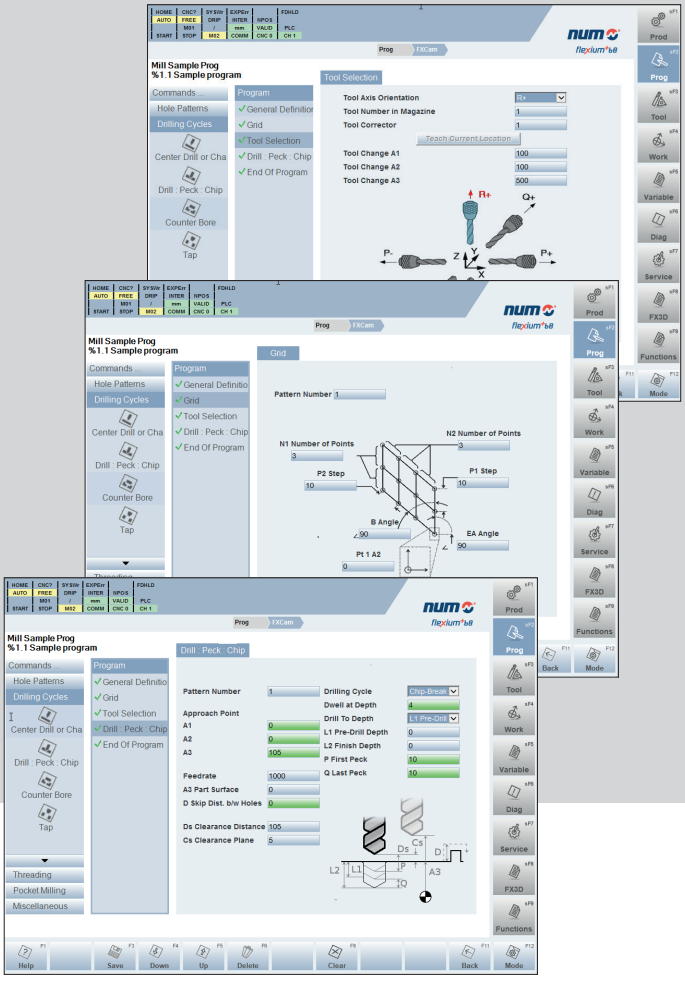
NUMmill

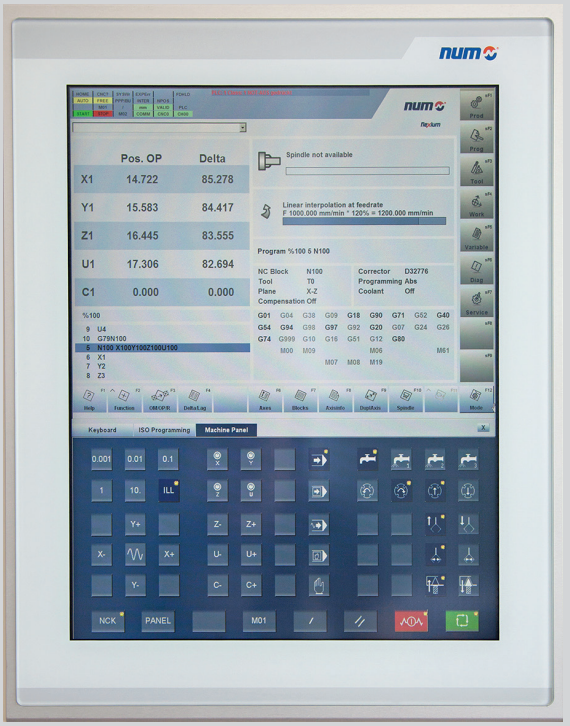
Operator manual

(from software release 4.1.30.00)

M00051EN-01

Edition 12.2020





flexium+

www.num.com

num®
CNC HighEnd Applications

Summary

Summary

Page deliberately empty

1 Foreword

1.1 Use of the manual

The NUMmill Operator manual gives information on how to use the NUMmill HMI of the Flexium+ system for a milling machine. This manual is for use by qualified personnel only.

To reduce the risk due to an improper use of the product, do not perform any servicing other than that contained in this manual unless you are qualified to do so.

To ensure proper use of these products, please always read this manual carefully and retain for future reference. Should the unit require maintenance, please contact a NUM authorized service center only.

1.2 Use of symbols in the manual

Symbol	Meaning of the symbol
	Important notes on product use.
	You may find this symbol whenever a wrong operation may damage the product.

1.3 Introduction

NUMmill HMI software runs on the *Flexium+ series* controls. It is designed primarily to meet the requirements of universal milling machines and is focused on drilling and threading operations.

The structure of the software allows the operator to use either NUMmill (conversational) or ISO-type programming methods, or any combination of the two methods.

The concept behind NUMmill HMI software is to provide an easy, user friendly method for creating programs to run on a milling machine. The user need only follow a menu driven data entry session which will define all parameters pertaining to the location of the holes, the drilling or threading cycle, and job specific machine dimensions.

The result is a modular, easily modifiable program which will produce the desired part.

The creation of the workpiece program is a simple matter of following a few steps:

1. Create a Drilling Part Program in the following manner:
   - Select Hole Pattern(s).
   - Enter Hole Pattern data.
   - Select Drilling Cycle(s).
   - Enter cycle data.
   - End of Program.

2. Create a Threading Part Program in the following manner:
   - Select Threading Cycle(s).
   - Enter cycle data.
   - End of Program.

Further customization of programs is achieved by adding miscellaneous functions such as tool change to change tools in between drilling cycles.

Drilling and threading cycles may also be combined into one part program.
A wide variety of function blocks are available to allow the user to create unique programs geared towards their specific applications.

1.4 Capabilities of NUMmill

The following is a general list of the cycles and features which are available through the NUMmill software:

- Create hole patterns in the following formats to efficiently perform multiple drilling operations on a group of holes:
  - ☑ Arc
  - ☑ Cover Pattern
  - ☑ Grid
  - ☑ Drilling with Rotary Axis
  - ☑ Pitch Circle
  - ☑ Row, by Point and Angle
  - ☑ Row, by Two Points
  - ☑ Single Points.

- Perform the following drilling operations for previously created hole patterns:
  - ☑ Center Drill or Chamfer
  - ☑ Drill : Peck : Chip
  - ☑ Counter Bore
  - ☑ Tap
  - ☑ Ream - Feed Out
  - ☑ Bore - Dwell/Feed Out
  - ☑ Bore - Stop/Rapid Out.

- Perform the following complex drilling operations for a single hole:
  - ☑ Thread Chase
  - ☑ Taper Threading.

- Perform the following pocket milling operations:
  - ☑ Pocket Definition
  - ☑ Simple Pocket Cycle.

- Insert the following miscellaneous functions including ISO functions to customize applications:
  - ☑ General Definition
  - ☑ Tool Selection
  - ☑ End of Program
  - ☑ Motion Request
  - ☑ Jump to Block
  - ☑ Sequence Call
  - ☑ Subroutine Call
  - ☑ ISO Function.

1.5 Document revisions

Date	Index	Reason for revision	See chapter
6 - 2017	00	Document creation	
12 - 2020	01	User Interface (Overview)	2
		Tool Bar	2.3
		Up version 4.1.30.00 the new softkey “Block number” is available	7.5
		Building an NUMMill Program	8

1.6 How to read the manual

Chapter	Description
1	**Foreword** This chapter introduces: - The use of the manual. - NUMmill Milling presentation and structure. - NUMmill Milling cycles and features and perform operations.
2	**User interface** This chapter introduces: - User interface of Flexium CAM. - Flexium CAM windows. - Task Bar description. - Program Tree description. - Tool Bar with first and second option Bar focus description. - Edit screen of part proogram block.
3	**Hole Pattern Definition** This chapter introduces: - Hole patters descriptions. - Use of the main icons. - Use of the Arc,Cover Pattern, Drilling with the Rotary Axis, Grid, Pitch Circle, Row by Point and Angle, Row by Two Points and Single Points functions.
4	**Drilling Cycles** This chapter introduces: - Center Drill or Chamfer cycle and Cycle Steps description. - Drill : Peck ; Chip cycle and Cycle Steps description. - Counter Bore cycle and Cycle Steps description. - Tap cycle and Cycle Steps description. - Ream - Feed Out Cycle and Cycle Steps description. - Bore - Dwell/Feed Out Cycle and Cycle Steps description. - Bore - Stop/Rapid Out Cycle and Cycle Steps description.
5	**Threading Cycles** This chapter introduces: - Thread Chase Cycle and Cycle Steps description. - Taper Threading Cycle and Cycle Steps description.
6	**Pocket Milling Cycles** This chapter introduces: - Pocket Definition Cycle. - Simple Pocket Cycle.
7	**Miscellaneous Functions** This chapter introduces: - General Definition description. - Tool Selection description. - End of Program. - Axis Motion Request description. - Jump to Block description. - Sequence Call description. - Subroutine Call description. - ISO Function description.
8	**Building an NUMmill Program** This chapter introduces: - Installation of NUMmill into Flexium HMI, Creating a New Part Program and Saving and Activating a Program.

1.7 NUM Agencies

The list of NUM agencies is given on http://www.num.com.

Page deliberately empty

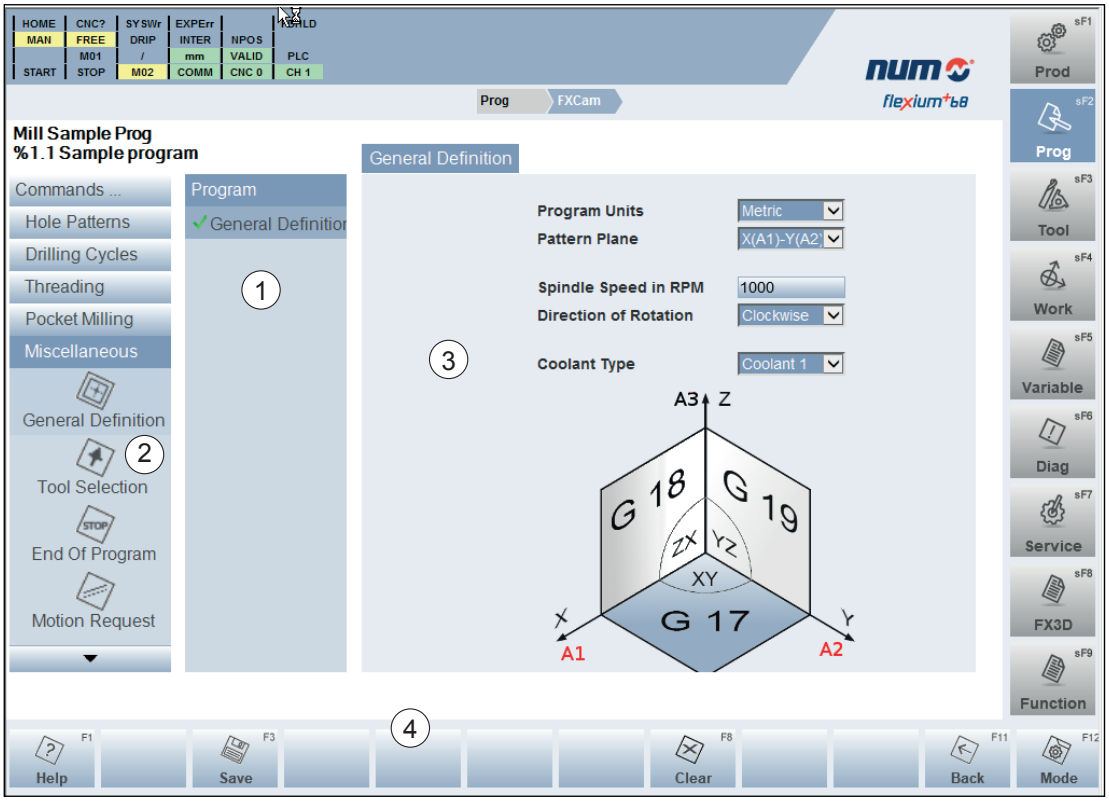
Page deliberately empty

Summary

Page deliberately empty

2 User Interface (Overview)

The Flexium CAM window has an easy to use interface similar to many Windows based products. The user interface is divided into 4 sections:



1	Program tree.
2	Task bar.
3	Edit Screen.
4	Tool bar.

2.1 Task Bar

The *Task Bar* as shown in the figure facilitates the user in carrying out various activities that help build a Part Program.

