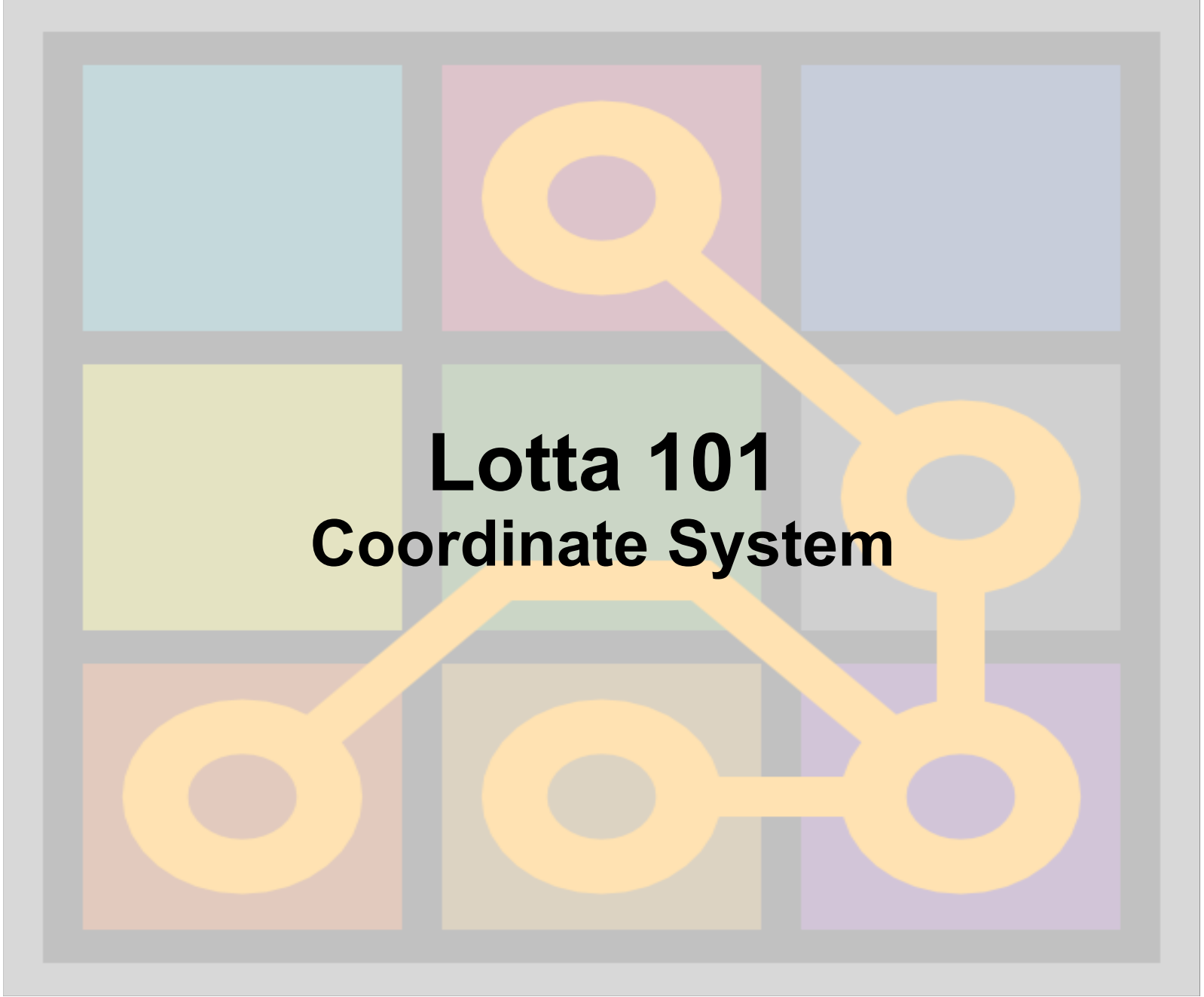
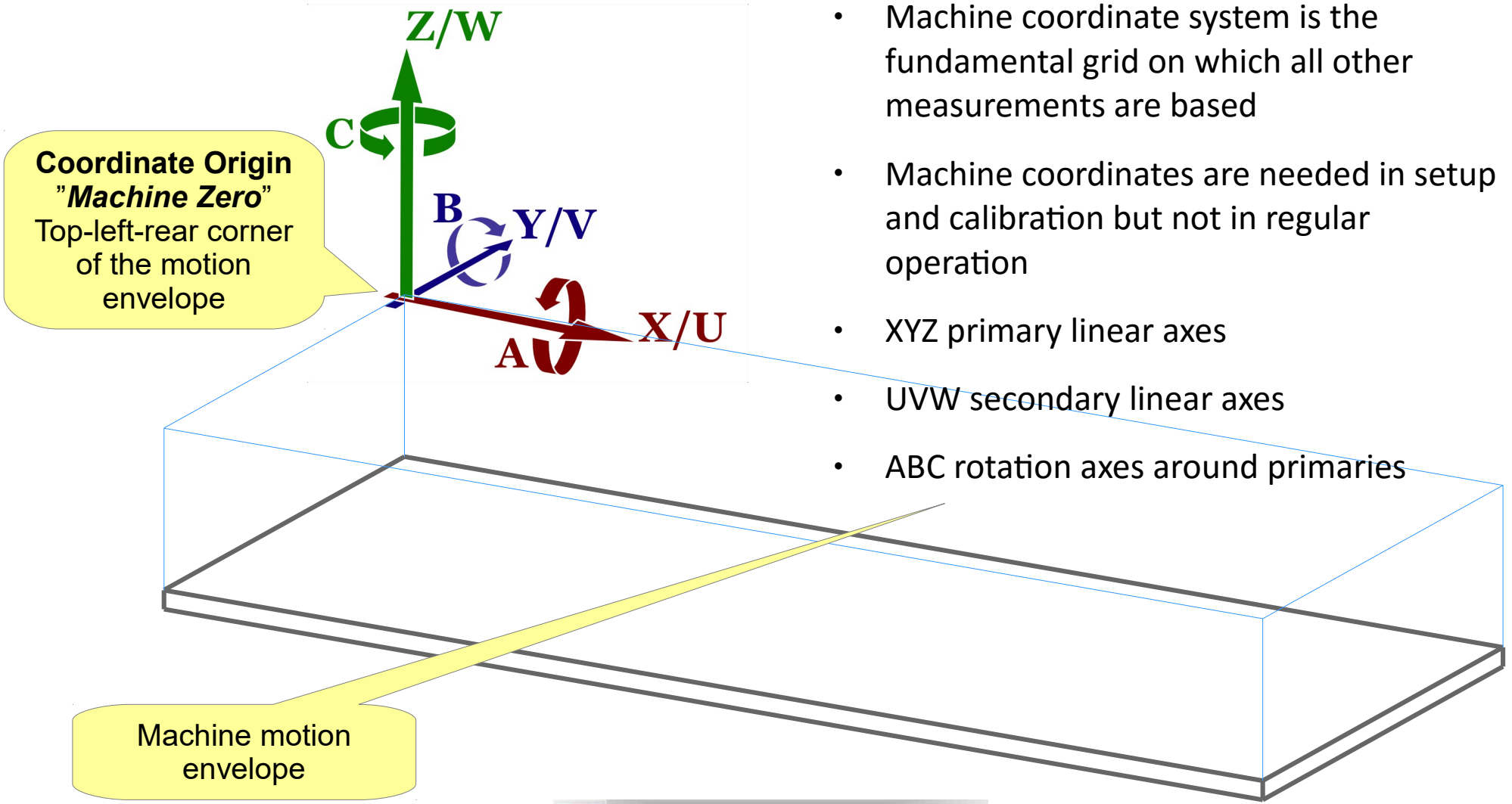

