CSC

# Clow Stamping Company

Cost Effective Metal Stampings

ISO 9001

BUREAU VERITAS

Certification

Certificate Number US 08000667

BUREAU VERITAS 1828

**11/16/06**

When Clow Stamping Company started operations back in 1970, we did so with two goals in mind: providing the highest quality parts, and serving you as if we were a partner in your business. We have flourished over the last three decades because we work with the customer to provide the solutions to your challenges, whether they be in design, manufacturing or shipping. Clow strives for perfection, so you, the customer, can be your best. Our ISO 9002 certification is just one example of our dedication to quality.

Today, Clow continues to operate with a singular dedication to our customers and employees. As a family-owned business, we believe in traditional values to drive our success: ethical behavior, respect for people, pride in craftsmanship, and cutting-edge technology. In the years to come we will continue to provide stamping and fabricating of metal components for original equipment manufacturers. And we will do it the Clow family way: through hard work, honesty, and innovation.

## *Commitment to Quality*

*Clow Stamping Company is committed to quality. To provide competitive prices, defect free product and services that meet customer requirements. To provide encouragement and supportive participation from leadership at all levels of the company. To provide a working environment which recognizes that each employee is a contributor to our success. To provide the necessary investment in people, education, and capital equipment that allows us to achieve our full potential. And to recognize that continuous efforts toward improvement must be maintained.*

Everett L. Clow
C.E. O.

Reginal C. Clow
President

Larry Rono
Sales and Marketing Supervisor

Eric Mitchell
Quality Assurance Manager

# WHY SHORT RUN STAMPINGS?

**PRICE-**

Both tooling and piece part costs are kept to a minimum through the use of common holders and common forming tools used by many of our customers. Design change therefore, is also more economical in short run stampings.

**QUALITY-**

Through the use of technical advances in both engineering and quality control, stampings will provide you with quality unmatched by most other manufacturing processes.

**DELIVERY-**

Technical advances, such as wire EDM machines, have drastically reduced tooling times. Also, as previously mentioned, with the use of common holders, for most parts, set up times in short run stampings are far less than in other processes.

**VALUE ADDED-**

With the aid of our outside services, which we work closely with, we can provide various value-added operations. Examples are: plating, painting, silk-screening, heat treat, etc.

# REVISIONS

| DATE | CHANGE |
|---|---|
| 02/04/99 | ORIGINAL BOOK |
| 10/20/99 | UPDATE CAD-CAM SYSTEM – PAGE 4 |
| 08/11/03 | UPDATE ISO LOGO ON COVER |
| 08/31/05 | UPDATE ISO LOGO ON COVER |
| 04/13/06 | CHANGE OF COMMAND |
| 11/16/06 | UPDATE ISO LOGO ON COVER AND CAD-CAM SYSTEM |

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## SPECIFICATIONS AND DESIGNS

Through the use of common materials in your stamping a cost savings will be assured. Clow Stamping Company stocks approximately three-fourths of a million pounds of "common warehouse" material. (Hot Rolled Steels, Cold Rolled Steels, 5052 Aluminum, 304 Stainless Steel and 110 Copper.)

**"*Don't include in your requirements or on your blueprint any specifications, tolerances or requirements for which you are not willing to pay*."**

## BLUEPRINTS

Good communication is required between the designer and the supplier to make your design easy to quote and manufacture and will speed up the quotation process. Drawings must be current, easily read and with clear details.

Even the most clearly detailed prints often fall victim to the reduction and faxing process. Convenient and quick as faxing is, details can get misrepresented in the process. Numbers, especially, get distorted, as is evident when fives turn into sixes and an eight becomes a three, etc.

For this reason, blueprints should never be faxed at all, unless it is **immediately followed up with the originals sent by mail, air carrier, etc**. The exception may be an original 8 $^{1}/_{2}$ x 11 inch print, which should come through the faxing process without distortion if it has crisp details. When the fax is used, as is often done for initial quoting purposes, an engineering contact person with project knowledge should be identified to field questions, which are almost certain to arise. **Blueprints for actual production must be submitted in their original size.**

Always supply sufficient **original** blueprint sets.

# CAD-CAM SYSTEM

The Cad-Cam system is based on a P6-450 IBM compatible (Windows 98) microcomputer which is used for Cad drawing and a file network server. It serves as a CAD FILE base for workstations in the PROGRAMING room, EDM room, TOOL DESIGN, JIG-BORE, MILLING, QUALITY and LASER operations.

The Cad software is CADkey for Windows, which is true 3D. It works with CADkey PRT or any high quality DXF drawings or IGS and Step 3-D Solid part files from other systems which includes direct DWG files from latest versions of AutoCAD generated and exploded.

One station of Pro-E was installed to accommodate importing native Pro-E and solid model IGS or Step files into our Cad Network. We are also able to plot and view SolidWorks blueprints in their native format.

The Cam software was developed and customized to run within CADkey to automate our Charmilles EDM machines and Measurement Masters P.E.P. is used to drive the Laser machine with Feature-Mill being used to drive the Fryer machining center.

The end result is a machine code that is used to program our EDM machines and the Laser or a complete blueprint plotted on a Hewlett Packard Designjet 700, which will plot a drawing (E size) for our own use or our customers.

We also have local access to the INTERNET, which is used to transfer CAD files from customers to us through e-mail with file attachments or the capability of logging onto an FTP site and transferring the files ourselves.

We also support the use of ZIP files, making them smaller to transfer through the modem.

Gilbert Pence
E-mail: clowcad@uslink.net
(218) 765-3111

# CAD-CAM SYSTEM Cont'd.

## Sample CAD Agreement

| | |
|---|---|
| **Company Name**:_____________________ | Date:_________________________ |
| **Project Name:** | **Contact Name:**_________________ |
| | Title:__________________________ |
| | Phone:________________________ |
| Part Number:_________________________ | Fax:__________________________ |
| Revision Level:________________________ | E-mail:________________________ |

| | |
|---|---|
| **Action Requested**<br>☐ Quote<br>☐ Prototype<br>☐ Production | **CAD Media**<br>☐ Disk<br>☐ Modem<br>☐ E-mail<br>☐ Other |
| **Deviations allowed:**<br>☐ Material substitutions<br>☐ Hardware substitutions<br>☐ Redesign for manufacturability | ☐ Tolerances<br>☐ Other |
| **Other docs required**<br>☐ Customer standards<br>☐ Other<br><br>**Controlling document is**<br>☐ CAD model<br>☐ Plot files<br>☐ Hardcopy drawings<br>☐ Other | **Types of files included:**<br>☐ .IGS model<br>☐ .DXFmodel/plots<br>☐ HPGL/HPGL2 plots<br>☐ .TXT docs<br>☐ Material/hardware list<br>☐ Pro E/sheetmetal<br>☐ Step Files<br>☐ Other<br>CAD software used? |
| **Command required to extract files:** | |

All nominal dimensions for prototypes and production parts will be taken from the **CAD model.**

The customer agrees that the **CAD model** will be used to program computer aided manufacturing (CAM) processes.

# LASER

Requests for just-in-time (JIT) manufacturing, shorter part runs, and limited product life cycles have created the need for laser machines for production and prototype fabrication.

Lasers are accurate and economical for profiling irregular exterior contours. These capabilities can be combined to produce accurate and complex parts.

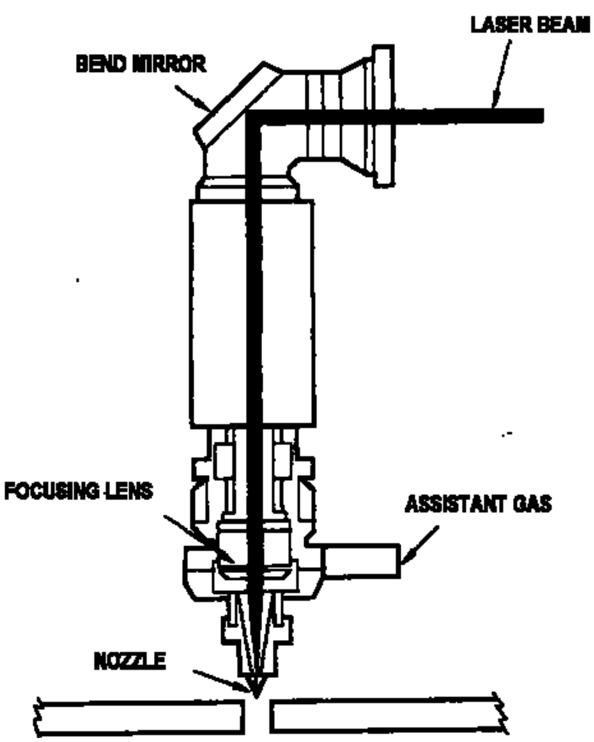
There are applications where the laser out performs other manufacturing tools. Lasers require virtually no set-up time, no special tooling and, with the use of CAD-Cam, very little engineering time. This means that a laser can be finished with a job before other machines have completed the set up.

