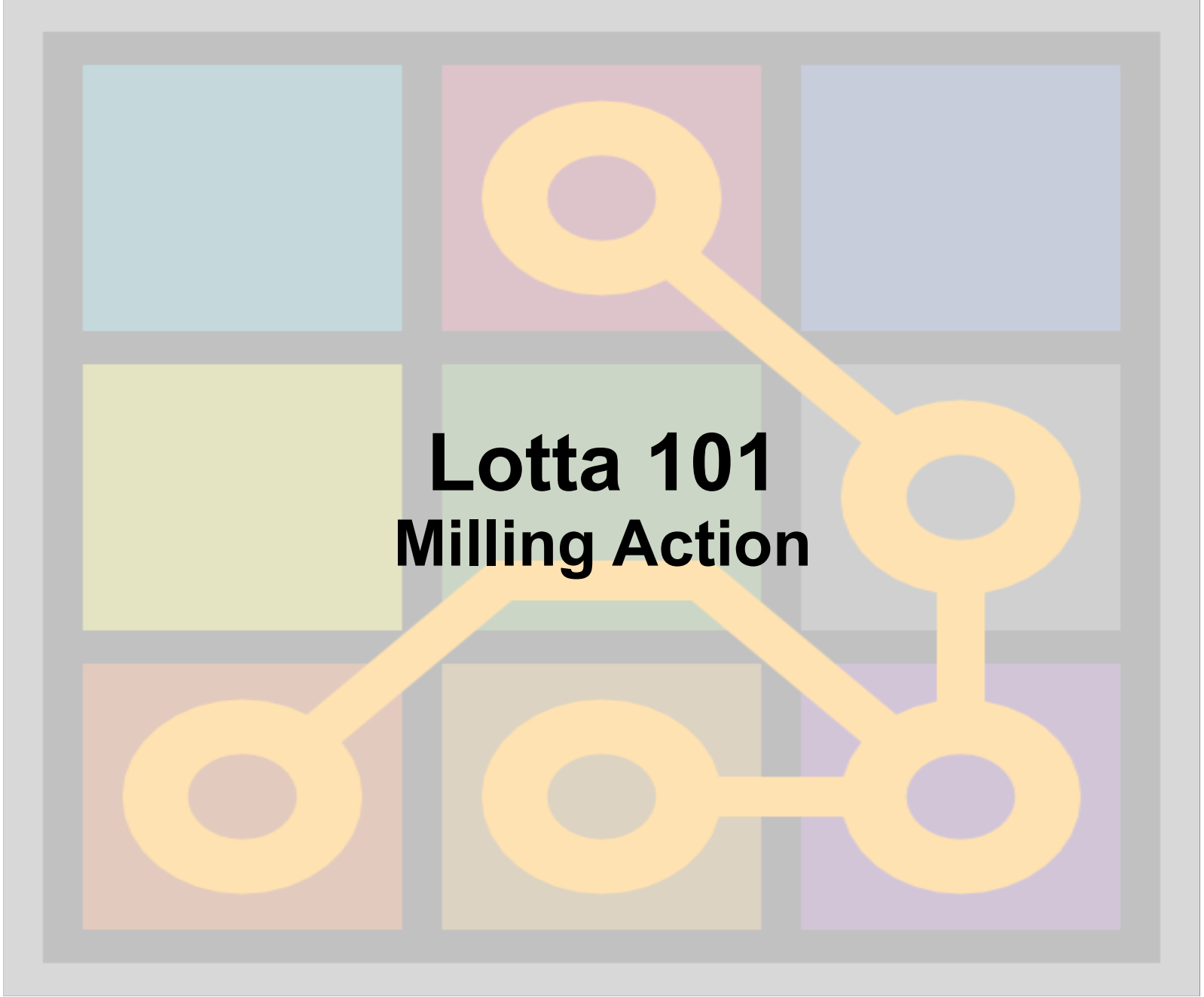
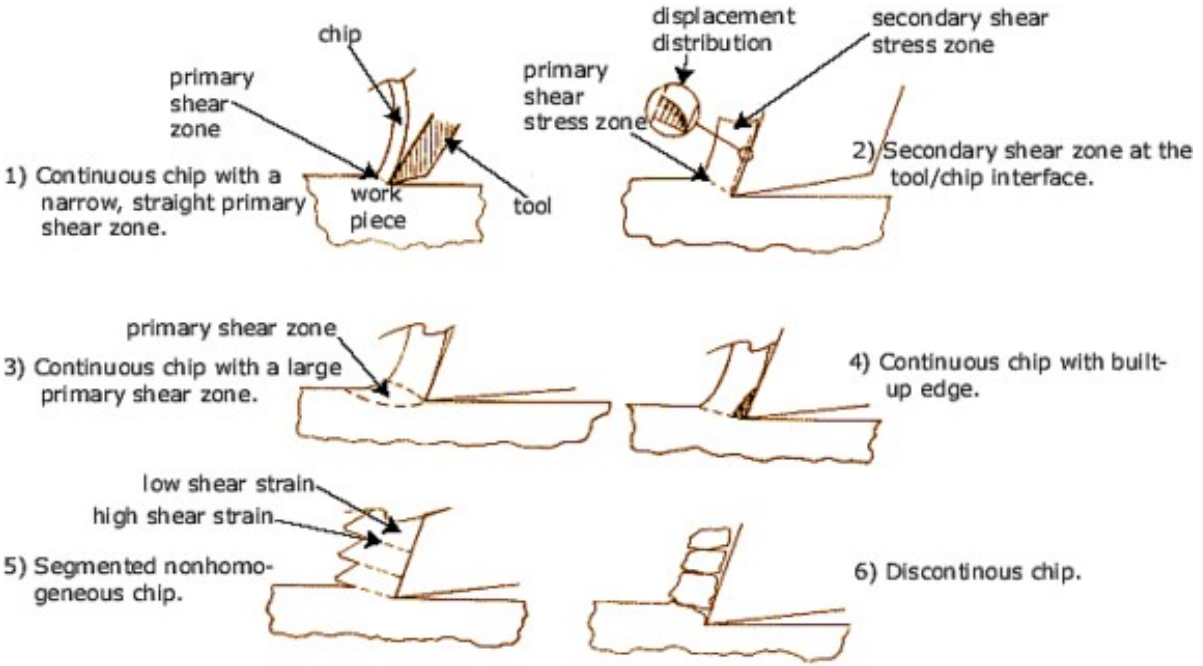