Lotta 101
Coordinate System

Coordinate system principles

Machine Coordinates
Absolute Coordinates
Relative Coordinates

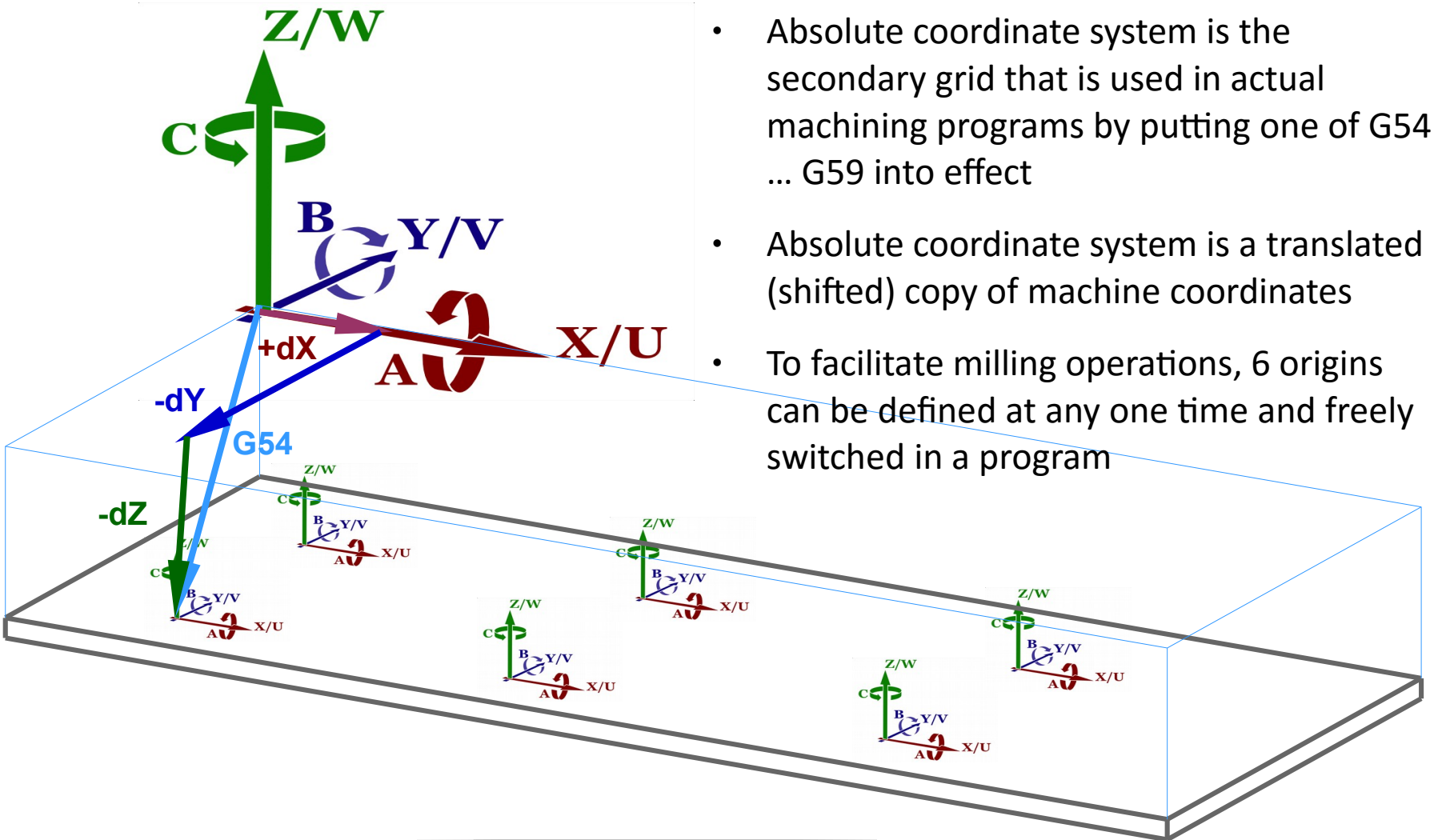
Coordinate System – Machine Coordinates



- Machine coordinate system is the fundamental grid on which all other measurements are based