It is not uncommon to produce a part from digital data (using CAD geometry) to finished blanks in less than an hour. This provides a quick, smooth path from concept to pre-production and even to production with all changes during that evolution driven by software.

## LASER EQUIPMENT CHARACTERISTICS

**Figure 1**

LASER CUTTING HEAD CONTSTRUCTION




The typical metal cutting laser consists of an evacuated container filled with $CO_2$, a high voltage system which excites the gas to emit single wavelength ("coherent") light and an optics system to focus and direct that light (see Figure 1). The optics system reduces the beam diameter to approximately 0.008 in. (0.2 mm) at the point where the beam meets the work piece.

Several hundred watts of power, fiercely concentrated, are sufficient to melt or vaporize most metals. The cutting action is enhanced through introduction of an inert shielding gas to blow away the vaporized metal (usually a nitrogen mixture) to promote combustion of the metal.

## LASER OPERATION

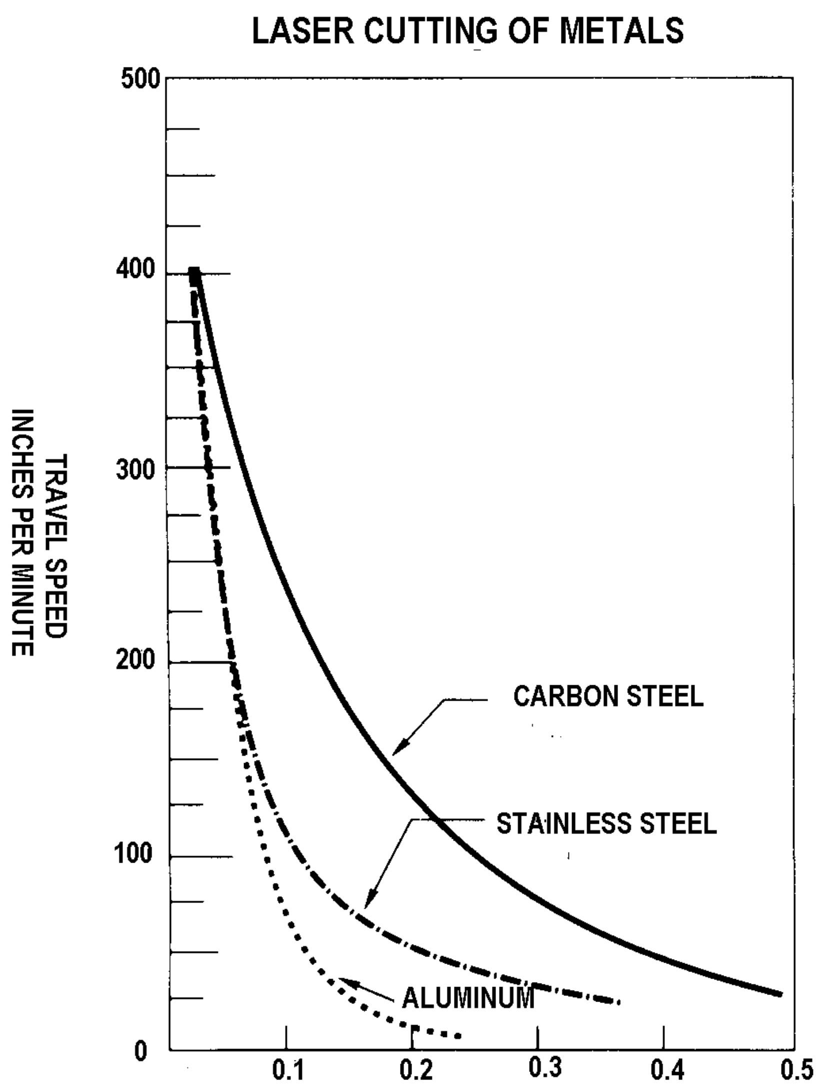
Lasers can be operated in either the continuous wave or pulsed mode. The continuous wave operation is faster and generates a smoother edge. It is inherently less accurate because of thermal work piece expansion due to the higher power levels reaching the work.

When there is a need for intricate or very close-tolerance cutting, the pulsed mode generates less heat but produces a very finely serrated edge. The finished quality of the work piece is a carefully balanced compromise between speed, work piece cooling and edge condition.

Lasers are most productive when applied to mild steel and stainless steel and are more difficult to employ on aluminum. Aluminum and certain other metals like zinc and lead continue to reflect light when molten. This scatters the beam, requiring more power. In addition, aluminum and copper alloys conduct heat away from the cutting area, again requires more power.

Table I gives a comparison of laser cutting speeds on three materials using the same machine at a power level of 1.5 kilowatts.

**Table I**



## LASER- OTHER CONSIDERATIONS

In addition to production economics, precision and edge condition, the knowledgeable designer considers other characteristics of laser produced parts when designing for laser:

- Localized Hardening. Lasers cut by melting or vaporizing metal. This can create problems when cutting heat treatable materials as the area around the part will become case hardened.

  Laser cut holes in stainless steel or heat treatable steel alloys which require machining (tapping, countersinking or reaming) can be particularly troublesome. By the same token, designers can employ this characteristic to their benefit when a product must be case hardened for wear resistance.

- Edge Taper. The laser is most accurate where the coherent light beam enters the work piece. As the beam penetrates the part, the light scatters creating an edge taper condition similar but opposite from "breakout" in a sheared or pierce part. (The hole on the side of the work piece from which the laser beam exits is generally smaller in diameter than on the entrance side).

  Thus the designer must carefully consider the final use of the part and in some cases, may have to specify from which side the part should be cut.

- Minimum Through-Feature Size. The cutting laser beam is focused down to approximately 0.008 in. (.02 mm) and is therefore capable of cutting holes and features with radii approximately 0.030 in. (0.76 mm).

  The limits applicable to piercing or blanking with a punch and die, such as the relationship between minimum hole size and material thickness, or the minimum distance between features to avoid distortion, do not apply when laser cutting.

  However, some limitations do exist, and are also related to the material thickness. Table II and III are a guideline to the minimum through-features that are possible by laser. Laser cutting allows for through-features to be $^{1}/_{6}$ to $^{1}/_{8}$ the size when compared to die piercing.

**Cold Rolled and Hot Rolled Pickled Oiled**

| Material Thickness Range | | Minimum Hole Diameter & Slot Width Achievable | |
|---|---|---|---|
| Inch | mm | Inch | mm |
| 0-0.075 | 0-1.9 | 0.020 | 0.25 |
| 0.075-0.090 | 1.9-2.3 | 0.030 | 0.38 |
| 0.090-0.125 | 2.3-3.2 | 0.050 | 0.05 |
| 0.125-0.156 | 3.2-4.0 | 0.070 | 0.64 |
| 0.156-0.187 | 4.0-4.8 | 0.090 | 0.76 |

**Table II**

## LASER- OTHER CONSIDERATIONS Cont'd.

### Stainless Steel and Aluminum

| Material Thickness Range | | Minimum Hole Diameter & Slot Width Achievable | |
|---|---|---|---|
| Inch | mm | Inch | mm |
| 0-0.075 | 0-1.9 | 0.030 | |
| 0.075-0.090 | 1.9-2.3 | 0.050 | |
| 0.090-0.125 | 2.3-3.2 | 0.060 | |
| 0.125-0.156 | 3.2-4.0 | 0.080 | |
| 0.156-0.187 | 4.0-4.8 | 0.100 | |

**Table III**

Also, since no mechanical force is applied, the width of material remaining between cut out features may be very narrow without distortion occurring during metal removal. A typical application would be tightly spaced venting slots on a visually important surface.

## LASER- ADVANTAGES AND LIMITATIONS

Laser cutting machines offer the capability of producing prototype and preproduction parts both quickly and inexpensively. No other fabrication machine can match the laser on these jobs.

As more powerful units become widely available, lasers are moving from production runs of less than 100 parts to runs of 1,000 or more.

Good design often includes techniques such as "common line cutting" where the nested edges of two parts are cut simultaneously. Designers rely on the burr-free edge produced by a laser for certain production application where burr removal is impractical or very costly.

Utilization of expensive materials can often approach 100% through nesting of odd profile parts on a common sheet. In addition, a blank need not be prepared for the laser. A small part can be profiled from a large sheet and the balance of the sheet stored for future use.

# COMPOUND DIES

Compound dies are hard tooling options that allow two or more operations to be combined into one. A compound blank and pierce, for example, permits the entire perimeter and holes to be cut in one stroke of the press.

