

Work steps for control and optimisation of VeraCAD Calibration Plan

Content

1. Check number of passes
2. Select suitable Calibration sequence
3. Adjust the reduction rates
4. Provide leading grooves
5. Provide draft angles
6. Make individual flash corner radius
7. Relative motion

1. Check the number of passes

The number of rolling passes basically is responsible for the height of reduction rates. When using too less passes, the maximum limit reductions often are exceeded. This will produce rolling defects (Fins). Using too much passes can be done without disadvantages, but will increase tool costs and process time.

The maximum allowed reduction rate depends on the diameter of rolling machine. If it is small the limit reduction is high and vice versa. For different roll diameters the following limit reductions should not be exceeded:

RW1 (370 mm) < 41 %

RW1A (460 mm) < 38 %

RW1A (920 mm) < 33 %

If it is not possible to keep the limit reduction, the following options are available:

- o Increase the number of passes.
- o Increase the cross-section area of individual cross-sections.
- o Accept the rolling defects (Fins); this is possible if the section later will go into the flash.

The rolled part design should be modified, until the reduction limits are maintained.

2. Select a meaningful Calibration sequence in each cross-section

If a Calibration Plan is created by the automated process, VeraCAD makes proposals for calibration sequences in each cross-section. Very often this is already an appropriate calibration sequence for all passes and can remain unchanged. But it should be checked and modified if necessary. Within this procedure different criteria can be considered:

- o Very high reduction is necessary
- o A minimum amount of friction should be guaranteed
- o Avoid twisting of the rolled piece

The examination and assessment should be done Line by Line (cross-section by cross-section). Suitable calibration sequences in relation to the necessary amount of reduction are:

Height of reduction	Calibration sequence
Very high reduction	OVAL – OVAL – OVAL LENS – LENS – LENS
High reduction	SQUARE – OVAL – SQUARE CIRCLE – OVAL – CIRCLE
Medium reduction	SQUARE – RHOMB – SQUARE CIRCLE – OVAL – CIRCLE
Low	all carriers: CIRCLE – CIRCLE – CIRCLE SQUARE – SQUARE – SQUARE CIRCLE – OVAL – CIRCLE

In addition there are some forbidden calibration sequences. All calibration sequences where the height in previous pass is more than the width in next pass are not possible. Here a pinching of the cross-section is inevitable and fins will be rolled.

3. Determine the height of reduction rates

VeraCAD calculates the reduction rate values according to the rule, to keep a maximum distance from the upper limit reduction. Behind this concept there is the idea to utilise each pass to its maximum capacity, but to avoid the danger of rolling defects.

In many cases it is more required to make an uneven distribution of reduction rates. For example it is possible to achieve the bigger part of total reduction in pass 1 + 2, while in pass 3 + 4 only a small reduction is performed. Some rules and objectives should be aspired when making modifications to reductions rates:

- o Do not exceed the maximum limit reduction in any pass, or if so only by little values.
- o Keep the minimum reduction limit given for some calibration sequences.
- o Realize a minimum reduction rate for carriers to have some friction (0.5 – 1 %)
- o Do little reduction in the first passes, in order to shift rolling defect to the process end.
- o Keep the linked reduction mechanism given by the EUMUCO diagram.
- o Arrange the width of cross-section in a manner (e.g. Oval, Lens, Rhomb), that a straight product (constant width) is formed, when watching the rolled product from top.

To give the rolled part a constant width, proceed as follows:

- o Enter all segment dimensions for the rolling machine and the tool segments.
- o Create the 3D-Geometry
- o Switch to View “Roll Products“ and display the parts (3D calibration plan) from top.
- o Evaluate the width of cross-section types Oval/Lens/Rhomb. Remember the pass number and cross-section number where a modification has to be made. In addition, keep in mind the direction of modification (smaller/wider).
- o Go to “Edit calibration“ and provide the necessary modifications. A higher reduction will make the Ovals/Lenses/Rhombi more wide, less reduction will lead to smaller cross-sections.
- o The modification and display of the 3D parts in top view should be carried out alternately, until a sufficient result is achieved (straight constant width).
- o It is very often that changes in pass 1 are useful, but will result in more bad results for pass 3. In this case a compromise has to be made, that results in all passes to a nearly constant product.
- o For pass 2 and 4 normally no modification is necessary. Mostly here the reduction rates are calculated automatically.