The following tasks can be performed using the *Task Bar*.

- Every program must define a set of holes to be drilled. This must be done prior to defining a drilling cycle. Many specific geometries of holes can be found under the *Hole Patterns* button.
- After a hole pattern has been defined, at least one drilling cycle or threading cycle must be added. Multiple cycles can be performed over the same set of holes. Drilling cycles and threading cycles can be found under both the *Drilling Cycles* button and the *Threading* button.
- A pocket or profile can be defined in place of the Drilling Cycles or Threading Cycles. To define the simple pocket and how it is milled,click the button *Pocket Milling*.
- Other miscellaneous blocks, such as *Tool Selection*, are also available.
  These block types offer flexibility in the creation of part programs. Access to these blocks is obtained by clicking the *Miscellaneous* button in the *Task Bar*.

1	Define where on the part the hole will be drilled.
2	Designate how the spindle drills each hole.
3	Perform complex drilling cycles.
4	Define a simple pocket cycle to be milled.
5	Define a milling cycle according to a customer profile.

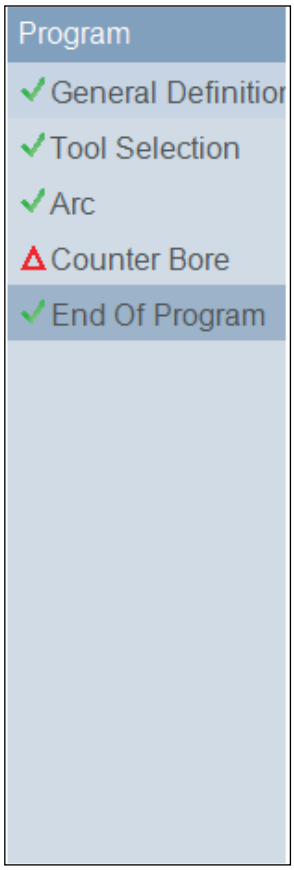
2.2 Program Tree

The *Program Tree* is an area where all the blocks added to your current program are displayed in the order in which they were added.

A green check mark next to the block indicates the block that has all required fields filled in without errors.

A red triangle next to a block indicates the block has either a missing required field or incorrectly filled in field.

All blocks should have green triangles next to them before trying to activate a program. The order of the blocks within the program can be rearranged from the *Tool Bar*.

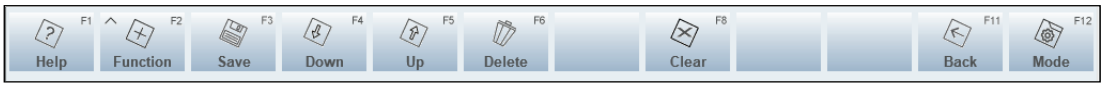


2.3 Tool Bar

The *Tool Bar* allows the user to edit the block order within a part program, or save the program. Depending on the area of focus in the page, one of two *Tool Bar* options is displayed.

First Tool Bar option when focus is on Task Bar or Edit Screen

Help	Online help.
Function	Open a popup menu with “Blok number” command.
Save	Allows the user to save the current program, save and transfer to the control without activating it, and save, transfer and activate the program.
Clear	This button will delete all the blocks currently added into the program and start the program from scratch.
Back	Return the to the sF2 Programming screen.
Mode	Switch to Operating Mode.



Second Tool Bar option when focus is on Program Tree

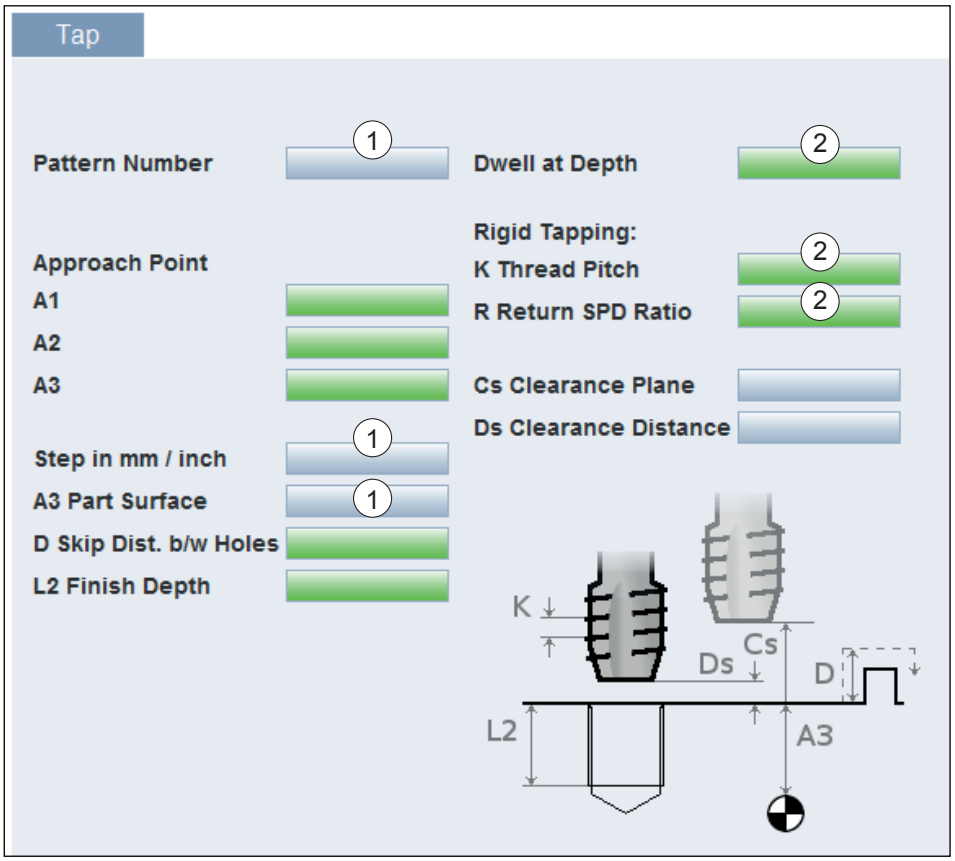
Help	Online help.
Function	Open a popup menu with “Blok number” command.
Save	Allows the user to save the current program, save and transfer to the control without activating it, and save, transfer and activate the program.
Down	Move the currently selected block in the *Program Tree* down one block in the order of the program.
Up	Move the currently selected block in the *Program Tree* up one block in the order of the program.
Delete	Delete only the currently selected block in the *Program Tree*. The remaining blocks stay in the program.
Clear	This button will delete all the blocks currently added into the program and start the program from scratch.
Back	Return the to the sF2 Programming screen.
Mode	Switch to Operating Mode.

2.4 Edit Screen

The *Edit Screen* displays a part program block in detail.

The text fields having a gradient blue background indicate required fields where as the text fields with gradient green backgrounds are optional. The diagrams on the screen are there to help the user understand the importance of each field in that cycle block.

More information on each field can be obtained by selecting the text field and clicking the *Help* button on the Tool Bar.



1	Required Fields.
2	Non-Required Fields (Optional).

Page deliberately empty

Summary

Page deliberately empty

3 Hole Pattern Definitions

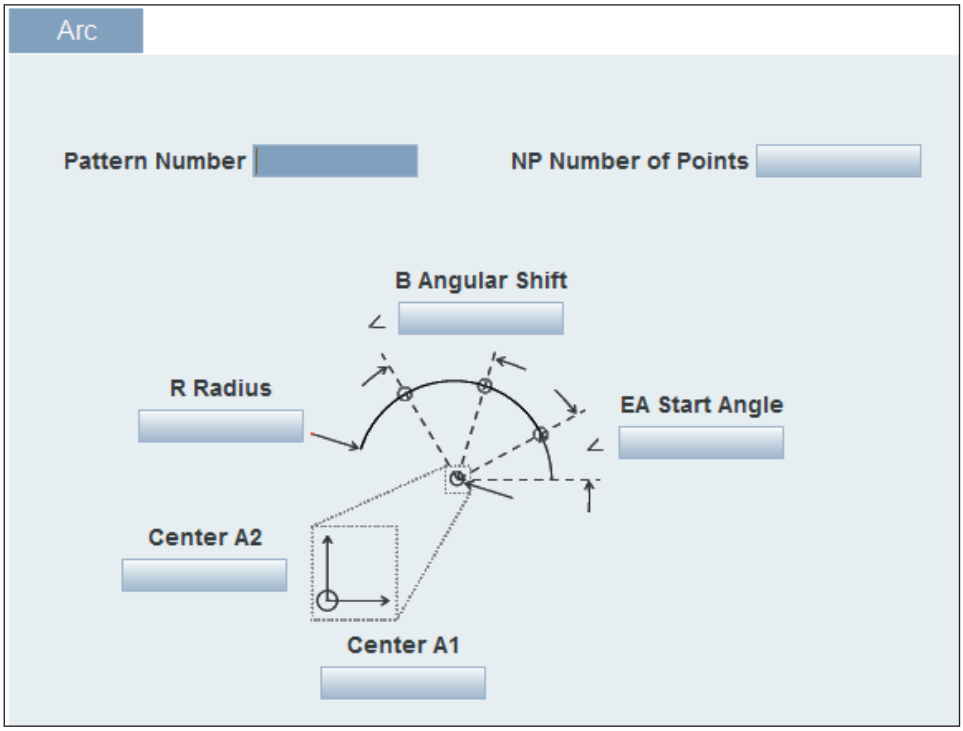
Hole patterns allow for easy reference to a specific geometry of holes.

They are particularly useful when performing multiple drilling operations on the same group of holes. For example, one could first define a hole pattern and then perform a center drilling operation followed by a boring operation. Both operations will reference the same hole pattern definition.

