GA INDUSTRIES

General Info Brochure

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Edition A.1

Introduction

GA Industries offers our clients expertise in fabricating high-precision metal components. Our exacting standards in quality workmanship, manufacturing ingenuity, and meticulous attention to detail have cultivated our reputation as one of the best fabrication shops in Western Canada.

We began as a fabricator of architectural metal products for the appliance industry and have since expanded substantially. Our company was founded in 1983 and has been growing steadily ever since.

This brochure contains information regarding standard sheet finishes and sizes, our machine capabilities, recommended design practices for manufacturability, and more. Please do not hesitate to contact us with any questions.

Figure 1 - Customer Installation of GA fabricated parts

Figure 2 - GA parts in public spaces

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Standard Stainless Finishes: HRAP, #1 (Mill finish)

Figure 1 - HRAP / #1 Finish

This is the standard finish for heavier plate material, 0.250” thick and up. The material is unfinished and is generally used in structural/non-sanitary environments. Multiple finishes can be achieved through increasing abrasive grits (until the desired surface roughness is obtained).

Key notes:

- If flatness is critical, consider that thicker material may be used and machined down. This will result in a machined finish instead of the mill finish

Standard Stainless Finishes: 2B (Bright, Cold Rolled)

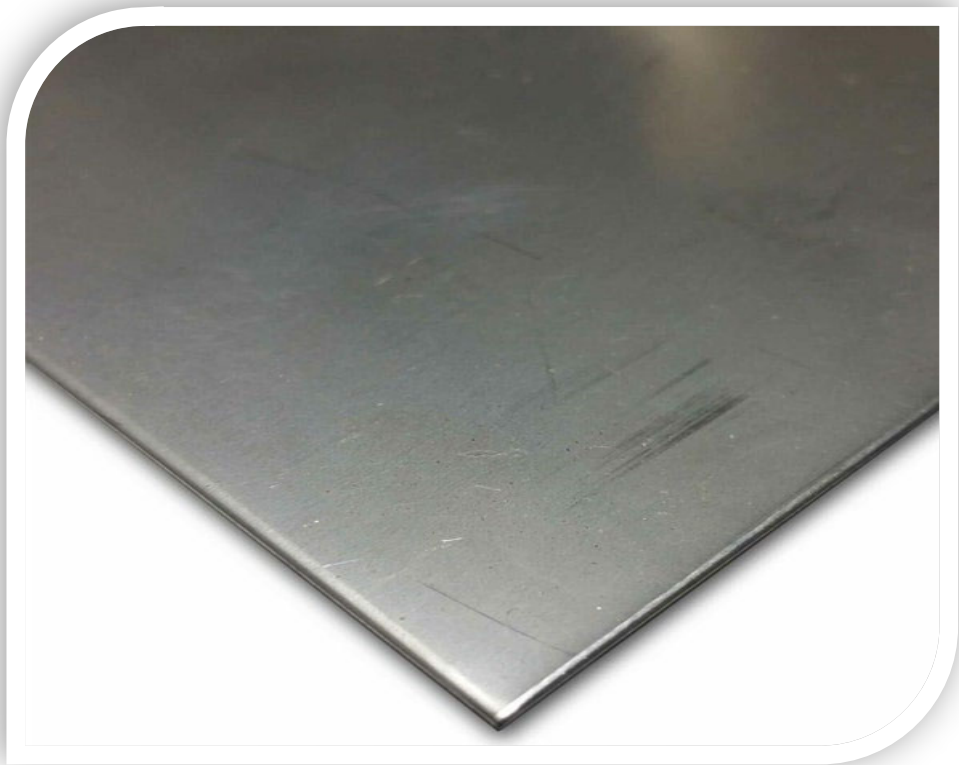

Figure 2 - 2B Finish

This finish comes from the mill on most thinner sheet sizes, up to and including 0.188” thick. This finish is obtained through passing the sheet through polished rolls, and therefore cannot be achieved through post-finishing/abrasives. Also, surface roughness will differ between different thicknesses; thinner sheets are more polished as they pass through more rollers than thicker material.

Key notes:

- Please note that maximum thickness available is 0.188” thick as this finish is sourced from the mill.
- If 2B is required on both faces, please note the back face may come scratched/marked due to handling. To remove scratches/marks, abrasives will be required which will result in either a uniform finish or brush finish

Standard Stainless Finishes: No. 4 (Brushed)

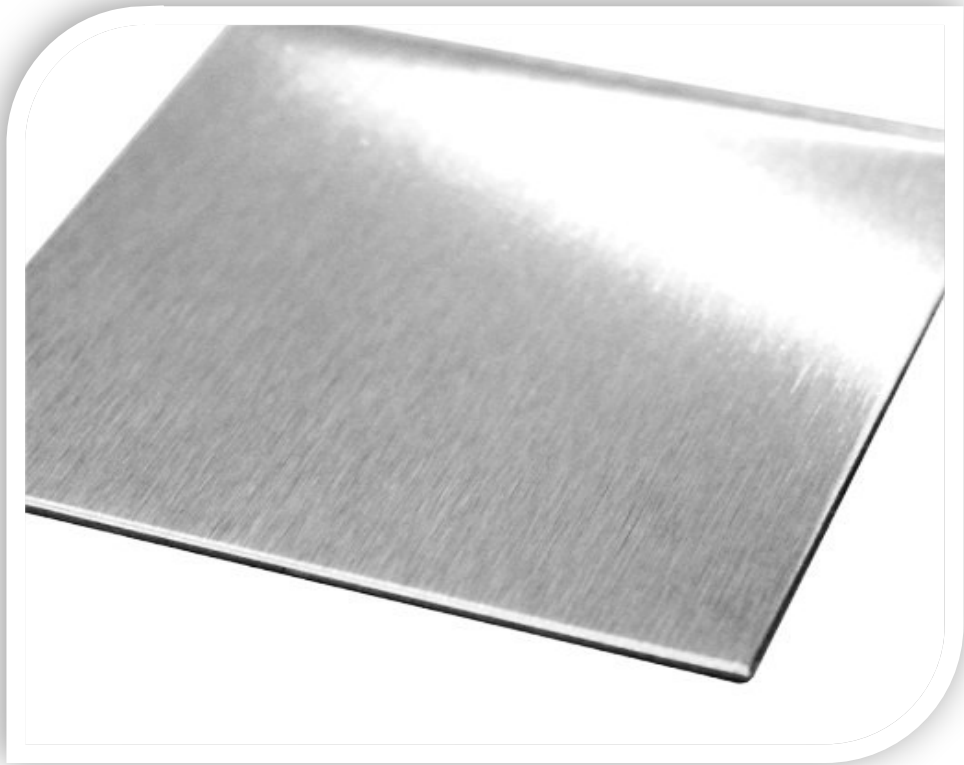

Figure 3 - No. 4 Finish

This finish can be purchased from the mill as a standard finish (up to and including 0.135”) and can also be achieved through abrasives. If specifying No.4 finish, please note that the top face is protected by PVC; however, the back face may see scratches and marks due to handling.

Key Notes:

- Please specify the surface roughness (RA) required on either face of the part, and if the back face also requires brushing (to remove scratches/marks from handling)

Tolerancing: Material

Thickness on sheet metal can vary due to a multitude of reasons – different alloys, finishes, and suppliers can all affect the final thickness. As such, it should be identified on part drawings when “sheet stock” tolerance is allowed, as specifying a tighter tolerance may require machining a thicker material to achieve the specified tolerance.

For standard tolerances and sheet sizes/thicknesses offered by GA Industries, please see pages 23-28.

Thickness

- Sheet metal (≤0.135” thick) has an approximate tolerance of +/- .005”
- Plate (≥0.188” thick) has an approximate tolerance of +/- .010”
- Thickness Tolerance changes depending on finish (e.g., brushed vs non-brushed)

Features on full-size sheets

Typical dimensions of full-size metal sheets are 4’ x 8’, 4 x 10’ and 5’ x 10’. When designing parts that require a full-size sheet, keep in mind that the outer edge may vary in dimension. This is because the edges of the sheets have a downwards curl as they are sheared/slit to size (see below figure). If the part is designed at a full-size sheet, please allow a ¼” offset from the outer edge of the sheet for features to stay within tolerance.

