HEIDENHAIN

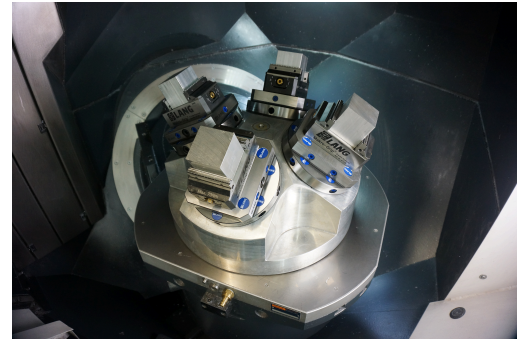# NC Solutions

Description of NC Program 4240

1 Description of NC program 4240_en.h

NC program for multi-axis machining of four workpieces clamped on a pyramid fixture

Requirement

An inclined tool is to be used to mill a chamfer of 5 x 45 degrees on all of the four edges of a workpiece. Another requirement is that the machine be equipped with a pyramid fixture that allows machining of four workpieces. These workpieces are machined using the NC program 4240_en.h.

The control needs to combine the following functions to ensure the correct inclination of the tool relative to the workpiece:

- Tilt working plane for aligning the pyramid
- Datum shift from the NC program
- Tilt working plane from the NC program

Definition of workpiece presets

You need to define the workpiece presets before machining.

The following presets are used in the example program:

- Workpiece at front, preset 6
- Workpiece at right, preset 7
- Workpiece at rear, preset 8
- Workpiece at left, preset 9
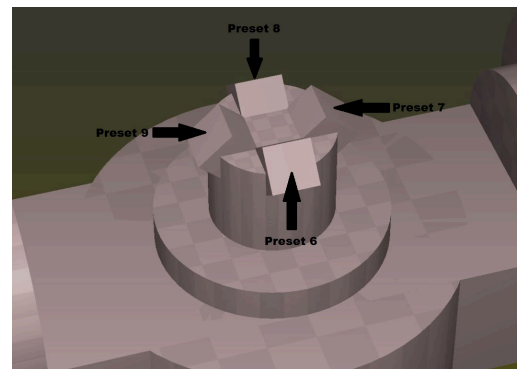

Proceed as follows to set the presets:

- ▶ Switch to the **Positioning w/ Manual Data Input** operating mode
- ▶ Use Cycle 247 to activate the preset to be defined
- ▶ Use the **PLANE SPATIAL** function to tilt the working plane to the surface of the pyramid fixture
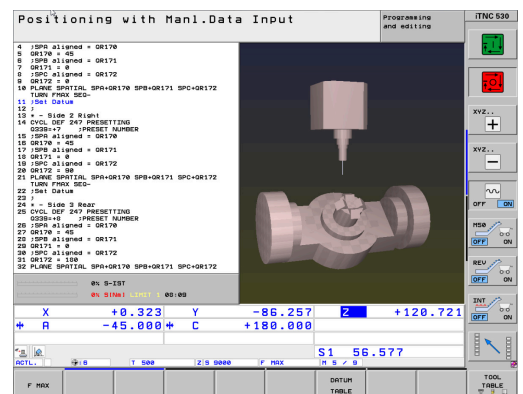
▶ Switch to the **Manual Operation** operating mode

▶ Press the **3-D ROT** soft key

▶ Set the Tilt working plane function to active in the **Manual Operation** operating mode
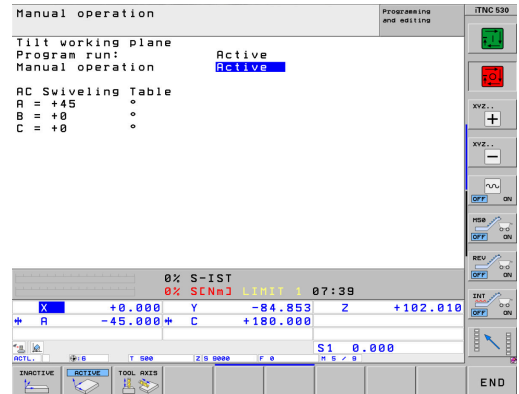
▶ Position the touch probe to the workpiece

▶ Press the **TOUCH PROBE** soft key

▶ Select the required probing function, e.g. **PROBING POS** Z-

▶ Start the probing function with **NC start**
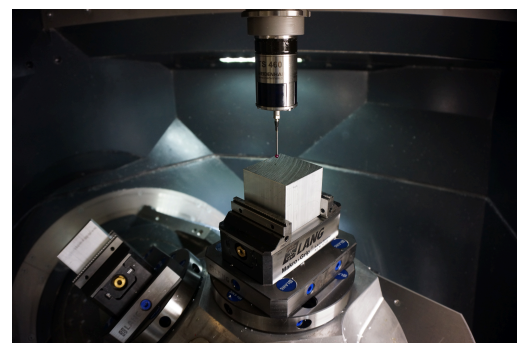
▶ Define the line of the preset table

▶ Press the **ENTRY IN PRESET TABLE** soft key

> The control asks you whether you want to overwrite the active preset

▶ Confirm with **Ent**

▶ Set the presets for the other linear axes
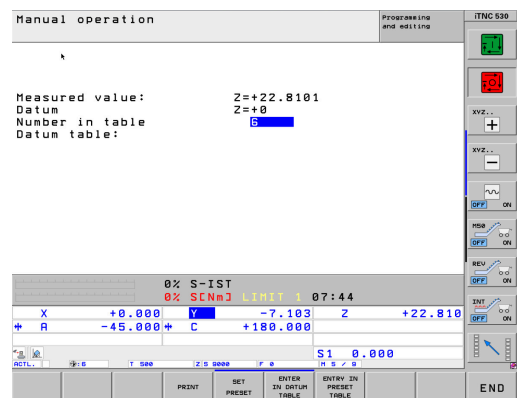
NOTICE

Caution: Danger to the tool and workpiece!

