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**Basic  
Design Guide  
for**

**GRIP** *flow*®

This book is a guide to designing parts for manufacturing with the GRIPflow process. We suggest that you have our firm review your requirements and share our manufacturing expertise as it relates to your specific needs.

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# WHAT IS GRIPFLOW?

GRIPflow is a patented metal stamping process that produces highly accurate parts with smooth square edges.

The process requires a single action GRIPflow press and precision-built dies with tight tolerances between punch and die.

In the stamping operation, before the material is actually blanked, it is firmly clamped in the area of the stamping. The scrap material is allowed to flow laterally. Hence, the name "GRIPflow".

#### **GRIPflow can:**

- Eliminate secondary machine operations.
- Pierce holes smaller in diameter than the stock thickness.
- Coin countersinks the entire thickness of the stock material.
- Stamp gear teeth.
- Hold close tolerances.
- Make the smooth-edge only where it is required.
- Improve your part's flatness.

**The following is required to manufacture GRIPflow Parts**

- GRIPflow Press
- GRIPflow Tool
- Malleable Material

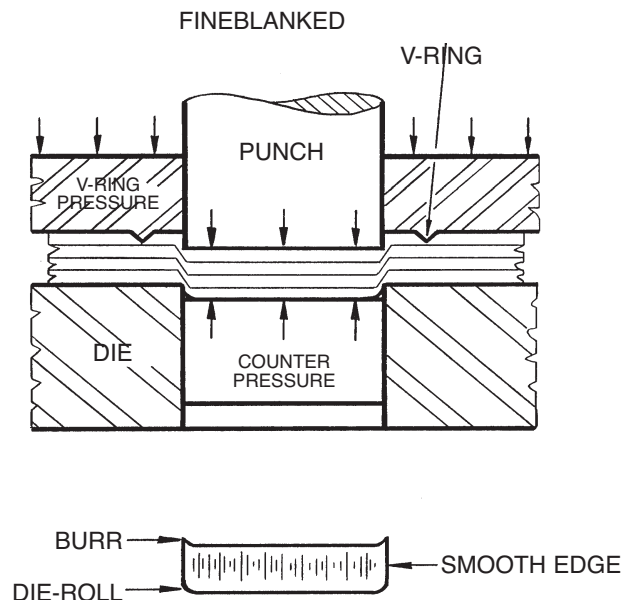
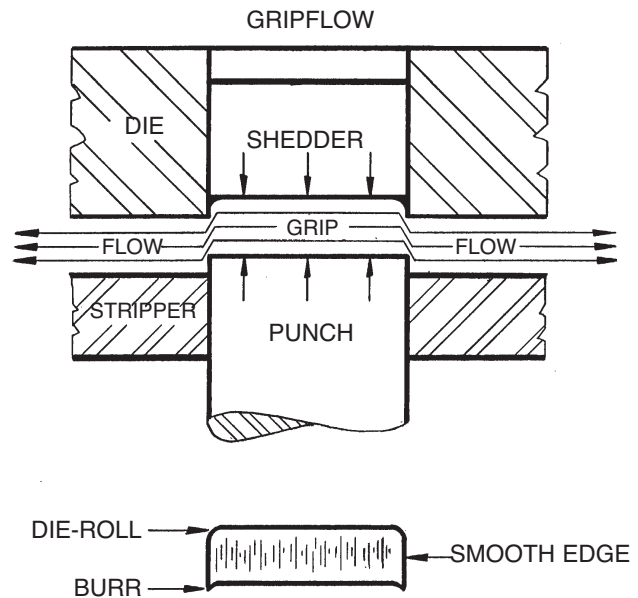
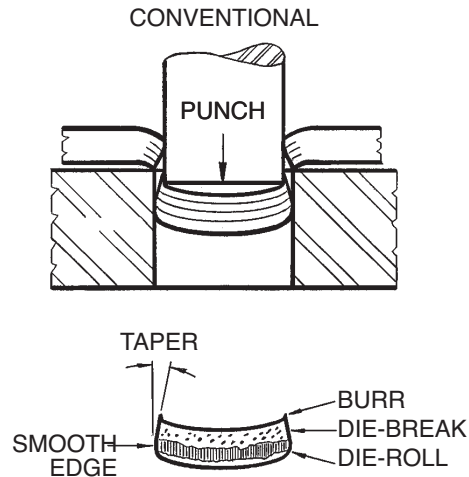
# HOW IS GRIPFLOW DIFFERENT?

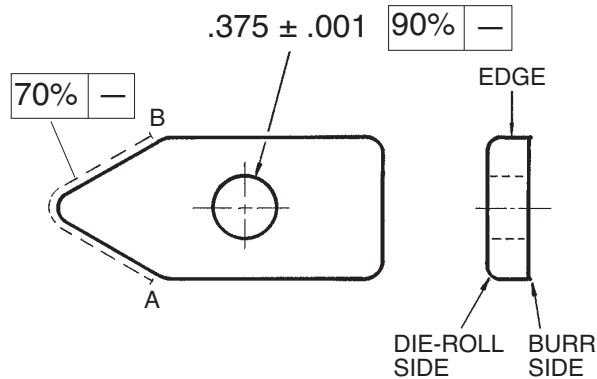
Conventional stamping bends the actual blank at the start of the blanking operation. Due to this bending, there is no smooth, fully continuous edge. Approximately 30% of the thickness is sheared while the remaining 70% tears. Rough edges and poor tolerances are the evident results. Typical edge-surface finish is 125-150 RMS.

