perimeter of the punch shape (in mm)

s = Sheet thickness (in mm)

Rm = tensile strength (in N/mm² or pascal)
for Stainless Steel (1.4301) 720 N/mm²
for Mild Steel (St 37) 420 N/mm²
for Aluminium (AlMg3) 220 N/mm²

f = factor between 0,5 - 0,95 when using punches with shear.

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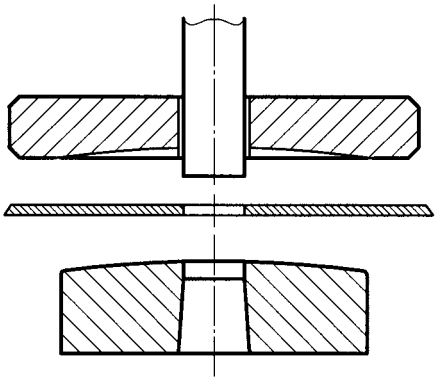
Tooling that relieves sheet stress and warping

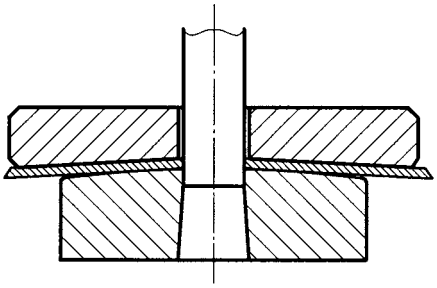
The problem is well known. You would like to produce a sheet with a large amount of holes. Sheet distortion results due to the small hole spacing. There is no patent solution for it. BUT: there are some countermeasures!

Fundamentally you should keep in mind that:

- you make the right choice for clearance
- you should use only sharp / ground tools
- use an active stripper or fully guided cluster punch

Should all of these points not be enough, there is the option to use tools that relieve sheet stress and warping.





Tooling with sheet stress relief feature

This is a solid tool.

The stripper is produced concave, the die is convex.

(Attention: use only active stripper)

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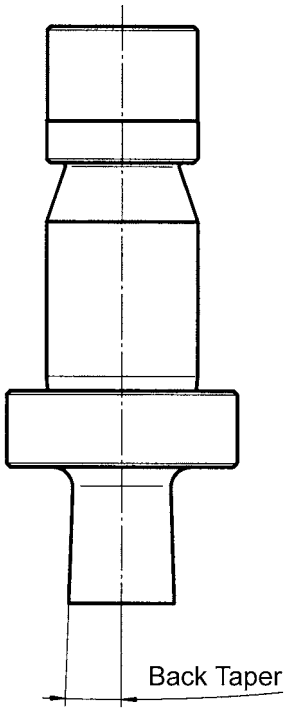
Back Taper on Punches

PASS punches are normally produced with back taper to reduce galling and premature punch wear.



However it should be mentioned that back taper is very important when punching materials such as Stainless Steel or very thick material to reduce galling and eliminate breakage of the tool corners and edges.

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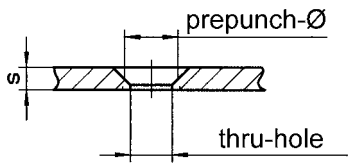
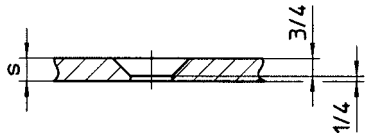
Max. Depth of Countersinks

Countersinks in the sheet are possible (e.g. for countersunk screws). Please note the following information:

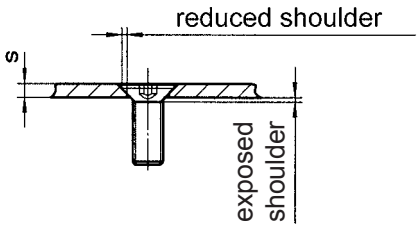


1.) In order to make deformations (material deformations) it is necessary to pre-punch the clearance hole. This pre-punch is normally bigger than the finished clearance hole.

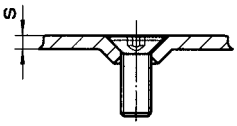


2.) The max. depth of a 90° sunk is 3/4 of the sheet thickness as the entire material thickness cannot be punched.

3.) If the screw head height is higher than the sheet thickness there are two possibilities to create the countersink.



a.) A bigger screw thread clearance hole than required. Keep in mind that the surface area for the head support is reduced and the strength calculation must be adjusted accordingly.



b) The sheet can be embossed to create the countersink. Be aware that a raised emboss may create problems with further sheet handling.