Within a program, the hole pattern definition is referenced by the pattern number field. The following hole patterns are available for use within the program:

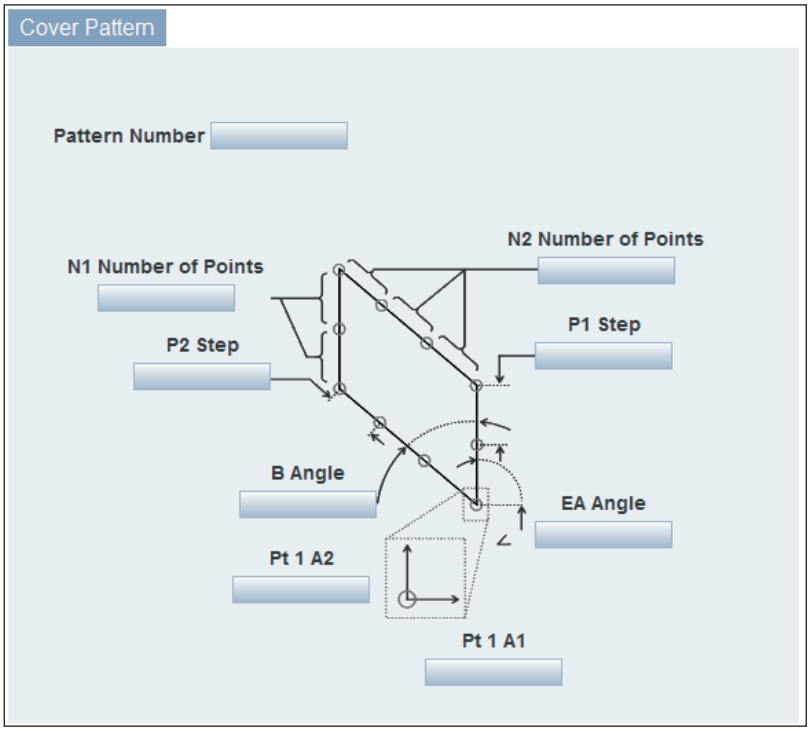
Arc 	The arc pattern is used to define an array of points along a curve with constant radius and constant spacing between points. A start angle may also be specified from the A1 axis to dictate where the first point is located.
Cover Pattern 	The cover pattern is used to define an array of points around a parallelogram perimeter. P1 is used to specify the distance between points along one set of parallel lines while P2 is used for the second set.
Drilling with Rotary Axis 	The drilling with rotary axis pattern is used to define an arc shaped array of points with a machine for which the part lies on a rotary axis. The spindle will only move along the A3 axis, while the part will be rotated on the rotary axis specified within the pattern.
Grid 	Similar to the cover pattern, the grid pattern is also used to define an array of points on a parallelogram; however, rather than just defining points around the perimeter, it will also define points throughout the plane. P1 is used to specify the distance between points along one set of parallel lines while P2 is used for the second set.
Pitch Circle 	The pitch circle pattern is used to define an array of points equally spaced around the perimeter of a circle with constant radius.
Row, by Point and Angle 	The row by point and angle pattern is used to define an array of points equally spaced along a straightl ine. The angle between the line and the A1 axis is specified by EA.
Row, by Two Points 	The row by two points pattern is also used to define an array of points equally spaced along a straight line; however, the array is calculated using the first and last points coordinates.
Single Points 	The single points pattern is used to define up to 5 single points with unique coordinates along the A1and A2 axes. An additional point can also be defined using a supplementary axis. For the machine to recognize a point, both the A1 and A2 fields must be entered. If one or the other is left blank, the machine will skip that point.

3.1 Arc



Field Name	Description
Pattern Number	This field defines the identification number of the pattern. This number will be referred to in the drilling cycle to link the pattern to the cycle.
NP Number of Points	This field defines the total number of points defined in the array.
B Angular Shift	This field will define the spacing between points. Explicitly, the angle in degrees from the A1 axis of the nth point in the array can be found by the following equation: *(Angle with respect to A1) = (B Angular Shift) * (nth point) + (EA StartAngle)*
R Radius	This field defines the radius of the arc.
EA Start Angle	After R has been set, this field will determine the exact position of the first point in the arc array. The coordinates of the first point can be described in polar notation, where R is the radius and EA is the angle in degrees from the A1 axis.
A3 Part Surface	This field specifies the absolute position of the part surface along the A3 axis. A3 refers to axis 3. The third axis is defined as the axis that is orthogonal to the pattern plane defined in the *General Definition* page.
Center A1	This field specifies the center of the arc along the first axis. A1 refers to axis 1. The first axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Center A2	This field specifies the center of the arc along the second axis. A2 refers to axis 2. The second axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).

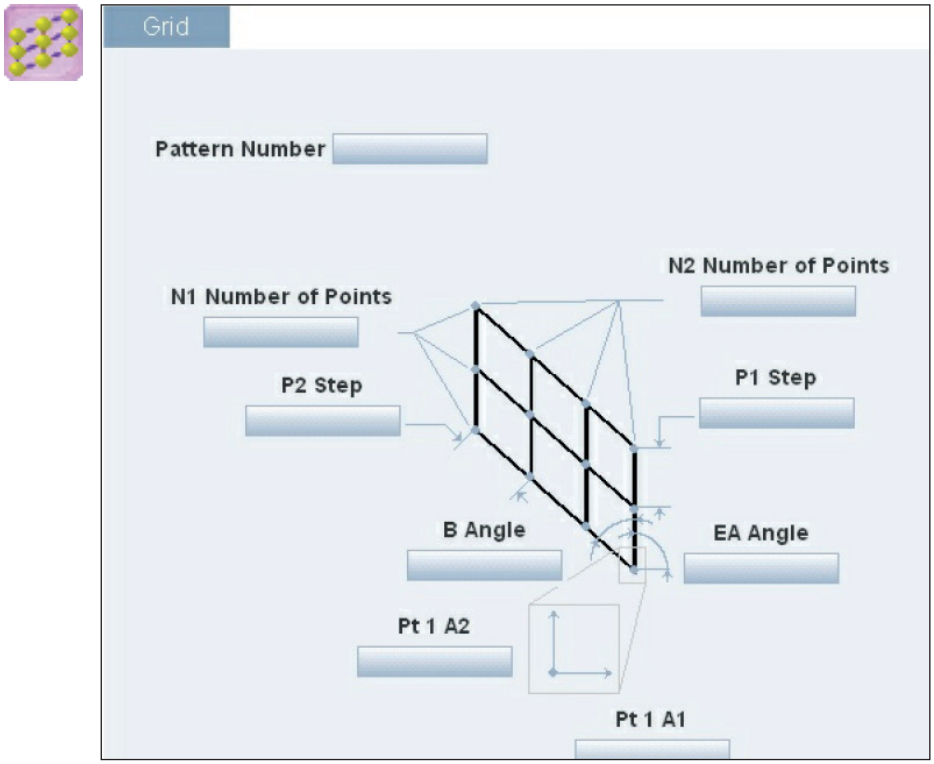
3.2 Cover Pattern



Field Name	Description
Pattern Number	This field defines the identification number of the pattern. This number will be referred to in the drilling cycle to link the pattern to the cycle.
Pt 1 A1	This field specifies the A1 coordinate of the first point in the array that will serve as a reference for every other point . A1 refers to axis 1. The first axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Pt 1 A2	This field specifies the A2 coordinate of the first point in the array that will serve as a reference for every other point . A2 refers to axis 2. The second axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).
EA Angle	This field allows the user to rotate the pattern within the interpolation plane about point 1 (defined by *Pt1 A1* and *Pt1 A2*). The angle is defined with respect to the reference axis of the interpolation plane (or A1). An *EA angle* of 0 degrees would set the line of points defined by *P1 Step* and *N1 Number of Points* parallel to the A1 axis. In contrast, an EA angle of 90 degrees would set the same line parallel to the A2 axis. The unit for this field is degree.
P1 Step	This field defines the spacing between points along the A1 axis (assuming an *EA Angle* of 0).
N1 Number of Points	This field defines the number of points in the line along the A1 axis. (assuming an EA Angle of 0).

B Angle	This field defines the angle between the first line of the grid array and the second line. Set at 90 degrees, with an *EA Angle* of 0, the second line runs parallel to the A2 axis.
P2 Step	This field defines the spacing between points along the A2 axis (assuming a *B Angle* of 90 and an *EA Angle* of 0).
N2 Number of Points	This field defines the number of points in the line along the A2 axis (assuming a B Angle of 90 and an *EA Angle* of 0).

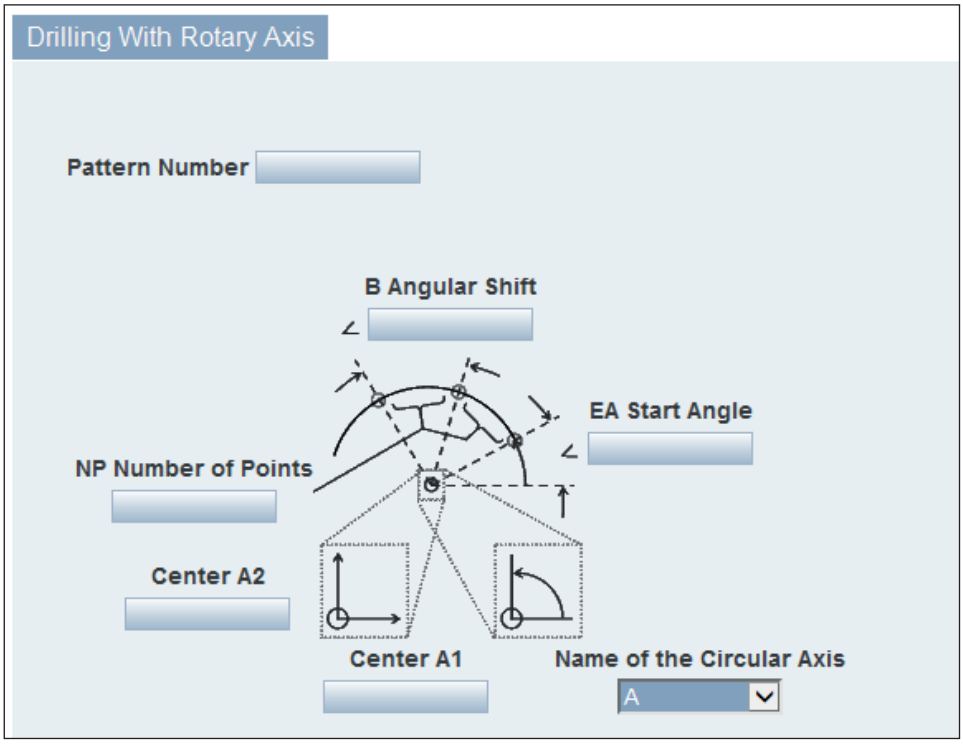
3.3 Grid



Field Name	Description
Pattern Number	This field defines the identification number of the pattern. This number will be referred to in the drilling cycle to link the pattern to the cycle.
Pt 1 A1	This field specifies the A1 coordinate of the first point in the array that will serve as a reference for every other point . A1 refers to axis 1. The first axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Pt 1 A2	This field specifies the A2 coordinate of the first point in the array that will serve as a reference for every other point . A2 refers to axis 2. The second axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).
EA Angle	This field allows the user to rotate the pattern with in the interpolation plane about point 1 (defined by *Pt1 A1* and *Pt1 A2*). The angle is defined with respect to the reference axis of the interpolation plane (or A1). An *EA angle* of 0 degrees would set the line of points defined by *P1 Step* and *N1 Number of Points* parallel to the A1 axis. In contrast, an EA angle of 90 degrees would set the same line parallel to the A2 axis. The unit for this field is degree.
P1 Step	This field defines the spacing between points along the A1 axis (assuming an *EA Angle* of 0).
N1 Number of Points	This field defines the number of points in the line along the A1 axis (assuming an *EA Angle* of 0).