GRIPflow combines cutting and metal flow to produce smooth (no tear), vertical, accurate sides through-out the entire part thickness. GRIPflow routinely holds accuracies of .001" and certain dimensions are held to .0005". Almost no difference can be measured between the first and the millionth part out of the tool. This is achieved on a single action punch press. Typical surface finish is 16-32 RMS.

Fineblanking requires a special triple-action press and a "V" ring in the die to restrict the material from moving away from the shear zone during the blanking operation (opposite of GRIPflow). This V-Ring requires extra stock material and press tonnage (maximum of 40% of total blanking tonnage).

Accuracies in most cases are similar to, or equal to, those of GRIPflow.





The less smooth-edge on a part, the smaller the burr and the lower the price because of:

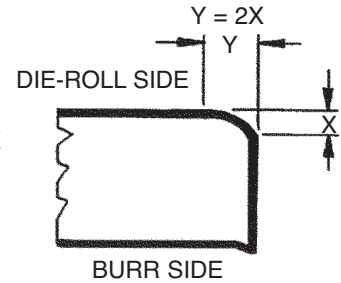
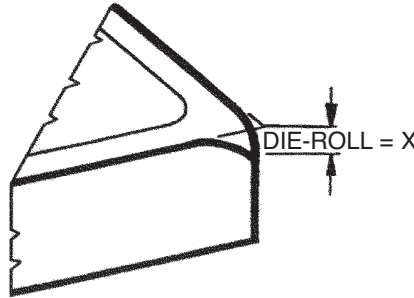
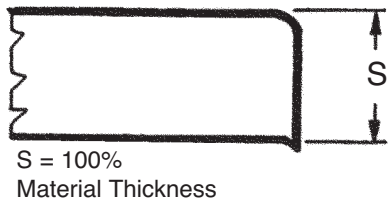
- less deburring
- less tool maintenance
- a faster production rate

Why pay for a total smooth-edge stamping when only specific portions of the stamping require a smooth-edge?

GRIPflow can give you the smooth-edge only where it is required.

### BASIC GUIDELINES

- 1.) Draw the part as it will look. The stamped part will have die-roll on one side and a burr on the opposite side (this burr is removed by vibratory deburring). Identify the die-roll or the burr side on your part.
- 2.) Identify the area(s) on the part that require a smooth edge with a broken line.
- 3.) Specify the amount of smooth-edge required (i.e. 50%, 75%, 90%, etc.).



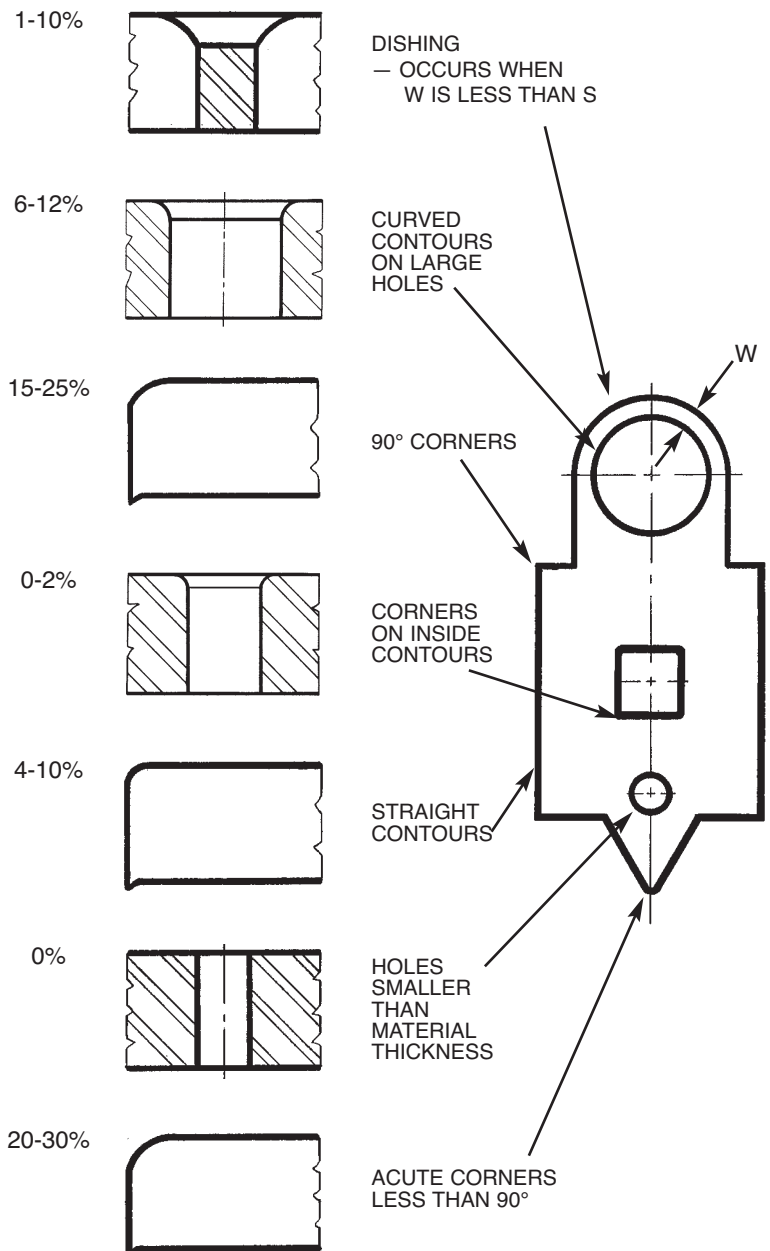
Die-Roll is produced on all stamped parts. The degree of die-roll is influenced by:

