Designing for Sheet Metal Parts

Sheet Metal Fabrication with Fathom Manufacturing

Fathom Manufacturing offers several sheet metal fabrication processing including cutting, etching, punching and more. **Contact us today to get started on your project!**

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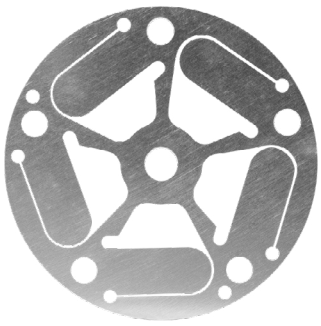

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At Fathom we offer a unique advantage of speed and agility. Our experts help companies go from concept to prototype to manufacturing in ways not previously possible.

25 Different Manufacturing Processes

7 Additive Technologies

530+ Mills, Lathes, Presses, Press Brakes, Turret Punches & Additive Systems

Contact Us

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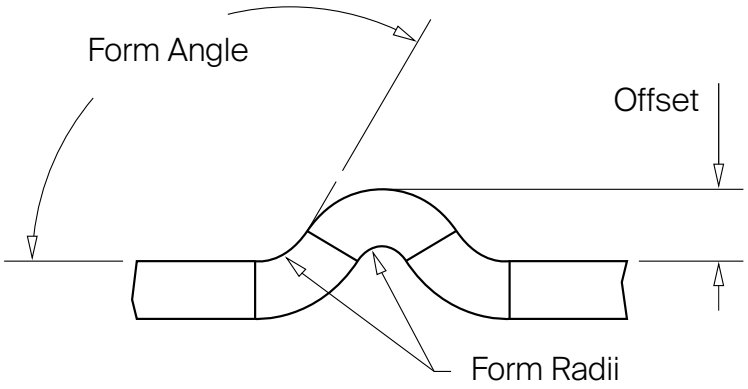
Part Features //

Gusset

- Strengthens bend locally
- Must be formed with custom tooling
- Minimal tooling cost

Design Tips
- Whenever possible, maintain minimum spacing of 2–2.5x raw material thickness from edge of cutout to bend radius tangency
- Lesser spacing requires secondary operations after bending, adding manufacturing costs

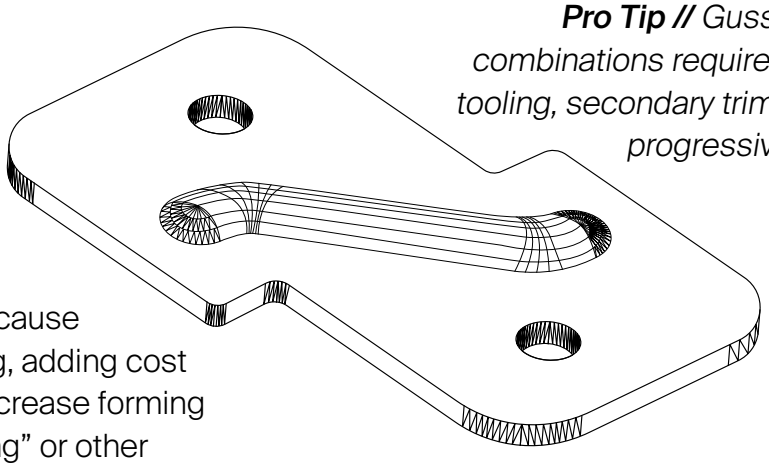


Pro Tip // *Applies to all 3 features and impacts manufacturing costs*

Rib

- Stiffens flat section
- May require secondary trimming
- Intermediate tooling cost

Pro Tip // *Gusset and rib combinations require high cost tooling, secondary trimming and progressive forming*