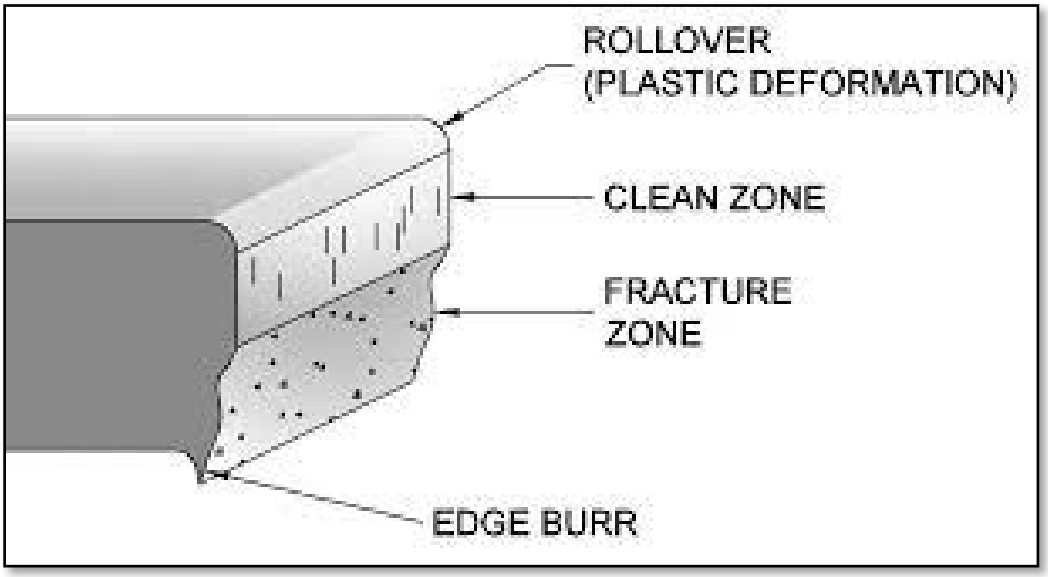

Figure 4 - Sheared edge of sheet metal

Tolerancing: Cutting

Cutting tolerance applies to all features, including holes/slots. Tighter tolerances can generally be achieved through machining.

Laser Cutter

Laser cutters have an average of +/- .003”, where tolerancing improves on thinner material and less on thicker material.

Waterjet Cutter

Waterjet cutters have a +/- .010” minimum tolerance, where material type and thickness impacts tolerance significantly. Taper becomes accentuated with thicker materials (taper compensation available to minimize taper)

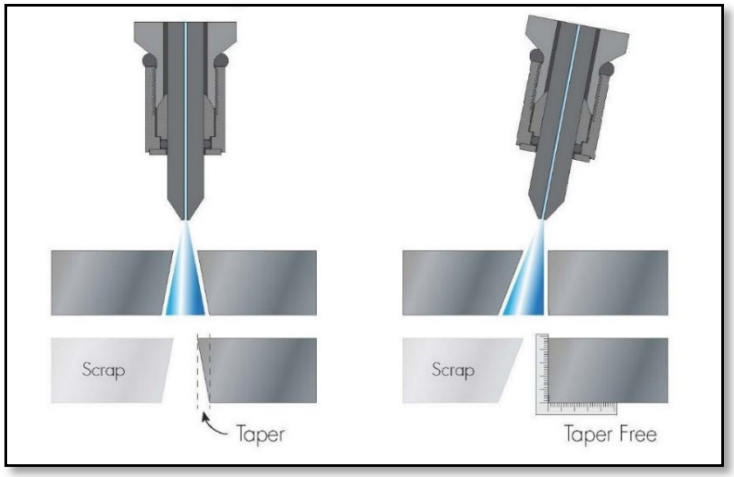

Figure 5 - Taper Compensation

Waterjet Striations

- For thicker material being cut on the waterjet, tolerancing on the sides vary depending on the quality of the cut. Specify quality for metal plates (≤0.313” thick) as required or specify surface roughness (RA) if striations are to be fully removed. For tighter tolerances, the perimeter may be machined as an option.

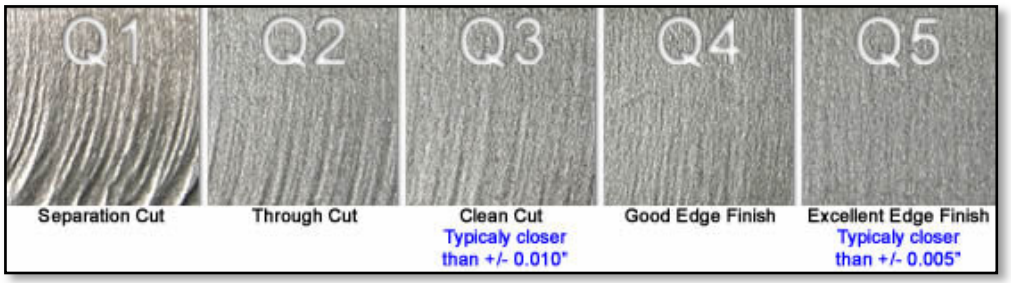

Figure 6 - Waterjet striations and cut quality

Tolerance: Bending

When bending sheet metal, there will be slight inconsistencies that are introduced due to a myriad of factors; material inconsistencies, cutting tolerance, post-cutting surface treatment etc. These inconsistencies should be considered when designing tolerances on bent parts.

The tables on pages 12 and 13 provide the tolerance that should be assumed on each flange per bend. For example, on a 0.063” thick cover with two bends:

- From table 1 (page 12), each bend will have a tolerance of ±0.010” per flange
- That means the outside flanges that have one bend controlling their dimension will have a tolerance of ±0.010”
- The middle flange which has two bends controlling its dimension will have a tolerance of ±0.020”

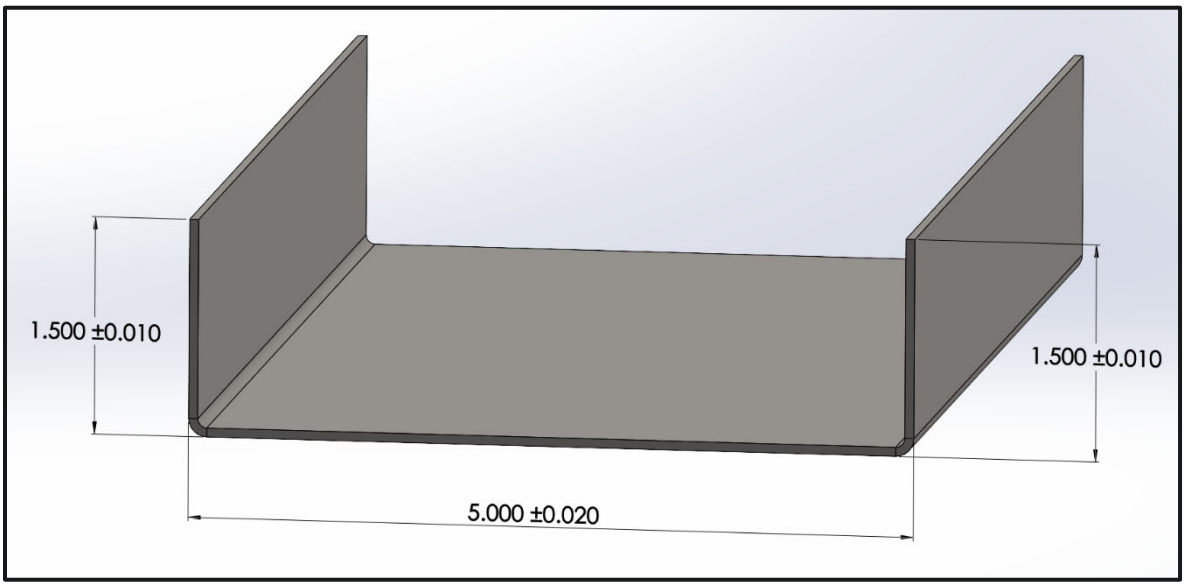

Figure 7 - Bend tolerances on sample part

Bending Guide – General Info

At GA Industries, we utilize the air bending process to form flanges on sheet metal parts. Air bending involves placing the part on a V-die and against a back gauge to control the flange length. Afterwards, a punch is driven down into the part to a specific depth in the V-die. Different angles are achieved by driving the punch to different depths in the V-die.