- Machine coordinates are needed in setup and calibration but not in regular operation
- XYZ primary linear axes
- UVW secondary linear axes
- ABC rotation axes around primaries

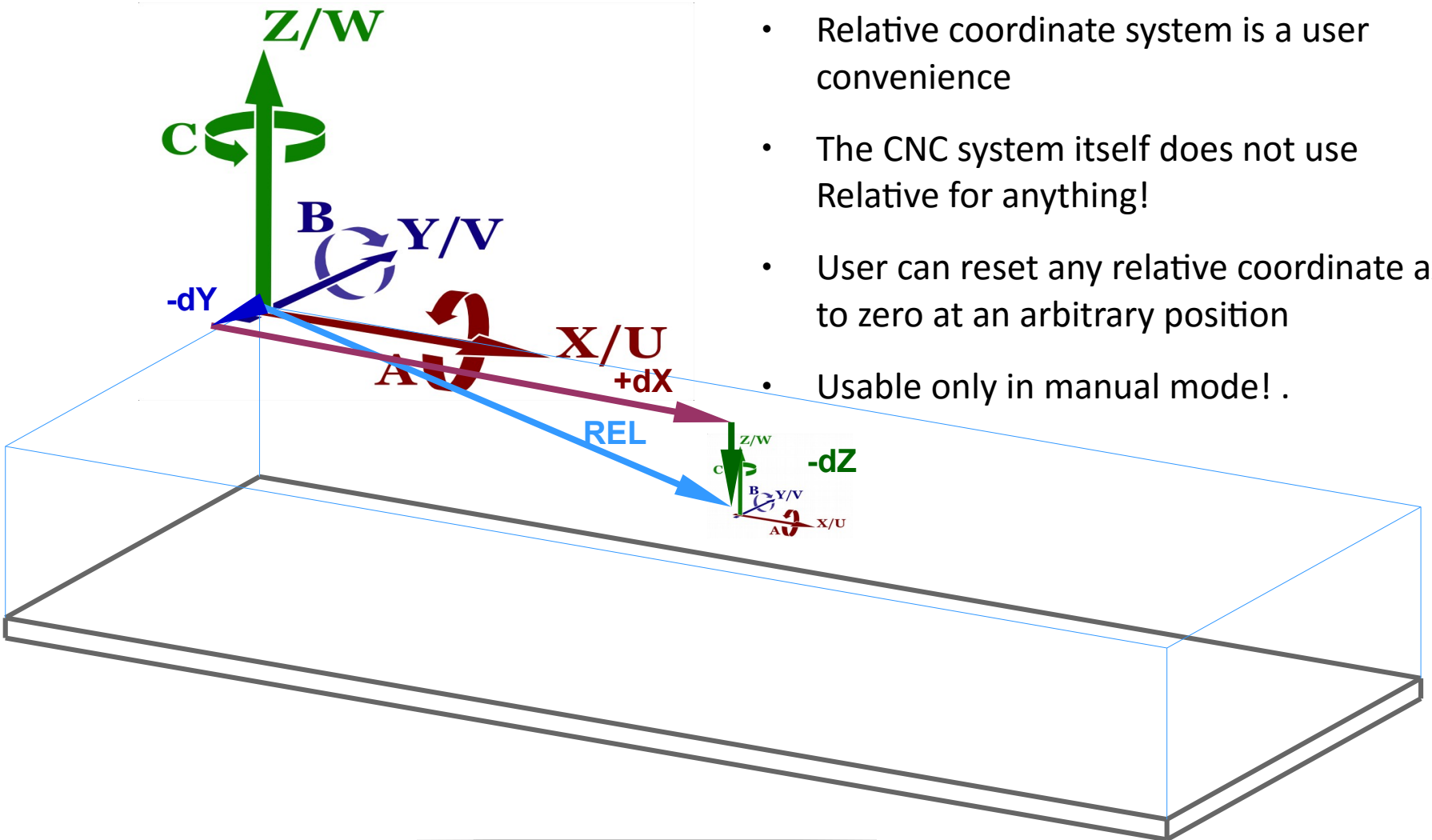
Coordinate System – Absolute Coordinates