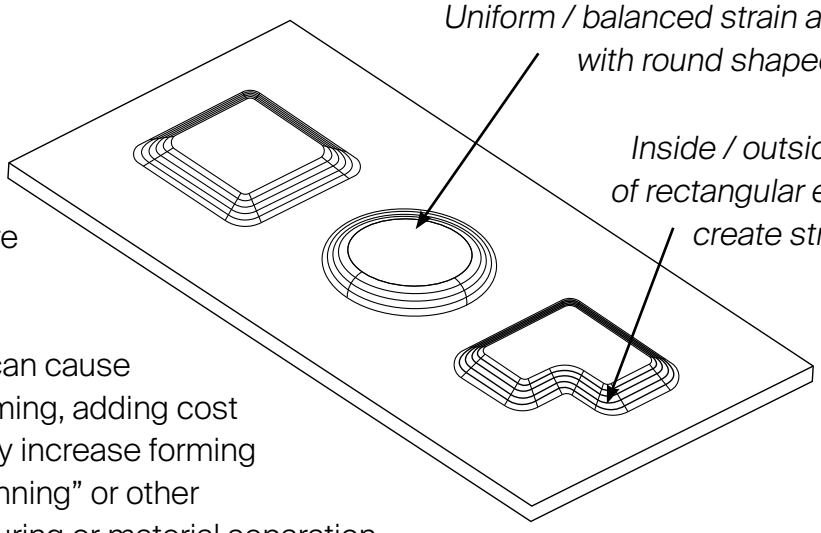
Design Tips
- Close proximity form features can cause secondary operations after forming, adding cost
- Form features in close proximity increase forming strain, which may cause “oil canning” or other deformation and possible fracturing or material separation

Emboss

- Adds strength
- May be used for clearance
- May be used as standoff feature

Uniform / balanced strain associated with round shaped emboss

Inside / outside corners of rectangular embosses create strain points



Design Tips
- Close proximity form features can cause secondary operations after forming, adding cost
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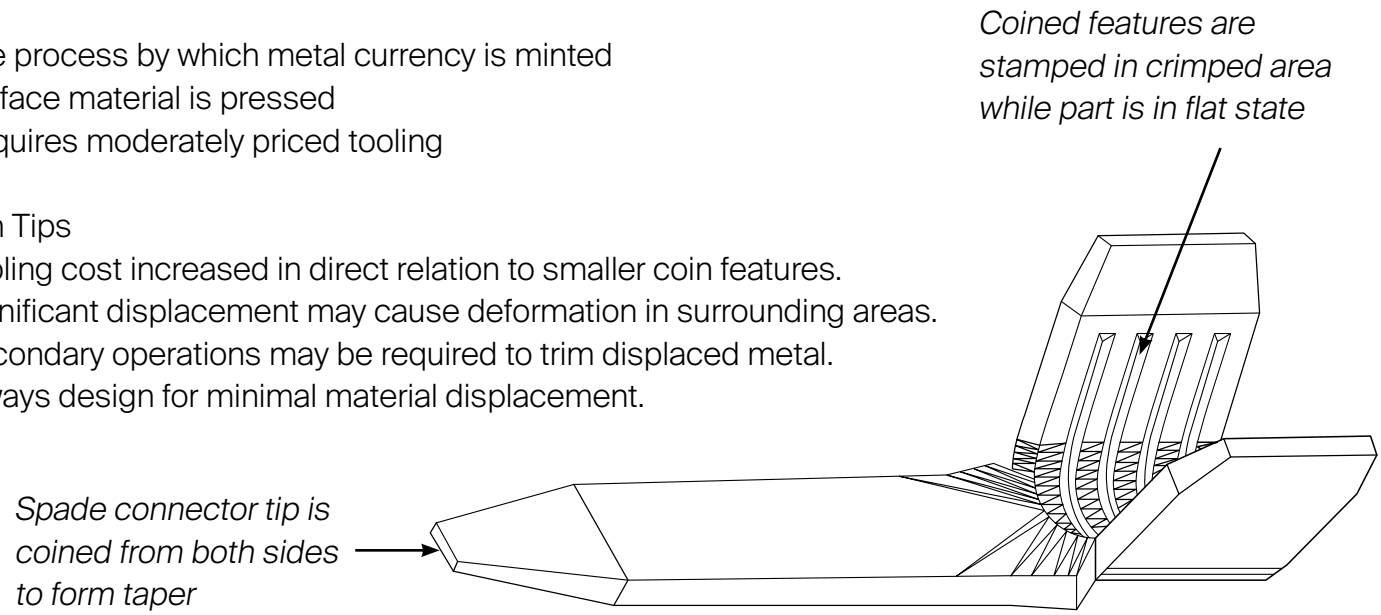
Coin

- The process by which metal currency is minted
- Surface material is pressed
- Requires moderately priced tooling

Design Tips

- Tooling cost increased in direct relation to smaller coin features.
- Significant displacement may cause deformation in surrounding areas.
- Secondary operations may be required to trim displaced metal.
- Always design for minimal material displacement.