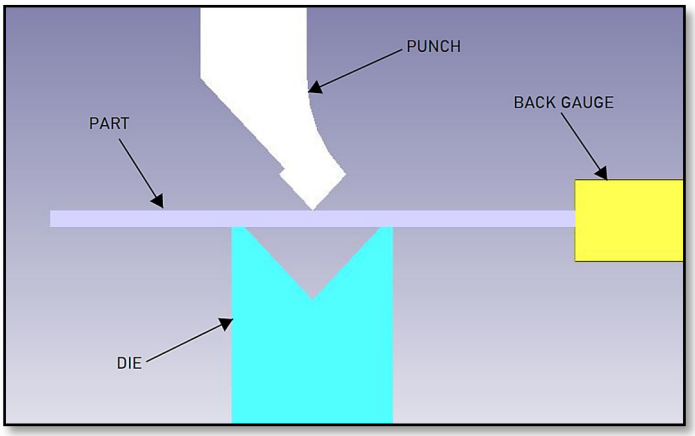

Figure 8 - Diagram and names of components

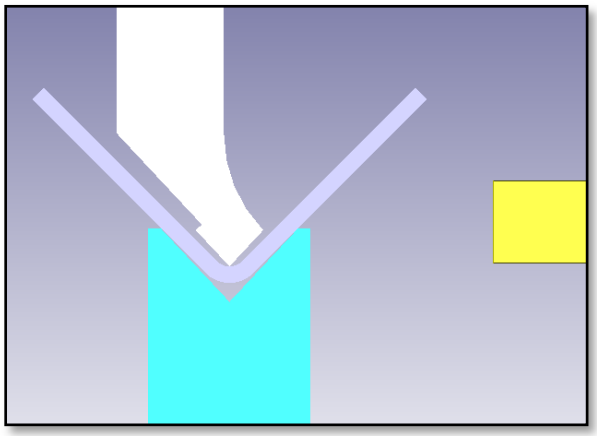

Figure 9 - Bending in process

The inside radius (IR) of the bend is generally controlled by the size of the V-die opening. The smaller the die, the smaller the radius. Keep in mind that decreasing the size of the die will increase the tonnage required to complete the bend; there is a limit on how small an IR can be achieved on any given part. Other factors that affect the tonnage requirements (which in turn limit the die size) are:

- **Material type:** Stainless steel requires more tonnage than aluminum
- **Material thickness:** Thicker materials require more tonnage
- **Length of bend:** Longer bends require more tonnage

Even if the tonnage requirement is met when using the smallest possible die, the fabricator runs the risk of leaving deep tool marks on the part surface, which cannot be refinished in many cases. In general, these factors are why parts should be designed with IRs equal to or larger than material thickness, and why IR tolerances should be undefined (or at least kept loose). This allows the fabricator to have the freedom to choose the best tooling options when forming parts.

Bending Guide - Bend Tables

To make designing parts easier, we have summarised our suggested IR for the sheet thicknesses we offer in the following tables. These tables give the necessary information to ensure that part can be fabricated.

Larger inside radii can be achieved for each of the thicknesses in the tables, but keep in mind that this constitutes a larger die which will increase minimum flange lengths. If a part requires a larger IR, please contact GA and we will be glad to assist in the design process.

The following terminology is used in tables 1 and 2:

Thickness (A): Nominal material thickness
IR (B): Inside radius
Maximum Length of Bend: Maximum distance of bend across the part
Minimum Flange Length (C): Minimum length of flange to bend without issues
Minimum Offset Distance (D): Minimum length for additional bends to avoid conflicts with the die
Overbend Max Angle: Maximum angle when bending past 90°
Overbend Max Length: Maximum length of bend when bending past 90°
Tolerance Per Flange: General bend tolerance (per individual bend)

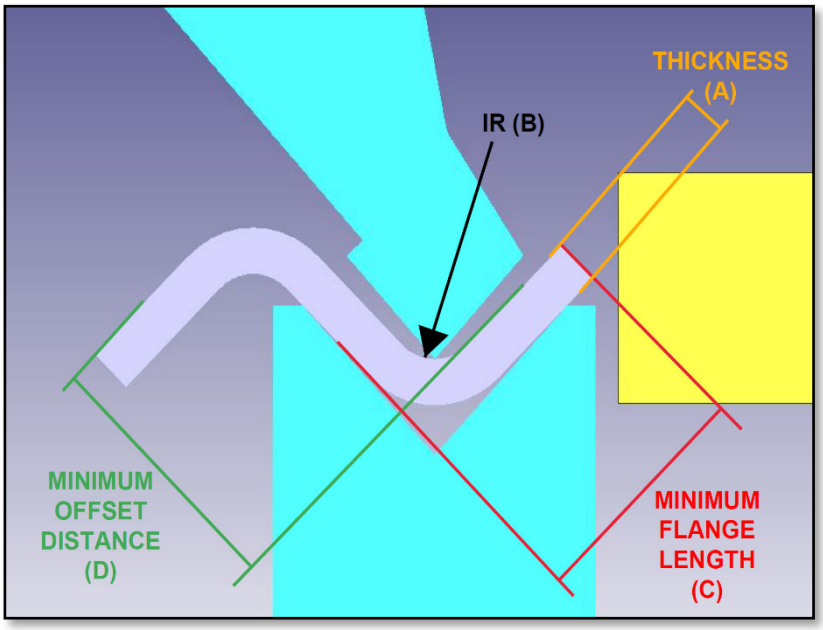

Figure 10 - Additional bending terminology

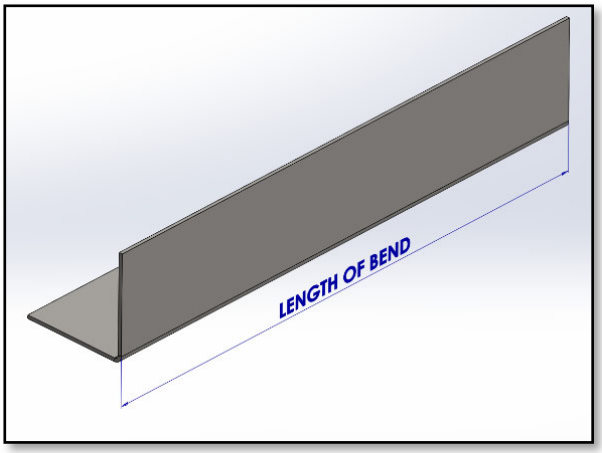

Figure 11 - Length of bend reference

Bending Guide – Table 1 (Stainless)

STAINLESS STEEL (304,316,430)							
UNITS: INCHES [MM]							
THICKNESS (A)	IR (B)	MAXIMUM LENGTH OF BEND	MINIMUM FLANGE LENGTH (C)	MINIMUM OFFSET DISTANCE (D)	OVERBEND MAX ANGLE	OVERBEND MAX LENGTH	TOLERENCE PER FLANGE
0.032 [0.8]	0.032 [0.8]	65.75 [1670]	0.175 [4.4]	0.340 [8.6]	45°	60 [1524]	±0.005
	0.055 [1.4]	120.00 [3048]	0.225 [5.7]	0.363 [9.2]	35°	33 [832]	
	0.078 [2.0]	75.00 [1905]	0.300 [7.6]	0.376 [9.5]	50°	70 [1778]	
0.036 [0.9]	0.036 [0.9]	65.75 [1670]	0.175 [4.4]	0.348 [8.8]	45°	60 [1524]	
	0.059 [1.5]	120.00 [3048]	0.225 [5.7]	0.371 [9.4]			
	0.070 [1.8]	75.00 [1905]	0.300 [7.6]	0.372 [9.4]	50°	70 [1778]	
0.048 [1.2]	0.048 [1.2]	120.00 [3048]	0.225 [5.7]	0.372 [9.4]	35°	33 [832]	
	0.100 [2.5]	75.00 [1905]	0.350 [8.9]	0.443 [11.3]			
	0.150 [3.8]	75.00 [1905]	0.400 [10.2]	0.533 [13.5]			
0.063 [1.6]	0.063 [1.6]	75.00 [1905]	0.300 [7.6]	0.392 [10.0]	50°	70 [1778]	±0.010
	0.078 [2.0]	120.00 [3048]	0.350 [8.9]	0.436 [11.1]			
	0.115 [2.9]	120.00 [3048]	0.550 [14.0]	0.611 [15.5]	55°	100 [2540]	
0.078 [2.0]	0.078 [2.0]	120.00 [3048]	0.335 [8.5]	0.451 [11.5]	35°	33 [826]	
	0.100 [2.5]	75.00 [1905]	0.400 [10.2]	0.513 [13.0]			
	0.125 [3.2]	120.00 [3048]	0.550 [14.0]	0.636 [16.2]	55°	100 [2540]	
0.105 [2.7]	0.100 [2.5]	75.00 [1905]	0.450 [11.4]	0.599 [15.2]			
	0.130 [3.3]	120.00 [3048]	0.550 [14.0]	0.668 [17.0]			
	0.150 [3.8]	120.00 [3048]	0.575 [14.6]	0.735 [18.7]			
0.125 [3.2]	0.125 [3.2]	75.00 [1905]	0.550 [14.0]	0.683 [17.3]	55°	80 [2032]	±0.015
	0.156 [4.0]	120.00 [3048]	0.575 [14.6]	0.761 [19.3]			
	0.172 [4.4]	120.00 [3048]	0.700 [17.8]	0.878 [22.3]			
0.135 [3.4]	0.135 [3.4]	100.00 [2540]	0.575 [14.6]	0.750 [19.1]			
	0.156 [4.0]	120.00 [3048]	0.700 [17.8]	0.872 [22.1]	50°	100 [2540]	
	0.188 [4.8]	120.00 [3048]	0.700 [17.8]	0.904 [22.9]			
0.188 [4.8]	0.188 [4.8]	65.50 [1664]	0.875 [22.2]	1.557 [39.5]			
	0.266 [6.8]	65.50 [1664]	0.875 [22.2]	1.635 [41.5]			
	0.313 [8.0]	115.00 [2921]	1.400 [35.6]	1.682 [42.7]			
0.250 [6.4]	0.250 [6.4]	63.50 [1613]	1.125 [28.6]	1.681 [42.7]			±0.025
	0.300 [7.6]	83.00 [2108]	1.400 [35.6]	1.731 [44.0]			
	0.406 [10.3]	74.00 [1880]	1.400 [35.6]	1.837 [46.7]			
0.313 [8.0]	0.438 [11.1]	32.75 [832]	1.800 [45.7]	2.326 [59.1]			±0.032
0.375 [9.5]	0.625 [15.9]	16.25 [413]	2.250 [57.2]	3.245 [82.4]			
	0.750 [19.1]	32.75 [832]	2.800 [71.1]	3.290 [83.6]			
	1.000 [25.4]	32.75 [832]	2.800 [71.1]	3.540 [89.9]			

