

3.9 Milling rectangular pockets - POCKET3



The POCKET3 cycle is available as from SW 4.



Programming

POCKET3 (_RTP, _RFP, _SDIS, _DP, _LENG, _WID, _CRAD, _PA, _PO, _STA, _MID, _FAL, _FALD, _FFP1, _FFD, _CDIR, _VARI, _MIDA, _AP1, _AP2, _AD, _RAD1, _DP1)



Parameters

The following input parameters are always required:

_RTP	real	Retraction plane (absolute)
_RFP	real	Reference plane (absolute)
_SDIS	real	Safety clearance (to be added to the reference plane, enter without sign)
_DP	real	Pocket depth (absolute)
_LENG	real	Pocket length for dimensioning from the corner with sign
_WID	real	Pocket width for dimensioning from the corner with sign
_CRAD	real	Pocket corner radius (enter without sign)
_PA	real	Pocket reference point, abscissa (absolute)
_PO	real	Pocket reference point, ordinate (absolute)
_STA	real	Angle between the pocket longitudinal axis and the first axis of the plane (abscissa, enter without sign); Value range: $0^\circ \leq _STA < 180^\circ$
_MID	real	Maximum infeed depth (enter without sign)
_FAL	real	Final machining allowance on pocket edge (enter without sign)
_FALD	real	Final allowance at base (enter without sign)
_FFP1	real	Feedrate for surface machining
_FFD	real	Feedrate for depth infeed
_CDIR	int	Milling direction: (enter without sign) Value: 0...Climb milling (as spindle rotation) 1...Opposed milling 2...with G2 (independent of spindle direction) 3...with G3
_VARI	int	Type of machining: (enter without sign) UNITS DIGIT: Value: 1...Roughing 2...Finishing

TENS DIGIT:

Value: 0...Perpendicular to pocket center with G0

1...Perpendicular to pocket center with G1

2...Along a helix

3...Oscillating along the pocket longitudinal axis

The other parameters can be selected as options. They define the insertion strategy and overlapping for solid machining: (enter without sign)

_MIDA	real	Maximum infeed width during solid machining in the plane
_AP1	real	Basic size pocket length
_AP2	real	Basic size pocket width
_AD	real	Basic pocket depth from reference plane
_RAD1	real	Radius of the helical path on insertion (relative to the tool center point path) or maximum insertion angle for oscillating motion
_DP1	real	Insertion depth per 360° revolution on insertion along helical path

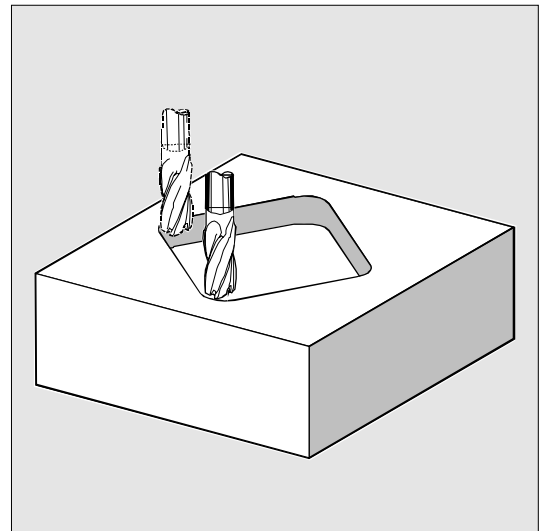
**Function**

The cycle can be applied to roughing and finishing. For finishing, a face cutter is needed.

The depth infeed will always start at the pocket center point and be performed vertically from there; thus predrill can be suitably performed in this position.

New functions compared to POCKET1:

- The milling direction can be defined with a G instruction (G2/G3) or climb milling or opposed from the spindle direction
- For solid machining, the maximum infeed width in the plane is programmable
- Finishing allowance for the pocket base
- Three different insertion strategies:
 - Vertically at the pocket center point
 - Along a helical path around the pocket center
 - Oscillating around the pocket central axis
- Shorter approach paths in the plane for finishing
- Consideration of a blank contour in the plane and a basic size at the base (optimum processing of pre-formed pockets possible)