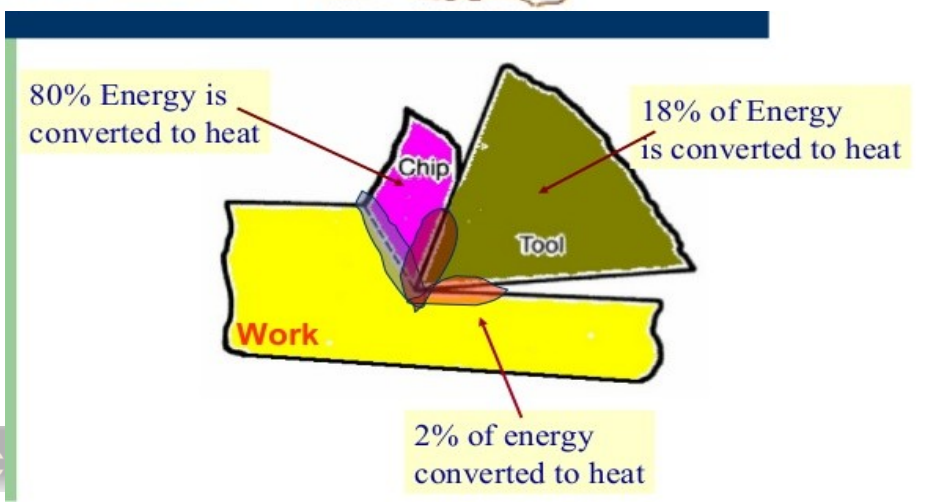