Bending Guide – Table 2 (Aluminum)

ALUMINUM (5052)							
UNITS: INCHES [MM]							
THICKNESS (A)	IR (B)	MAXIMUM LENGTH OF BEND	MINIMUM FLANGE LENGTH (C)	MINIMUM OFFSET DISTANCE (D)	OVERBEND MAX ANGLE	OVERBEND MAX LENGTH	TOLERENCE PER FLANGE
0.032 [0.8]	0.030 [0.8]	120.0 [3048]	0.225 [5.7]	0.338 [8.6]	35°	32.75 [832]	±0.005
0.040 [1.0]	0.030 [0.8]	120.0 [3048]	0.225 [5.7]	0.346 [8.8]	35°	32.75 [832]	
	0.035 [0.9]	75.0 [1905]	0.300 [7.6]	0.341 [8.7]	50°	70.00 [1778]	
	0.094 [2.4]	75.0 [1905]	0.400 [10.2]	0.469 [11.9]			
0.050 [1.3]	0.030 [0.8]	65.5 [1664]	0.175 [4.4]	0.356 [9.0]	45°	60.00 [1524]	
	0.032 [0.8]	120.0 [3048]	0.225 [5.7]	0.358 [9.1]			
	0.050 [1.3]	120.0 [3048]	0.300 [7.6]	0.366 [9.3]	50°	100.00 [2540]	
0.060 [1.5]	0.030 [0.8]	120.0 [3048]	0.225 [5.7]	0.366 [9.3]	35°	32.75 [832]	±0.010
	0.060 [1.5]	75.0 [1905]	0.225 [5.7]	0.396 [10.0]			
	0.080 [2.0]	75.0 [1905]	0.300 [7.6]	0.406 [10.3]			
0.080 [2.0]	0.031 [0.8]	120.0 [3048]	0.225 [5.7]	0.387 [9.8]			
	0.047 [1.2]	75.0 [1905]	0.350 [8.9]	0.422 [10.7]	35°	32.50 [826]	
	0.063 [1.6]	75.0 [1905]	0.350 [8.9]	0.438 [11.1]			
	0.125 [3.2]	120.0 [3048]	0.550 [14.0]	0.638 [16.2]			
0.090 [2.3]	0.065 [1.7]	75.0 [1905]	0.350 [8.9]	0.450 [11.4]	35°	32.50 [826]	
	0.090 [2.3]	75.0 [1905]	0.400 [10.2]	0.515 [13.1]			
0.100 [2.5]	0.063 [1.6]	75.0 [1905]	0.350 [8.9]	0.458 [11.6]			
	0.090 [2.3]	75.0 [1905]	0.400 [10.2]	0.525 [13.3]			
	0.095 [2.4]	120.0 [3048]	0.550 [14.0]	0.628 [16.0]	55°	100.00 [2540]	
0.125 [3.2]	0.109 [2.8]	75.0 [1905]	0.450 [11.4]	0.628 [15.9]			±0.015
	0.125 [3.2]	120.0 [3048]	0.550 [14.0]	0.683 [17.3]			
	0.250 [6.4]	80.0 [2032]	0.575 [14.6]	0.855 [21.7]			
0.157 [4.0]	0.125 [3.2]	120.0 [3048]	0.550 [14.0]	0.715 [18.2]			
0.188 [4.8]	0.090 [2.3]	75.0 [1905]	0.700 [17.8]	0.859 [21.8]			
	0.125 [3.2]	65.5 [1664]	0.875 [22.2]	1.494 [37.9]			
	0.157 [4.0]	95.0 [2413]	1.125 [28.6]	1.526 [38.8]			
	0.250 [6.4]	80.0 [2032]	1.125 [28.6]	1.619 [41.1]			
0.250 [6.4]	0.195 [5.0]	65.5 [1664]	0.875 [22.2]	1.626 [41.3]			±0.025
	0.250 [6.4]	65.5 [1664]	0.875 [22.2]	1.681 [42.7]			

Bending Guide – Design and Limitations

Minimum Flange Length

The whole flange must reach both sides of the die to be bent. Breaking this rule will cause deformation and unbent sections, which in turn will affect the consistency and accuracy of the part. Cut-outs (holes, slots, etc..) on the flange must also be positioned at least the minimum flange length away from the bend or they will also deform. See page 15 for additional details.

Minimum Offset Distance

Depending on the size of the die used, the length of offset available is limited. See figure that shows the conflict between a bent part and the die.

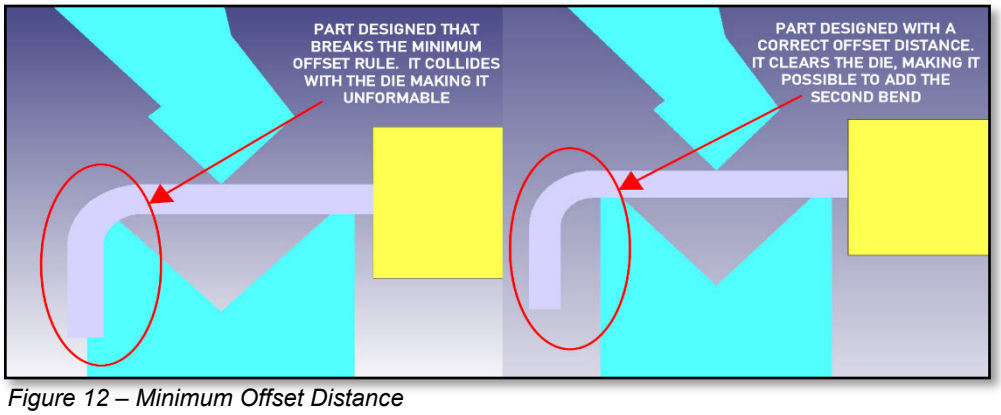

Figure 12 – Minimum Offset Distance

Bend Tolerancing

Bending sheet metal causes a controlled and uncontrolled side when it comes to tolerancing. Details about this can be found earlier on page 9. The tolerances provided in tables 1 and 2 of pages 12 and 13 indicate the tightest tolerance range ***per flange*** for each thickness of material.

Oversquare Parts

Return flanges are limited based on the punch tooling size and shape. In general, do not design square and oversquare parts. Figure 15 below shows how an oversquare part collides with the punch.