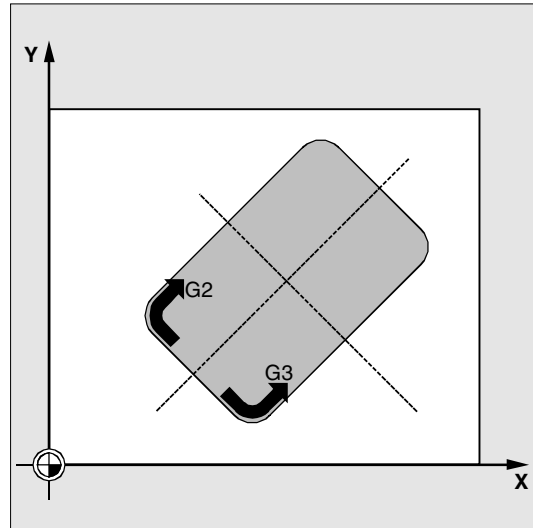
Sequence of operations

Position reached prior to cycle start:

This can be any position from which the starting position on the center point of the pocket at the retraction plane level can be approached without collision.

Motion sequence when roughing (VARI=X1):

With G0, the pocket center point is approached at the retraction plane level and then, from this position, with G0 the reference plane brought forward by the safety clearance is approached. Pocket machining is then performed according to the selected insertion strategy and considering the programmed base size.



Insertion strategies:

- **Vertical insertion to pocket center (VARI=0X, VARI=1X)** means that the current infeed depth internally calculated in the cycle (\leq programmed maximum infeed depth through _MID) is executed in one block with G0 or G1.
- **Insertion along helical path (VARI=2X)** means that the milling center point travels on the helical path determined by radius _RAD1 and depth per revolution _DP1. The feedrate is always programmed through _FFD. The sense of rotation of this helical path corresponds to the direction to be used for machining the pocket.
The depth programmed under _DP1 on insertion is calculated as the maximum depth and is always calculated as a whole number of revolutions of the helical path.
When the current depth for the infeed (these may be several revolutions on the helical path) has been calculated, a full circle is made to remove the slope on insertion.
Then pocket solid machining starts in this plane and continues until reaching the finishing allowance.
The starting point of the helical path described is on the pocket longitudinal axis in the "plus direction" and reached with G1.

- **Oscillating insertion on center axis of pocket (VARI=3X)**

means that the mill center point oscillates along an oblique linear path until it has reached the next current depth. The maximum insertion angle is programmed under `_RAD1`, the position of the oscillation path is calculated within the cycle. When the current depth has been reached, the path is traversed again without depth infeed in order to remove the slope caused by insertion. The feedrate is programmed through `_FFD`.

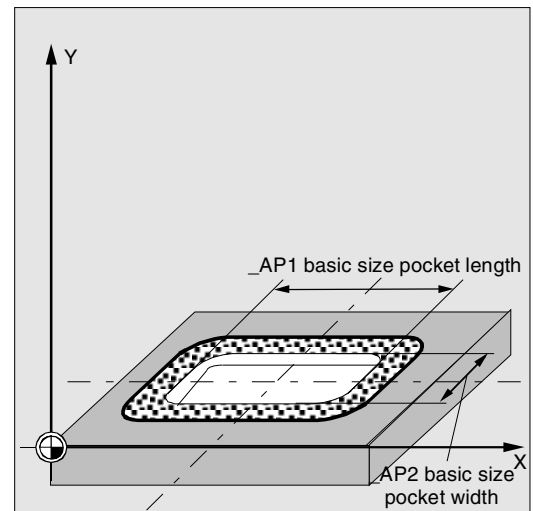
Accounting for blank dimensions

During solid machining, it is possible to take blank dimensions (for example, in the machining of precast workpieces) into account.

The basic size for the length and width (`_AP1` and `_AP2`) are programmed without sign and their symmetrical positions around the pocket center computed in the cycle. They define the part of the pocket that does not have to be solid machined. The basic size for the depth (`_AD`) is also programmed without a sign and computed in the direction of the pocket depth from the reference plane.

Depth infeed to account for workpiece sizes is carried out according to the programmed type (helical path, oscillating, vertical). If the cycle recognizes that by means of the blank contour and the radius of the active tool there is enough room in the pocket center, infeed takes place as long as possible vertically downwards to the pocket center in order to avoid time-consuming approach paths in the open.

The pocket is solid machined beginning from the top and proceeding in the downward direction.



Motion sequence when finishing (VARI=X2)

Finishing is performed in sequence from the edge until reaching the finishing allowance on the base, then the base is finished. If one of the finishing allowances is equal to zero, this part of the finishing process is skipped.

- Finishing on the edge

While finishing on the edge, the pocket is only machined once.

For finishing on the edge the path includes one quadrant reaching the corner radius. The radius of this path is normally 2 mm or, if "less room" is available, equals the difference between the corner radius and the mill radius.