This produces the closest feature-to-feature tolerances, flattest part, and easiest to control burr height. Plus, all burrs are formed in the same direction.

In production, parts typically run slightly slower than normal blanking, but a lot faster than separate blanking and piercing.

Other operations can be combined with compound dies. Among them are blanking, piercing and stenciling.

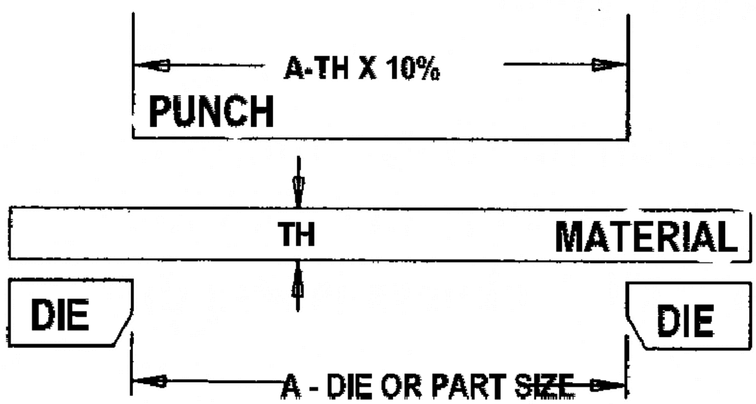
Keep in mind not all parts can be done by a compound tool.

## BLANKED PARTS
## Edge Conditions

Blanking of parts by stamping operations necessitates a punch and die combination conforming to the periphery.

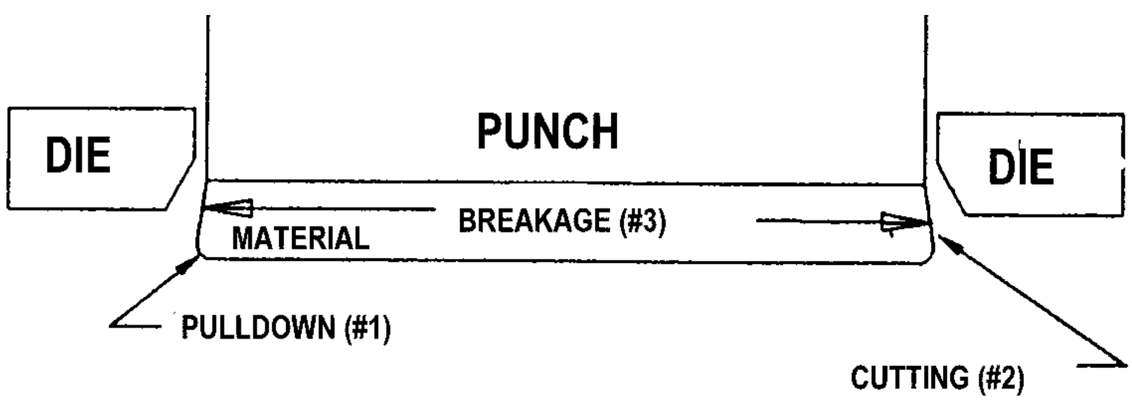
On ferrous materials, the clearance between punch and die should be ten percent of material thickness.

**Figure 1. (This may vary due to hardness and thickness of material.)**




This clearance causes a "Pulldown" (#1) prior to the "Cutting" (#2) a portion of the material before finally "Breaking" (#3) the remainder of the material.

**Figure 2.**



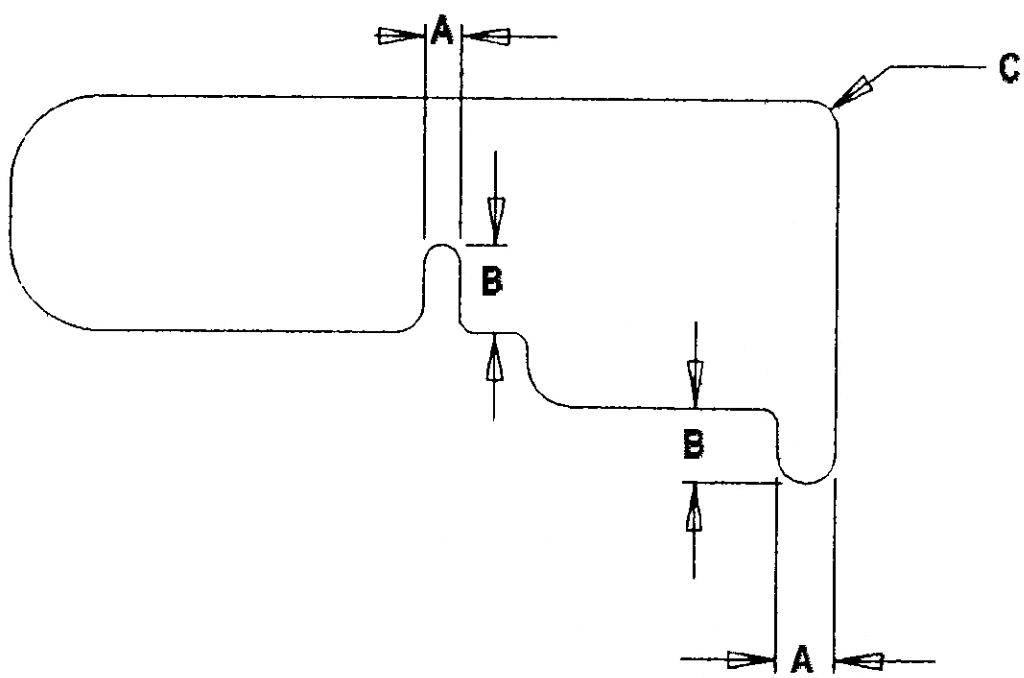
# BLANKED PARTS
## Blank Design

If the following guidelines are adhered to, all blank peripheries can be included in the blanking die, eliminating secondary operations that will add additional cost to your stamping.

**A.** 1 $^{1}/_{2}$ to 2 times the material thickness minimum.

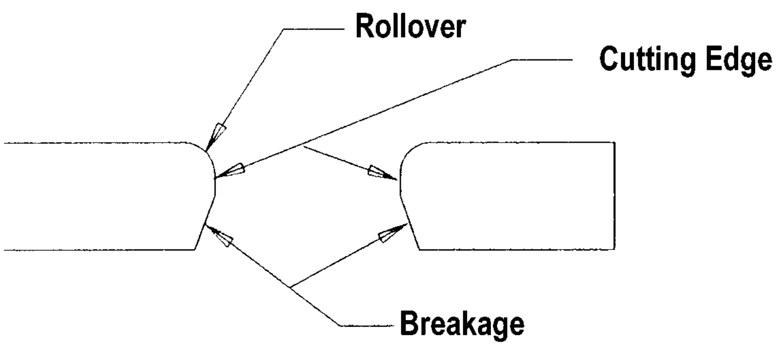
**B.** 5 times a maximum.

**C.** $^{1}/_{2}$ of material thickness minimum on materials $^{1}/_{16}$ thick or greater. Sharp corners are acceptable when material thickness is less than $^{1}/_{16}$.



# PUNCHED HOLES
## Edge Condition of Punched Holes

**Figure 1**



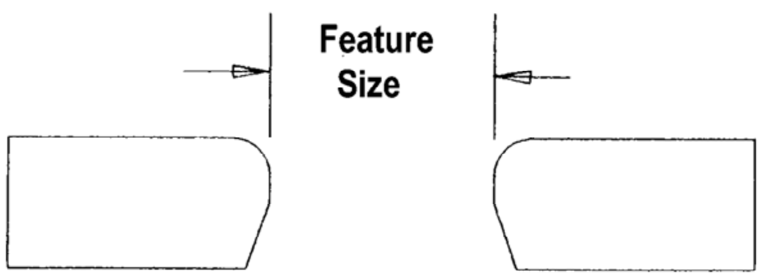

Breakage occurs in all punched openings in much the same way as it does on blanked edges. Therefore, the same conditions that are present on the contour of a blanked edge are present on a pierced hole.
.

## Measurement of Punched Holes

When specifying tolerances for punched holes, it is necessary to consider the conditions that exist within a punched hole.

Punched holes maintain tolerances only on the cutting edge.  If the tolerance must be maintained throughout the hole, additional operations will have to be performed to obtain this.