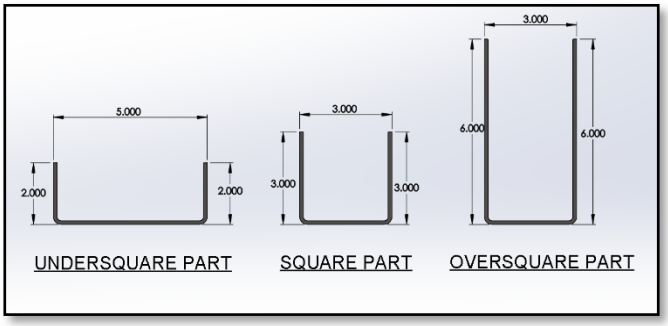

Figure 15 - Different bend variations

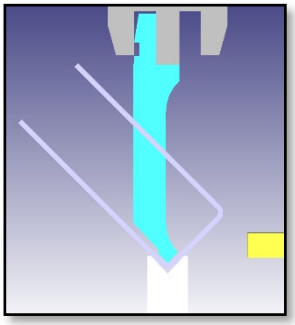

Figure 16 - Oversquare part

We do carry gooseneck punches that allow for certain oversquare profiles. Generally, most oversquare profiles under 3” by 3” are achievable.

Bending Guide – Design and Limiations Cont'd.

Features too close to bends

Holes/Slots and other features that are in close proximity to a bend may become distorted. Splitting the bend (as shown in right image below) will avoid this issue – if a smooth radius is required, the split section can be welded and finished to match the bend radius. Other options include reaming out holes after forming, changing the radius or feature location, etc.

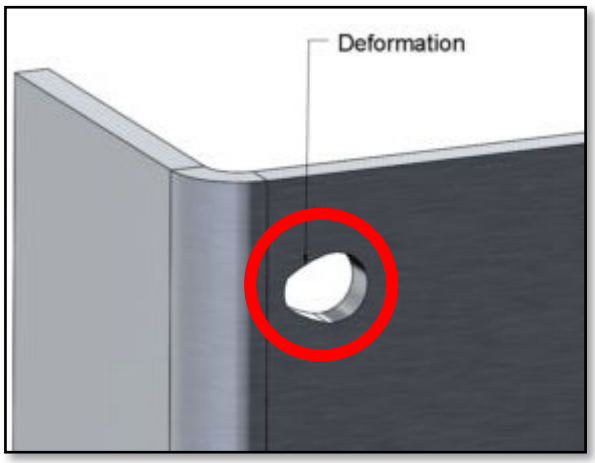

Figure 13 - Deformed hole due to bend

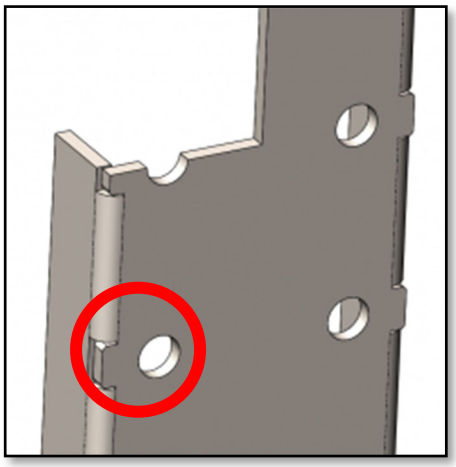

Figure 14 - Split section to prevent deformation

Drawing Tolerance Rounding

As per example below, the rounding of the drawing already takes the part out of spec as the actual model is designed to 7.005". If we fabricated to exactly 7.005", we would already be out of tolerance based on the drawing (with -.00" lower tolerance). Please keep in mind rounding errors when using tolerances; symmetrical tolerancing is preferred. More details on the mating component will assist with passing quality control.

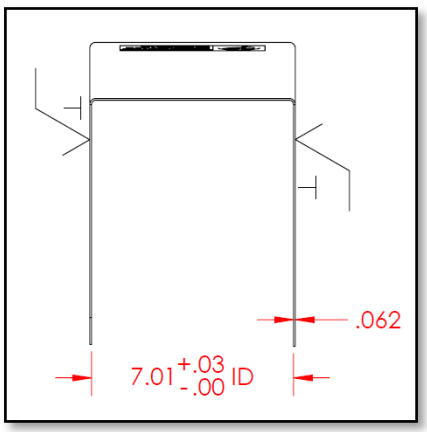

Figure 15 - Drawing with rounded tolerance

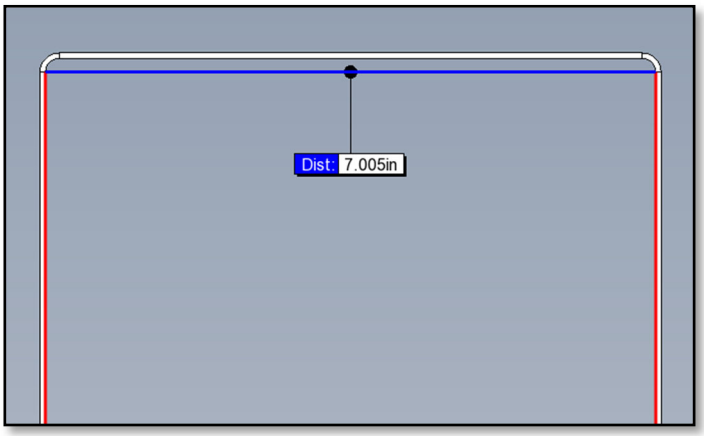

Figure 16 - Actual part model dimension

Bending Guide – Bending Features

GA Industries offer multiple types of bending features, including:

Overbending

Overbending is when a bend goes past 90°. Overbending is more restrictive in the tooling options available which will limit the IRs available. Also, keep in mind the minimum flange length for overbends is larger because the punch needs to go deeper into the die to achieve the required angle. See the tables on pages 12 and 13 for the available options for overbending.

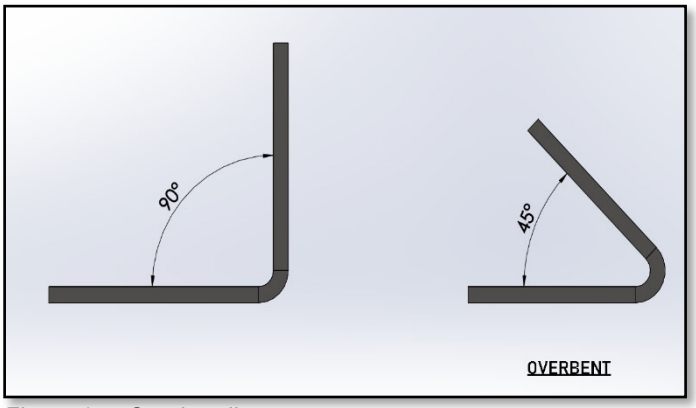

Figure 17 - Overbending

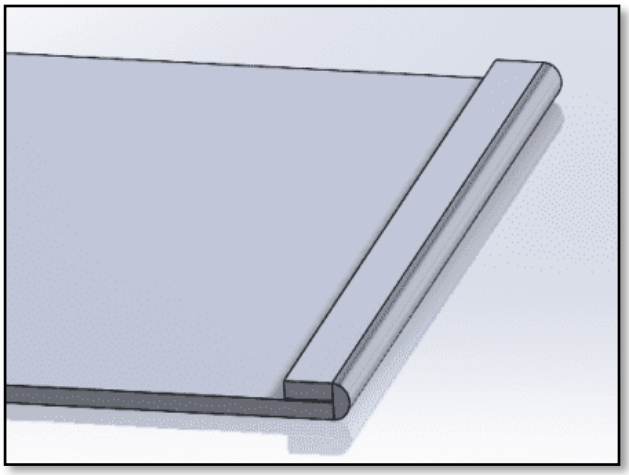

Figure 18 - Flat / Closed Hem

Hems

We offer hems on parts up to 0.063” thick stainless (thicker stainless requires tonnage that is over machine capacities) and 0.048” aluminum (thicker aluminum cracks). Hems are excellent for avoiding sharp edges when necessary, such as wire protection or to increase durability due to the thicker edge. On thicker parts we recommend edge rounding instead. Keep in mind hems are not easily controlled and should not be given a tight tolerance, a ±0.025” tolerance is suggested.

Bridge Lances

At GA Industries we can add lance features to sheet metal products. These features can be used as locators, card guides, dividers, ventilation, and wire tie downs. They do require custom tooling that we design and make in house. The limitations and details change from one application to the next. If a specific lance feature is required, please feel free to contact us.