- 1.) Material
- 2.) Material Thickness
- 3.) Part Shape

- The harder the material  
— The less the die-roll
- The more acute the corner  
— The greater the die-roll
- The smaller the corner radius  
— The greater the die-roll
- The thicker the material  
— The greater the die-roll

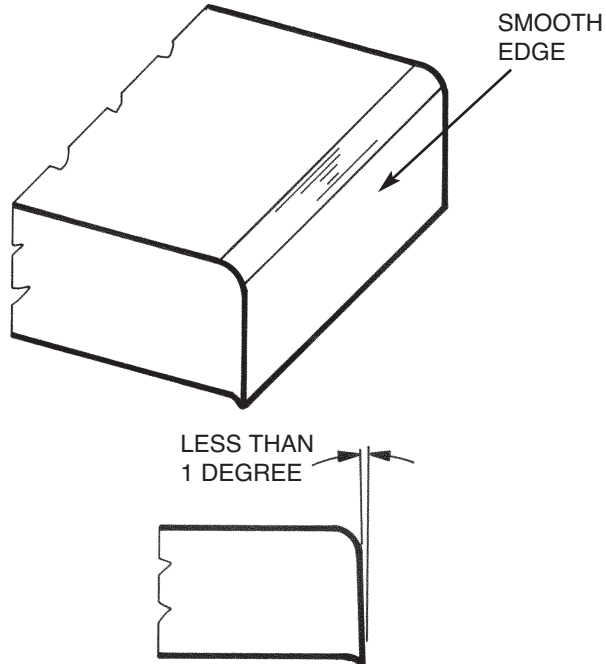
## GRIPflow DIE-ROLL IN PERCENT OF THE MATERIAL THICKNESS

(BASED ON MATERIAL OF 57,000 P.S.I. TENSILE STRENGTH)

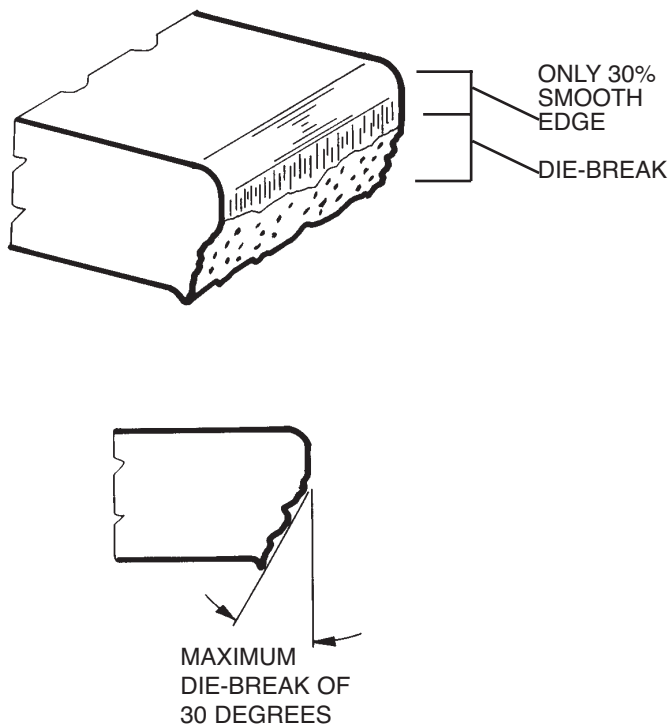


# EDGE TAPER

## GRIPflow EDGE



## CONVENTIONAL EDGE



The GRIPflow Edge Taper is influenced by:

### 1.) Material

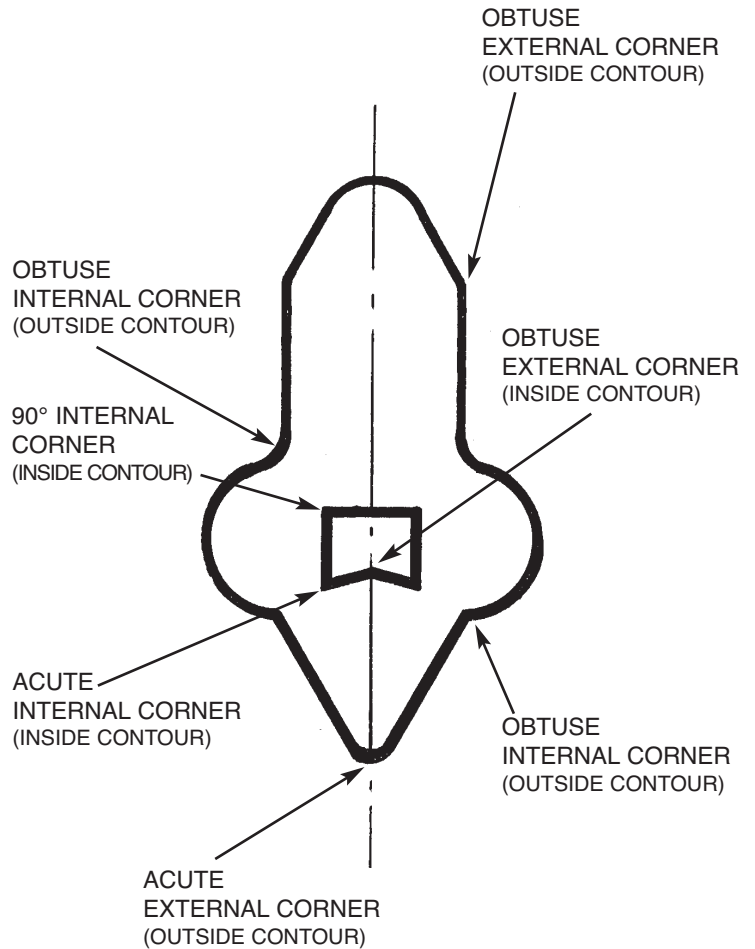
- The thicker the material
  - The greater the edge taper
- The higher the carbon
  - The greater the edge taper
- The greater the alloy content
  - The greater the edge taper

