

Minable and Maxable - Operations at the ends of the bar

Description and definition of minable and maxable on a Stuga flowline. Why and how this leads to larger trim and waste amounts at the start and end of the bar

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Loading and Optimising

A major feature of the control software is its ability to optimise a batch for the best use of profile. This is absolutely necessary on the flowline because:

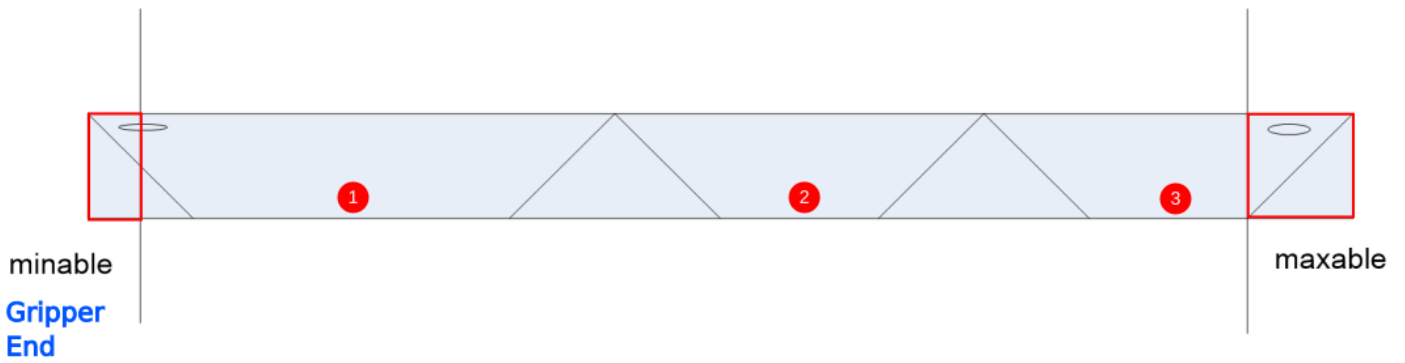
- The way that the machine is able to utilise profile is specialised and it is too difficult for another optimiser to manage. For example, when an arrow head is cut, the following piece has an arrow head on it already – this is a situation the optimiser will try to achieve because it saves profile and time
- The machine is unable to rout an operations or Y notch near the beginning and end of the bar – at the beginning the gripper is in the way, at the end the clamping is insufficient to support the profile. The on-board optimiser will try to avoid this situation by putting pieces with no end operations at the start and end of the bar. If this is not possible, the area will be earmarked as waste.
- When bar length measuring is used, the machine re-optimises on each bar length anyway.

Operations at the end of a bar

The flowline cannot machine anything where the gripper is, or at the very end of the bar. To cope with this, the software looks at each piece to see if there are any operations near the ends – i.e. if this piece was at the end, the operation would be unmachinable.

- The unmachinable area at the gripper end is defined by the “minable” parameter in spams.mul
- The area at the end of the bar is defined by the “maxable” parameter.

This diagram shows the minable and maxable areas on a machine where the gripper is on the left hand side - the position of the gripper could be the other end depending on the feed direction or hand of the machine, and the machine type. **The minable is always the gripper end**



The actual size of the minable and maxable is dependent on the physical distances of the machine.

- minable depends on how big the gripper is
- maxable depends on the distance from the spindle centreline to the next supporting clamp area

Footprint

The software also takes account of the footprint of the operation. It checks the X axis movements in a positive and negative direction and checks to see if this footprint would overlap the minable or maxable area

End Prep Modification

If there is an operation on a piece that is in the minable / maxable area, the end prep is modified to a “mechanical” prep.

Square Cut		Becomes	s
Mitre Cut	\	Becomes	m
Mitre Cut	/	Becomes	i
Arrow Head Cut	>	Becomes	a
Front Y Notch		Becomes	f
Rear Y Notch		Becomes	r

In the above diagram:

