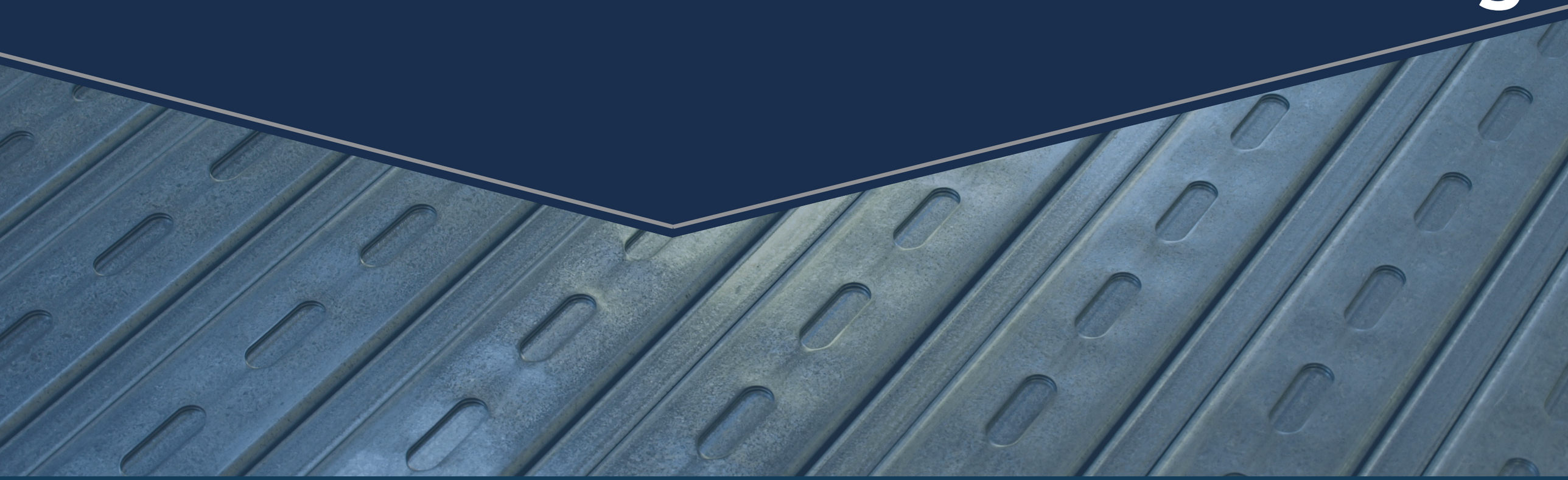
DAHLSTROM
DAHLSTROM ROLL FORM

How to Design a Great Part With Custom Roll Forming



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Table of Contents

What Is a Great Roll Formed Part? 3

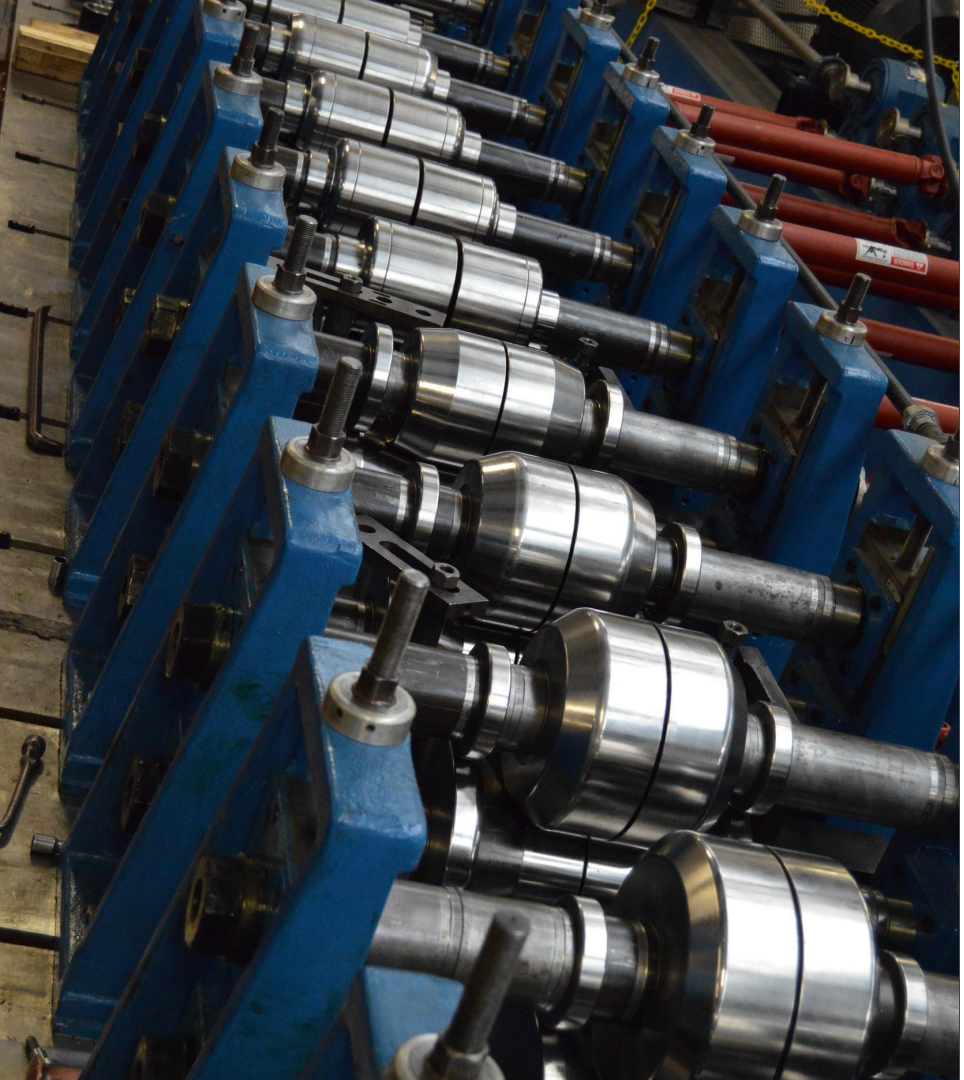
Materials 4

Tolerances 6

Design Requirements 8

Summary 10





Great Roll Formed Part: *noun*, **a part whose material, tolerances, and design are executed effectively, on schedule, and at an acceptable cost.** A Great Roll Formed Part can easily become part of a reliable supply system.

Any part can be a “great” part. Realistically, most conventional manufacturers have the ability to accommodate almost any part design requests - **as long as you’re willing to pay for them**.

But we’re talking about a great part with custom roll forming.

With a Great Roll Formed Part, there are no extra costs or considerations. **Increased lead times are nonexistent**, **scrap is reduced to virtually nothing**, and your designed part is produced **efficiently and with great repeatability**.

You show us the design and we’ll say, “yup, we can make that” with no additional tweaking, tooling, or process changes required. Game, set, match.

This eBook is for those who are interested in the basics: **an efficient, super affordable part.** No bells, whistles, or fancy trim.

Here’s how to make your part a great one.

Materials

Where does any great part begin? With its materials.

Your materials should be high-quality, yes, but they should also be appropriate for both the roll forming process AND your application. What types of materials make the cut?

First, a great roll formed part will be made of a material that's readily available in coil or sheet form. This is the easy part. The hard part is choosing a metal that can tolerate bending to the desired radius. In general, the more ductile the better.