### 2.) Shape of Part

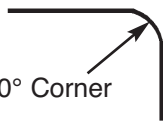
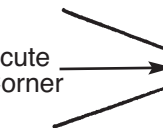
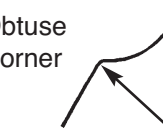
- Outside contours have a larger degree of edge taper than internal contours

The extrusion type characteristics of GRIPflow require sharp corners to have a blending radius. This radius allows for a smooth, uninterrupted flow of the metal during blanking. Sharp corners should be avoided wherever possible. If a sharp corner is absolutely necessary, it may be accomplished by utilizing a progressive tool.

- The larger the radius  
--The less corner tear
- The larger the radius  
--The less die wear
- The larger the radius  
--The less die-roll
- The harder the material  
--The larger the radius

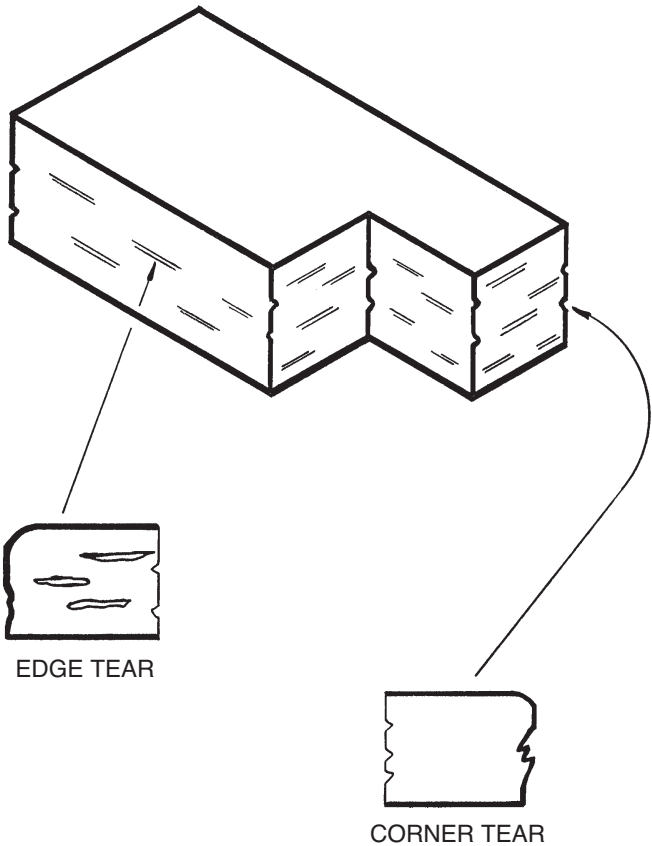


## DESIGN GUIDELINES

TYPE OF CORNER	INSIDE CONTOUR	OUTSIDE CONTOUR	% OF MATERIAL THICKNESS
 90° Corner	YES		7 - 12%
		YES	10 - 15%
 Acute Corner	YES		11 - 15%
		YES	15 - 20%
 Obtuse Corner	YES		4 - 7%
		YES	5 - 10%