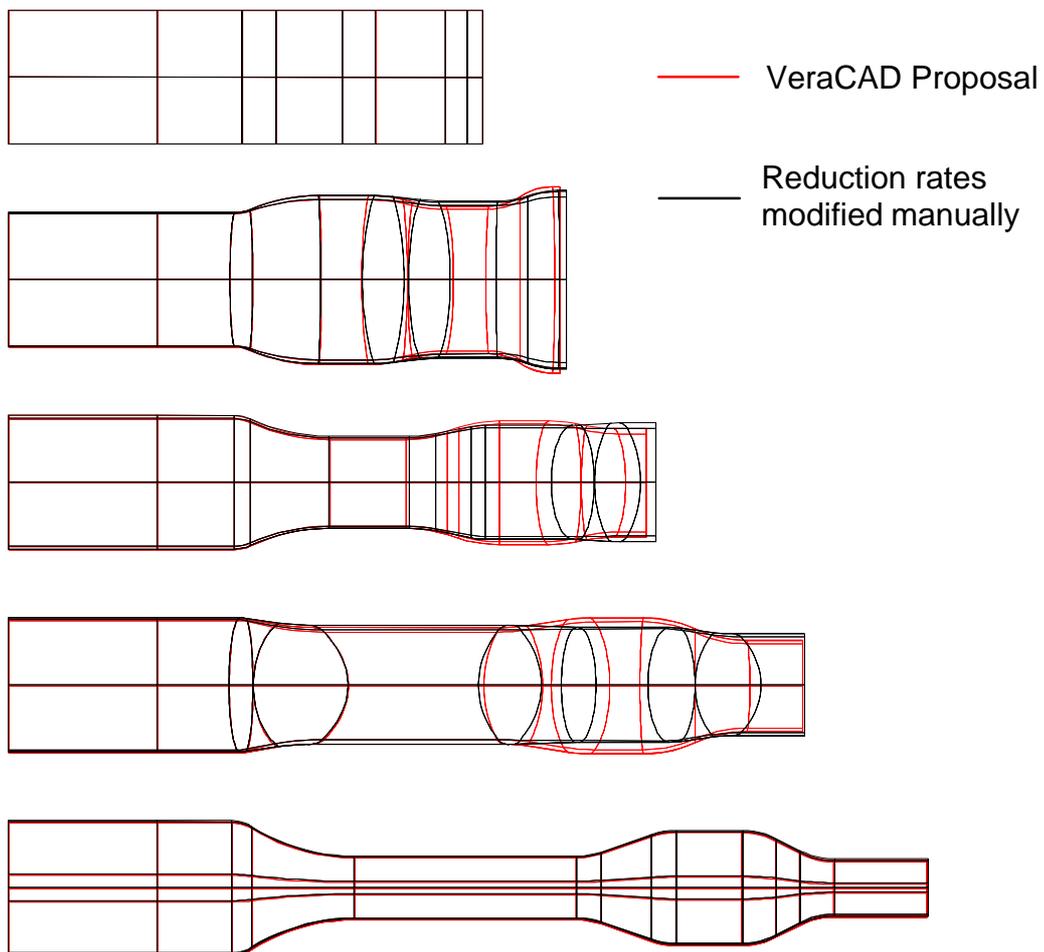


Figure: Constant product width achieved by manipulation of reduction rates (Top view)

4. Provide leading grooves

For some cross-sections leading grooves must be applied. The leading grooves will prevent a flat Oval from overturning in subsequent pass and the rolled part from twisting. Particularly with regard to very long and thin parts, as well as aluminium parts, there is a strong danger of the piece to be twisted during rolling operation. In addition the leading groove will provide a central guidance. By fixing the part to the centre of tool segments, a bended part is avoided.

Mainly a leading groove in subsequent pass is necessary, if the calibration sequence matches the following table:

Previous pass	Next pass with leading groove
Oval / Lens / Rhomb	Circle / Oval / Lens
Square (on tip)	Oval / Lens

A general rule for the depth of leading grooves cannot be given. It depends from the size of cross-section, the length of a rolled section and the relation width/height in the previous oval.

5. Apply draft angles

For some cross-sections draft angles will become necessary (Tab „Impression geometry “). The advantages of draft angles are as follows:

- o Avoid fins. If the deformation (reduction) is more than in the design (e.g. if the flash is smaller, different temperature, spreading is more than expected), a draft angle can absorb the oversized material.
- o Adaptation to Pre-material variations in the entrance cross-section.
- o Additional option to realize a constant width of the rolled part.

Provide a draft angle to the cross-section in the following cases:

- o All Circle-cross-sections in the entry-section (cross-section 1 and 2, likewise no. 3 for pockets)
- o All Circle-cross-sections in finished part (last pass).
- o All cross-section that have very little space for spreading; difference in width between previous and next pass.
- o All squares that have a double radius (S-curve) at intersection to flash corner radius. The double radius will be eliminated by a 45° draft angle.

6. Individual flash corner radius

Sometimes it is not possible to make a straight product with constant width by only using “Reduction rates” and “Draft Angle”. Particularly if the rolled sections are short and large changes in cross-section area must be performed, it is possible that transitions between strong differing cross-sections may develop pinches. These corners should be smoothed already during design phase, by giving them a bigger flash corner radius. The dialog “Calibration>Edit>Impression Geometry>Corner radius” is the right place for that. The result can be reviewed after creating the 3D geometry in the view “Segment geometry”.

7. Relative motion

Last step of editing and optimising the calibration plan is to correct the unwinded impression lengths by means of relative motion. Click on the option “Proposal” in property sheet „Relative motion“. The relative motion parameters will be automatically calculated by VeraCAD. The program uses a very simple algorithm and calculates percentage values for the whole calibration plan.

If after the tryout of the tool segments, some length modifications will become necessary, the property sheet “Length correction” can be used to provide the changes in length.



ERATZ-Engineering

* Kirchhörder Str. 94
D-44229 Dortmund
(+49) 231-7273290
Fax: (+49) 231-7273291

Important

The use of VeraCAD-Software on the one hand principally excludes calculation errors, but on the other hand does not prevent from necessary modifications of the roller tool segments during try out of the tools.

We point out, that when ordering a VeraCAD Service, expenses for try out and all modifications of the tools cannot be charged to us.