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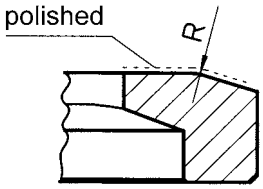
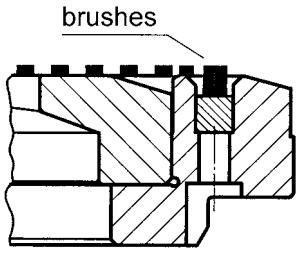
Minimizing sheet scratches in production; „brush / polish“

There is often a problem with the die causing scratches on the sheet. Of course you can order steel with protective films, however there are other options with the tooling.



1.) Polishing the die
The entire horizontal surface is polished. Furthermore, a large radius is blended onto the edge of the die and this is also polished.



2.) Adapter rings (for dies) with brush inserts
The adapter ring is fitted a „brush ring“ with several brush inserts in order to lift the sheet above the cutting surface of the die.

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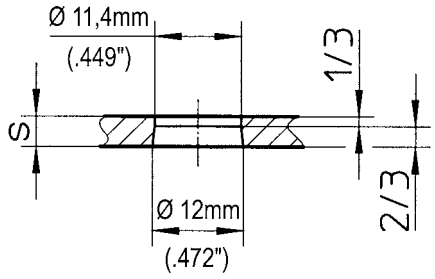
Punching Press-Fit Holes

Exact size or press fit holes can be punched relatively simple.

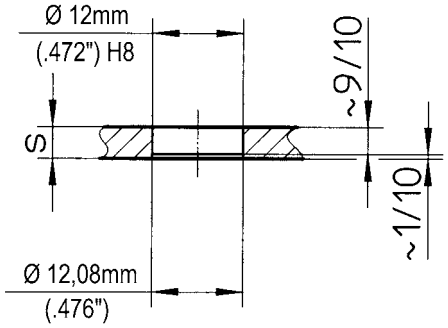
Example:
2 tools are required:

Example 1



1.) Tool (first hit)
Punch Ø 11,4 mm (.449").
[0,6 mm (.024") smaller than hole dimension]
Die Ø 12 mm (.472"). (Exact hole dimension)
Stripper Ø 13 mm (.512").

Example 2



2.) Tool (second stroke)
Punch Ø 12,027 mm (.474"). (TiCN-coated)
Die Ø 12,08 mm (.476"). [ca. 0,05 mm (.002") play]
Stripper Ø 13 mm (.512").

With this procedure almost any press fit dimension is possible. Please keep in mind that the punch has to be coated for the second hit, or the wear would be too excessive.

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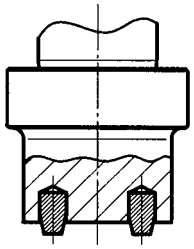
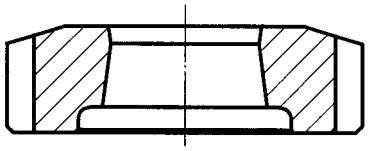
Problems with pulling slugs

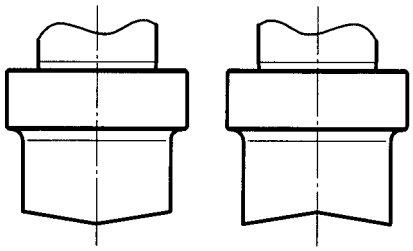
There are special, technical possibilities to avoid pulling slugs, e.g. on machines without vacuum or punching with the vacuum offline.



1.) Punch with rubber ejector pin



2.) Dies in slug-trap version (negative cutting-edge, to trap the slug).



3.) rooftop shear or inverted rooftop shear

The problem can eventually be cleared when the punch goes past the grind life approx. 1 - 2 mm deeper into the die.

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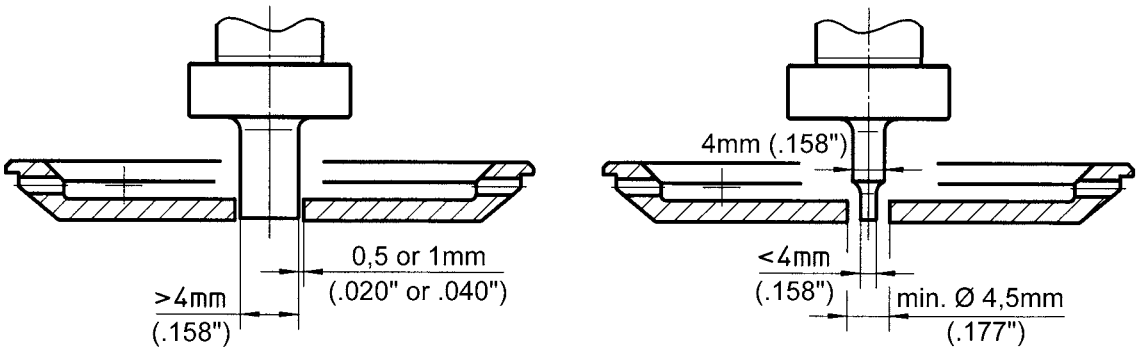
Types of PASS punch designs

PASS-punches are produced with a reinforced shoulder in the standard version when the cutting section is smaller than 4 mm (.158").