# TEARS



## Edge Tears Result From:

### Material

- being too hard
- having a poor grain structure

### Tooling

- having a worn or chipped punch

## Corner Tears Occur Only On External Corners. Causes May Be:

### Design

- corner radii too small

### Material

- being too hard
- having a poor grain structure

### Tooling

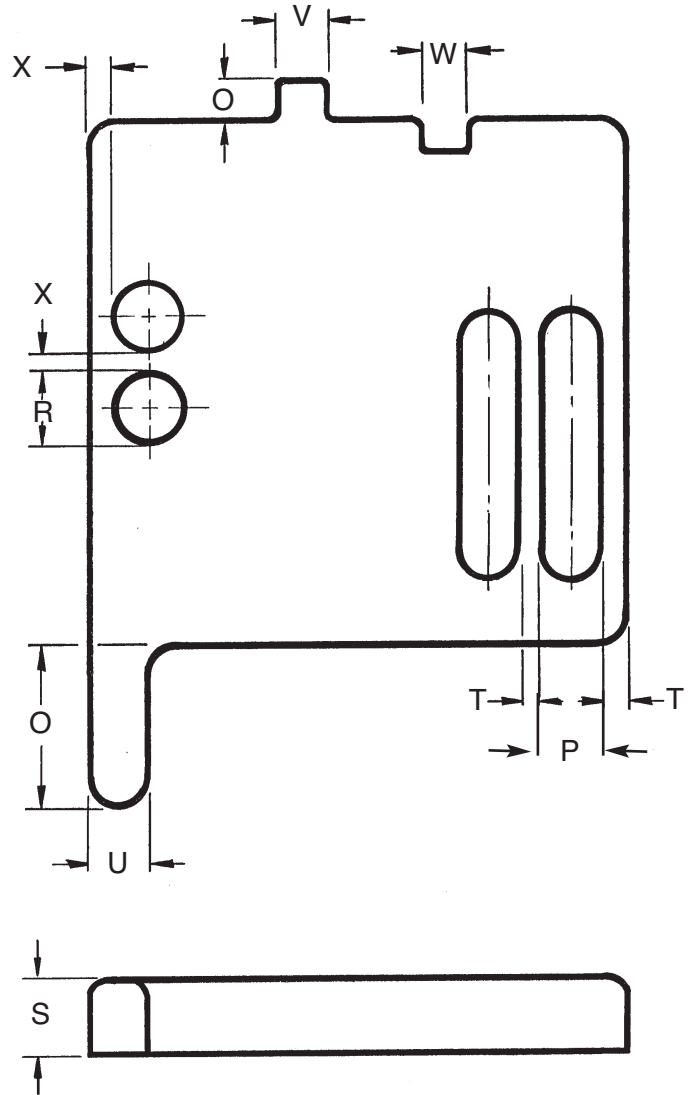
- worn or chipped punch

# CLOSE WEB SECTIONS, SMALL HOLE DIAMETERS AND SLOTS

- O - Protrusion Length
- P - Slot Width
- R - Hole Diameter
- S - Material Thickness
- T - Web (Slots)
- U - Protrusion Width (If  $O \geq S$ )
- V - Protrusion Width (If  $O < S$ )
- W - Notch Width
- X - Web (Holes)

Design Guidelines based on 57,000 p.s.i. Tensile Strength (i.e. AISI 1010 hot rolled steel)

- Minimum Protrusion Width
  - If  $O < S$  then  $V = 1/2 S$
  - If  $O \geq S$  then  $U = 2/3 S$
- Minimum Hole Diameter
  - $R = 1/2 S$
- Minimum Hole Web
  - $X = 1/2 S$
- Minimum Slot Width
  - $P = 1/2 S$
- Minimum Slot Web
  - $T = 1/2 S$
- Minimum Notch Width
  - $W = 1/2 S$



- Minimum web sections, hole diameters and slot widths are limited to the forces that the punch can tolerate.
- The danger of a punch fracturing is higher in the areas where contours abruptly change direction.
- The harder and thicker the material, the larger the tolerance.

# HOLE TOLERANCES

## TOLERANCES

BASED ON 57,000 PSI TENSILE  
STRENGTH MATERIAL (i.e. AISI 1010)

### MATERIAL THICKNESS

Hole Diameter	Up to .157	.157 - .236	.236 & Up
.118 - .236	+0.001 - 0	+0.0015 - 0	+0.002 - 0
.237 - .393	+0.001 - 0	+0.0015 - 0	+0.002 - 0
.394 - .708	+0.001 - 0	+0.0015 - 0	+0.002 - 0
.709 - 1.181	+0.001 - 0	+0.0015 - 0	+0.002 - 0
1.182 - 1.968	+0.001 - 0	+0.0015 - 0	+0.0024 - 0
1.969 - 3.149	+0.0012 - 0	+0.0018 - 0	+0.0029 - 0
3.150 - 4.724	+0.0014 - 0	+0.0021 - 0	+0.0034 - 0
4.725 - 7.086	+0.0016 - 0	+0.0025 - 0	+0.004 - 0

Dimensional accuracy of a GRIPflow part is primarily dependent on the quality of the tool.

Tolerance range is influenced by:

- Material Thickness
- Tensile Strength of Material
- Grain Structure of Material
- Configuration of Part

Closer tolerances can be held, if required by designing a more involved and complex tool.

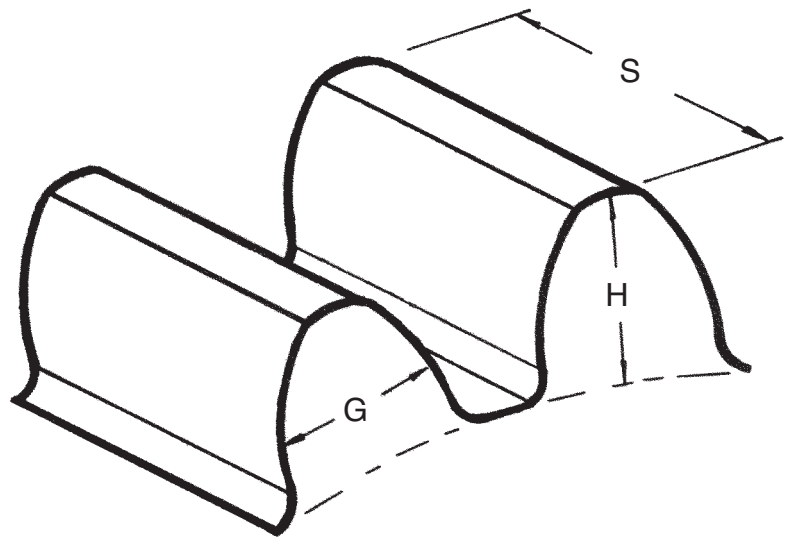
Tolerances on internal contours are easier to maintain than outside contour tolerances.

Tooth forms for gear wheels, gear segments and racks can be produced by GRIPflow.