Lotta 101
Milling Action

Chip formation

https://www.youtube.com/watch.v=mRuSYQ5Npek

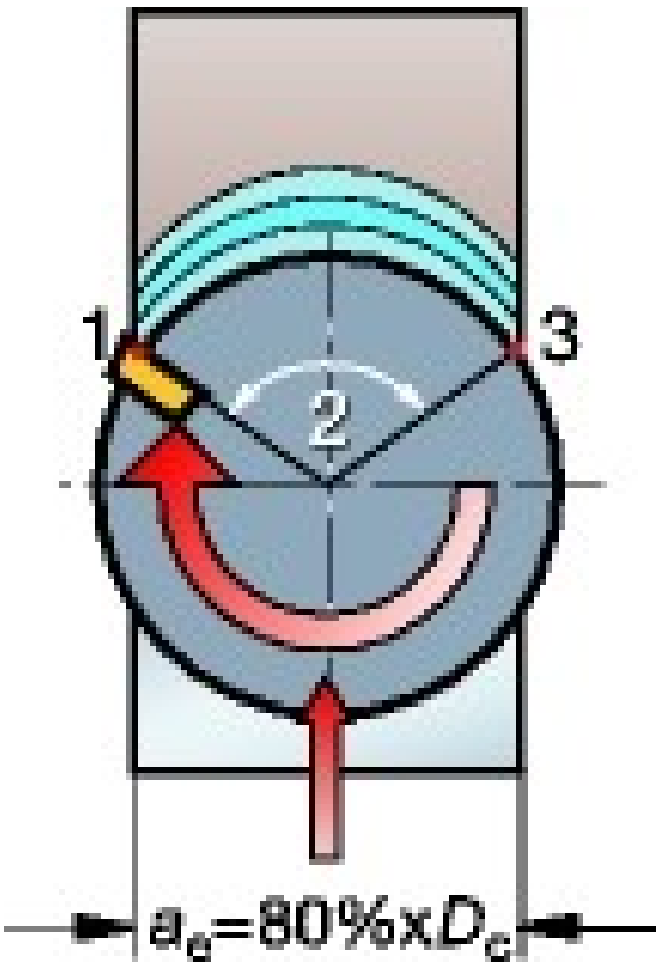
- The tool creates a chip by plastic deformation in the so called primary shear zone
  - The material heats until it softens
- The aim is a continuous solid chip with smooth tool side
  - The primary shear zone in front of the blade heats up resulting in plastic deformation
  - Ideal chip color is from straw colored to blue (steel)





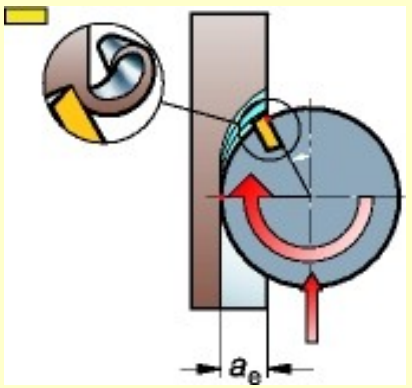
Successive phases of cutting and chip formation

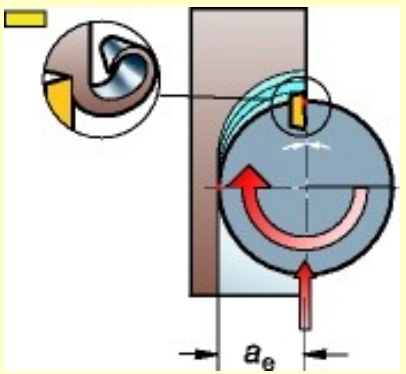
- 1. Initial contact
- 2. Actual cutting
- 3. Exit