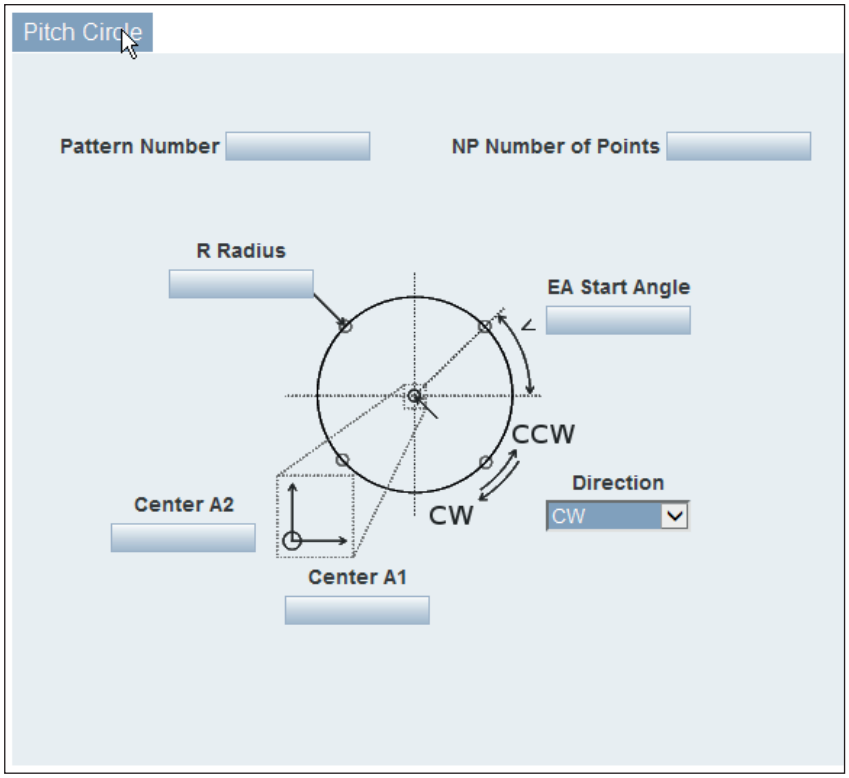
B Angle	This field defines the angle between the first line of the grid array and the second line. Set at 90 degrees, with an *EA Angle* of 0, the second line runs parallel to the A2 axis.
P2 Step	This field defines the spacing between points along the A2 axis (assuming a *B Angle* of 90 and an *EA Angle* of 0).
N2 Number of Points	This field defines the number of points in the line along the A2 axis (assuming a B Angle of 90 and an *EA Angle* of 0).

3.4 Drilling with Rotary Axis



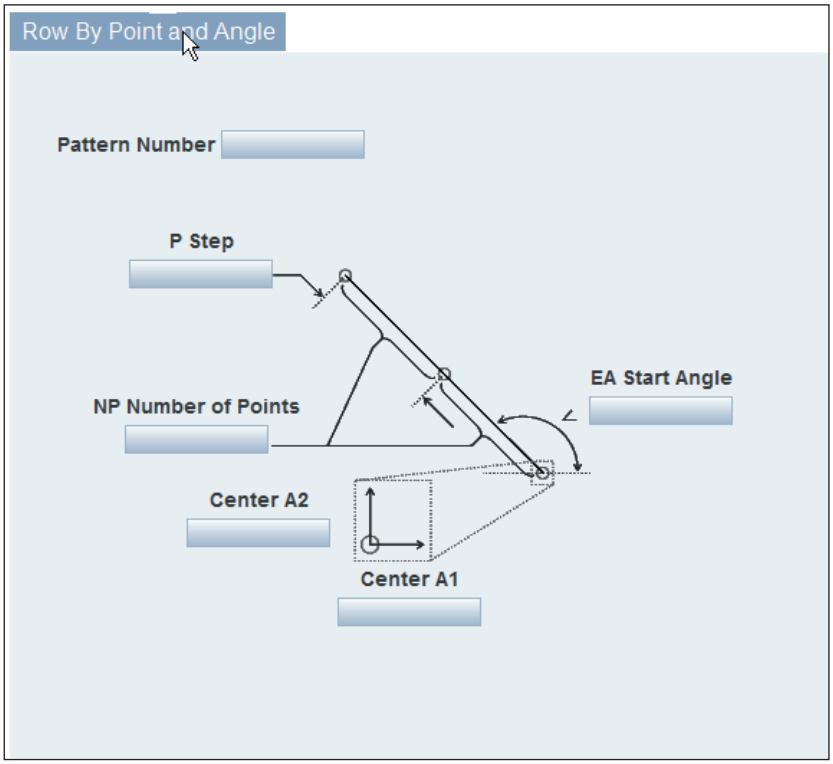
Field Name	Description
Pattern Number	This field defines the identification number of the pattern. This number will be referred to in the drilling cycle to link the pattern to the cycle.
Center A1	This field defines the position of the A1 axis for the drilling operation. A1 refers to axis 1. The first axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1). The A1 axis will remain stationary during the drilling operation.
Center A2	This field defines the position of the A2 axis for the drilling operation. A2 refers to axis 2. The second axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2). The A2 axis will remain stationary during the drilling operation.
Name of the circular axis	This field defines the circular axis that the part rests on.
EA Start Angle	This field defines the angular offset in degrees from the zero position of the circular axis to the position of the first hole in the array.
B Angular Shift	This field defines how many degrees the machine will rotate the specified circular axis between points. Explicitly, the angle in degrees from the home position to the “nth point” in the array can be found by the following equation: *(Angle with respect to home) = (B Angular Shift) * (nth point) + (EA Start Angle)*
NP Number of Points	This field defines the total number of points defined in the array.

3.5 Pitch Circle



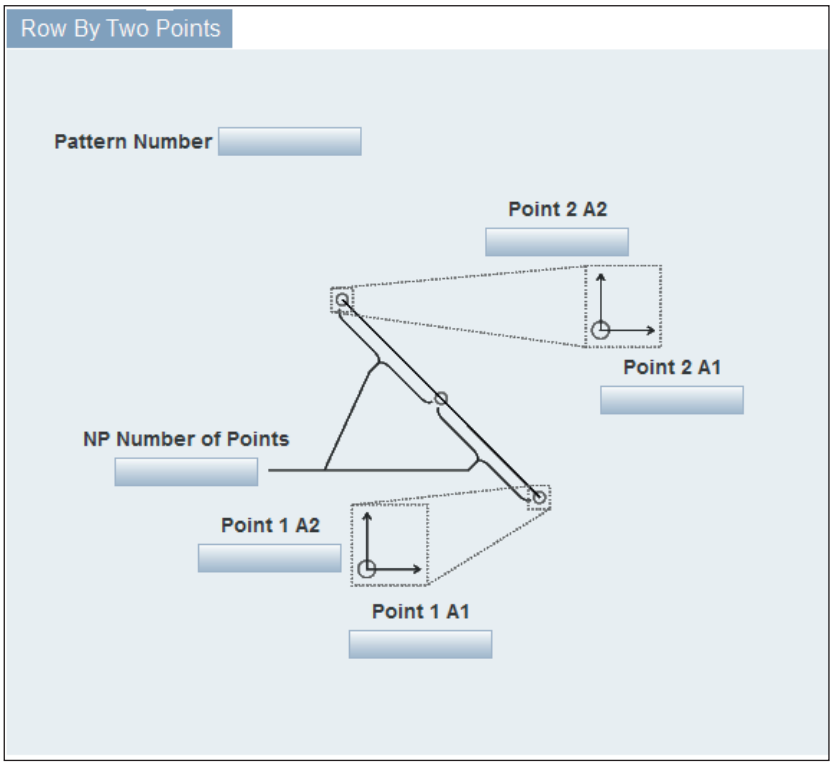
Field Name	Description
Pattern Number	This field defines the identification number of the pattern. This number will be referred to in the drilling cycle to link the pattern to the cycle.
Center A1	This field specifies the center of the circle along the first axis. A1 refers to axis 1. The first axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Center A2	This field specifies the center of the circle along the second axis. A2 refers to axis 2. The second axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).
R Radius	This field defines the radius of the circle.
EA Start Angle	After R has been set, this field will determine the exact position of the first point in the circular array. The coordinates of the first point can be described in polar notation, where R is the radius and EA is the angle in degrees from the A1 axis.
NP Number of Points	This field defines the total number of points to include in the circul ararray. The angular offset between points will be equal to 360 degrees divided by the number of points.
Direction	This field defines the order in which to drill the points within the circular array. The first point specified in polar coordinates by radius R and angle EA will always be drilled first. If CLW is selected, pointing your right thumb along the drilling axis towards the tool tip, your fingers will curl to point in the direction that the machine will move next. If CCLW is selected, the next hole will be in the opposite direction.

3.6 Row, by Point and Angle



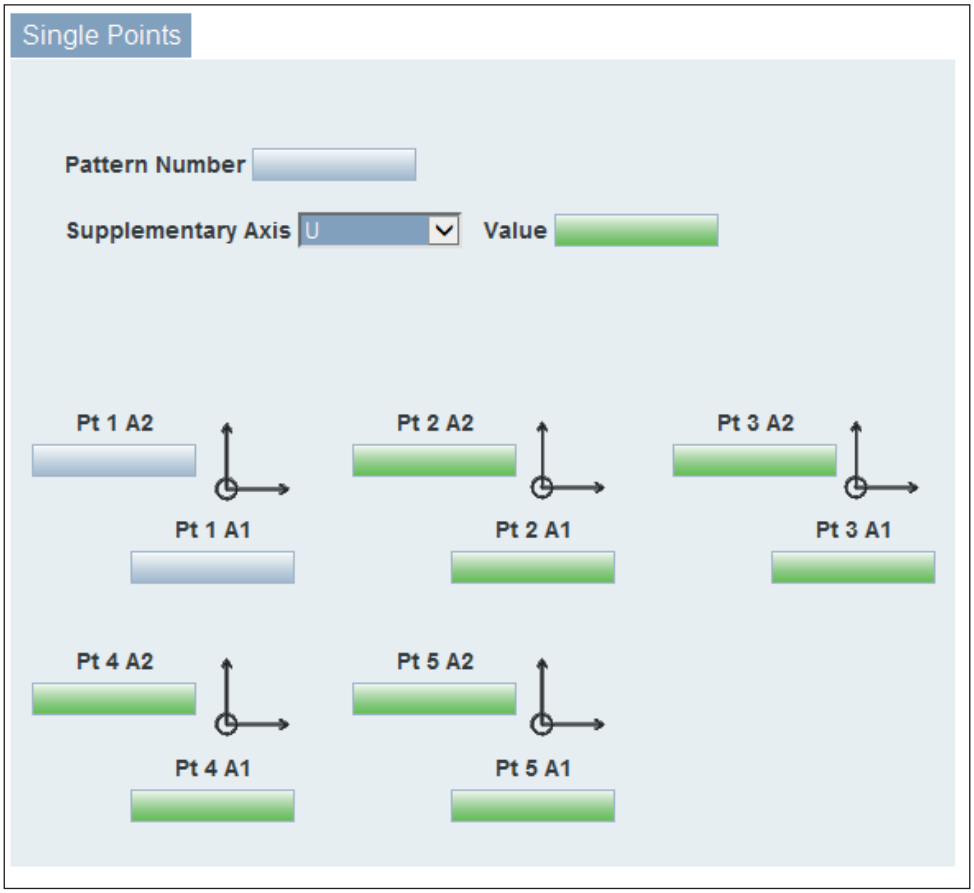
Field Name	Description
Pattern Number	This field defines the identification number of the pattern. This number will be referred to in the drilling cycle to link the pattern to the cycle.
Center A1	This field specifies the A1 coordinate of the first point in the array that will serve as a reference for every other point . A1 refers to axis 1. The first axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Center A2	This field specifies the A2 coordinate of the first point in the array that will serve as a reference for every other point . A2 refers to axis 2. The second axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).
EA Start Angle	This field represents the angle in degrees from the A1 axis. If it is desired for the array to have no component in the A2 axis (i.e. to be parallel to the A1 axis), this angle will be 0 (or 180). Conversely, if it is desired for the array to have no component in the A1 axis (i.e. to be parallel to the A2 axis), this angle will be 90 (or 270).
P Step	This field defines the spacing between points along the array.
NP Number of Points	This field defines the number of points along the array.