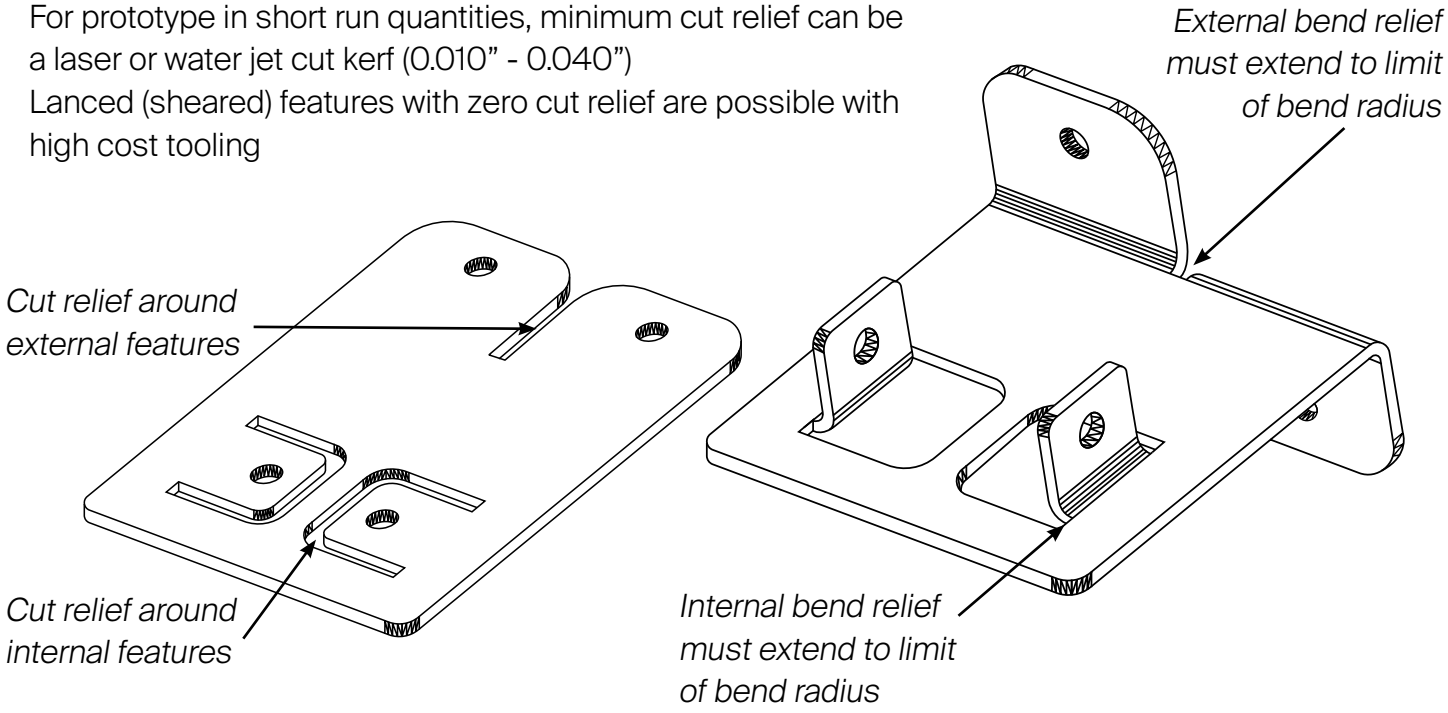


Spade Connector

Cut / Bend Relief

Design Tips

- To ensure cost effective production, design cut/bend relief at a minimum of 2.5x material thickness
- For prototype in short run quantities, minimum cut relief can be a laser or water jet cut kerf (0.010” - 0.040”)
- Lanced (sheared) features with zero cut relief are possible with high cost tooling



Material Properties //

Aluminum Alloys

ALLOY	TEMPER	DUCTILITY	STRENGTH	CORROSION RESISTANCE	HEAT TREATABLE	COMMENTS
6061	T6	Low	Mid	Good	No	Minimum bend radii 3x raw material thickness
	T0	High	Low	Good	Yes	High cost of heat treating due to warping and need for secondary straightening
5052	H32	High	Mid	Good	No	Most commonly used aluminum alloy / temper
	H34	Mid	High	Good	No	Small radius bends in line with grain may fracture
3003	H14	High	Low	Good	No	Good for deep drawn parts