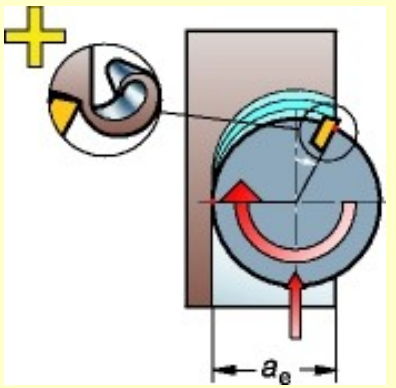


Cutting Directions

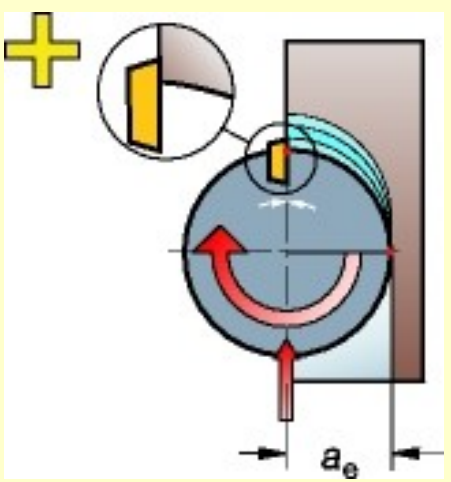
Conventional cut
(older machines with manual leadscrews [backlash!])

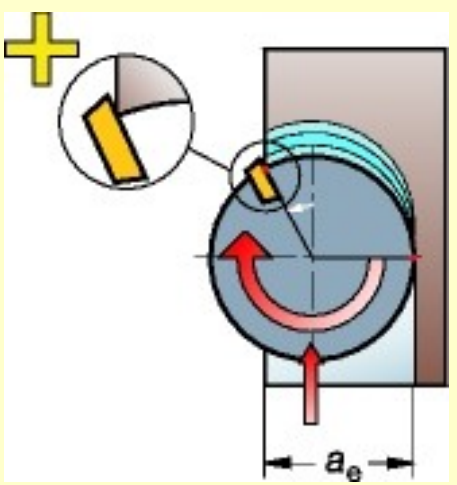


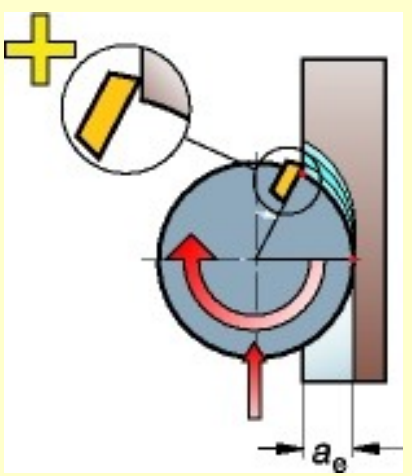




Climbing cut
(preferred for machines with ballscrews;
always use for carbide tools)