If the finishing allowance on the edge is larger than 2 mm, the approach radius is increased accordingly.

The depth infeed is performed with G0 in the open towards the pocket center and the starting point of the approach path is also reached with G0.

- Finishing on the base

During finishing on the base, the machine performs G0 towards the pocket center until reaching a distance equal to pocket depth + finishing allowance + safety clearance. From this point onwards, the tool is always fed in **vertically** at the depth infeed feedrate (since a tool with a front cutting edge is used for base finishing).

The base surface of the pocket is machined once.



Description of parameters

See Section 2.1.2. (Drilling, Centering – CYCLE81) for a description of parameters `_RTP`, `_RFP`, `_SDIS`.
See Section 3.7 for a description of parameter `_DP`.
See Section 3.2 for cycle setting data `_ZSD[1]`, `_ZSD[2]`.

`_LENG`, `_WID` and `_CRAD` (pocket length, pocket width and corner radius)

The shape of a pocket in the plane is determined with parameters `_LENG`, `_WID` and `_CRAD`.

The pocket can be dimensioned from the center or from one corner point. When dimensioning from a corner point, use `_LENG` and `_WID` with sign.

If it is not possible to traverse to the programmed corner radius with the active tool because its radius is larger, the corner radius of the completed pocket corresponds to the tool radius.

If the milling cutter radius is greater than half the length or width of the pocket, the cycle is aborted and alarm 61105 "Cutter radius too large" is output.

`_PA`, `_PO` (reference point)

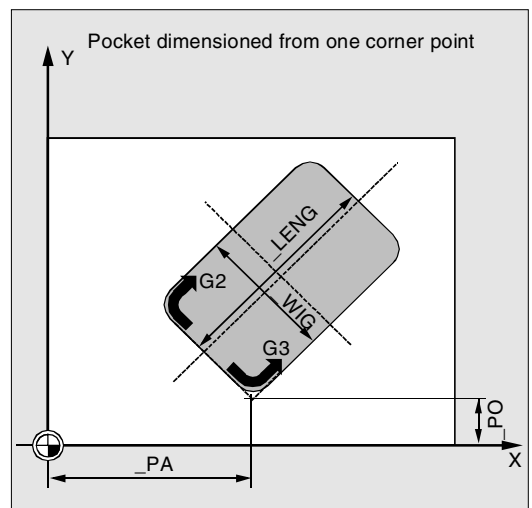
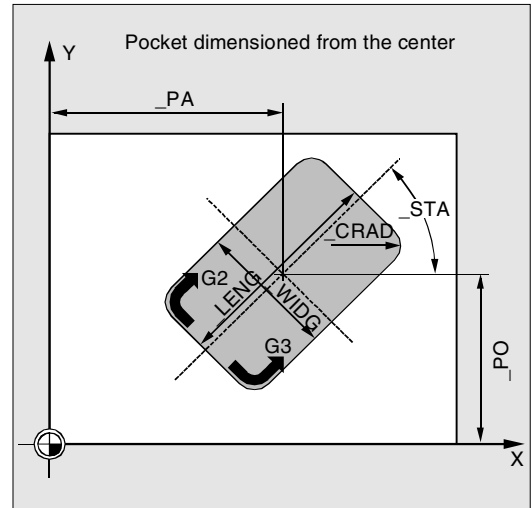
The center point of the pocket in the abscissa and ordinate is defined with parameters `_PA` and `_PO`. This is either the pocket center point or a corner point. The value of this parameter depends on cycle setting data bit `_ZSD[2]`:

- 0 means pocket center point
- 1 means corner point

When dimensioning the pocket from a corner, the length and width parameters must be entered with sign (`_LENG`, `_WID`), thus completely defining the position of the pocket.

`_STA` (angle)

`_STA` indicates the angle between the 1st axis of the plane (abscissa) and the longitudinal axis of the pocket.



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_MID (infeed depth)

With this parameter you determine the maximum infeed depth when roughing.

The depth infeed is performed by the cycle in equally sized infeed steps.

The cycle automatically calculates this infeed using _MID and the total depth. The minimum possible number of infeed steps is used as the basis.

_MID=0 means that the cut to pocket depth is made with one infeed.

_FAL (final machining allowance at the edge)

The final machining allowance only affects machining of the pocket in the plane at the edge.

When the final machining allowance \geq tool diameter, the pocket will not necessarily be machined completely. The message

"Caution: Final machining allowance \geq tool diameter" is output but the cycle is continued.