3.7 Row, by Two Points



Field Name	Description
Pattern Number	This field defines the identification number of the pattern. This number will be referred to in the drilling cycle to link the pattern to the cycle.
Point 1 A1	This field defines the coordinate in the A1 axis of the first point. A1 refers to axis 1. The first axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Point 1 A2	This field defines the coordinate in the A2 axis of the first point. A2 refers to axis 2. The second axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).
Point 2 A1	This field defines the coordinate in the A1 axis of the second point.
Point 2 A2	This field defines the coordinate in the A2 axis of the second point.
NP Number of Points	This field defines the number of points along the array. The spacing between consecutive points will automatically be calculated to be constant.

3.8 Single Points



Field Name	Description
Pattern Number	This field defines the identification number of the pattern. This number will be referred to in the drilling cycle to link the pattern to the cycle.
Pt 1 A1	This field defines the coordinate in the A1 axis of the first point. A1 refers to axis 1. The first axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Pt 1 A2	This field defines the coordinate in the A2 axis of the first point. A2 refers to axis 2. The second axis is identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).
Supplementary Axis	This field is used to define a supplementary axis for use in drilling an additional point.
Value	This field defines the value that the supplementary axis will move to. After the machine has drilled all of the holes specified by the Pt 1 A1 / A2- Pt 5 A1 / A2 fields, it will drill a final hole if both the supplementary axis and value fields have been filed in. After the drilling axis has moved to the A3 part surface + Ds Clearance Dist. + D Disengagement, it will move the supplementary axis to the value specified in this field. The A1 and A2 axes will remain at their last value. The last hole will be drilled in this position. After the program has completed, the specified supplementary axis will remain at the value specified in this field.

Pt 2 A1	This field defines the coordinate in the A1 axis of the second point.
Pt 2 A2	This field defines the coordinate in the A2 axis of the second point.
Pt 3 A1	This field defines the coordinate in the A1 axis of the third point.
Pt 3 A2	This field defines the coordinate in the A2 axis of the third point.
Pt 4 A1	This field defines the coordinate in the A1 axis of the fourth point.
Pt 4 A2	This field defines the coordinate in the A2 axis of the fourth point.
Pt 5 A1	This field defines the coordinate in the A1 axis of the fifth point.
Pt 5 A2	This field defines the coordinate in the A2 axis of the fifth point.

Page deliberately empty

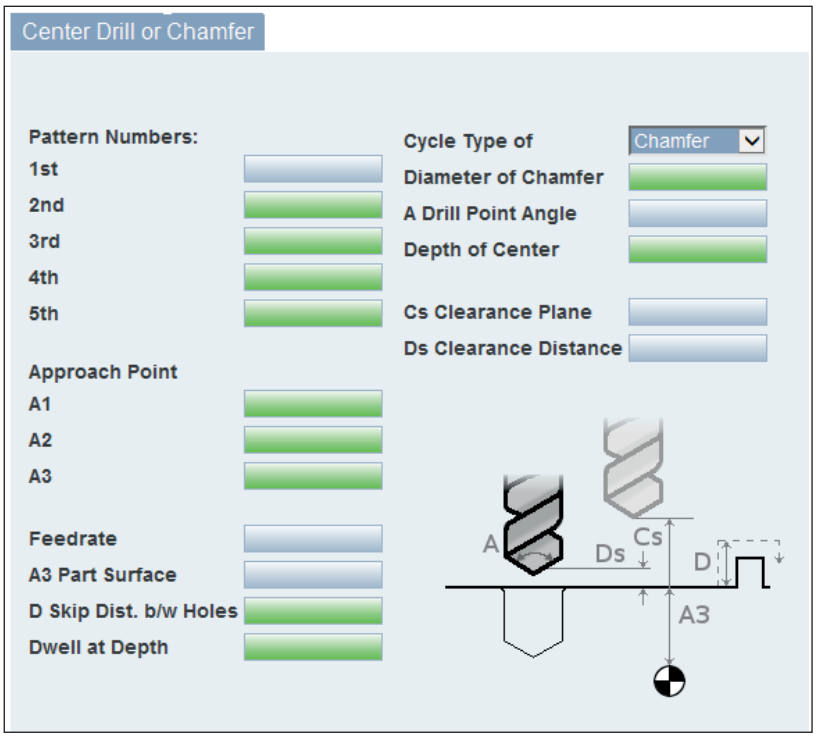
Page deliberately empty

Summary

Page deliberately empty

4 Drilling Cycles

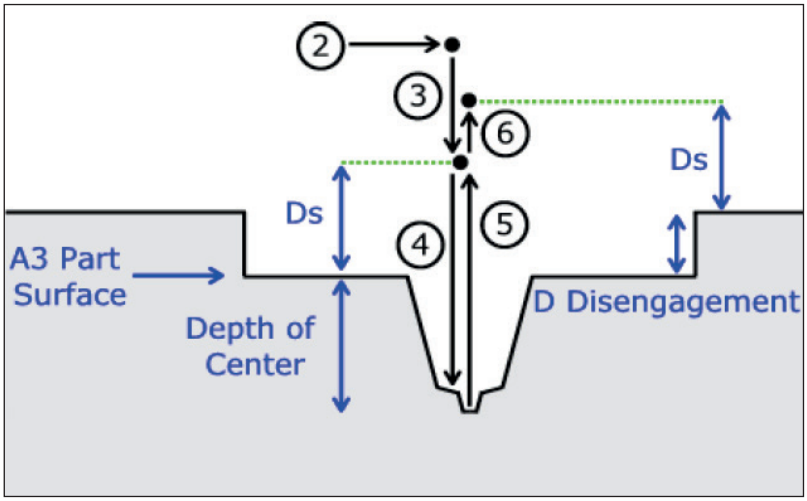
4.1 Center Drill or Chamfer



Field Name	Description
Pattern Numbers	When running a cycle, the following fields are used to reference the specific geometry defined for the position of the holes by the user in a previous block of code. The machine will begin drilling holes defined by pattern one and if other patterns are present will step to the next respective pattern after completing pattern one.
1st	Integer value of 1st hole pattern in drilling cycle.
2nd	Integer value of 2nd hole pattern in drilling cycle.
3rd	Integer value of 3rd hole pattern in drilling cycle.
4th	Integer value of 4th hole pattern in drilling cycle.
5th	Integer value of 5th hole pattern in drilling cycle.
Approach Point	The following fields are used to defined the point that the machine will move to initially before the cycle begins.
A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.

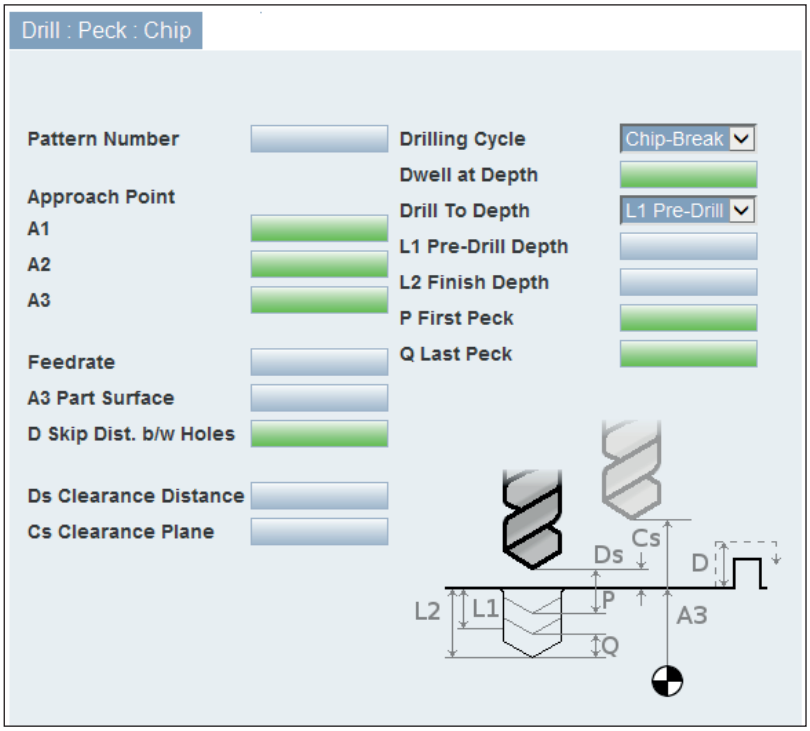
A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Feedrate	This field defines a fixed feed rate to be used during the cycle. In ISO code, the F argument is used with G94 to set the feed rate in millimeters or inches per minute to the value specified in this field.
A3 Part Surface	This field defines the A3 coordinate at which the tool tip will be touching the part surface.
D Skip Dist. b/w Holes	This field sets the skip distance (or Disengagement distance) that it will back off by when moving to the next hole in addition to the *Ds Clearance Distance*. It will move to the *Ds Clearance Distance* first when finishing a drilling operation, and then move further back by the amount in this field. The final position moved to is *A3 part surface + Ds Clearance Dist. + D Disengagement*.
Diameter of Chamfer	This field defines the diameter of the chamfer to be drilled.
Cycle Type Of	This field allows you to select between a Chamfer or Center Drilling operation.
Dwell at Depth	This field defines how long the machine will dwell in seconds at the bottom of the hole (0.01 to 99.99 seconds). If left blank, the default dwell is 0 seconds.
Depth of Center	This field defines the desired drill depth from the part surface to the bottom of the hole.
A Drill Point Angle	This field defines the angle of the drill point.
Cs Clearance Plane	When finished drilling every hole, this field defines the point along the tool axis that the machine will retract to.
Ds Clearance Dist.	When making a move from one hole to the next within a pattern, this field defines the distance between the part surface and tool tip.

4.1.1 Cycle Steps



1	Move to approach point.
2	Move to first point as specified by pattern.
3	Move to A3 Part Surface + Ds Clearance Distance.
4	Move to A3 Part Surface - Depth of Center.
5	Move to A3 Part Surface + Ds Clearance Distance.
6	Move to A3 Part Surface + Ds Clearance Distance + D Disengagement.
7	Move to next point as specified by pattern.
8	Repeat steps 3-7 until all points in pattern have been completed.
9	Move to Cs Clearance Plane.