**Figure 2**



# PUNCHED HOLES
## Hole Size Versus Material Thickness

If the following guidelines are adhered to, all punched holes can be punched without additional secondary operations.

| Material Ultimate Tensile Strength | Ratio P to T |
|---|---|
| 32,000 PSI | P=1.0T |
| 50.000 PSI | P=1.5T |
| 95,000 PSI | P=2.0T |

**P= Punched Hole Diameters** (.062 minimum)

**T= Stock Material Thickness**

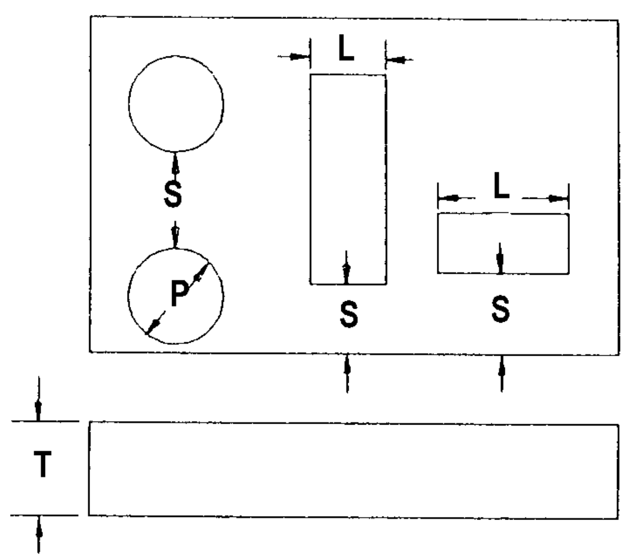
**Note-**

Holes less than stock thickness can be punched in some soft materials such as aluminum.

## Location and Spacing

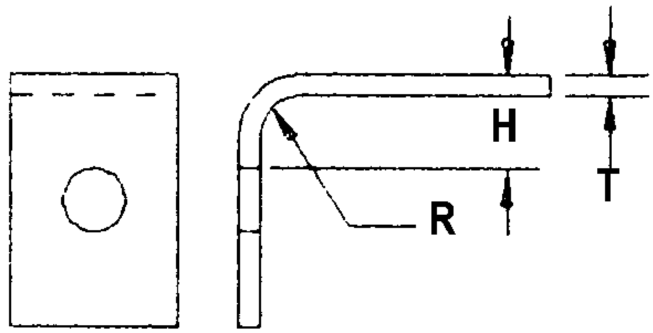
The following guidelines are generally used to determine minimum spacing of punched openings as they relate to outside contour and each other.

| Length "L" is less than | Punched Dia. "P" is less than | Space "S" Minimum |
|---|---|---|
| | 5T | 1.5T |
| | 10T | 2T |
| 10T | | 2T |
| 25T | | 4T |

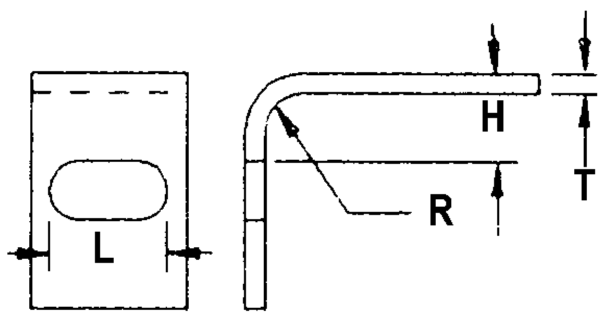


# PUNCHED HOLES
## Location in Relation to Bends

To maintain punched hole tolerances without distortion, when openings are in close proximity to bends, you should use the following guidelines.




**Hole Diameters**
$H = 1\ ^1/_2\ T + R$




**Openings parallel to bend**

| | |
|---|---|
| If "L" is up to 1" | $H = 2T + R$ |
| If "L" is 1" to 2" | $H = 2\ ^1/_2\ T + R$ |
| If "L" is 2" or more | $H = 3$ to $3\ ^1/_2\ T + R$ |

**Note:**

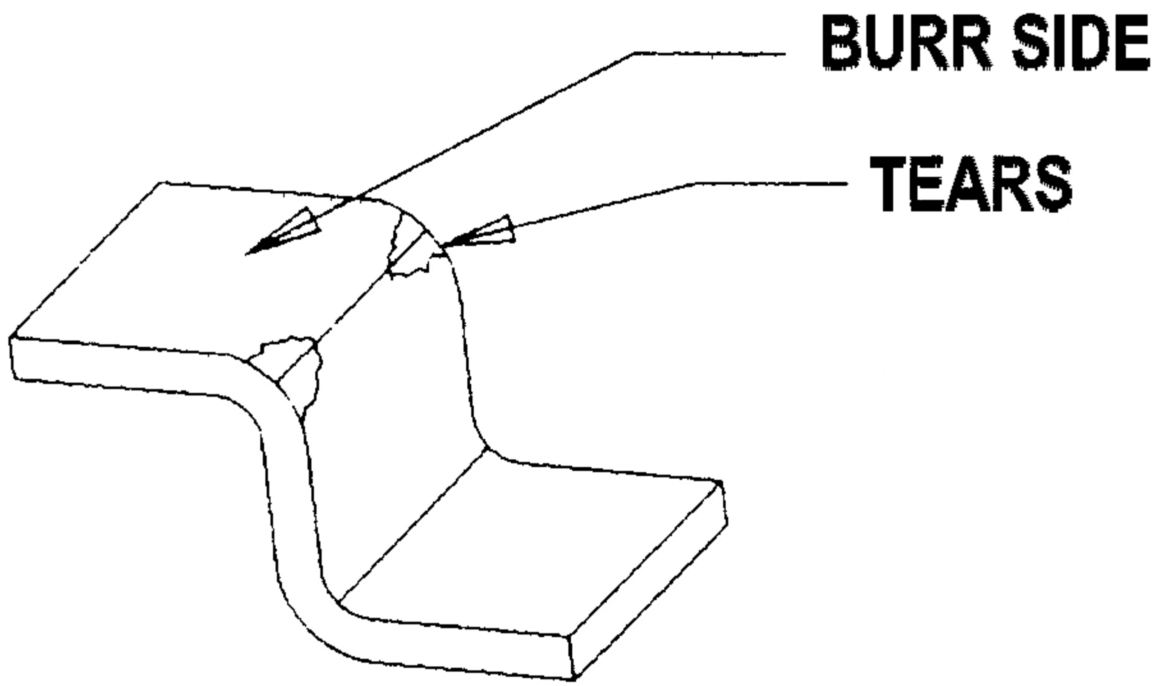
Openings that do not fit these guidelines can be punched by secondary operations.

## FORMED PARTS
### Burr Side

Due to the part design, Figure 1 illustrates a part with a burr on the inside of one bend and a burr on the outside of the other bend. *Note* that the bend with the burr on the outside has a slight "Fracture" due to stress on the material. This fracture will hardly be noticeable on parts $^1/_{16}$" or less. However, the thicker the material and the smaller the inside radius, the larger the fractures become.

For the most economical stamping, when possible, designate ample inside bend radius and burrs to the inside of bends.

**Figure 1**



# FORMED PARTS
## Bend Reliefs

It is necessary to take special care in designing bends in your stampings that allow the use of bend reliefs. Figure 1 shows a part without bend reliefs. This particular part is costly to manufacture because it requires the use of special bending tools. This part will also have a tear in the material, which may lead to reliability problems, if this part is under stress.

**Figure 1**

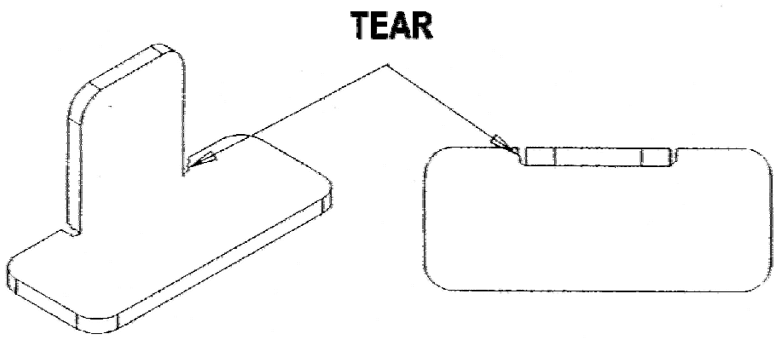
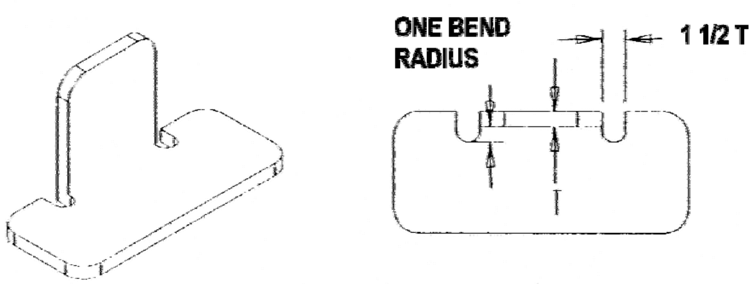



Figure 2 shows the same part with bend reliefs in place. This will allow for the use of stock bending tools as well as reducing any fatigue in this area. A bend relief should be as deep from the inside of the bend as the bend radius is large. The bend relief should be one and one half a material thickness wide. $^{1}/_{16}$" minimum.