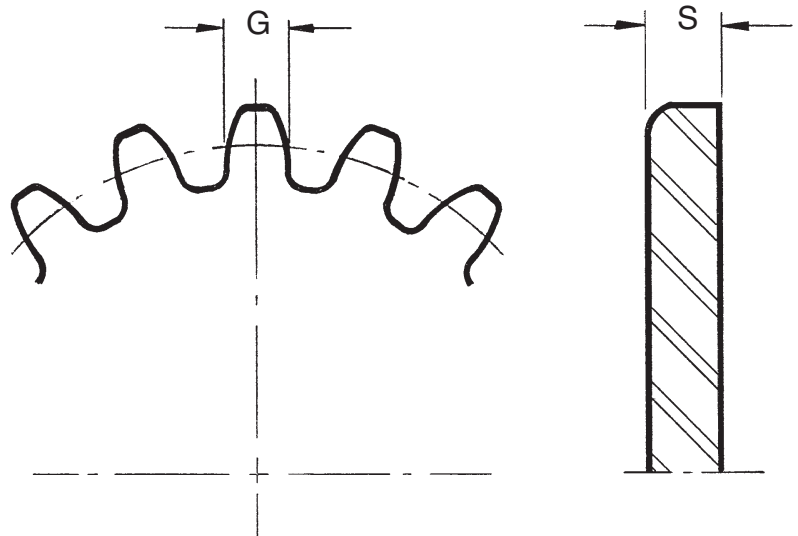
As a general rule the tooth thickness at the pitch radius (dimension G) should be equal to or greater than 60 percent of stock thickness. Reductions to 40 percent of dimension G may be possible depending on tooth shape and the material hardness.

Die-Roll will be greater in cases where dimension G approaches the minimum --- especially at the tip of the tooth.

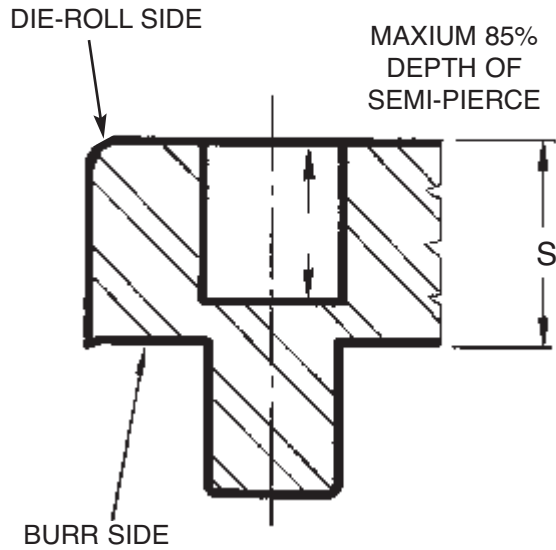
To help prevent die-break the root and crest of the tooth must be radiused.



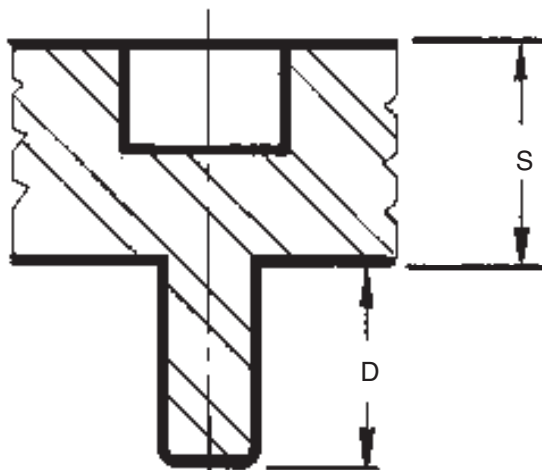
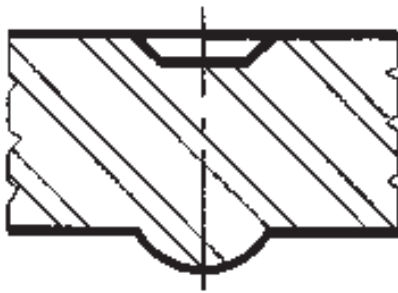
**G = 60% MINIMUM OF S**



# PROJECTIONS



WELD PROJECTION



MAXIMUM OF D IS S

A GRIPflow extruded projection is not separated from the parent material. Even after 85% punch penetration a uniform uninterrupted grain flow exists (based on 57,000 p.s.i. tensile strength material i.e. AISI 1010). The harder the material, the larger the connecting zone must be.

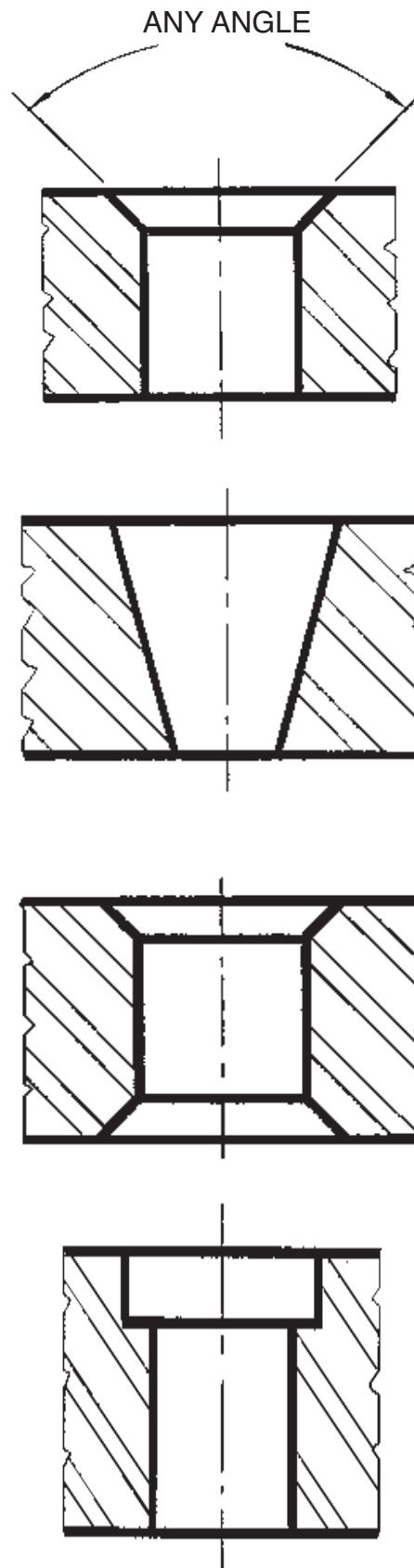
Semi-pierced projections can serve many varied uses:

- Contact Points
- Weld Projections
- Feet
- Self Rivets
- Locator Pins
- Assembly Pins

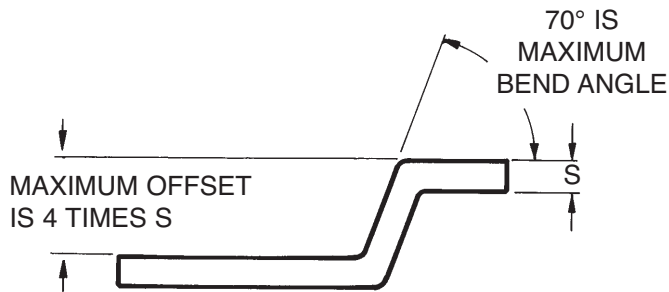
All of the above mentioned projections occur on the burr side. Projections on the die roll side are possible by progressive or secondary dies.

GRIPflow countersinking is very simple as long as the countersink is on the die-roll side. A countersink can be put on the burr side by a progressive die.

- No bulge will result from a GRIPflow countersink.
- A countersink equal to the thickness of the material is possible with GRIPflow.
- Countersinks on both the die-roll side and the burr side are possible with a progressive GRIPflow die.
- A counterbore with a round hole can be produced by a progressive GRIPflow die.

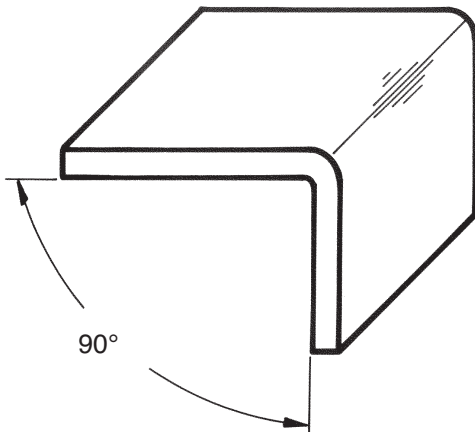


# FORMING & OFFSETS



Offsets of 70% or less can be achieved with a GRIPflow compound die. The maximum height of the offset can not be greater than 4 times the stock material thickness.

If an angle over 70% is required or the offset will be over 4 times the part thickness then a progressive tool will be necessary.



GRIPflow PROGRESSIVE DIE REQUIRED

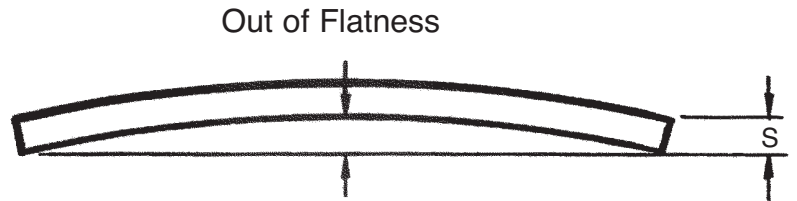
- The steeper the bending angle — the higher the degree of difficulty.
- The harder the material — the less the offset.
- The thicker the material — the less the offset.
- The bend direction can be at any angle in relation to the part contour.

Flatness describes the condition which exists when all points on a surface lie in the same plane.

Out of flat conditions are undesirable and normally result from one or more of the following:

- Configuration of Part
- Grain Direction of Material
- Original Material Not Flat Prior to Blanking
- Stresses in Material from Rolling/Slitting.

Flatness is more difficult to control on parts with coinings, offsets, bends and extrusions.