Here are the materials that match these criteria:

- Carbon steels with most any coating
- 200-, 300-, and 400-series stainless steels
- Aluminum (non-hardened)
- Copper
- Brass/Bronze
- Pre-painted coil steel



There is a spectrum of ductility even among these metals that made the cut. The type of alloy will also affect the level of ductility.

Based on metal ductility and thickness, machine requirements may change for roll shaft diameter, drive horsepower, or the number of forming stations.

Worried about choosing the right material? Leave it to us! You show us your part, your material of choice, and the strength you need - we'll identify the correct metal chemistry for your great roll formed part!

Chart of Ductility

Element		ν	Nanoscale κ	Physical Ductility D
Absolute Limit, Perfect Ductility		1/2	0	1
Gold	Au	0.44	0.08	0.93
Lead	Pb	0.44	0.08	0.93
Niobium	Nb	0.40	0.14	0.82
Palladium	Pd	0.39	0.16	0.80
Platinum	Pt	0.38	0.17	0.76
Silver	Ag	0.37	0.19	0.73
Vanadium	V	0.37	0.19	0.73
Tin	Sn	0.36	0.21	0.69
Aluminum	Al	0.35	0.22	0.65
Copper	Cu	0.34	0.24	0.62
Tantalum	Ta	0.34	0.24	0.62
Titanium	Ti	0.32	0.27	0.54
Nickel	Ni	0.31	0.29	0.50
Cobalt	Co	0.31	0.29	0.50
Magnesium	Mg	0.29	0.33	0.43
Iron	Fe	0.29	0.33	0.43
Tungsten	W	0.28	0.34	0.40
Zinc	Zn	0.25	0.40	0.30
Manganese	Mn	0.23	0.44	0.23
Uranium	U	0.23	0.44	0.23
Silicon	Si	0.22	0.46	0.20
Plutonium	Pu	0.21	0.48	0.18
Chromium	Cr	0.21	0.48	0.18
Carbon	C	0.20	0.50	0.16
Beryllium	Be	0.032	0.91	0.00
Absolute Limit, Total Brittleness		0	1	0

Tolerances

The number one rule of tolerances for efficient and affordable parts is to make them as **loose as possible while maintaining proper functionality and quality expectations**.