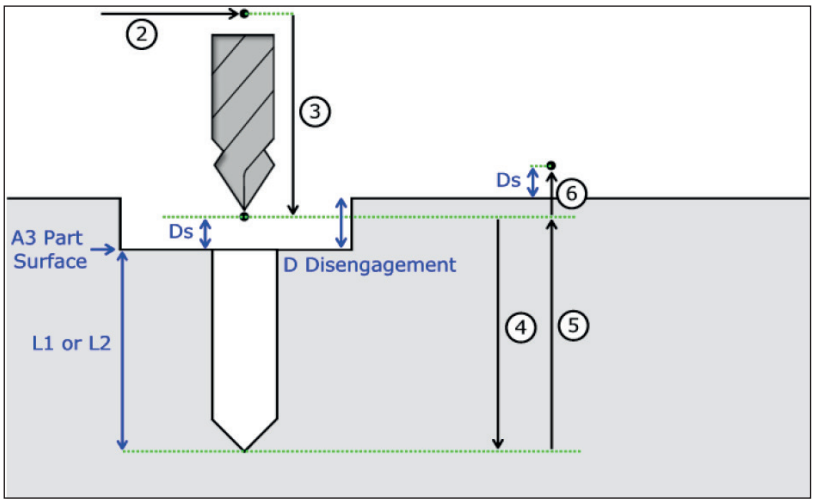
4.2 Drill : Peck : Chip



Field Name	Description
Pattern Number	This field is the integer value of the hole pattern to be used in drilling the holes. Each hole pattern has a unique hole pattern that can be used here.
Approach Point	The following fields are used to defined the point that the machine will move to initially before the cycle begins.
A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Feedrate	This field defines a fixed feed rate to be used during the cycle. In ISO code, the F argument is used with G94 to set the feed rate in millimeters or inches per minute to the value specified in this field.
A3 Part Surface	This field defines the A3 coordinate at which the tool tip will be touching the part surface.
D Skip Dist. b/w Holes	This field sets the skip distance (or Disengagement distance) that it will back off by when moving to the next hole in addition to the *Ds Clearance Distance*. It will move to the *Ds Clearance Distance* first when finishing a drilling operation, and then move further back by the amount in this field. The final position moved to is *A3 part surface + Ds Clearance Dist. + D Disengagement.*

Ds Clearance Dist.	When making a move from one hole to the next within a pattern, this field defines the distance between the part surface and tool tip. The part surface is defined within the pattern.
Cs Clearance Plane	When finished drilling every hole, this field defines the point along the tool axis that the machine will retract to.
Drilling Cycle	This field is used to define the type of drilling operation. Normal will cause the machine the follow the cycle steps listed below under normal. In ISO code, selection of normal will generate a G81. Wood-Peck will cause the machine the follow the cycle steps listed below under Wood-Peck. In ISO code, selection of Wood-Peck will generate a G83. Finally, Chip-Break will cause the machine the follow the cycle steps listed below under Chip-Break. In ISO code, selection of Chip-Break will generate a G87.
Dwell at Depth	This field defines how long the machine will dwell in seconds at the bottom of the hole (0.01 to 99.99 seconds). If left blank, the default dwellis 0 seconds.
Drill to Depth	This field refers to the desired drill depth that is specified in the hole pattern. Selecting *drill* indicates that the desired drill depth for this cycle is specified in the hole pattern field labeled *L1 Drill Depth*. Selecting finish indicates that the desired drill depth for this cycle is specified in the hole pattern field labed *L2 Finish Depth*.
L1 Pre-Drill Depth	This is the depth the holes will be drilled to if *L1 Drill Depth* is selected from the *Drill to Depth* field.
L2 Finish Depth	This is the depth the holes will be drilled to if *L2 Drill Depth* is selected from the *Drill to Depth* field.
P First Peck	In a wood-peck or chip-break cycle, this field defines how far the machine will drill for the first peck. If left blank, the cycle operation will be similar to a center drill and the machine will drill the entire hole in one step.
Q Last Peck	In a wood-peck or chip-break cycle, this field defines how to change the pecking increment. If left blank or filled in to be greater than or equal to P first peck, the machine will drill in increments equal to P first peck until the last two increments. At this point, it will drill in increments less than P. If filled in to be less than P first peck, the machine will begin drilling in increments of P first peck and gradually decrease the increment such that the second to last peck will be greater than Q and the final peck will be less than Q. See figure in the next page for further details.

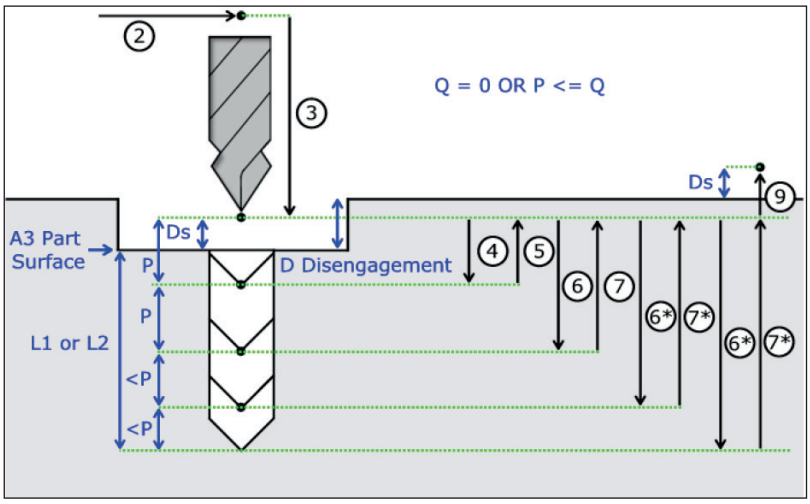
4.2.1 Cycle Steps Drilling Cycle : Normal



1	Move to approach point.
2	Move to first point as specified by pattern.
3	Move to A3 Part Surface + Ds Clearance Distance.
4	Move to A3 Part Surface - (L1 or L2)[1].
5	Move to A3 Part Surface + Ds Clearance Distance.
6	Move to A3 Part Surface + Ds Clearance Distance + D Disengagement.
7	Move to next point as specified by pattern.
8	Repeat steps 3-7 until all points in pattern have been completed.
9	Move to Cs Clearance Plane.

(1) If drill is selected for depth L1 will be substituted for (L1 or L2).
Likewise, if finish isselected for depth L2 will be substituted for (L1 or L2).

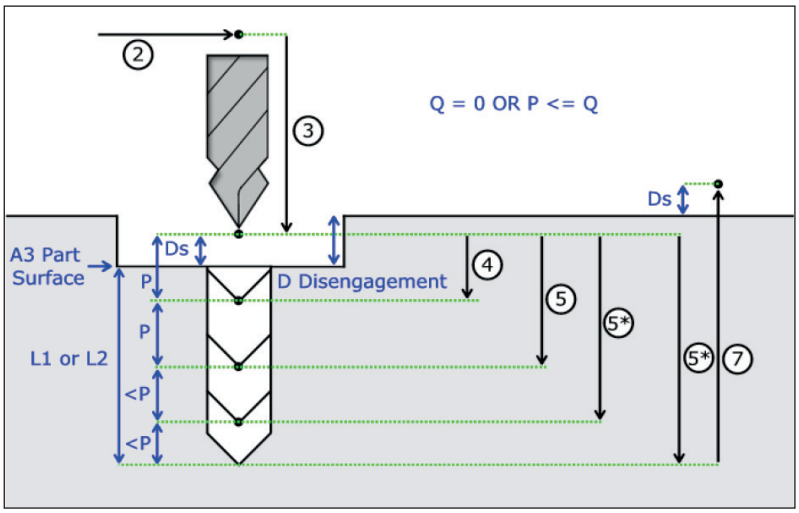
4.2.2 Cycle Steps Drilling Cycle : Wood-Peck



1	Move to approach point.
2	Move to first point as specified by pattern.
3	Move to A3 Part Surface + Ds Clearance Distance.
4	Move to A3 Part Surface + Ds Clearance Distance - P First Peck.
5	Move to A3 Part Surface + Ds Clearance Distance.
6	Move to A3 Part Surface + Ds Clearance Distance - Peck Depth.
7	Move to A3 Part Surface + Ds Clearance Distance.
8	Repeat steps 6-7 while increasing Peck Depth until A3 Part Surface - (L1 or L2)[1] is reached.
9	Move to A3 Part Surface + Ds Clearance Distance + D Disengagement..
10	Move to next point as specified by pattern.
11	Repeat steps 3-9 until all points in pattern have been completed.
12	Move to Cs Clearance Planet.

(1) If drill is selected for depth L1 will be substituted for (L1 or L2).
Likewise, if finish isselected for depth L2 will be substituted for (L1 or L2).The steps below are given for reference. The number of steps depends on the valuesprogrammed with the cycle.

4.2.3 Cycle Steps Drilling Cycle : Chip-Break

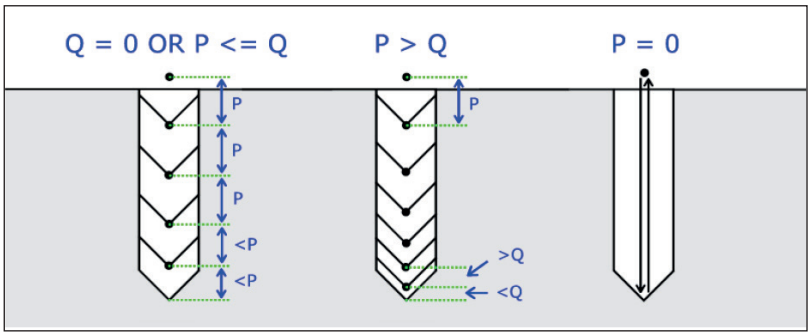


1	Move to approach point.
2	Move to first point as specified by pattern.
3	Move to A3 Part Surface + Ds Clearance Distance.
4	Move to A3 Part Surface + Ds Clearance Distance - P First Peck.
5	Move to A3 Part Surface + Ds Clearance Distance - Peck Depth.
6	Repeat step 5 while increasing Peck Depth until A3 Part Surface - (L1 or L2)[1] is reached.
7	Move to A3 Part Surface + Ds Clearance Distance + D Disengagement.
8	Move to next point as specified by pattern.
9	Repeat steps 3-7 until all points in pattern have been completed..
10	Move to Cs Clearance Plane.

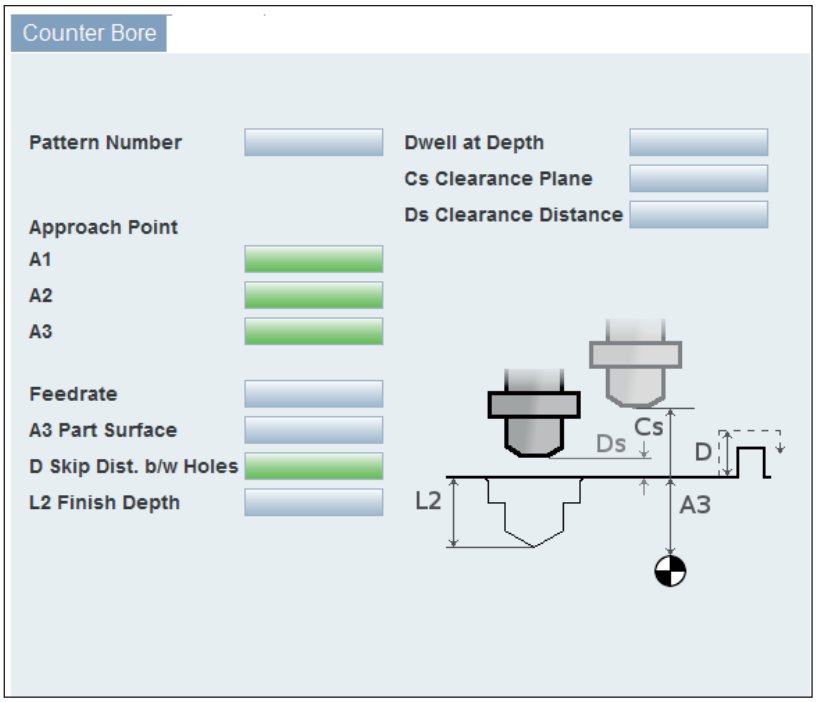
(1) If drill is selected for depth L1 will be substituted for (L1 or L2).
Likewise, if finish isselected for depth L2 will be substituted for (L1 or L2).