You must not set any preset in a rotary axis that moves another rotary axis or the tool. This could lead to incorrect positioning.

▶ Zero only those axes that do not move other rotary axes

▶ Zero only those axes that do not move the tool

▶ Verify the NC program by carefully executing it block by block

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ℹ In this example, the A axis must not be set to zero.

▶ Switch to the **Positioning w/ Manual Data Input** operating mode

▶ Use the **PLANE RESET** function to deactivate the tilting of the working plane

You need to perform this procedure for all of the four surfaces of the pyramid and the assigned presets Then you can verify the entries in the preset table.

Programming the machining operation

You program the NC program for the machining operation without taking into account the pyramid fixture The working plane is tilted relative to the workpiece coordinate system.

> ℹ️ You must use only solid angle functions for tilting the working plane.
>
> The following functions are available on the control:
> - **PLANE SPATIAL**
> - **PLANE EULER**
> - **PLANE PROJECTED**
> - **PLANE VECTOR**
> - **PLANE POINTS**
> - **PLANE RELATIVE**
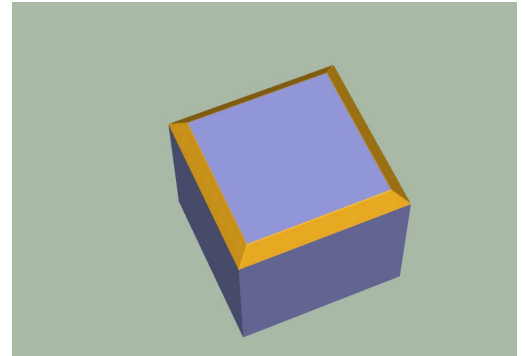
Structure of NC program 4240_en.h and program run

At the beginning of the NC program, you define the preset for each workpiece on the pyramid fixture. Then you define the solid angles SPA, SPB, and SPC in the non-volatile parameters QR170, QR171, and QR172. These parameters define the position of the pyramid surface.

The control then calls the "MACHINING" subprogram. After the subprogram has been executed, the control jumps back to the main program. In the main program, you define the presets and solid angles for the other sides. Every time a side has been defined, the control jumps to the "MACHINING" subprogram.

After all of the four sides have been machined, the main program calls the "Reset" subprogram. After the subprogram has been executed, the control ends the NC program.

"MACHINING" subprogram:

In the "MACHINING" subprogram, you program the machining of the workpiece without taking into account the pyramid fixture. You first define the tool to be used for carrying out the machining operation. The control then calls the "SAFE" subprogram. Then a subprogram for shifting the datum and tilting the working plane is called for each workpiece edge (**LBL** "TILTx"). After each of these subprograms, the control calls the "MILL" subprogram. After all edges have been machined, the control jumps back to the main program.

"MILL" subprogram:

The tool path for the machining operation is programmed in the "MILL" subprogram. In the example program, this movement consists of simple linear segments.

"TILTx" subprograms:

All of the subsequent "TILTx" subprograms have the same structure. First, **PLANE RESET** is defined. It is followed by a datum shift to the tilting position. The control then calls the "SAFE" subprogram. After this subprogram has been executed, tilting of the working plane relative to the workpiece coordinate system is defined. As a final step in each of the five subprograms, the control calls another subprogram, the "TILT_NEW" label.

"SAFE" subprogram:

In this subprogram, the control moves to a safe position. This position is defined by an X coordinate, Y coordinate, and Z coordinate relative to the machine coordinate system.

> The position **M91** varies depending on the machine. You have to adapt this position to the respective machine.

"RESET" subprogram:

In the "RESET" subprogram, the control resets all of the functions for coordinate transformation.

"TILT_NEW" subprogram:

The "TILT_NEW" subprogram is used to include the datum shift and the tilting of the working plane from the "TILTx" subprogram as well as the aligning of the pyramid fixture in the calculations.

This is done in the following steps:

▶ Read the active 3-D rotation of the SPA solid angle and save the value to Q170

▶ Read the active 3-D rotation of the SPB solid angle and save the value to Q171

▶ Read the active 3-D rotation of the SPC solid angle and save the value to Q172

▶ Deactivate the tilting of the working plane with **PLANE RESET**

▶ Read the active datum shift of the X axis and save the value to Q175

▶ Read the active datum shift of the Y axis and save the value to Q176

▶ Read the active datum shift of the Z axis and save the value to Q177

▶ Reset the datum shift

▶ Use **PLANE SPATIAL** and the angles **SPA** QR170, **SPB** QR171, and **SPC** QR172 to align the pyramid fixture by tilting

▶ Shift the datum in the tilted plane incrementally by X Q175, Y Q176, and Z Q177

▶ Use **PLANE RELATIVE** to further tilt the working plane by **SPC** Q172

▶ Use **PLANE RELATIVE** to further tilt the working plane by **SPB** Q171

▶ Call the "SAFE" subprogram

▶ Use **PLANE RELATIVE** to further tilt the working plane by **SPA** Q170 and to position the rotary axes

> ℹ️ It is important that the angles read be tilted in the following sequence: **SPC**, **SPB**, and then **SPA**. A different sequence will lead to an incorrect result.

All of the functions for tilting the working plane, except for the last **PLANE RELATIVE**, can be programmed using **STAY** in the NC syntax. These functions are used only for calculations. The control uses the last function to tilt the working plane to the result of the calculations.