Anything beyond that is secondary.

Here's a little bit about what design aspects will influence tolerance fluctuations for different sections of roll formed parts.

1. Accumulated Angular Tolerances

Accumulated angular tolerances affect variations in overall part dimensions beyond normal tolerance ranges.

2. Dimensional Hold

Outside dimensions can be held very precisely when roll forming, though inside dimensions are subject to a variation of twice the strip thickness.

3. Multiple Hole Punching

Multiple hole punching causes an accumulation of tolerances.

Although tolerances from each hole to the next may be held very closely, the overall deviation from the first hole to the last can vary by the sum of all intermediate allowable tolerances.

4. Strip Width & Rolling Tolerances

One leg of the shape should be able to "float" to accommodate metal flow in corners, gauge, and strip variation.



5. Clustered Hole Patterns

Especially near the end of parts, clustered hole patterns may be punched using a single die with multiple punches.

This allows for very accurate hole to hole tolerances.

6. Holes Near Bends

Holes punched on or near bends will distort into ovals or egg shapes. Plan your design and tolerances accordingly.

Design

Roll forming design exercise: Draw a continuous line of any shape on a piece of paper.

- As long as the line doesn't cross itself, the roll forming process can probably produce that shape.
- The potential applications for roll form shapes are only limited by your imagination.
- Do not restrict your thinking when designing your product - always create the best design possible.
- Think in terms of bending the metal into the functional configuration that is really needed.
- IF you have issues with your design, your manufacturer can help you optimize it for the manufacturing process.



Rules of a Great Roll Formed Part

We know, we know. We just told you to get outside of the box, and now we want you to stuff yourself back into it.

Actually, these “rules” are more like guidelines to help you maximize efficiency and cost-effectiveness in your design.

After all, you’re aiming for a great roll formed part – a part that is quick and easy to manufacture right out of the gate.

If your design requires non-standard processes, shapes, fabrications, etc., your manufacturer will certainly do its best to accommodate it

However, custom tooling and dies can be quite expensive for *you*, the customer - that’s why we aren’t calling them **Great.** Keep this in mind before committing to a nontraditional part design.*

*One thing to think about regarding custom tooling: once you decide to create a set of roll forming tools, incremental changes within that toolset are very affordable. *And*, you receive the benefits of the additional features for the life of the product.

As for the following rules: Currently, there are limits to what a roll forming line can do with a coil of sheet metal.

If you want to create a design that’s absolutely perfectly optimized for your application (not just optimized for current manufacturing processes), your manufacturer can take that design and make it work with their machinery.

Again, these rules are more like guidelines and can be bent or broken when necessary. A great roll formed part, however, will follow all or most of these rules.



Rule #1: No Extremely Deep or Narrow Channels

As much as we all love a tall, leggy u-channel, they can be difficult (read: impossible) to produce on standard machinery.

We have a separate service for this type of product, known as MeshTrim. Using this service will greatly decrease the amount you spend on deep, narrow channels, which are still considered specialty items by other manufacturers.

In general, deep and narrow channels require larger diameter forming rolls, which are more expensive to procure. Average size machines do best with a max depth of four inches.

Rule #2: Uniform Thickness

Design for a uniform thickness throughout your part, whether you stick with the raw strip stock or fold the material back on itself for increased thickness.

Depending on the metal type and profile complexity, we can roll thicknesses of 0.012” to 0.220”.

Rule #3: No Wide, Flat Areas at One Edge

Wide shapes with forming work on one edge are unbalanced and prone to waviness.

To avoid waves and other warping, add a small leg or offset on the flat edge for greater strength and balance. Small stiffening ribs or hems can make the part flatter and stronger.

Rule #4: Proper Leg Lengths

Short legs can be impossible to roll form in heavier gauge materials due to the lack of leverage. Extremely long legs are difficult to form without specialty equipment. This also applies when hemming or bending material back on itself.

There's a happy middle ground: if you're worried about your legs being too short, make sure they're a minimum of 3x material thickness past the tangent point.

If you think your legs might be too long, you can make your section wider or open the sidewall at an angle.

Rule #5: Proper Pre-Piercing Hole Locations

If the hole location of your design is not critical, you should design your pre-piercing pattern to be repetitive without specifying where the holes fall in relation to the end of the part. A partial hole may appear at the end of some parts, and that's OK.

When hole location is critical, place holes at least ½" but less than 4" from the end of the part. This allows for an economical design of the cutoff/punch die set.