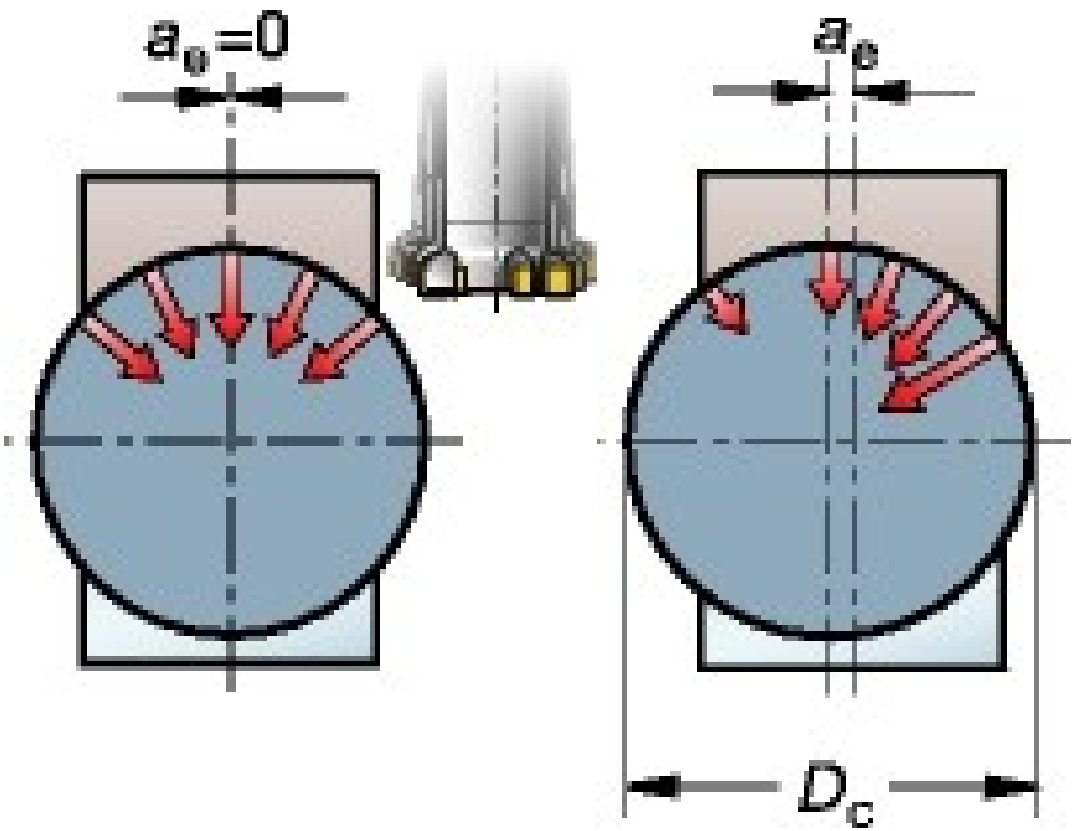






Desirable Tool Position Relative to Workpiece

- The chip should thin out at exit
- The tool should track left of centerline (in direction of motion)
  - Cutting force is more stable – less risk of resonant vibration
- The tool should be 20-50% wider than the workpiece



Milling terms - Speeds

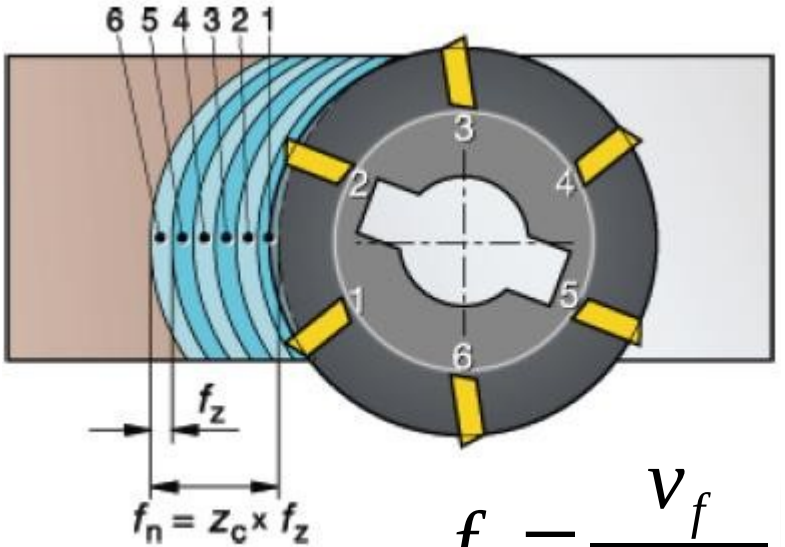
- Cutting speed v_c (m/min)
  - Nominal cutting speed at tool outer radius. This is the speed at which the cutting edge moves through material.
- Effective cutting speed (m/min)
  - Actual cutting speed at the effective radius D_{cap}

$$v_c = \frac{D_{cap} * \pi * n}{1000}$$

  - Spindle speed n = RPM

Milling terms - Feeds

- Feed per tool flute f_z (mm/flute)
  - The distance the tool advances for each individual cut of a flute (one factor that determines chip thickness)
- Feed per revolution f_n (mm/rev)
  - The distance the tool advances per one complete revolution (in tapping, this is programmed)
- Feed per minute (mm/min)
  - The distance the tool advances in one minute (with normal milling, this is programmed)



$$f_z = \frac{v_f}{n * z_c}$$

Phases of a milling job

- 1. Roughing
  - Coarse milling that removes lots of material quickly
  - Get the workpiece close to final shape
  - No special requirements for surface quality
  - Tool selected to achieve fast material removal with reasonable accuracy
- 3. Finishing
  - Light final passes that achieve the desired dimensions precisely
  - Tool selected to produce precise dimensions and optimal surface quality

Esityksen tuotti

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