_FALD (final machining allowance on the base)

For roughing, a separate final machining allowance is considered on the base (POCKET1 does not normally consider any finishing allowance).

_FFD and _FFP1 (infeed depth and plane)

Feedrate _FFD is used for insertion into the material.

Feedrate FFP1 is used for all movements in the plane traversed at feedrate when machining.

_CDIR (milling direction)

The value for the machining direction of the pocket is defined in this parameter.

Under parameter _CDIR the mill direction

- direct "2 for G2" and "3 for G3" or
 - alternatively "climb milling" or "opposed milling"
- can be programmed. Climb milling or opposed milling is determined within the cycle via the spindle direction activated prior to the cycle call.

Climb milling

M3 → G3

M4 → G2

Opposed milling

M3 → G2

M4 → G3

_VARI (machining mode)

You can define the type of machining with parameter _VARI.

Possible values are:

Units position:

- 1=Roughing
- 2=Finishing

Tens digit (infeed):

- 0=Perpendicular to the pocket center with G0
- 1=Perpendicular to the pocket center with G1
- 2=Along an helical path
- 3=Oscillating along the pocket longitudinal axis

If another value has been programmed for parameter _VARI, the cycle is aborted after alarm 61002 "Machining type incorrectly defined" is output.

_MIDA (max. infeed width)

With this parameter you define the maximum infeed width for solid machining in the plane. In the same way as the known calculation of the infeed depth (equal distribution of the overall depth using the largest possible value), the width is evenly divided, using the value programmed in _MIDA as a maximum value.

If this parameter is not programmed, or if its value is 0, the cycle uses 80% of the mill diameter as maximum infeed width.

**Further notes**

Applies if the width infeed determined from edge machining is recalculated on reaching the full pocket depth; otherwise, the width infeed calculated at the start is retained for the full cycle.

_AP1, _AP2, _AD (blank dimension)

With the parameters _AP1, _AP2 and _AD you define the blank dimension (incremental) of the pocket in the horizontal and vertical planes.

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_RAD1 (radius)

With the parameter _RAD1 you define the radius of the helical path (i.e. the tool center point path) or the maximum insertion angle for oscillation.

_DP1 (insertion depth)

With the parameter _DP1 you define the infeed depth for insertion on the helical path.



Further notes

A tool offset must be activated before the cycle is called. Otherwise the cycle is aborted and alarm 61000 "No tool offset active" is output.

A new workpiece coordinate system that influences the actual value display is used in the cycle. The zero point of this coordinate system lies on the pocket center point.

The original coordinate system becomes active again after the end of the cycle.



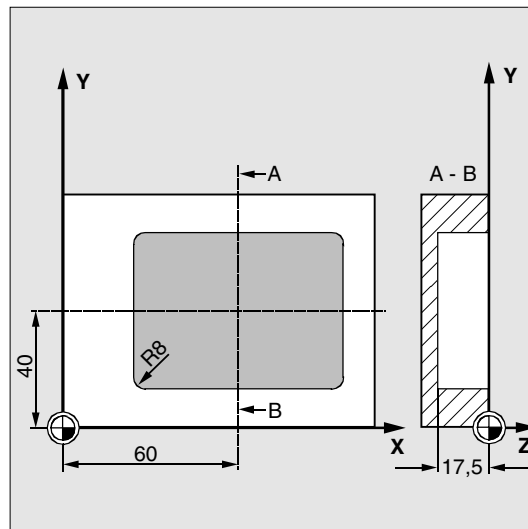
Programming example

Pocket

With this program you can machine a pocket that is 60 mm long, 40 mm wide, 17.5 mm deep in the XY plane, and which has a corner radius of 8 mm. The angle in relation to the X axis is 0 degrees. The final machining allowance of the pocket edges is 0.75 mm, 0.2 mm at the base, the safety clearance in the Z axis, which is added to the reference plane, is 0.5 mm. The center point of the pocket lies at X60 and Y40, the maximum depth infeed is 4 mm.

Climb milling uses the spindle rotation direction as direction of machining.

Only roughing is to be performed.



```
N10 G90 T20 D2 S600 M4
```

Specification of technology values

```
N20 G17 G0 X60 Y40 Z5
```

Approach starting position

```
N25 _ZSD[2]=0
```

Dimensioning the pocket via the center point

```
N30 POCKET3 (5, 0, 0.5, -17.5, 60 ->
-> 40, 8, 60, 40, 0, 4, 0.75, 0.2 ->
-> 1000, 750, 0, 11, 5)
```

Cycle call

```
N40 M30
```

End of program

-> Must be programmed in a single block