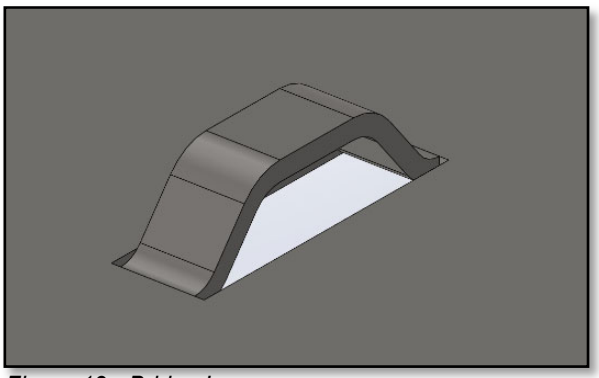

Figure 19 - Bridge Lance

Surface Finishing / Grain Direction

Approximate Surface roughness Conversion table

RA (µin)	RA (µm)	Grit[1]	Finish # [2]	Common Name	Notes
250	8.3	60	#1	Mill Finish	
125	3.2	-	-	-	
63	1.6	120	#4	Commercial #4	
32	0.8	180		ANSI #4 Sanitary Finish	
16	0.4	240-320	-	-	
8	0.2	400	#8	Mirror Finish	Contact GA for availabilty
4	0.1	500+			
2	0.05			Supermirror Finish	
1	0.025				

[1] Grit is dependent on multiple factors, including alloy, existing finish quality, condition of abrasives, abrasive material, etc. Typically, a higher grit than listed is required to achieve the finish/RA required

[2] 2B finish (not shown in table) can range from 12RA to 40RA (µin), or 0.3RA to 1RA (µm) depending on thickness/quality

Grain Direction

- In most cases, the preferred direction of brushing is along the longitudinal length of the part. This is due to machine capacities, size of part, surface finish requirement, etc. There are exceptions such as cosmetic requirements, as well as preferred grain for formed pieces (case by case)

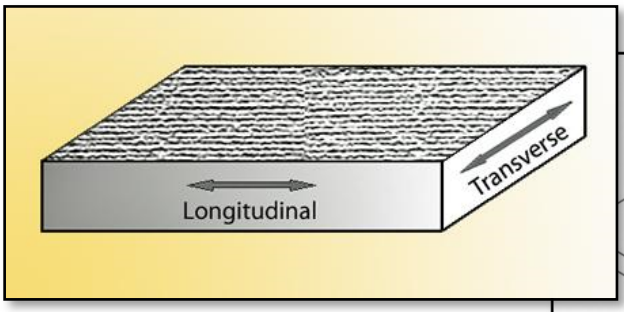

Figure 20 - Preferred grain direction

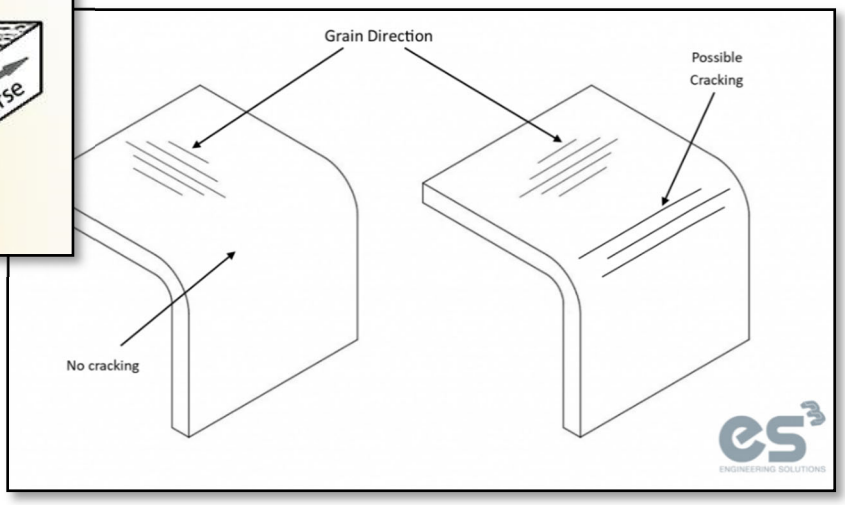

Figure 21 - Grain direction when bending

Machining Design

Sharp/Tight Internal Angles

Machining sharp/tight internal angles can be time-consuming due to the nature of CNC cutting bits being round. Increase the corner radii, or use dogbones (see right most image in below figure)

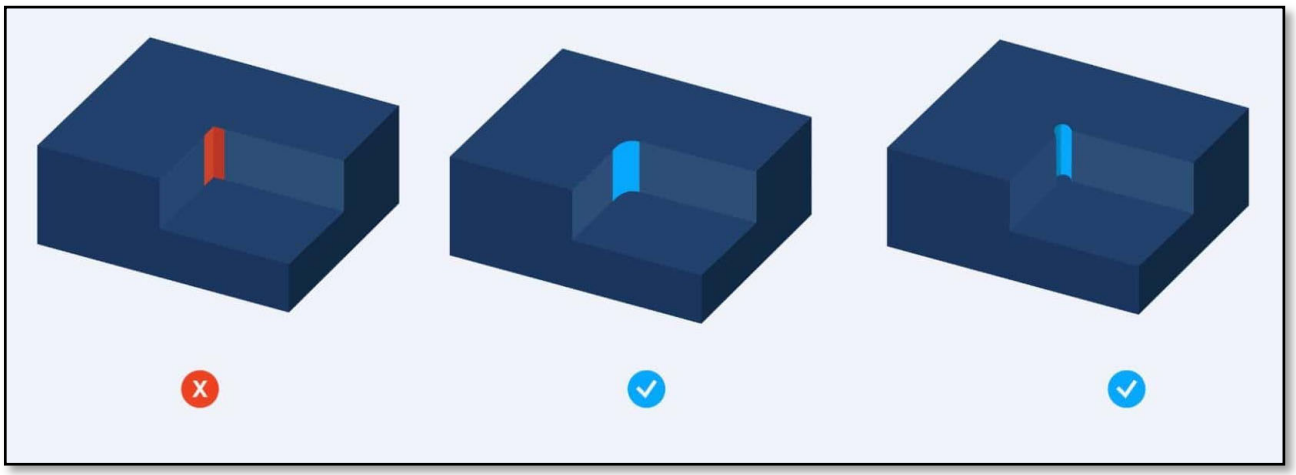

Figure 22 - Sharp/Tight Internal Angles

Thin walls

Thin walls causes chatter in metals, and possible warping in plastics which affects dimensions and surface finish As a rule of thumb, use a width-to-height ratio of 3:1 if a thin wall must be implemented. Adding a draft can assist in ridgidty of the wall.

Figure 23 - Thin walls

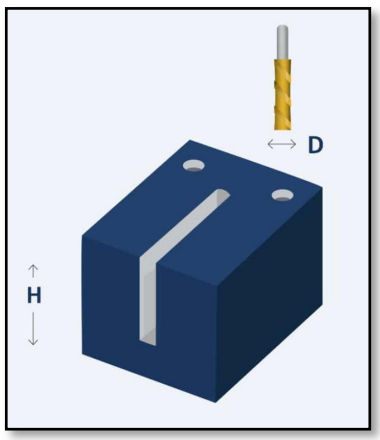

Figure 24 - Deep features

Deep features

Deep Cavities, holes, and threads can damage both the part and the tool due to chatter, lack of chip evacuation (clogs), tool deflection and even fracturing. Avoid deep cavities where possible by leaving more clearance for steps, counterbores, etc. Generally, the depth “H” should be no greater than 3x the diameter “D” of the smallest tool required to finish the feature (see figure 28).

Hardware Insertion Materials and Coatings

GA Industries utilizes PEM brand self-clinching fasteners for quality and consistency. Fastener types include self-clinching nuts, studs, standoffs, and more. When selecting fasteners for parts,

Material Selection

	PEM Material and Cost[1]			
	$	$$	$$	$$$
Part Material	Zinc Plated Carbon Steel	Stainless Steel	Aluminum	Hardened Stainless Steel
Steel	Yes	Yes	Yes[2]	Yes
Stainless Steel (300 series)	Yes	No	No	Yes
Stainless Steel (400 series)	Yes	No	No	Yes
Aluminum	Yes[3]	Yes[3]	Yes[2]	Yes[3]
Copper	Yes	Yes	No	Yes

[1] Price comparison for estimation; costs are affected by size and availability
[2] For alloys that are HRB 50 / HB 82 or less
[3] If part requires anodizing or chromate conversion, fasteners will be installed after anodizing. Depending on part clearances, inserting fasteners afterwards may not be possible and alternatives will need to be considered.