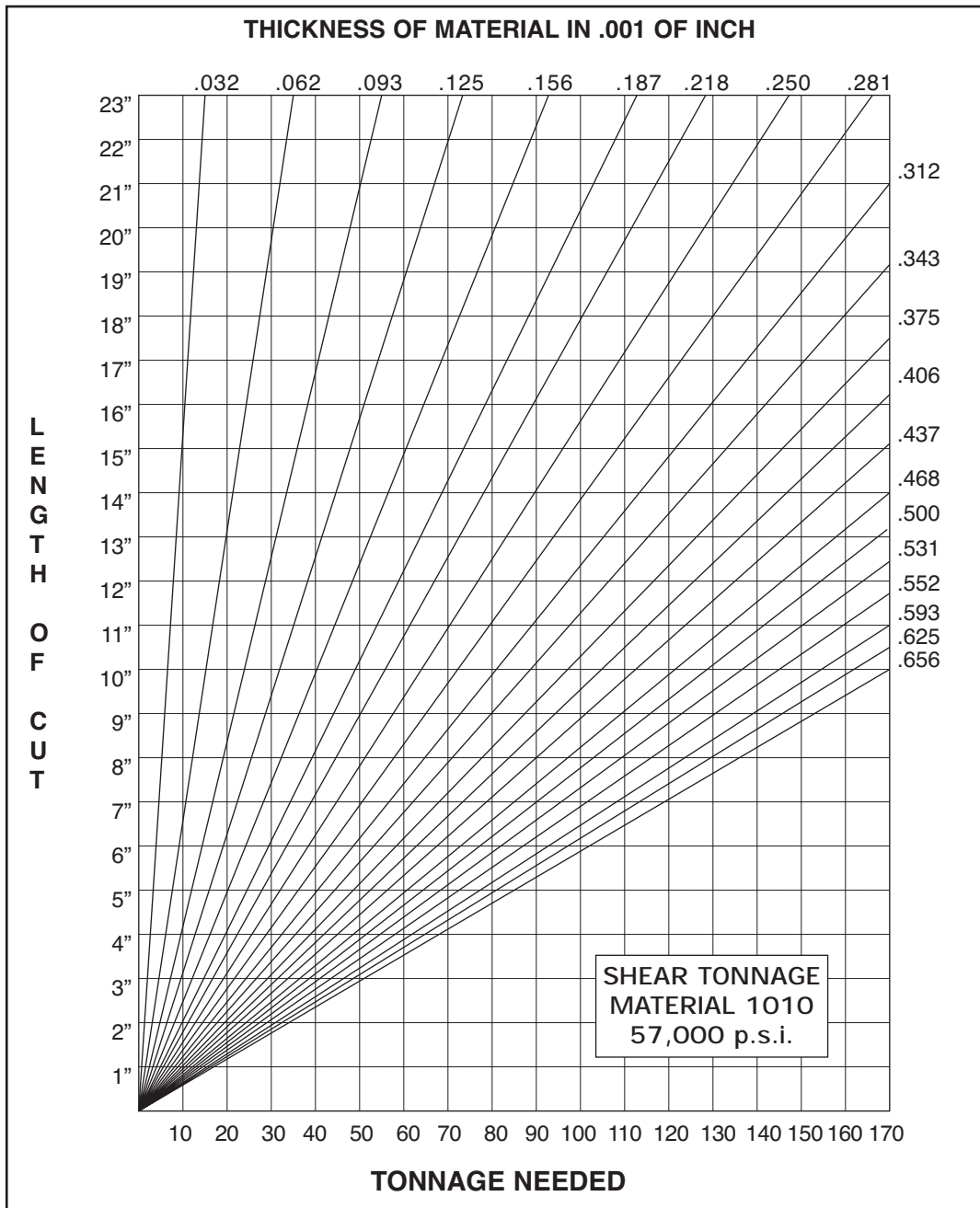


Flatness Tolerances For Gripflow Stamping (Based on 57,000 p.s.i. tensile strength--i.e. AISI 1010)	
Surface Length	Flatness
From 0 - 5"	.001" to .0015" per each inch T.I.R.*
Over 5"	.004" to .006" plus .0012" per each inch of additional length T.I.R.

\*T.I.R. --Total Indicator Reading



# TONNAGE



T= Total Stamping Tonnage = Part Contour Periphery including all cut-outs & holes in the part (in inches) x Material Thickness (in inches) x Factor

P= Part Contour Periphery Including All Holes and Cutouts

S= Stock Thickness

F=Factor

MATERIAL MULTIPLIER CHART	
Material Description	Factor
Aluminum	9.5
Brass	17.5
Copper	14.0
Steel AISI 1006 to 1025	25.0
Steel AISI 1030 to 1090	35.0
Stainless Steel	35.0

Formula  
T=P X S X F

# Suitable Materials for the Gripflow Stamping Process

Material Grade	Thickness Range				
	< 0.125"	0.125 - 0.1875"	0.1875 - 0.250"	0.250 - 0.3125"	> 0.3125"
	< 3.175 MM	3.17 - 4.75 MM	4.75 - 6.35 MM	6.35 - 8.00 MM	> 8.00 MM
<b>Low Carbon Steel</b> SAE 1006 - 1010 SAE 1011 - 1025	E E	E E	E G	G G	G A
<b>Medium Carbon Steel</b> SAE 1026 - 1035 (Annealed)	E	E	G	A	I
<b>High Carbon Steel</b> (Spheroidized Annealed) SAE 1036 - 1050 SAE 1053 - 1078 SAE 1080 - 1095	E E E	E G G	G A I	A A I	I I NR
<b>Alloy Steel</b> (Spheroidized Annealed) SAE 4130  SAE 4140, 4620, 5140, 5160, 6150, 8615, 8620, etc.	E E	E G	G A	A I	I I
<b>High Strength, Low Alloy (HSLA)</b>  Grade 050 (340 MPa) Grade 060 (410 MPa) Grade 070 (480 MPa) Grade 080 (550 MPa) Grade 090 (620 MPa)	E E G G G	E E G G G	G G A A I	A A I I NR	I I NR NR NR
<b>Aluminum</b> 1100 2011, 2014, 2017, 2024 3003 5005, 5052 6061, 6063	E E E E E	E G E E G	G A G G A	A I A A I	I I I I I
<b>Stainless Steel (Annealed)</b> Austenitic (302, 304, 304L, 316, 317L, 321) Ferritic (409) Martensitic (410, 420)	E E E	G E G	A E I	I G NR	NR A NR
<b>Copper - Brass - Bronze</b> Soft 1/4 Hard 1/2 Hard Full Hard	E E E G	E E G A	E G G I	G A A I	G A I I

**Note:** The part shape/contour and the material hardness may effect how the material reacts when stamped. All technical data is for comparison purposes and this chart is to be used as a guide only. The information has been compiled from sources that we believe to be accurate but cannot guarantee. We will be pleased to review your part prints and advise you on the expected results of a potential material.

**Key:**      **E** = Excellent      **G** = Good      **A** = Acceptable      **I** = Inquire Further      **NR** = Not Recommended