4.2.4 P and Q Values

To understand how the CNC computes how many pecks to take and how deep to drill perpeck, please refer to the following examples of P and Q values:



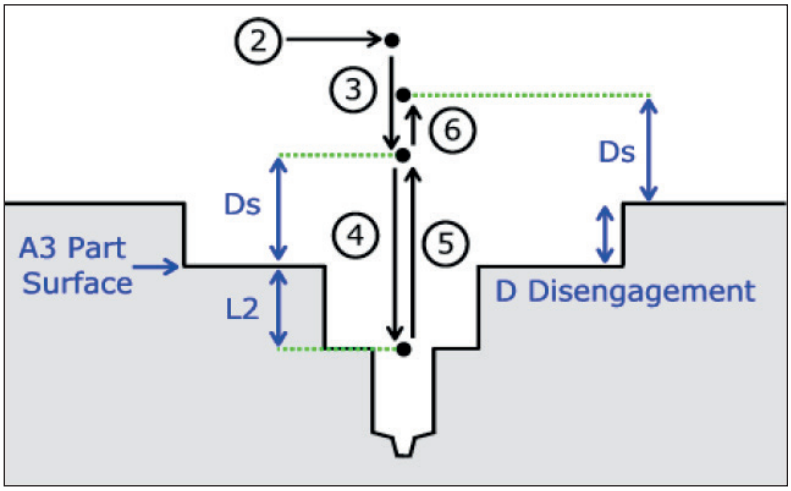
4.3 Counter Bore



Field Name	Description
Pattern Number	This field is the integer value of the hole pattern to be used in drilling the holes. Each hole pattern has a unique hole pattern that can be used here.
Approach Point	The following fields are used to defined the point that the machine will move to initially before the cycle begins.
A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Feedrate	This field defines a fixed feed rate to be used during the cycle. In ISO code, the F argument is used with G94 to set the feed rate in millimeters or inches per minute to the value specified in this field.
A3 Part Surface	This field defines the A3 coordinate at which the tool tip will be touching the part surface.
D Skip Dist. b/w Holes	This field sets the skip distance (or Disengagement distance) that it will back off by when moving to the next hole in addition to the *Ds Clearance Distance*. It will move to the *Ds Clearance Distance* first when finishing a drilling operation, and then move further back by the amount in this field. The final position moved to is *A3 part surface + Ds Clearance Dist. + D Disengagement.*
L2 Finish Depth	This is the depth the holes will be drilled.

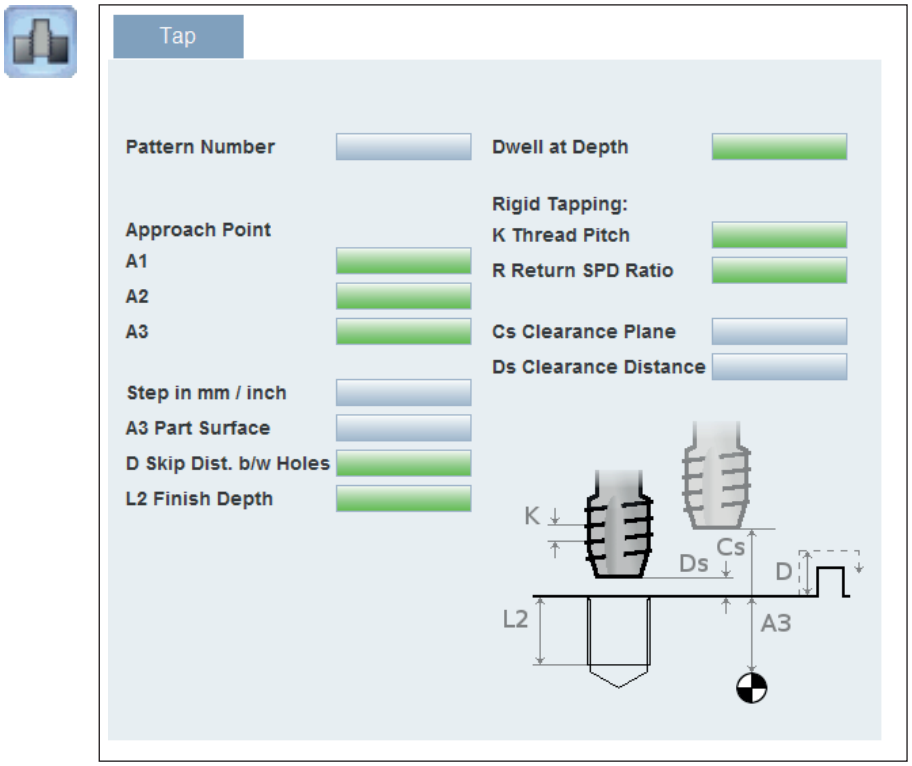
Dwell at Depth	This field defines how long the machine will dwell in seconds at the bottom of the hole (0.01 to 99.99 seconds). If left blank, the default dwell is 0 seconds.
Cs Clearance Plane	When finished drilling every hole, this field defines the point along the tool axis that the machine will retract to.
Ds Clearance Dist.	When making a move from one hole to the next within a pattern, this field defines the distance between the part surface and tool tip. The part surface is defined within the pattern.

4.3.1 Cycle Steps



1	Move to approach point.
2	Move to first point as specified by pattern.
3	Move to A3 Part Surface + Ds Clearance Distance.
4	Move to A3 Part Surface - L2 Finish Depth.
5	Move to A3 Part Surface + Ds Clearance Distance.
6	Move to A3 Part Surface + Ds Clearance Distance + D Disengagement.
7	Move to next point as specified by pattern.
8	Repeat steps 3-7 until all points in pattern have been completed.
9	Move to Cs Clearance Plane.

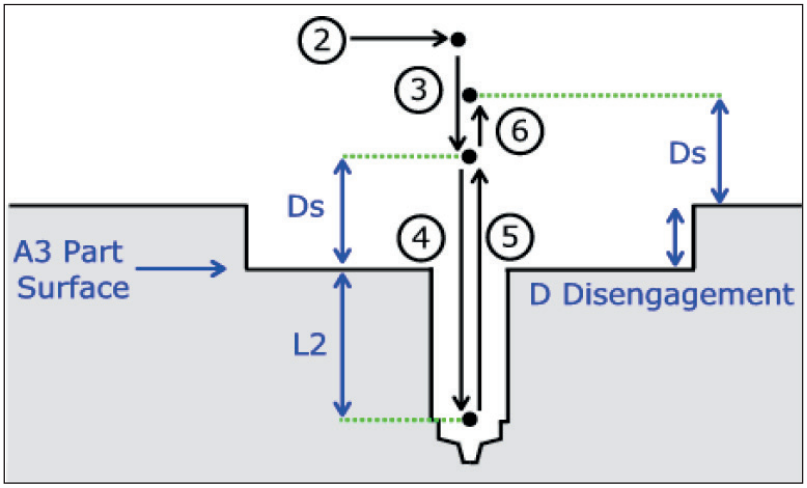
4.4 Tap



Field Name	Description
Pattern Number	This field is the integer value of the hole pattern to be used in drilling the holes. Each hole pattern has a unique hole pattern that can be used here.
Approach Point	The following fields are used to defined the point that the machine will move to initially before the cycle begins.
A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Step in mm / inch	This field defines the step in mm or inch that will be used to calculate the feed rate. In ISO code, the F argument is used with G94 to set the feedrate in millimeters or inches per minute to the value calculated by the product of the value in the spindle speed in RPM field and the value in this field. Explicitly, *Feed Rate = (Spindle Speed in RPM) * (Step in mm or inch).*
A3 Part Surface	This field defines the A3 coordinate at which the tool tip will be touching the part surface.

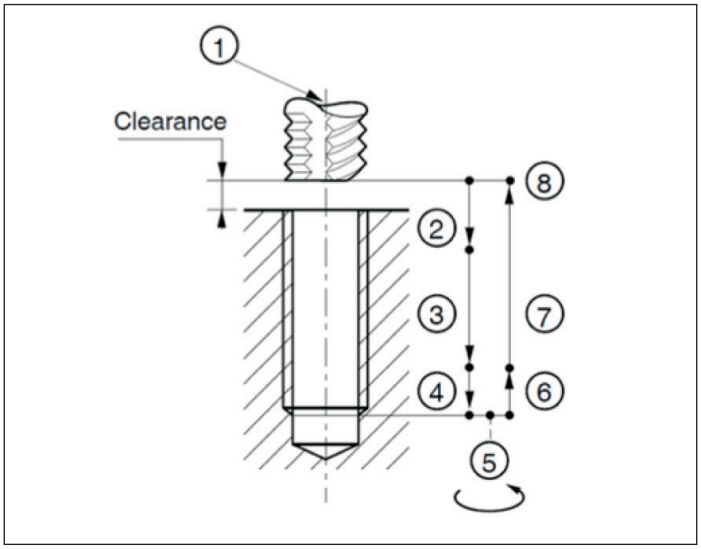
D Skip Dist. b/w Holes	This field sets the skip distance (or Disengagement distance) that it will back off by when moving to the next hole in addition to the *Ds Clearance Distance*. It will move to the *Ds Clearance Distance* first when finishing a drilling operation, and then move further back by the amount in this field. The final position moved to is *A3 part surface + Ds Clearance Dist. + D Disengagement.*
L2 Finish Depth	This is the depth the holes will be drilled.
Dwell at Depth	This field defines how long the machine will dwell in seconds at the bottom of the hole (0.01 to 99.99 seconds). If left blank, the default dwell is 0 seconds.
K Thread Pitch	This field defines the tap pitch in mm. Use of this field specifies rigid tapping.
R Return Speed Ratio	This field defines the spindle outfeed/infeed ratio. The default value is 1.
Cs Clearance Plane	When finished drilling every hole, this field defines the point along the tool axis that the machine will retract to.
Ds Clearance Dist.	When making a move from one hole to the next within a pattern, this field defines the distance between the part surface and tool tip. The part surface is defined within the pattern.