Figure 25 - Assortment of PEM fasteners

Hardware Insertion Design Recommendations

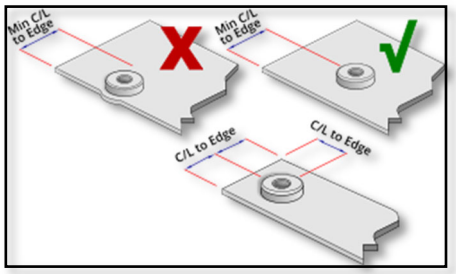

Figure 26 - Distance to edge

Distance to edge

Ensure there is ample space between the edge of the part and the fastener as material will deform and bulge otherwise. This dimension is available on PEM datasheets.

Formed Features

When placing fasteners close to bends, check the overall diameter confirm that the fastener does not conflict with the bend. In addition, note that additional space is required for the tooling to fit around the fastener.

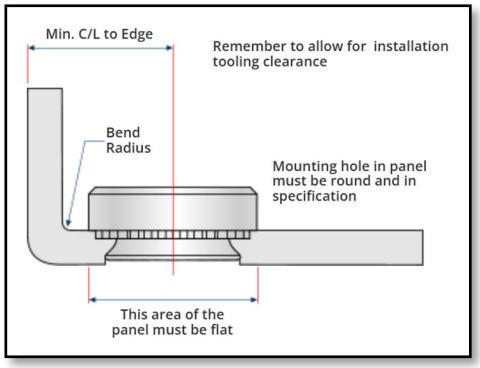

Figure 27 - Distance to formed features

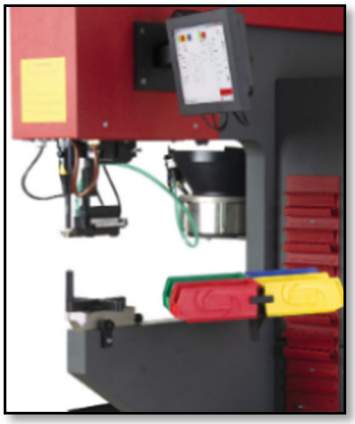

Figure 28 - Tooling Clearance in Pemsetter

Tooling Clearance

Pem fasteners are inserted using tooling in a Pemsetter. A stationary tool sits on the bottom frame to hold the fastener, while a flat anvil on the top frame applies the required force to seat the fastener into the part. This requires space under and above the fastener for proper installation, which must be considered when designing parts. Other holders are available for difficult to reach positions.

Fastener Proximity

If multiple fasteners are required in close proximity, check the spacing in between the fasteners to ensure that deformation from installing does not affect the installation of other fasteners. The calculation for minimum center to center distance is as follows;

Minimum center to center distance
= Min. Centerline to edge + (Diameter of second hole / 2)

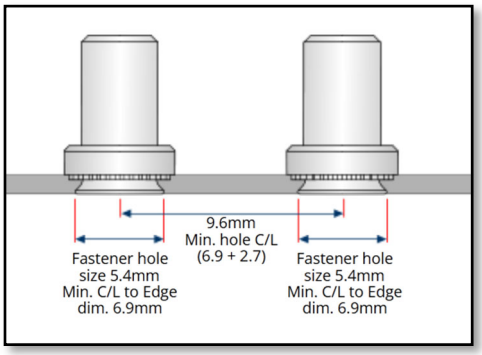

Figure 29 - Distance between fasteners

GA Industries Machine Capabilities

Below machine and capacities are standard services we provide at GA Industries. There are exceptions due to limiting factors in part design, however, there are other solutions we can offer if such situation arises.

Cutting

Machine	Size Capacity	Materials
Waterjet	≤ 5’ x 10’ sheet*	Steel, Stainless, Aluminum, Copper, Brass, Various Plastics (Acetal, UHMW, etc.), Rubber, Foam, Wood
Laser (Sheet)	≤ 5’ x 10’ sheet	Steel, Stainless, Aluminum, Copper
Laser (Tube)	≤ 20’ length Round tube Dia. 0.625” – 8.75” Square/Rect tube 0.75” – 6” Angle ≤ 6” x 6”	Steel, Stainless, Aluminum

Machining

Machine	Size Capacity	Accessories
CNC Lathe	Turning Diameter ≤ 19.7” Turning length ≤ 23.6”	Sub-Spindle Live Tooling 3” Bar feeder
CNC Mill	Working Envelope (L x W x H): 96” x 86” x 48”	5-axis machining

Finishing

Machine	Description
Vibratory	Breaks edges and creates uniform finish on smaller sheet metal or machined components
Uniform finish (sheet metal)	Breaks edges and creates uniform finish on sheet metal components
Finish #4 (architectural, food grade)	Creates brushed finish to requested surface roughness

GA Industries Machine Capabilities Cont'd

Forming

Machine	Size Capacity
Pressbrake	10' long ≤ 146 US tons
Slip Roller	≤ 5' wide ≤ 0.135" thick for Stainless Steel *Contact GA Industries for available radius

Hardware Insertion

Machine	Size Capacity
Heager Pemsetter	24" throat depth ≤ 11 US tons
Pneumatic (Rivets/rivnuts)	N/A

Welding

Machine
GMAW (MIG)
GTAW (TIG)
RSW (Spot)
CD (Studs)

Passivation

Machine	Description
TIG Brush	Removes discolouration and restores protective chromium oxide layer after welding without mechanical action

Laser etching

Machine	Size Capacity	Materials
Fiber / CO2	40" x 28" etching envelope Etching also available during laser cutting (limited graphics)	**Avoid:** PVC, PC/Lexan, ABS, HDPE, Foam, Fiberglass, Coated Carbon Fiber

GA INDUSTRIES

Sheet metal Tolerances

Stainless steel

Dimensions
Nominal Thickness

Thickness		Tolerance	
Inch	MM	Imperial	MM
0.018”	0.46	+/- 0.0015”	+/- 0.04
0.024”	0.64	+/- 0.0015”	+/- 0.04
0.030”	0.76	+/- 0.0020”	+/- 0.05
0.036”	0.91	+/- 0.0020”	+/- 0.05
0.048”	1.22	+/- 0.0030”	+/- 0.08
0.060”	1.52	+/- 0.0030”	+/- 0.08
0.075”	1.91	+/- 0.0040”	+/- 0.10
0.103”	2.6	+/- 0.005”	+/- 0.13
0.120”	3.1	+/- 0.005”	+/- 0.13
0.135”	3.4	+/- 0.006”	+/- 0.15
0.188”	4.8	+/- 0.007”	+/- 0.18

Aluminum

Dimensions
Nominal Thickness

Thickness		Tolerance	
Inch	MM	Imperial	MM
0.025”	0.64	+/- 0.0030”	+/- 0.08
0.032”	0.81	+/- 0.0035”	+/- 0.09
0.040”	1.02	+/- 0.0045”	+/- 0.11
0.050”	1.27	+/- 0.0050”	+/- 0.13
0.063”	1.60	+/- 0.0050”	+/- 0.13
0.080”	2.03	+/- 0.0060”	+/- 0.15
0.090”	2.29	+/- 0.0060”	+/- 0.15
0.100”	2..5	+/- 0.007”	+/- 0.18
0.125”	3.2	+/- 0.007”	+/- 0.18
0.160”	4.1	+/- 0.011”	+/- 0.28
0.190”	4.8	+/- 0.011”	+/- 0.28

Copper

Dimensions
Nominal Thickness

Thickness		Tolerance	
Inch	MM	Imperial	MM
0.021”	0.5	+/- 0.0015”	+/- 0.04
0.043”	1.1	+/- 0.0030”	+/- 0.08
0.049”	1.2	+/- 0.0030”	+/- 0.08
0.065”	1.6	+/- 0.0050”	+/- 0.13
0.086”	2.2	+/- 0.0060”	+/- 0.15
0.125”	3.1	+/- 0.007”	+/- 0.18
0.187”	4.8	+/- 0.011”	+/- 0.28

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Line card
Stock material

Aluminum Type 5052

- North America 5052 / UNS A95052
- Europe EN AW-AlMg2(B)
- Japan 5052

Dimensions
Nominal Thickness

Imperial		Metric	
GA	Inch	MM	Sheet size
20	0.032”	0.8	48” x 96”
18	0.040”	1.0	48” x 96”
16	0.050”	1.3	60” x 120”
14	0.063”	1.6	60” x 120”
12	0.080”	2.0	60” x 120”
11	0.090”	2.3	60” x 120”
1/8”	0.125”	3.1	60” x 120”
4/25”	0.160”	4.1	60” x 120”
3/16”	0.190”	4.8	60” x 120”
1/4”	0.250”	6.3	60” x 120”