This reinforced shoulder has a minimum width of 4 mm (.158") and is meant to strengthen the cutting section (to prevent breakage).

Please note that the minimum stripper measurement has to be min. 4,5 mm (.177") to avoid a collision.



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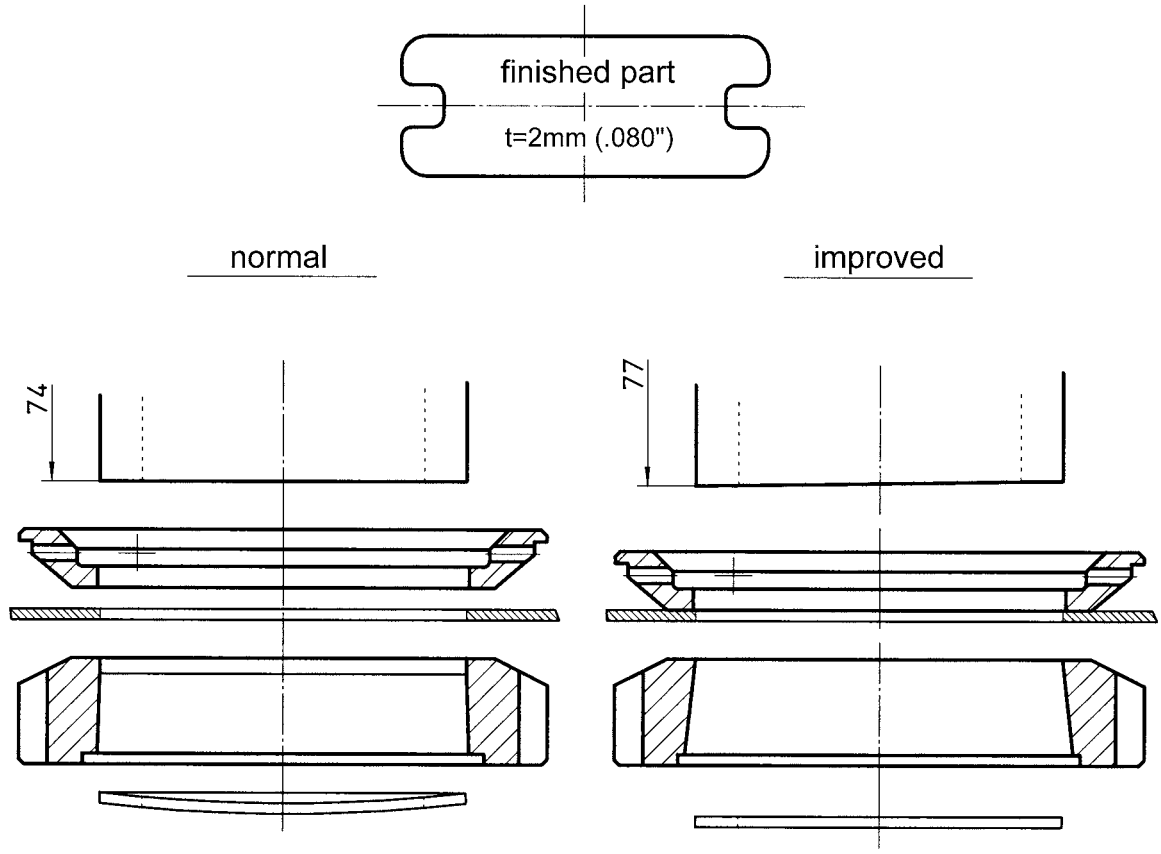
Improving part flatness

There are some measures to be taken, when parts have to be produced through the dies to improve the part flatness (Blanking out parts).



Flat	⟸	punch	⟹	whisper cut 1/2 of s
Normal	⟸	stripper	⟹	active
Cylindric Cut	⟸	die	⟹	big free angle
Normal	⟸	clearance	⟹	significantly decreased (depends on the material)