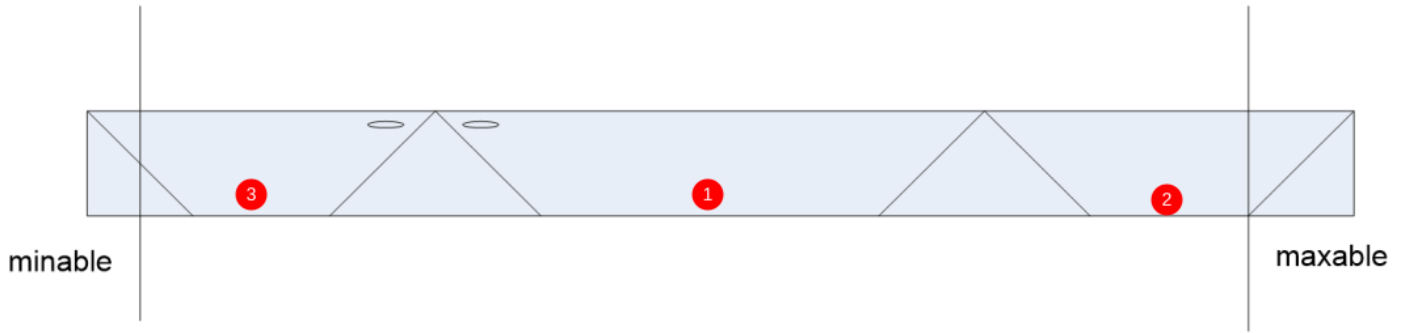
1	\/	Becomes	m /
2	\/	Becomes	\/
3	\/	Becomes	\i

Gaps Calculations and Optimisation

The optimiser uses these end prep symbols during the optimisation process to work out the least wasteful use of the profile. The actual gap used is defined in a file named gaps.mul or gaps.saw. This is a table of the calculations used for each and every end prep calculation

On optimisation, the optimiser will determine that there is a large waste associated with putting a “mechanical” prep at the end of a bar, and will therefore try a different combination. If this is not possible (e.g. on a short offcut), the optimiser will allow for the waste at the start or end of the bar.

Result:



Reducing the impact of minable and maxable

The value of minable and maxable is set as parameters in the shared parameters file spams.saw. To stop or reduce the frequency of bars with minable / maxable waste:

1. Move the drainage operations further "in" on the pieces so they are not close to the end and are therefore at least "minable" parameter value from the end of the piece
2. Decrease the minable amount - if it is decreased too much, you may risk pieces not being clamped properly when they are machined

⚠ ...Do not change minable or maxable half way through a batch. Always ensure the transfer table is clear of bars and exit both sides of the machine

Complications

Gripper Clash with Ring

When an operation is close to the gripper, such that the gripper is inside the ring area, there are Y and Z positions on the tooling system that will clash with the gripper. This regularly happens if the V notching heads are required, when the V notching is on the ring, ie flowline, ZX3 and Microline machines when the Z axis position is at its very maximum.

Two solutions are required for this

Scenario	What is needed	How solved
V notch close to gripper end of piece	minable applied even though the V notch is not in minable area	use mrdummy.x command to force a minable end prep modifier
Y notch at gripper end - minable is applied but it is not enough	apply an even bigger minable amount	Use the gaps file f and r end preps to add a bigger minable waste Update - use yNotchStartGap parameter

Spindle Assembly Clash with Gripper

On toothed gripper systems (eg ZX5), the high speed spindle assembly can clash with the gripper end when the tool is at an angle between 90 and 180 degrees, and the profile is narrow. This happens because the mechanism that plunges the spindle is exposed to the area that the gripper wants to be.

The simple solution to this would be to increase the minable in all situations to a bigger amount. This has been the case on all ZX5s where the gripper is quite small and can work with a minable of 40.

However, due to this clash problem, the minable has to be set to 140mm. This has had a consequential effect of creating a problem on the saw side. The 140mm minable creates a sizeable offcut on the gripper end of the bar, which is challenging to dispose of - it is too big to go down the chute, but too small to be pushed across to eject as a piece. It cannot be chopped into smaller pieces to go down the chute because the top clamp of the saw cannot clamp it, as the gripper is in the way. This creates a disposal problem - see Vimeo video . This is especially a problem on wide door profiles with a mitre, as the large triangle created by the mitre makes the offcut even longer (+width)

This was solved on version 6.4.54.0 Nov 2020 with the addition of the following parameters

New Parameters

Parameter	Default Value ZX5
gripClashMinable	140

gripClashAngleMin	100
gripClashAngleMax	170
gripClashProfileWidth	45

These parameters will modify the minable amount if this situation arises

```
if profile width > gripClashProfileWidth and tool angle between gripClashAngleMin and gripClashAngleMax THEN minable=gripClashMinable
```

This means there only needs to be a large 'minable' offcut when absolutely necessary, avoiding the issue created in the saw.