(= Work Coordinates G54 … G59)



- Absolute coordinate system is the secondary grid that is used in actual machining programs by putting one of G54 … G59 into effect
- Absolute coordinate system is a translated (shifted) copy of machine coordinates
- To facilitate milling operations, 6 origins can be defined at any one time and freely switched in a program

Coordinate System – Relative Coordinates



- Relative coordinate system is a user convenience
- The CNC system itself does not use Relative for anything!
- User can reset any relative coordinate axis to zero at an arbitrary position
- Usable only in manual mode! .

Principles of Calculating Motion

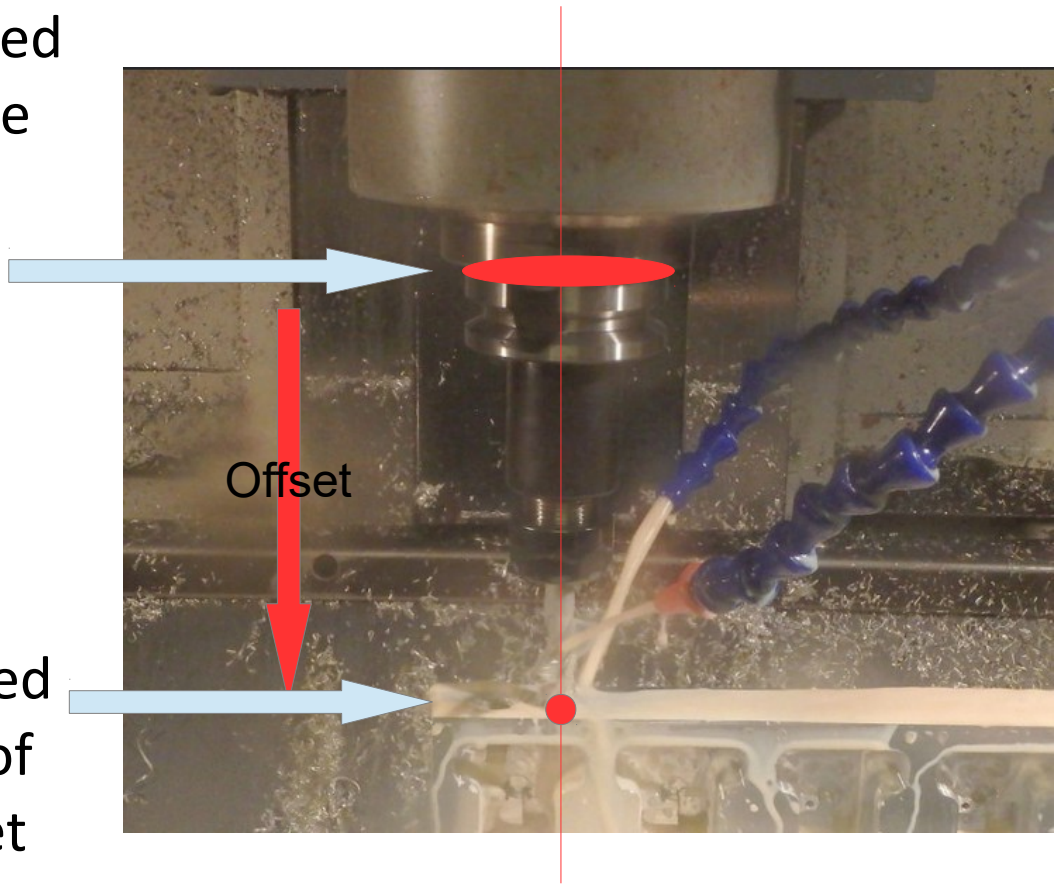
Or,

How Lotta calculates motion based on Coordinates

Controlled Point; Distance-to-Go
Measuring and Programming Work Coordinates
Measuring and Programming Tool Offsets