**Figure 2**



# FORMED PARTS
## Form Heights

To reduce the chance of costly secondary operation, sufficient material height must be incorporated into your design. Figure 1 shows a part with insufficient height, which will require either a secondary notching operation or a secondary machining operation.

**Figure 1**

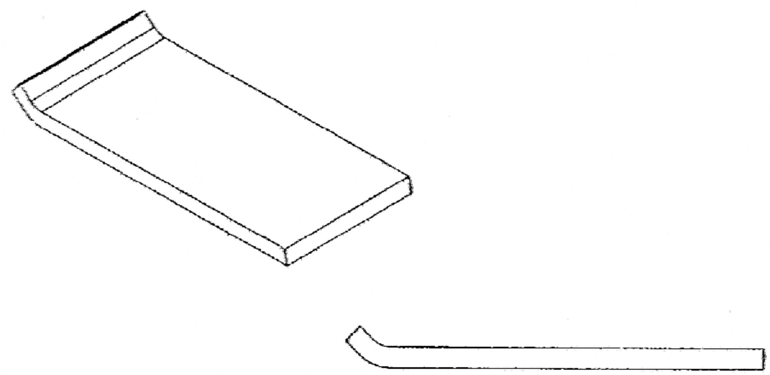


Figure 2 shows a form with sufficient height to allow forming of the material without costly secondary operations. Therefore, to gain cost effective metal stampings, the general rule of thumb is the height of the form should be 2 $^{1}/_{2}$ times the material thickness plus the bend radius.

**Figure 2**

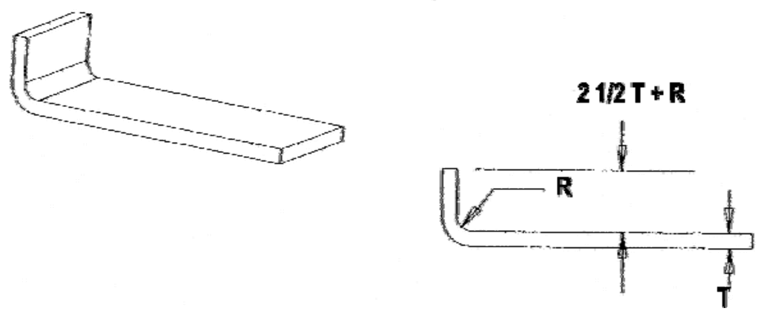



Figure 3 is a chart listing the minimum "H" (Height of form) based on the "T" (Material Thickness) and "R" (Bend Radius). Some easily formed materials such as aluminum can be formed with approximately 20 percent less height.

**Minimum inside height "H"**

| "T" Stock Thickness | Sharp | Inside | "R" Bend | Radius | |
|---|---|---|---|---|---|
| | | 1/32 | 1/16 | 3/32 | 1/8 |
| 1/32 | 5/64 | 7/64 | 9/64 | 11/64 | 13/64 |
| 1/16 | 5/32 | 3/16 | 7/32 | 1/4 | 9/32 |
| 3/32 | 15/64 | 17/64 | 19/64 | 21/64 | 23/64 |
| 1/8 | 5/16 | 11/32 | 3/8 | 13/32 | 7/16 |
| 5/32 | 25/64 | 27/64 | 29/64 | 31/64 | 33/64 |
| 3/16 | 15/32 | 1/2 | 17/32 | 9/16 | 19/32 |

**Figure 3**

## FORMED PARTS
## Form Bulges

A distorted condition that occurs in forming is generally referred to as a form bulge. See Figure 1.

Although hardly noticeable on material thickness less than $^{1}/_{16}$", (or when the form radius is much larger than the material thickness) some bulge is present on all forming.

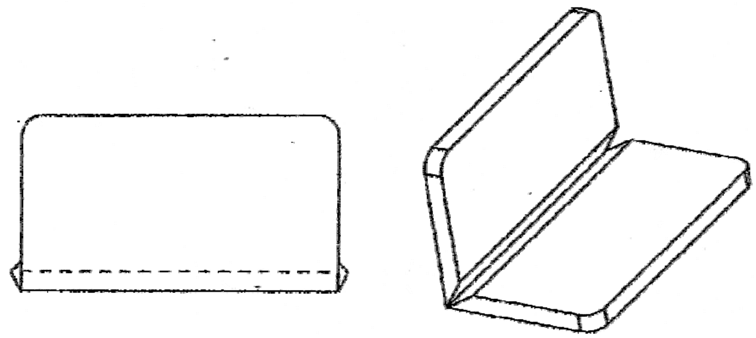


**Figure 1**

Such a bulge is usually of no concern and is accepted as standard practice. If this condition will cause problems when mating parts, this should be stated as such on the drawing so a secondary operation can be considered at quote time.

## Shear Forms

Shear forms as shown in Figure 2 are a costly design feature that should be manufactured by another means whenever possible. Figure 3 shows a bend relief around the tab that is to be formed. This option will provide a more economical part as well as a part of much higher quality.

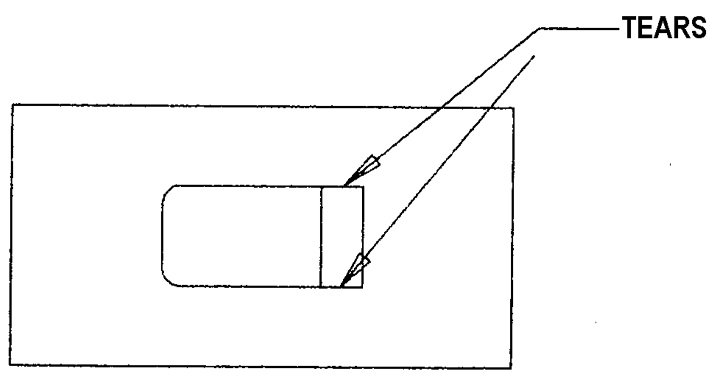



**Figure 2**

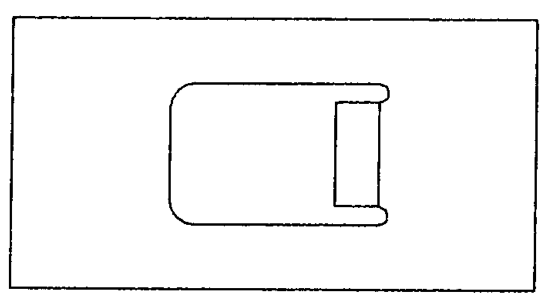


**Figure 3**

## FORMED PARTS
## Dimensioning

One area of concern when labeling actual dimensions on a blueprint is to ensure they are given to the inside of material thickness whenever possible.