Rule #6: Keep Punched Features Away From Edges

Punched features that are too close to the edge of the profile can distort the edge and/or the feature. These should be located at least ½ of the diameter (or width) of the feature away from the edge of the profile.

Rule #7: Max Bend Radii When Possible

Tight corners cause cracking in harder materials due to stresses generated in the outer fibers of the bend. Small radii can also increase tool wear and breakage, lessen roll life, and require a mill with greater horsepower.

While tighter radii can be accommodated sometimes, none of these things are optimal for roll formers or for your cost.

To avoid these issues, allow for a minimum radius of 1-½ to 2 times material thickness.

Rule #8: Symmetrical Design

Asymmetrical parts are more prone to twists and other types of distortion in the finished shapes. Designing your part as symmetrically as possible can decrease or eliminate the probability of warping.

Many parts cannot be designed symmetrically; Dahlstrom can accommodate these projects in roll tool design and machine setup parameters.





Rule #9: Keep Punched Features Away From Bends

Fabrications such as slots, notches, and holes can distort themselves or the part when placed incorrectly. Issues arise when they're placed too close to (or directly on) the bend line, as well as when they're placed too close to the edge.

To avoid this issue, the edge of the hole or slot should be at least 3x material thickness away from the tangent point of the nearest bend.

Note: Harder materials with higher tensile yield will require more distance from the bend line.

Rule #10: Keep Tolerances Loose

As mentioned in the tolerances section of this eBook, great roll formed parts have generous tolerances to reduce part defect rate and keep lead times low.

(Don't worry too much about defective products; Dahlstrom has a field defect level of less than 4,000 ppm. Four sigma level is 6,210.)

Summary

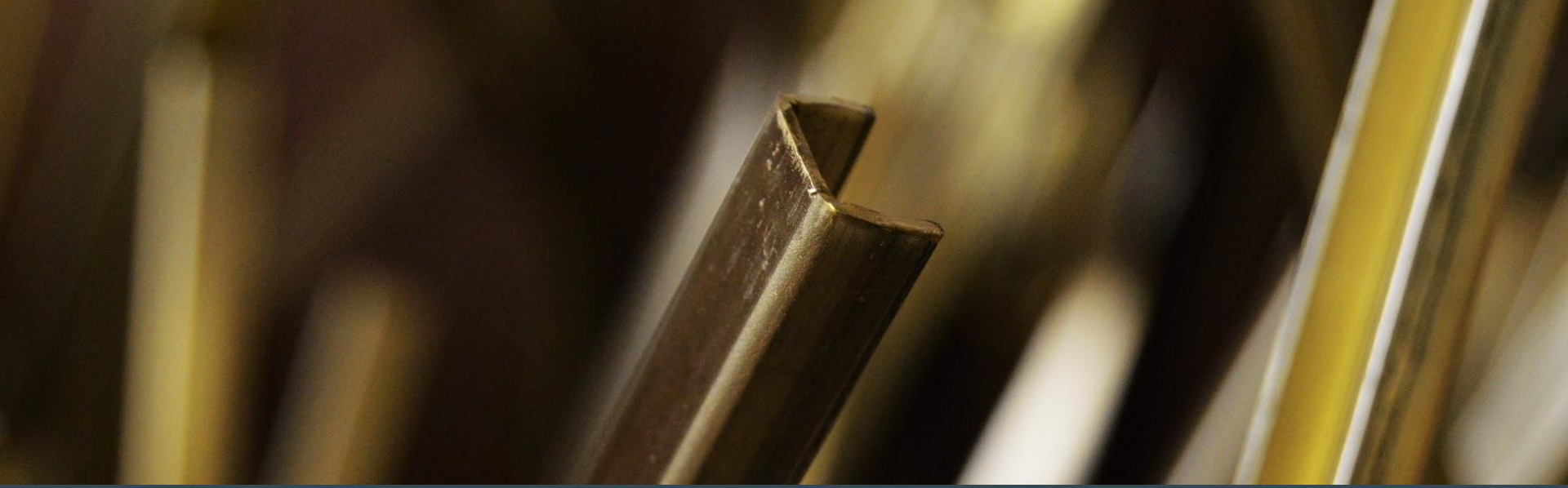
So, what makes a great part with custom roll forming?

- Readily available materials that are easy to roll form AND fulfill the requirements of your project
- Less strict tolerances allow your manufacturer some freedom in fabrication and bend placement, while maintaining your product standards
- Following the 10 design “rules” as closely as possible

If you want to know more about design accommodations, or you’d like to get your great roll form part in the works, feel free to contact us!

We are happy to take calls during normal business hours at (716) 664-2555. To reach a representative by email, see our contact page.





If you have any other questions about designing your product for roll forming, feel free to contact us at DahlstromRollForm.com.

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