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LINE CARD
STOCK MATERIAL

Aluminum Type 6061

- North America 6061 / UNS AA6061
- Europe EN AW-AlMg1SiCu
- Japan 6061

Dimensions
Nominal Thickness

Imperial		Metric	
GA	Inch	MM	Sheet size
22	0.025”	0.6	60” x 120”
20	0.032”	0.8	48” x 96”
18	0.040”	1.0	48” x 96”
16	0.050”	1.3	60” x 120”
14	0.063”	1.6	60” x 120”
12	0.080”	2.0	60” x 120”
11	0.090”	2.3	60” x 120”
1/8”	0.125”	3.1	60” x 120”
4/25”	0.160”	4.1	60” x 120”
3/16”	0.190”	4.8	60” x 120”

Dimensions
Nominal Thickness

Imperial		Metric	
GA	Inch	MM	Sheet size
1/4”	0.250”	6.3	60” x 120”
5/16”	0.313”	8.0	48” x 96”
3/8”	0.375”	9.5	60” x 120”
1/2”	0.500”	12.7	60” x 120”
5/8”	0.625”	15.9	60” x 120”
3/4”	0.750”	19.1	60” x 120”
1.0”	1.000”	25.4	60” x 120”
1-1/4”	1.250”	31.8	60” x 120”
1-1/2”	1.500”	38.1	60” x 120”
2.0”	2.000”	50.8	60” x 120”

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LINE CARD
STOCK MATERIAL

Stainless Steel Type 304

- North America AISI 304 / AISI/SAE 304 / S30400
- Europe 1.4301
- Japan SUS304
- International 4301

Finish #4

Dimensions
Nominal Thickness

Imperial		Metric	
GA	Inch	MM	Sheet size
26	0.018”	0.5	48” x 96”
24	0.024”	0.6	48” x 96”
22	0.030”	0.8	48” x 96”
20	0.036”	1.0	48” x 120”
18	0.048”	1.2	60” x 120”
16	0.060”	1.5	60” x 120”
14	0.078”	2.0	60” x 120”
12	0.102”	2.5	60” x 120”
11	0.120”	3.0	60” x 120”
10	0.135”	3.5	60” x 120”

Finish #2B

Dimensions
Nominal Thickness

Imperial		Metric	
GA	Inch	MM	Sheet size
26	0.018”	0.5	48” x 96”
24	0.024”	0.6	48” x 96”
22	0.030”	0.8	48” x 96”
20	0.036”	1.0	48” x 120”
18	0.048”	1.2	60” x 120”
16	0.060”	1.5	60” x 120”
14	0.078”	2.0	60” x 120”
12	0.102”	2.5	60” x 120”
11	0.120”	3.0	60” x 120”
10	0.135”	3.5	60” x 120”
7	0.188”	4.75	60” x 120”

Finish #1 (Mill)

Dimensions
Nominal Thickness

Imperial		Metric	
Fraction	Inch	MM	Sheet size
7	0.188”	4.7	60” x 120”
1/4”	0.250”	6.3	60” x 120”
5/16”	0.313”	8.0	48” x 120”
3/8”	0.375”	9.5	60” x 120”
1/2”	0.500”	12.7	60” x 120”
5/8”	0.625”	15.9	60” x 120”
3/4”	0.750”	19.1	60” x 120”
1”	1.000”	25.4	60” x 120”
1-1/4”	1.250”	31.8	60” x 120”
1-1/2”	1.500”	38.1	60” x 120”
2”	2.000”	50.8	60” x 120”

#4 - finish is supplied standard with PVC protection
#2B - finish can be supplied with or without PVC protection
- Other finishes or sheet sizes available

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GA INDUSTRIES

LINE CARD
STOCK MATERIAL

Stainless Steel Type 316

- North America AISI 316 / AISI/SAE 316 / S31600
- Europe 1.4401 / 14436
- Japan SUS316
- International 4401 / ISO 4436

Finish #4

Dimensions
Nominal Thickness

Imperial		Metric	
GA	Inch	MM	Sheet size
26	0.018”	0.5	48” x 96”
24	0.024”	0.6	48” x 96”
22	0.030”	0.8	48” x 96”
20	0.036”	1.0	48” x 120”
18	0.048”	1.2	60” x 120”
16	0.060”	1.5	60” x 120”
14	0.078”	2.0	60” x 120”
12	0.102”	2.5	60” x 120”
11	0.120”	3.0	60” x 120”
10	0.135”	3.5	60” x 120”

Finish #2B

Dimensions
Nominal Thickness

Imperial		Metric	
GA	Inch	MM	Sheet size
26	0.018”	0.5	48” x 96”
24	0.024”	0.6	48” x 96”
22	0.030”	0.8	48” x 96”
20	0.036”	1.0	48” x 120”
18	0.048”	1.2	60” x 120”
16	0.060”	1.5	60” x 120”
14	0.078”	2.0	60” x 120”
12	0.102”	2.5	60” x 120”
11	0.120”	3.0	60” x 120”
10	0.135”	3.5	60” x 120”
7	0.188”	4.75	60” x 120”

Finish #1 (Mill)

Dimensions
Nominal Thickness

Imperial		Metric	
Fraction	Inch	MM	Sheet size
7	0.188”	4.7	60” x 120”
1/4”	0.250”	6.3	60” x 120”
5/16”	0.313”	8.0	48” x 120”
3/8”	0.375”	9.5	60” x 120”
1/2”	0.500”	12.7	60” x 120”
5/8”	0.625”	15.9	60” x 120”
3/4”	0.750”	19.1	60” x 120”
1”	1.000”	25.4	60” x 120”
1-1/4”	1.250”	31.8	60” x 120”
1-1/2”	1.500”	38.1	60” x 120”
2”	2.000”	50.8	60” x 120”

#4 - finish is supplied standard with PVC protection
#2B - finish can be supplied with or without PVC protection
- Other finishes or sheet sizes available

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GA Industries

LINE CARD
STOCK MATERIAL

Stainless Steel Type 430

- North America AISI 430 / AISI/SAE 430 / S43000
- Europe 1.4016
- Japan SUS430
- International 4016

Finish #4

Dimensions
Nominal Thickness

Imperial		Metric	
GA	Inch	MM	Sheet size
20	0.036”	1.0	48” x 120”
18	0.048”	1.2	48” x 120”
16	0.060”	1.5	48” x 120”
14	0.078”	2.0	48” x 120”
12	0.102”	2.5	48” x 120”
11	0.120”	3.0	48” x 120”

Finish #2B

Dimensions
Nominal Thickness

Imperial		Metric	
GA	Inch	MM	Sheet size
20	0.036”	1.0	48” x 120”
18	0.048”	1.2	48” x 120”
16	0.060”	1.5	48” x 120”
14	0.078”	2.0	48” x 120”
12	0.102”	2.5	48” x 120”
11	0.120”	3.0	48” x 120”

#4 - finish is supplied standard with PVC protection
#2B - finish can be supplied with or without PVC protection
- Other finishes or sheet sizes available

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GA Industries

LINE CARD
STOCK MATERIAL

Copper C11000

- North America UNS C11000 / CDA 110 ETP / C110
- International ISO Cu-ETP
- Japan XXX
- British BS C101

Sheet

Dimensions
Nominal Thickness

Imperial			Metric	
OZ	GA	Inch	MM	Sheet size
16	24	0.021"	0.5	36" x 96"
32	19	0.043"	1.1	36" x 96"
36	18	0.049"	1.2	36" x 96"
48	16	0.065"	1.6	36" x 96"
64	14	0.086"	2.2	36" x 96"
96	10	0.125"	3.1	36" x 96"
./.	./.	0.187"	4.8	36" x 96"

Flat bar

Dimensions
Nominal Thickness

Imperial		Metric	
Fraction	Inch	MM	Width
1/8"	0.125"	3.2	various
1/4"	0.250"	6.3	various
5/16"	0.313"	8.0	various
3/8"	0.375"	9.5	various
1/2"	0.500"	12.7	various
5/8"	0.625"	15.9	various
3/4"	0.750"	19.1	various
1"	1.000"	25.4	various

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https://www.aaaairsupport.com/
https://www.es3.co.nz/
https://www.fastradius.com/resources/
https://fastenerengineering.com/
http://www.npfasteners.com/
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