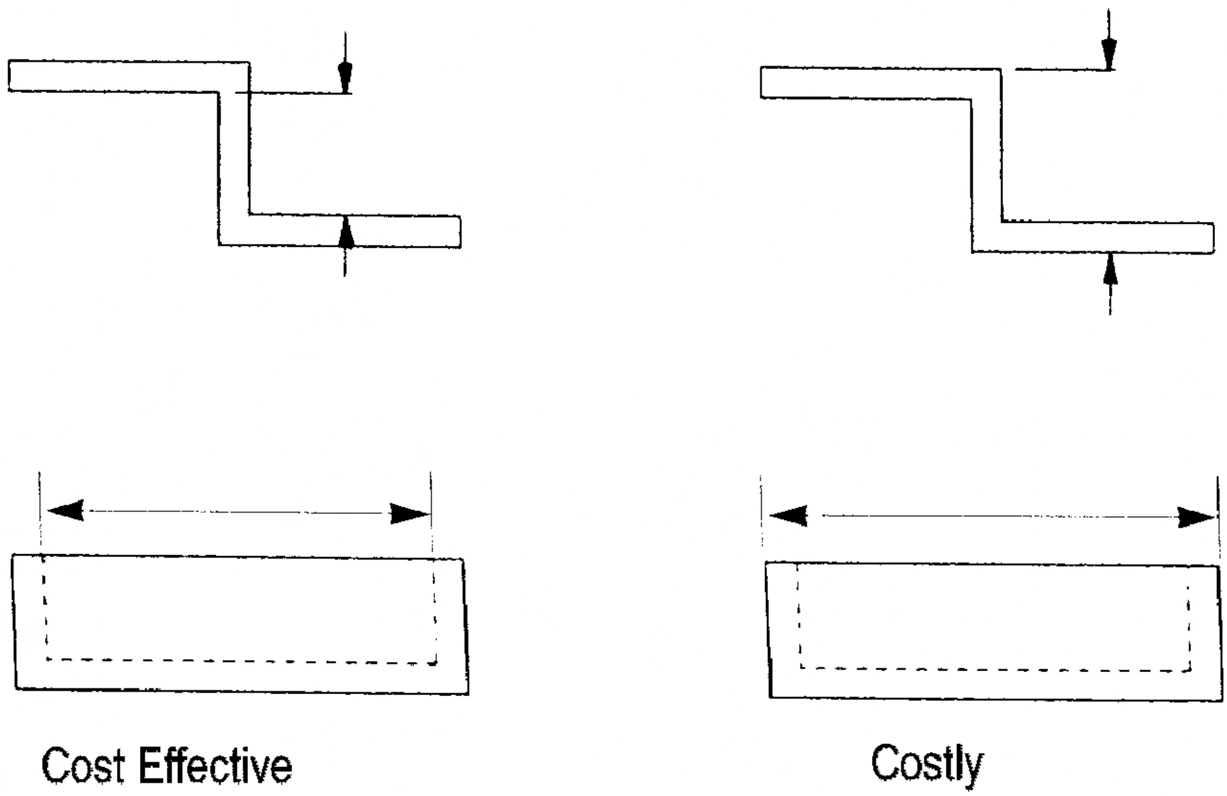



**Figure 1**

# DRAWN PARTS
## Guidelines for Drawing

The following recommendations apply to the design of drawn parts:

- ♦ Shapes are virtually unlimited because of the ability to perform multiple draws. Round is the easiest to draw, followed by square with adequate corner radii. Irregular shapes and those that combine two basic shapes into one are much more difficult and costly to produce.
- ♦ Radii should be as generous as possible to facilitate drawing. Normally, the punch radius and die radius (R1 and R2 in Figure 1) should be a minimum of four times the material thickness.

The part radius (R3 in Figure 1) should be a minimum of six times the material thickness with suitable drawing-quality material. Small parts may require a larger radius. Generally, the larger the radius, the easier and less costly it is to draw the shape.

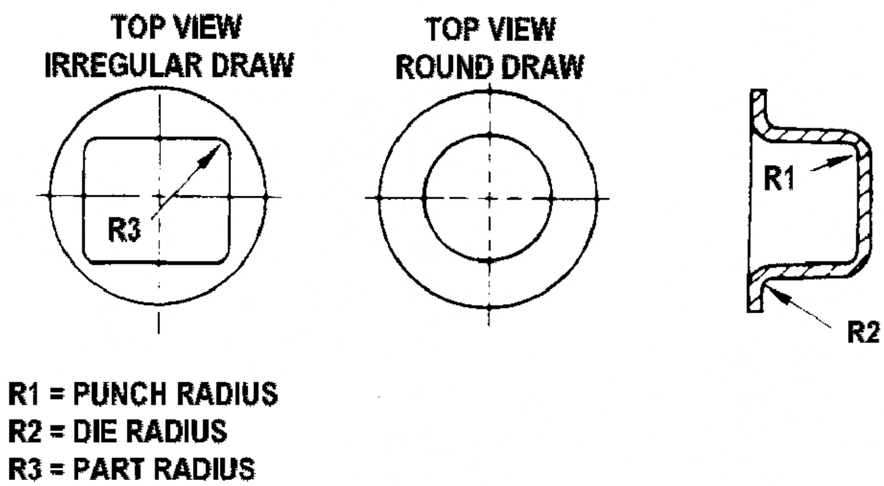



**Figure 1**

## DRAWN PARTS
## Additional Considerations

- Burr direction should be indicated in the part drawing. Otherwise, for flat parts, burrs are assumed to be on the "near side" of the drawing. On formed parts burrs are assumed to be on the inside of the form. Some slide forming equipment allows the placement of burrs on either side of the form.
- Squareness (angularity). Normal variation on formed 90 ° bends is usually ±1°.
- Feature distortion is more likely to occur when various design feature like holes or slots are too close to an edge, form, or each other.
- Die marks are most apparent in drawn parts, which undergo much more deformation than formed ones (Figure 1). Likewise, grippers, if required to hold down a part, may result in significant marking on the part surface. Other types of tooling may also cause marking.

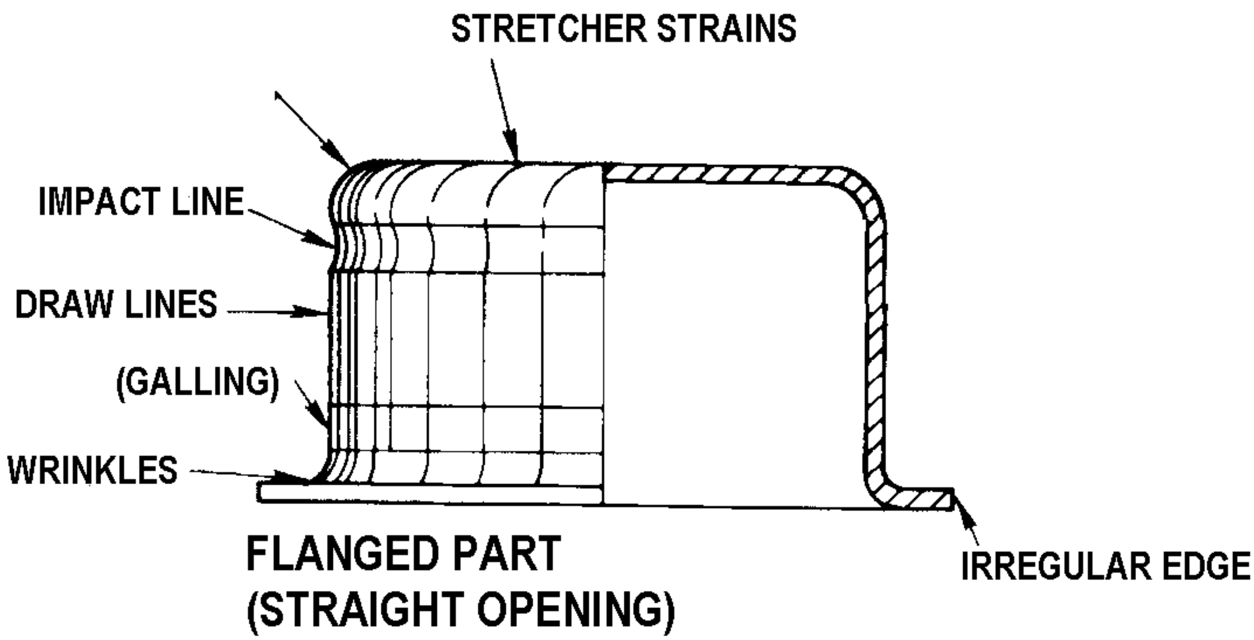



**Figure 1**

- Flatness should not be over-specified. Requiring flatness of less than 0.003 in./in. (0.031 mm/cm) may require a secondary operation at added expense.

## BURRS

Burrs are usually ragged, sharp protrusions on edges of metal stampings. See Figure 1.

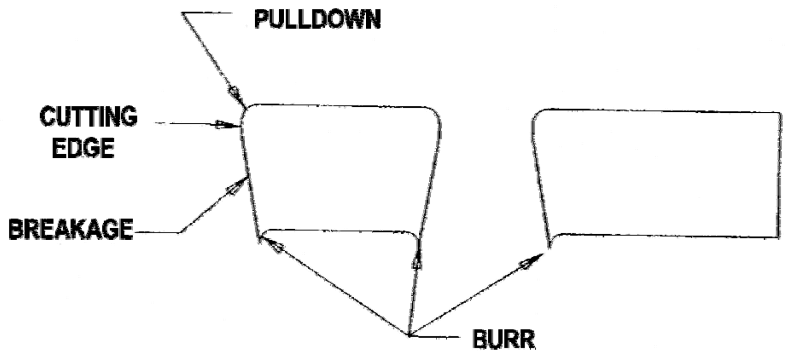



**Figure 1**

All parts manufactured by **Clow Stamping Company** are deburred by roto tumbling or time saving when practical to do so. If it is not practical due to the design of the part, the industry standard for acceptable burr limits is ten percent of the material thickness for .02 and thicker, .002 maximum of thinner materials.

## FLATNESS

Flatness tolerance is the permissible distance between two parallel planes within which all irregularities of a given surface must lie. See Figure 1.