Principles of calculating motion – Controlled Point

- The thing that moves in the envelope of motion is a so called Controlled Point. *By default* the controlled point is the intersection of the central axis and the seating plane of the spindle tool holder cavity (i.e. the middle bottom of the spindle)
- For practical use, The Controlled Point is translated to the end of the tool in use by defining a set of *offsets*



Principles of calculating motion – Distance-to-Go

- For every commanded motion, the CNC computer calculates for each axis the ***distance-to-go*** from current to target position
- This calculation accounts for:
  - The current MACHINE XYZ coordinates of the CP
  - The target XYZ coordinate values
  - Any values in **EXT** offset
  - Any tool length compensation offset in effect (G43)
  - Any work coordinate offset in effect (G54...G59)

- Distance-to-go =

  Work coordinate set XYZ -

  CURRENT MACHINE XYZ +

  TARGET XYZ +

  EXT coordinate set XYZ +

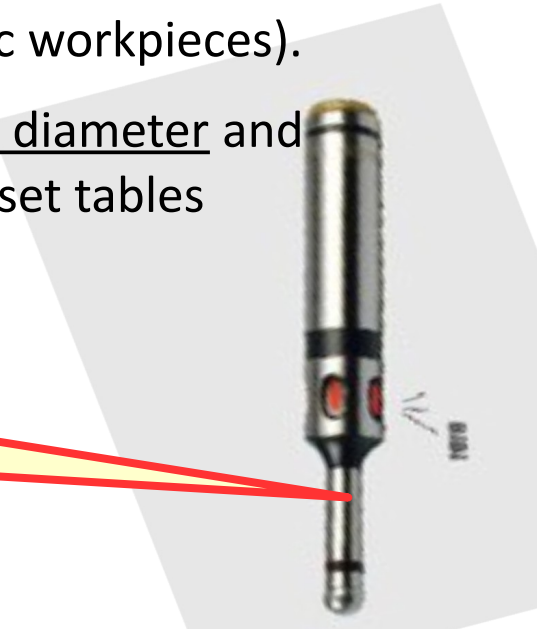
  tool length compensation (Z)

EXT offset register is a special Work Coordinate Set (00) that is ALWAYS IN EFFECT

How to Set Up Work Coordinates: 1/2: Measuring X and Y Coordinates

- XY *work coordinates* are measured and programmed directly as the corresponding *machine coordinates*.
- Coordinate setup
  - Use the beeper to find the X and Y components of the coordinate.
  - Manually approach the reference surface until the beeper ball touches at which point there is an audible beep (works only for metallic workpieces).
  - Read the appropriate *machine coordinate*, allow for the ball diameter and enter the result in the correct work offset location in the offset tables

The beeper lives in a dedcated holder
Do not remove it under any circumstances!
Removal invalidates all tool length offsets!

