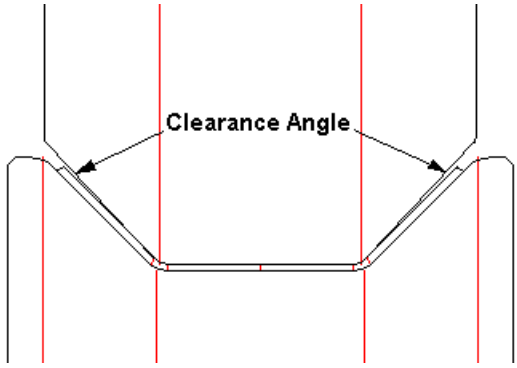


A clearance angle often is used in order to roll form high quality profiles

Clearance Angle

What is a clearance angle?

Clearance angle means, the inclined flank of a roll (top roll in the picture above) is rotated by a small angle (normally 1-2 degree) around the roll corner point. Thereby an acute gap opens between roll and sheet. The more the circumferential speeds of top and bottom rolls differ, the larger is the gap width.

What a clearance angle is required for?

There a two reasons why a clearance angle should be provided:

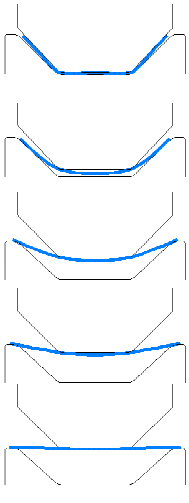
- Balancing of different circumferential speeds in case of the roll diameter ratio does not fit to the gear transmission ratio.
- Avoiding wedging, thereby better "flowing" (transversal moving) of the profile legs into the stand.

We will discuss these two reasons now.

Balancing of different circumferential speeds

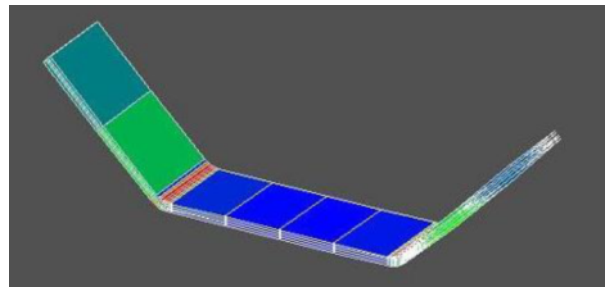
Each roll has a working diameter, this is the diameter at the profile web (the horizontal part of the profile, see picture above). If the gear transmission ratio of the machine is 1:1, top and bottom rolls should have the same working diameter in order to have equal circumferential speeds and the profile is moved safely and free of slip. Some machines have the transmission ratio 1:1.4, this enables forming open profiles with higher legs. If e.g. the transmission ratio is 1:1.4, equal circumferential speeds are possible if the working diameter of the top roll is set to 1.4 times the working diameter of the bottom roll. But equal circumferential speeds only can be achieved at the web of the profile. At the profile legs always friction arises, enhanced roll wearing, and sheet surface damaging will be incurred. In order to minimize this, experienced designers use a clearance angle.

Better "flowing" of the profile legs into the stand

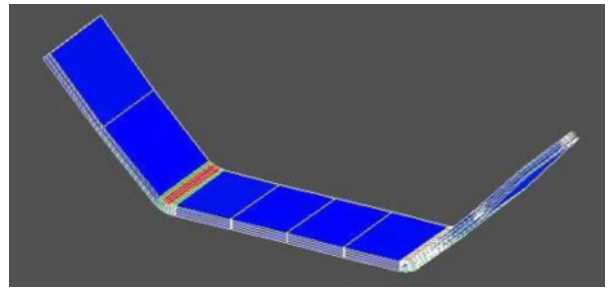


Imagine, the flat sheets runs into a stand like in the picture above. First it will get contact with the roll surfaces that have the largest diameters (bottom picture). The top roll has its largest diameter at the center cylindrical part, whereas the bottom roll has it at the side shoulders. By turning on the top roll presses the sheet into the trapezoidal slot of the bottom roll and the profile legs are drawn over the shoulder edges of the bottom roll. The shoulder edges should have a large fillet radius as shown in the picture above in order to prevent the sheet surface from damage. In doing so, the legs must be able to move horizontally, they say, they must "flow". This can be archived by using a clearance angle. Without it, the legs would wedge and the sheet would be stretched in transversal direction. Very important are clearance angles for profiles with more than one bending zone per side and per stand. Example: Trapezoidal profiles. Often a full trapezoid that consist of four angles is bent per side.

Verification with FEA (Finite Element Analysis)



Running of a flat sheet into a stand with 45 degree rolls was simulated. Without clearance angles considerable strain is shown in the legs (green: medium strain).



With clearance angles the legs are not strained (blue color). The red color shows high plastic strain in the bending zones, which is necessary that the profile does not spring back after leaving the machine.

Designing with PROFIL

By using UBECO PROFIL, it is quite simple to attach a clearance angle to a roll: After right-clicking on a roll corner point a context menu opens, **Clearance Angle** is selected, and the desired angle in degree is entered. Furthermore the direction can be defined. In the example above **To The Outside** is the appropriate direction. For special roll contours it may be necessary to select **To The Inside**.

If a clearance angle should be continued over multiple roll corner points (e.g. for trapezoidal profiles), the designer should attach a clearance angle for the first point. For the rest the roll diameter should be decreased (e.g. by using the tool box **Modify**).

More info: www.ubeco.com