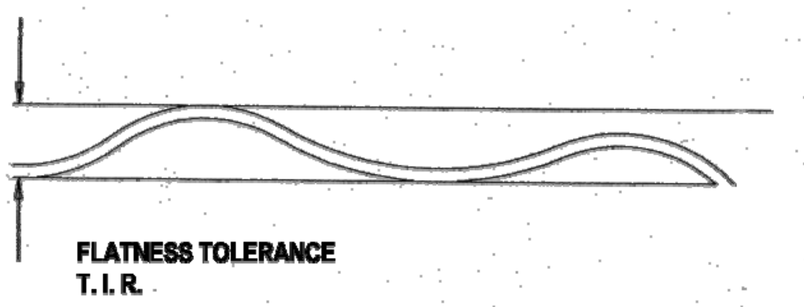
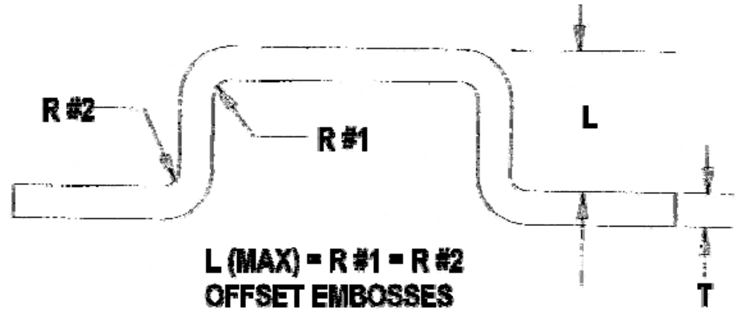


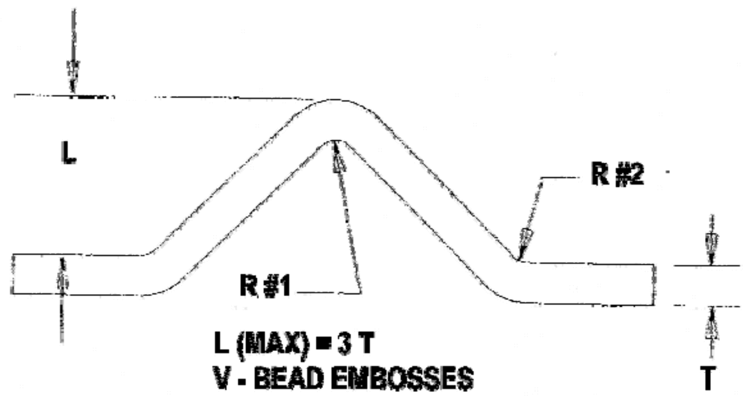

**Figure 1**

Standard flatness tolerance for **Clow Stamping Company** produced parts is .005 per inch of total length.

## EMBOSSES

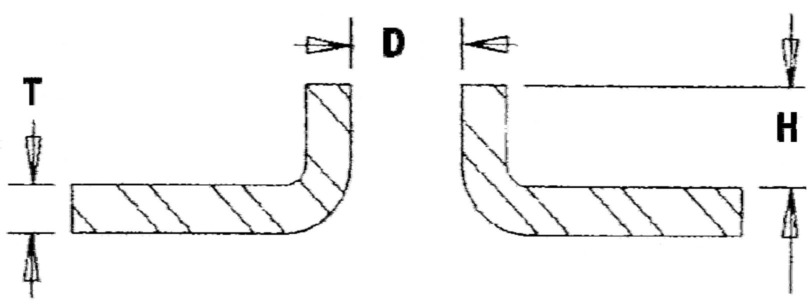
Embosses used to change mounting heights on a part or structural rigidity are a common practice.  They are also a cost-effective practice when the following guidelines are adhered to.




## EXTRUSIONS

**WHEN "D" IS GREATER THAN 2 X "T'**
**"H" = 1 X "T"**
**WHEN "D" IS LESS THAN 2 "T"**
**"H" = 1/2 "T"**




The function of extrusions is generally to increase material thickness to achieve more bearing surface or more threads in the case of a tapped extrusion.

Maximum height that can be achieved is usually one material thickness "T".  Higher heights can be achieved; however, fractures occur and become greater as height is increased.

Decreasing the hole diameter "D" will also decrease the height "H" per the formula to the left.

## COUNTERSINKING

When specifying a machined countersink in sheet metal, it must be understood that the depth "D" of the countersink can only be .010 minimum less than the thickness "T" of the material. See Figure 1.

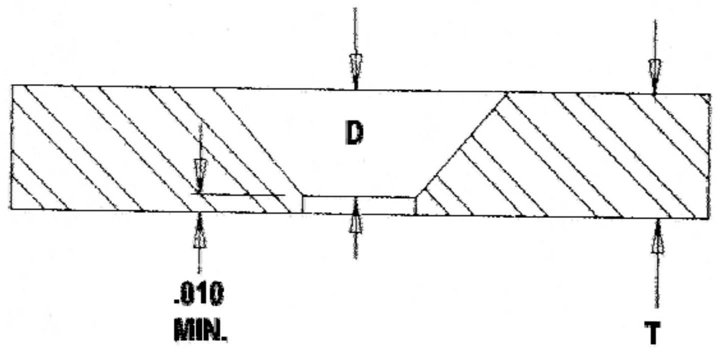



**Figure 1**

In order to maintain the original hole sizes and keep from adding costly secondary operations, the depth dimension must be adhered to.

## SPOT WELDING

When spot welding two items together, the minimum contacting overlap area for tip contact should be as shown in Table I in order to secure a solid weld. See Figure 2 and Table I

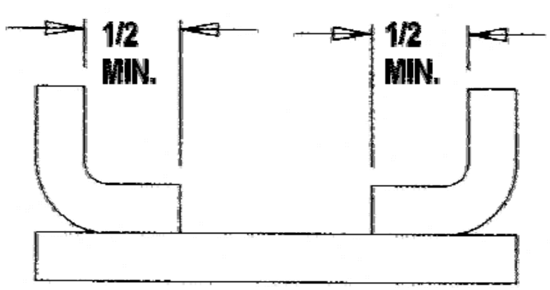



**Figure 2**

| Thickness of Sheet | Minimum Contacting Overlap Inches |
|---|---|
| 0.010 | 3/8 |
| 0.021 | 7/16 |
| 0.031 | 7/16 |
| 0.040 | 1/2 |
| 0.050 | 9/16 |
| 0.062 | 5/8 |
| 0.078 | 11/16 |
| 0.094 | 3/4 |
| 0.109 | 13/16 |
| .0125 | 7/8 |

**Table I**

**Note:** A bulge can occur on flanges less than .040 thickness specified in the table. If this condition will cause problems when mating parts, this should be stated as such on the drawing.

# PROJECTION WELDING

A refinement of resistance spot welding is resistance projection welding (RPW). It makes use of projections previously formed on the work piece to reduce the power required to make a resistance weld. Consequently, multiple welds can be made more easily at the same time, and thicker sections can be joined more readily than in RSW. Other advantages include reduced shunting effects, closer weld-to-weld spacing and welding of work pieces with smaller flanges.

Projection welding can be used on low-carbon, low-alloy and stainless steels. Typically, thicknesses up to 0.125 in. (3.18 mm) can be joined. Thin work pieces-- from 0.010 in. (0.25 mm) up to 0.022 in. (.056mm) -- may require special equipment. Below 0.010 in. (0.25 mm), resistance spot welding is recommended, because on this thin material the projections would collapse before the fusion temperature is reached. Projection welding of aluminum alloys is seldom done because the quality of projection welds is less uniform than that of regular spot welds.

While projection welding can be less expensive than resistance spot welding, work piece alignment is more critical, and heights of projections with simultaneous welds need to be closely controlled -- typically, within 0.003 in. (0.08 mm) of each other.

# SPOT WELDED FASTENERS

Weld nuts and weld studs are commonly used to provide a means for subsequent fastening of additional components and assemblies, or for periodic removal of service parts for maintenance and repair. When specifying welded fasteners, care should be taken not to tightly tolerance concentricity or perpendicularity to a datum plane, since this drastically increases cost. Weld fasteners located by holes punched by prior stamping operations are an accurate and generally preferred location method.

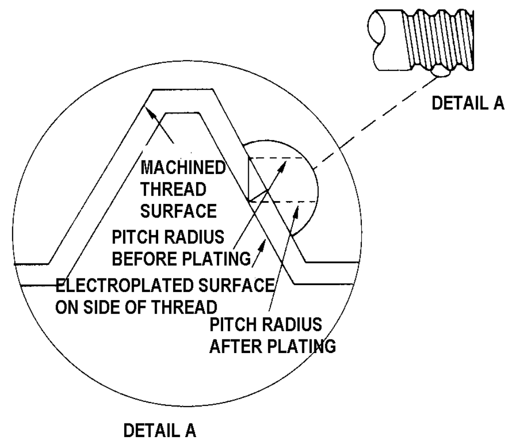
For maximum cost-effectiveness, select weld nuts and studs of one size that will be used throughout the assembly. This helps to keep set-ups to a minimum and increases manufacturing output.