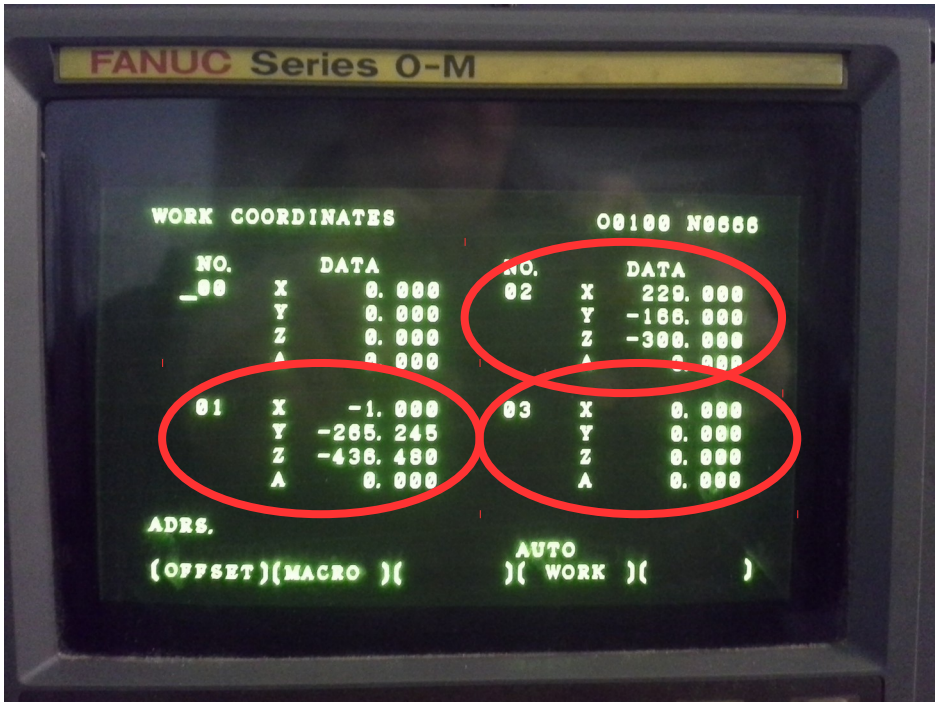


How to Set Up Work Coordinates: 2/2: Measuring Z Coordinate

- Due to the way Lotta calculates Distance-to-go and how tool lengths are compensated, the Z component of a work coordinate set is measured simply as *height above the table surface*.
- Method 1 is to use a caliper and a parallel bar to directly measure the distance above table, of a workpiece feature. This method is good to about 0.1 mm or so.
- A more precise method is to use the beeper and a precision ground pin to measure 2 numbers: machine Z coordinate of table surface (+pin) and workpiece feature Z coordinate (+pin). Subtract second from 1st and you have the work Z coordinate. Program accordingly.
  NOTE: the beeper ball does NOT flex in Z direction, so you have to use the pin method.

Programming Work Coordinates

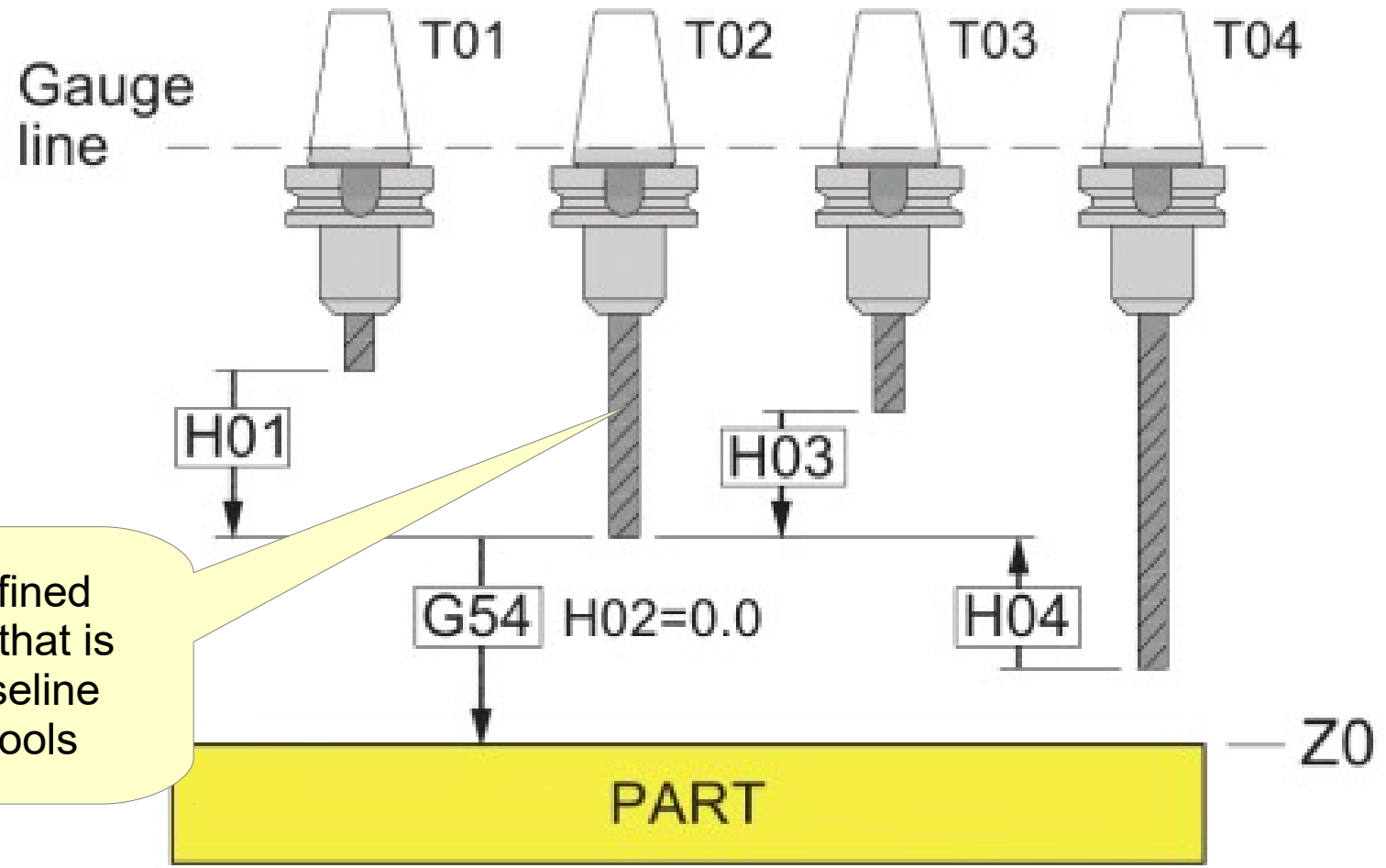
- Once the coordinates have been measured as above, program them to Lotta.
  - Select [PARM/OFSET]
  - Navigate [Pg up][Pg Dn] to the Work Offset page 1 or 2
  - Navigate [Cursor Up[]Cursor Dn] to the correct coordinate set (1 = G54, 2 = G55 etc)
  - Enter [X] nnn.nnn [INPUT], and Y,Z similarly. Done