Stainless Steel

ALLOY	TEMPER	DUCTILITY	STRENGTH	CORROSION RESISTANCE	HEAT TREATABLE	COMMENTS
301 302 304	* Range	** High	High	Excellent	No	Small radius bends in line with grain may fracture in full hard temper. Full hard cost effective for springs due to no need for heat treating or plating.
316 316L	Annealed	High	High	Excellent	No	Used heavily in the medical industry
410	Annealed	High	Mid	Mid	Yes	Excellent for springs – stay stable in heat treating with bright finish
17-4 PH	Annealed	Low	Excellent	Mid	Yes	Small radius bends in line with grain may fracture
17-7 PH Cond. A	Annealed	Mid	High	Mid	Yes	Excellent for springs intended for repeated cycles. Remains stable in heat treating.
17-7 PH Cond. C	Mill hardened	Low	High	Mid	Yes	Small radius bends in line with grain may fracture. Highest hardness and strength achievable in alloy 17-7 PH.

* Annealed, 1/2, 1/4, 3/4 and full hard possible
** Ductility decreases in harder tempers and mill hardened materials

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Low Carbon and Spring Steel

ALLOY	TEMPER	DUCTILITY	STRENGTH	CORROSION RESISTANCE	HEAT TREATABLE	COMMENTS
1008 1010	Soft, 1/2, 1/4, Full Hard	High	Mid	* Poor	** Yes	Rolled at near room temperature, production excellent ductility and strength. More uniform and consistent than Hot Rolled Steel
	Annealed	High	Mid	* Poor	** Yes	Rolled at high temperature above recrystalization temperature producing surface scale. Good ductility, but less strength and uniformity than Cold Rolled Steel.
HSLA	Annealed	Mid	High	* Poor	** Yes	Requires 25-30% more power to form than CRS and HRS
1050 1074 1075 1095	Annealed	Excellent	*** High	* Poor	Yes	1095 has the highest carbon content of those listed. Higher carbon content yields higher strength after heat treatment with less ductility.
3003	Blue Tempered	Low	High	Mid	No	Good for flat springs or leaf springs with large radii.

* Pour without plating or surface treatment
** Limited to carburizing
*** High strength after heat treatment

Copper Alloys

ALLOY	TEMPER	DUCTILITY	STRENGTH	CORROSION RESISTANCE	HEAT TREATABLE	COMMENTS
C10 Copper	Wide Range	High	Mid	Good	No	High conductivity. High cost.
C172 Beryllium Copper	Wide Range	Excellent	Excellent	Fair	Yes	Excellent for electrical spring contacts. Highly conductive. Moderate cost. Stays very stable in heat treating. Excellent electroplating adhesion coefficient.
C260 Brass	Wide Range	* Ranges	High	Good	No	Small radius bends in line with grain may fracture in full hard and spring tempers.
C510 Phosphor Bronze	Wide Range	* Ranges	High	Fair	No	Small radius bends in line with grain may fracture in full hard and spring tempers.

* Ranges according to temper

Raw Material Selection Guide //

Heat Treatable Alloys

When stiffness and/or spring characteristics are required, the design engineer should consider the following:

For parts with small radius forms, high carbon spring steel or other heat treatable metal with good ductility may need to bevused. The added cost of heat treating is required after forming to acheive necessary stiffness or spring performance characteristics.

Note that broad flat sections in high carbon spring steel parts tend to warp during heat treating. Where potential warping may be a factor, consider alternate materials which have marginally higher cost, but stay more stable in heat treating:

- 410 Stainless Steel
- 17-7 PH stainless steel, condition A (annealed)
- C172 Beryllium copper
- Low Carbon Cold Rolled Steel - carburizing hardens the surface but reduces spring characteristics

Mill Hardened Alloys

For flat parts or parts with **large radius form features**, a **mill hardened alloy** may be selected based on hardness or spring performance characteristics to **eliminate the need for heat treating**. Consider the following:

- 6061 Aluminum in T4 or T6 temper
- 300 series Stainless Steel in 1/4, 1/2, 3/4 or full hard temper
- 1095 blue temper spring steel
- C110 Copper and C260 Brass in H04 (hard), H06 (extra hard), H08 (spring temper) and H10 (extra spring temper)
- C510 Phosphor Bronze in H06 (extra hard), H08 (spring temper) and H10 (extra spring temper)

Note that raw material grain impacts forming characteristics in all materials, but **more so in mill-hardened alloys.**

Talk to a Fathom Expert //

The Engineering & Design team at Fathom is a group of experts with industry-leading digital manufacturing experience. These highly trained engineers and designers can be contracted to support your in-house design team throughout the product development process from prototyping to production.

Talk to a Fathom Expert about your project goals today!

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