Nuts or studs located by holes are typically within ±0.006 (0.15 mm) of the original hole location. Studs without through holes can be located to ±0.020 (0.51 mm) with simple fixturing. Closer tolerances require more sophisticated and costly fixtures.

## PLATING

Electroplating thickness varies according to the part configuration. Design consideration must be given special attention to enclosed features, recesses, holes and threaded parts.

**Figure 1**




- Threaded features can be troublesome if not planned for in the design stage. Allowance should be made for pitch diameters of screw threads, which can increase by a factor of four times the plating thickness. (See Figure 1)
- Tapped holes may require re-tapping after plating to ensure dimensional accuracy. Specifying "check with standard hardware" or the use of thread forming screws are probably the most economical options. Most metal forming suppliers are able to control thread tolerances by using specific oversized taps.
- Threaded studs (and other projections like pins) accumulate more plating than other areas. Specifying "must accept standard hardware" instead of inspection with go/no-go gauges often eliminates masking.
- Recessed areas, such as internal isolated corners, channels, etc., may be very difficult to plate, resulting in little to no coverage inside of parts. Although special electrodes help, they do not entirely correct the problem and always create additional expense. In some cases, this can be avoided by plating individual parts before assembly; in others, a redesign or different coating method may be warranted. A good rule of thumb is to avoid plating of overly complex assemblies.
- Lap-Welded joints will trap plating solutions through capillary action between the two surfaces. The resulting salt bleed-out is not only a cosmetic defect, but leads to severe corrosion problems.

  A compromise solution is to place the welds on embossed areas raised a minimum of 0.015 (0.3 mm) height to allow for flushing and blow drying between the surfaces. Other alternatives are riveting or the use of threaded fasteners for post-plating assembly. Fabrication from preplated material is another compromise approach, resulting in the plating being discolored and damaged in the electrode contact area during spot welding.
- Masking of stampings and fabrications to selectively anodize only certain areas is usually not recommended because of occasional processing problems and associated costs. Although the process is technically feasible, anodizing solution sometimes penetrate the masking, producing a part that must be reworked. (The part has to be unmasked, stripped, cleaned, remasked and then reanodized.) In addition to being less than completely reliable, masking is time-consuming and costly.

# SHIPPING KANBAN

The purpose of **Production JIT** is to foster a Just In Time shipping environment by facilitating the smooth and consistent flow of material from Clow Stamping Company (Clow) to ABC COMPANY (ABC) via faxed material releases or other forms of releases through EDI, etc.

**<u>Procedure:</u>**

One blanket order may be issued for each part involved, and shipments will be made against those orders. (Can be set up to accept another purchase order per run quantity if customer requires.) Clow will manufacture and stock the "Production Run Quantity" for each part (Example A). As Clow receives information (fax, EDI, e-mail, etc.) about ABC's requirement (Example B), Clow will make the next shipment in 24 hours of notification provided notification is received by Clow before 9:00 A.M. Central Time or as agreed upon.

When a part's inventory at Clow is depleted to the predetermined level, Clow will be responsible for initiating the next production run of that part by faxed communication with customer (Example C). Customer will be required to sign and return fax communication prior to each new production run. This predetermined level, or "Trigger" is calculated by considering the lead time of the part, ABC's usage rate, and the order quantity. (Example A). If Clow's lead times and ABC's consumption remain as planned, Clow should finish their production runs as the stock from the previous run is depleted. **Customer will be responsible for advising Clow when Production Run Quantities and Trigger Quantities should be changed due to increase or decrease usage of part.**

# COMMON STAMPING TERMS AND DEFINITIONS

**Annealing** - Softening or strain relieving of the material by application of heat above the critical temperature for the correct time interval, then cooling slowly enough to avoid hardening.

**Bead** - (A) Narrow ridges in a part for reinforcement. (B) Narrow ridges along the edge of a part, and corresponding ridges in the die to improve holding action in press working.

**Bend Relief** - Clearance notch at an end of a flange to allow bending without distorting or tearing adjacent material.

**Blank** - (A) Sheet metal stock from which a product is to be made. (B) Workpiece resulting from blanking operation.

**Blank Development** - Because of stretching and ironing present in drawing and forming operations, it is usually necessary to arrive at the blank size and shape by trial and error. The drawing and forming dies, therefore, are made first. When the blank size and shape are finally determined, the blanking die is made last.

**Blanking Die** - A die used for shearing or cutting blanks usually from flat sheets or strips. The single blanking die used for producing one blank at each stroke of the press is the simplest of all dies, consisting essentially of punch, die block and stripper.

**Brake Bending** - A form of open frame, single action press comparatively wide between the housings, with bed designed for holding long narrow forming edges or dies. It is used for bending and forming strips and plates.

**Breakout** - Fractured portion of the cross section of a cut edge of stock. A condition naturally occurring during shearing, blanking, punching and other cutting operations.

**Burnish** - Smooth or shiny area above the breakout on a sheared edge. Also called shear or cut band.

**Burr** - A rough ridge, edge, protuberance, or area, that is left on metal after cutting, drilling, punching, etc. In stamping, it occurs in cutting dies because of the clearance between punch and die.

**Burr Side -** This generally refers to the side or face of a blank or other stamping which comes in direct contact with punch of a blanking operation, and the side or face of a blank or other stamping which comes in direct contact with the die in piercing or perforating operations.

**Capacity of a Press -** The rated capacity of a press is the tons of pressure, which the slide will safely exert at the bottom of the stroke in doing work within the range of the press.

# COMMON STAMPING TERMS
# AND DEFINITIONS Cont'd.

**Coining -** A squeezing operation usually performed cold in a closed die, in which the metal is forced to flow and fill the shape and profile of the die. The term is also applied loosely to other very severe and localized cold forming operations. It is usually done in a Knuckle Joint or Coining Press.

**Compound Die -** A tool used to pierce and blank a part at the same time, with one stroke of the press.

**Deburr** - To remove the sharp, knife-like edge from parts.

**Die Set -** A standardized tool or tool holder consisting of die base to which a die is to be attached. The base and plate are held in accurate alignment by guide pins or posts and bushed guides.

**Fixture -** A tool or device for holding and accurately positioning a piece or part on a machine tool or other processing machine.

**Forming -** Any change in the shape of a metal piece, which does not intentionally reduce the metal thickness.

**Hot Rolled Sheets -** Steel sheets reduced to required thickness at a temperature above the point of scaling, and therefore, carrying hot mill oxide. They may be flattened by cold rolling without appreciable reduction in thickness or by roller leveling or both, depending on the requirements. Hot rolled sheets can be pickled to remove hot mill oxide and are so produced when specified.

**Inclinable (O.B. I. Press) -** Small and medium size crank presses which may be inclined (tilted backward) to facilitate ejecting of finished parts by gravity. These presses are usually of the open-back, gap type frame with right to left crankshaft. They are built in a maximum size of about 250 tons. They may be, and very often are, used in the upright or vertical position, being readily adjustable, (usually by a hand mechanism), to any desired inclination up to the usual maximum of 45 degrees. The inclinable press is the most widely used type of press, being particularly adapted for blanking, piercing, forming and shallow drawing operations on a multitude of small and medium size parts.

**Lead-Time -** Time required to manufacture product from order placement to availability.

**Mechanical Press -** A press whose slide or ram is operated by a crank, eccentric cam, toggle links or other mechanical means, as contrasted to fluid or other means.

**Mills Extras -** The charges above base price for a sheet such as gage extra, width extra, length extra, pickling and oiling extra, etc.

## COMMON STAMPING TERMS
## AND DEFINITIONS Cont'd.

**Perforating -** The piercing of many holes, usually identical and arranged in a regular pattern, in a sheet, blank or previously formed part. The holes are usually round, but may be of any other shape. The operation is also called multiple piercing. See piercing.

**Periphery** - The extreme outer edge of part or drawing.

**Piercing -** The general term for cutting (shearing or punching) openings, such as holes and slots in a sheet material, plates or parts. This is practically the same operation as blanking with the difference being that the slug or piece produced by piercing is scrap, whereas the blank produced by blanking is the useful part. In the two cases the burr is opposite. See burr side.

**Progressive Dies-** A series of two or more dies arranged in line for performing two or more operations on a part. One operation (single or compound) being performed is each die at each station. Material in the form of a strip is usually fed to progressive dies automatically by a roll feed, or blanks or parts are fed by a transfer feed.

**Tolerance** - Permissible variation from a specification for any characteristic of the product.

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