Measuring and Programming Tool Length Offsets

- Tool lengths differ and it is not practical to program them all individually for each separate G-code program.
- There are multiple methods how to define and program the length information. It is highly desirable to use a method that makes the length differences invisible to the programs.
- Lotta uses one such method – a reference tool method called the ***longest tool method*** (although the reference tool does not have to be actually longest)

Reference (longest) tool method



There is a defined reference tool that is the length baseline for all other tools

Reference tool method – 1: Setting the reference

This is not needed for every tool, only done once

1: select the reference tool

Machine coordinate Z = **0.000**

2: HOME the Z axis so that the Machine coordinate resets to zero

3: Run the spindle Close to the table on manual (MPG)

Z < 0 and increases in the negative direction

4: Close to the table find the contact point calibrated pin just passes under the beeper

At contact the machine coordinate Z = **-nnn.nnn** - 5.000 mm

5: Subtract the pin diameter from the coordinate Result becomes more negative still

Table surface

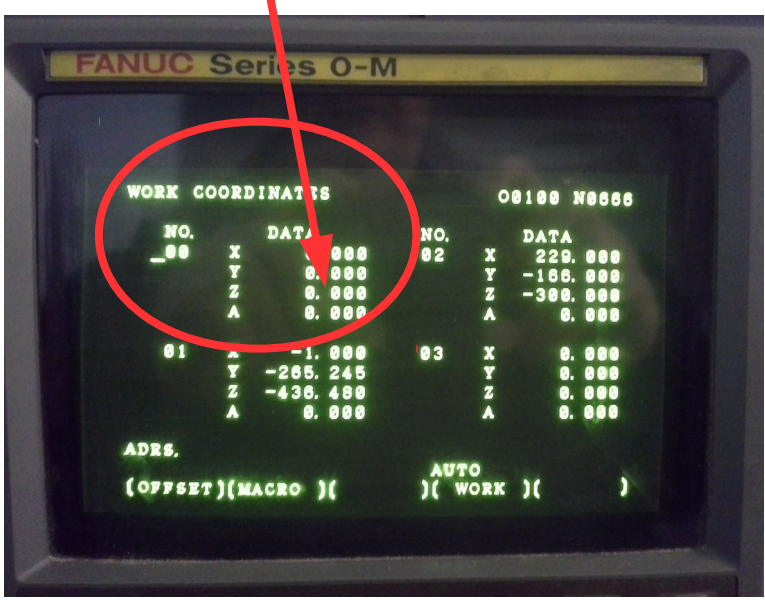
Pin diameter 5 mm

00:		
	X	0.000
	Y	0.000
	Z	-nnn.nnn
	A	0.000

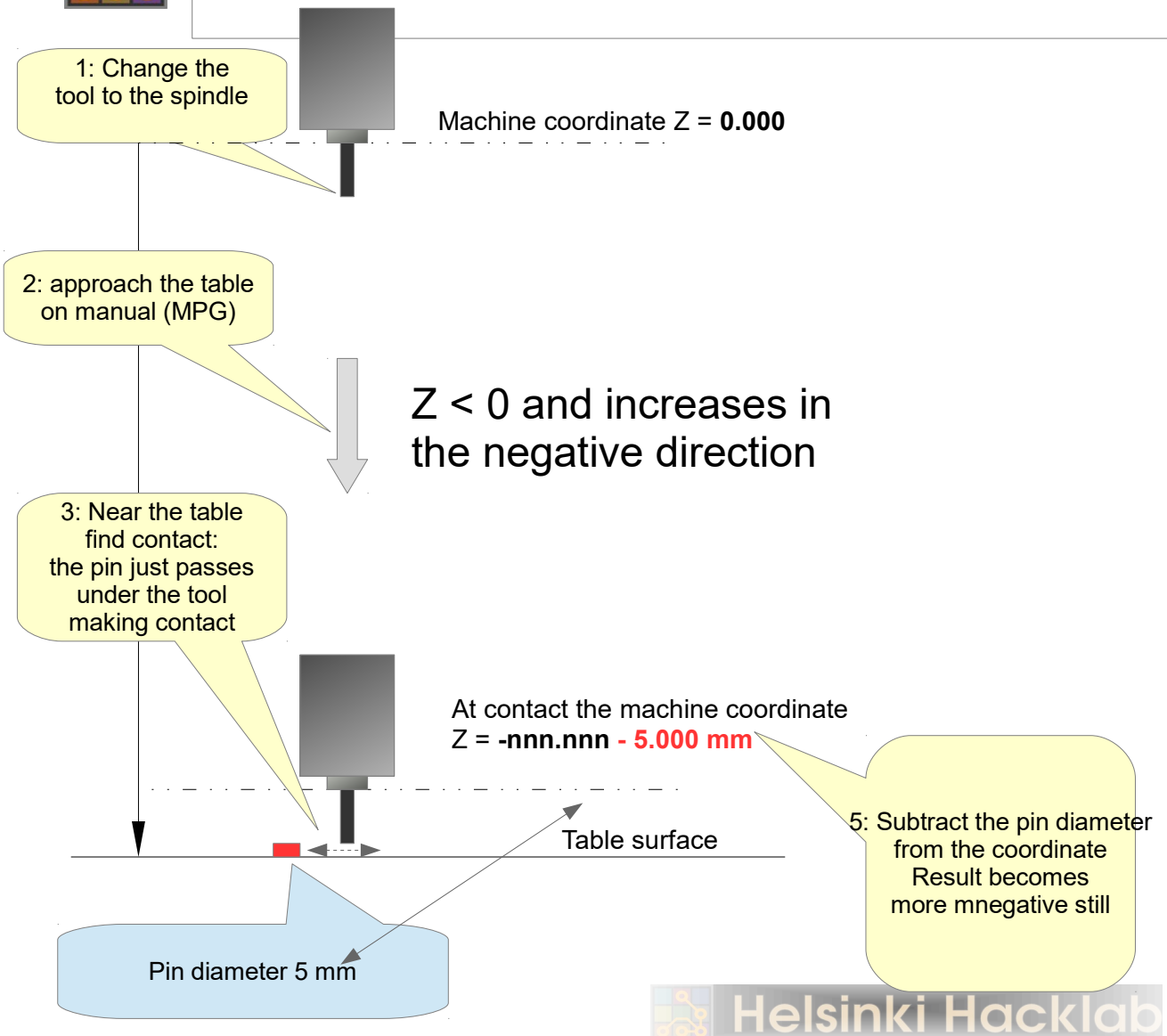
6: Enter the contact coordinate as **work coordinate 00** Z value

01:		
	X	
	Y	
	Z	???
	A	

Result = Z_{ref}



Reference tool method – 2: tool offset measurement



Result = Z_{tool}

Programming the Tool Length Offset

6: calculate the offset to program:

$$F_{tool} = Z_{tool} - Z_{ref}$$

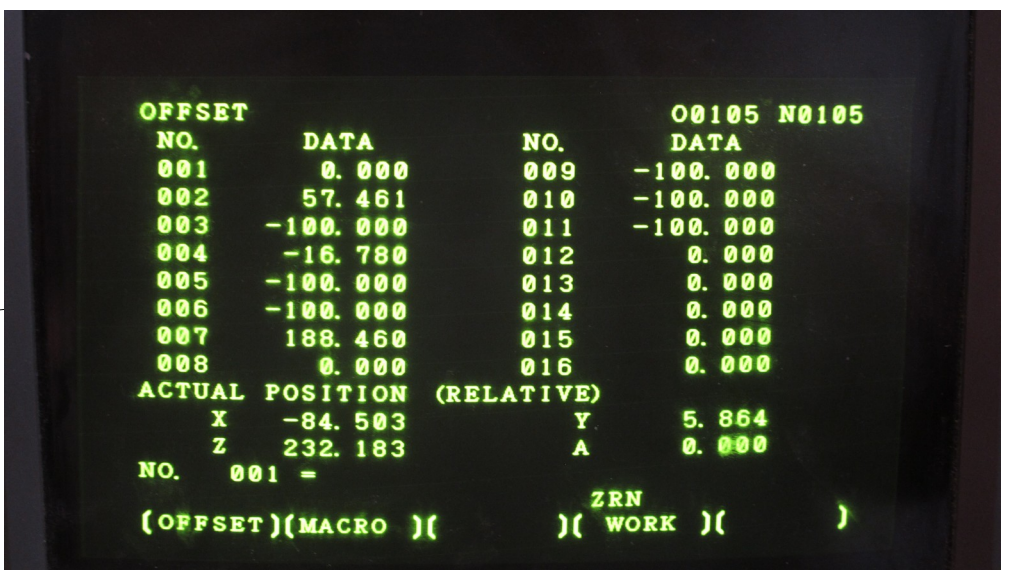
7: enter calculation result in the tool offset table at the row corresponding to the tool magazine position

NOTE!: The calculation ***must*** preserve signs, i.e.:

F_{tool} = (-mmm.mmm) **-** (**-**nnn.nnn)

NOTE!: If the tool is shorter than the reference, the result *must be negative!*

Tool offset table



Esityksen tuotti

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