4.4.1 Cycle Steps: Axis Movement



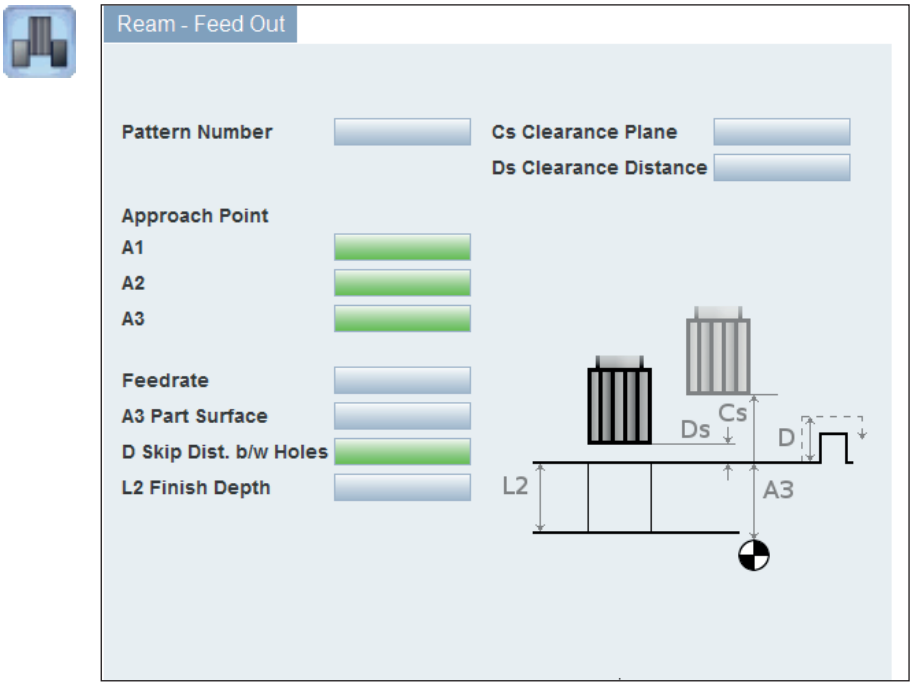
1	Move to approach point.
2	Move to first point as specified by pattern.
3	Move to A3 Part Surface + Ds Clearance Distance.
4	Move to A3 Part Surface - L2 Finish Depth.
5	Move to A3 Part Surface + Ds Clearance Distance.
6	Move to A3 Part Surface + Ds Clearance Distance + D Disengagement.
7	Move to next point as specified by pattern.
8	Repeat steps 3-7 until all points in pattern have been completed.
9	Move to Cs Clearance Plane.

4.4.2 Cycle Steps: Rigid Tapping Spindle Movement



1	Move to first point as specified by pattern.
2	Infeed with acceleration of the spindle and feed rate.
3	Feed at constant speed.
4	Deceleration before reaching depth.
5	Reversal of the direction of rotation.
6	Retraction with acceleration over a distance equal to the deceleration.
7	Feed at constant speed.
8	Return of the spindle to the initial state.

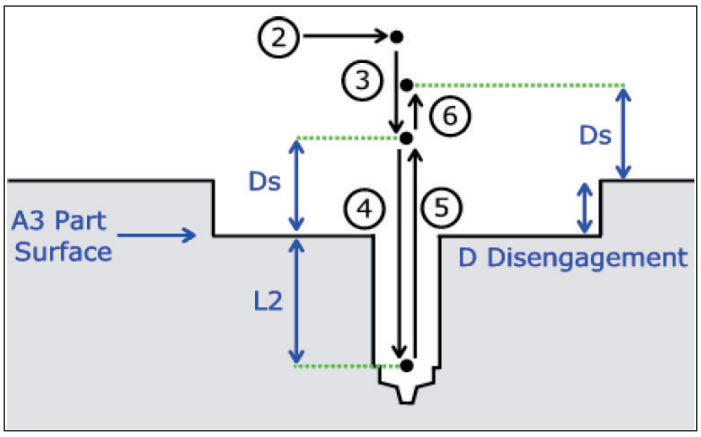
4.5 Ream – Feed Out



Field Name	Description
Pattern Number	This field is the integer value of the hole pattern to be used in drilling the holes. Each hole pattern has a unique hole pattern that can be used here.
Approach Point	The following fields are used to defined the point that the machine will move to initially before the cycle begins.
A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Feedrate	This field defines a fixed feed rate to be used during the cycle. In ISO code, the F argument is used with G94 to set the feed rate in millimeters or inches per minute to the value specified in this field.
A3 Part Surface	This field defines the A3 coordinate at which the tool tip will be touching the part surface.
D Skip Dist. b/w Holes	This field sets the skip distance (or Disengagement distance) that it will back off by when moving to the next hole in addition to the *Ds Clearance Distance*. It will move to the *Ds Clearance Distance* first when finishing a drilling operation, and then move further back by the amount in this field. The final position moved to is *A3 part surface + Ds Clearance Dist. + D Disengagement.*
L2 Finish Depth	This is the depth the holes will be drilled.

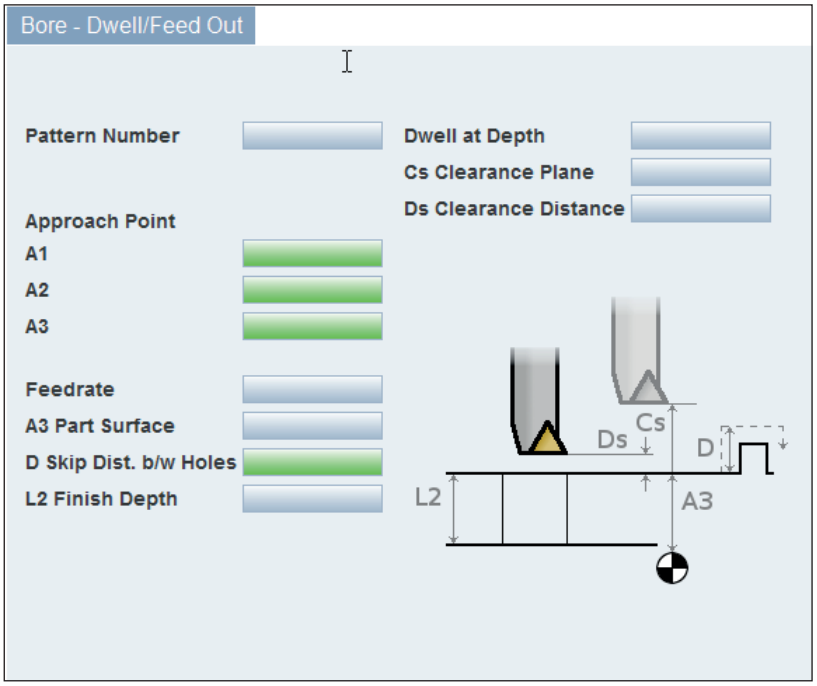
Cs Clearance Plane	When finished drilling every hole, this field defines the point along the tool axis that the machine will retract to.
Ds Clearance Dist.	When making a move from one hole to the next within a pattern, this field defines the distance between the part surface and tool tip. The part surface is defined within the pattern.

4.5.1 Cycle Steps: Rigid Tapping Spindle Movement



1	Move to approach point.
2	Move to first point as specified by pattern.
3	Move to A3 Part Surface + Ds Clearance Distance.
4	Move to A3 Part Surface - L2 Finish Depth.
5	Move to A3 Part Surface + Ds Clearance Distance.
6	Move to A3 Part Surface + Ds Clearance Distance + D Disengagement.
7	Move to next point as specified by pattern.
8	Repeat steps 3-7 until all points in pattern have been completed.
9	Move to Cs Clearance Plane.

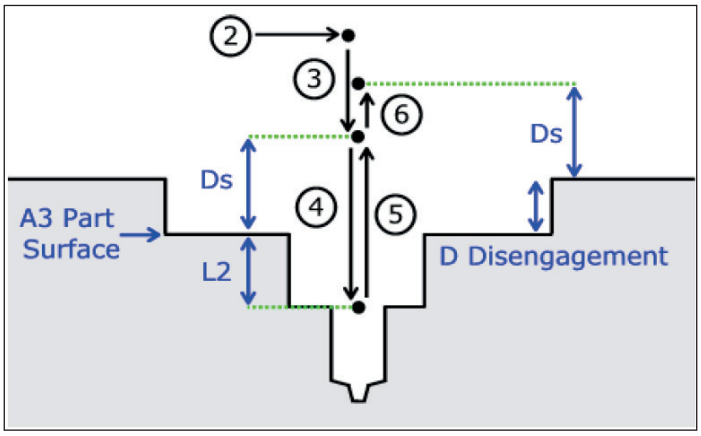
4.6 Bore – Dwell/Feed Out



Field Name	Description
Pattern Number	This field is the integer value of the hole pattern to be used in drilling the holes. Each hole pattern has a unique hole pattern that can be used here.
Approach Point	The following fields are used to defined the point that the machine will move to initially before the cycle begins.
A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Feedrate	This field defines a fixed feed rate to be used during the cycle. In ISO code, the F argument is used with G94 to set the feed rate in millimeters or inches per minute to the value specified in this field.
A3 Part Surface	This field defines the A3 coordinate at which the tool tip will be touching the part surface.
D Skip Dist. b/w Holes	This field sets the skip distance (or Disengagement distance) that it will back off by when moving to the next hole in addition to the *Ds Clearance Distance*. It will move to the *Ds Clearance Distance* first when finishing a drilling operation, and then move further back by the amount in this field. The final position moved to is *A3 part surface + Ds Clearance Dist. + D Disengagement.*
L2 Finish Depth	This is the depth the holes will be drilled.

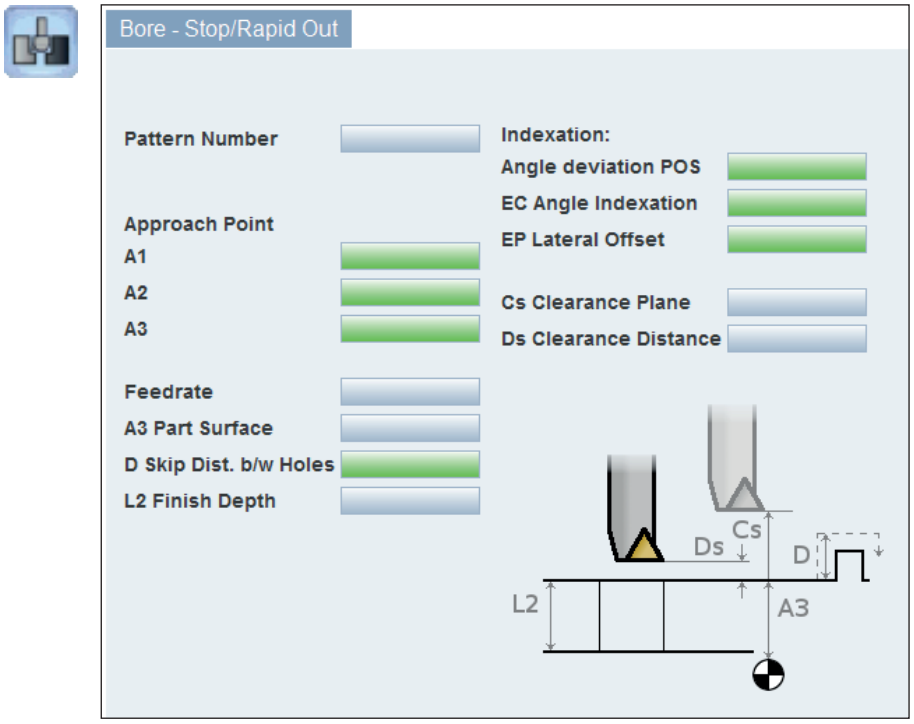
Dwell at Depth	This field defines how long the machine will dwell in seconds at the bottom of the hole (0.01 to 99.99 seconds). If left blank, the default dwell is 0 seconds.
Cs Clearance Plane	When finished drilling every hole, this field defines the point along the tool axis that the machine will retract to.
Ds Clearance Dist.	When making a move from one hole to the next within a pattern, this field defines the distance between the part surface and tool tip. The part surface is defined within the pattern.

4.6.1 Cycle Steps



1	Move to approach point.
2	Move to first point as specified by pattern.
3	Move to A3 Part Surface + Ds Clearance Distance.
4	Move to A3 Part Surface - L2 Finish Depth.
5	Move to A3 Part Surface + Ds Clearance Distance.
6	Move to A3 Part Surface + Ds Clearance Distance + D Disengagement.
7	Move to next point as specified by pattern.
8	Repeat steps 3-7 until all points in pattern have been completed.
9	Move to Cs Clearance Plane.

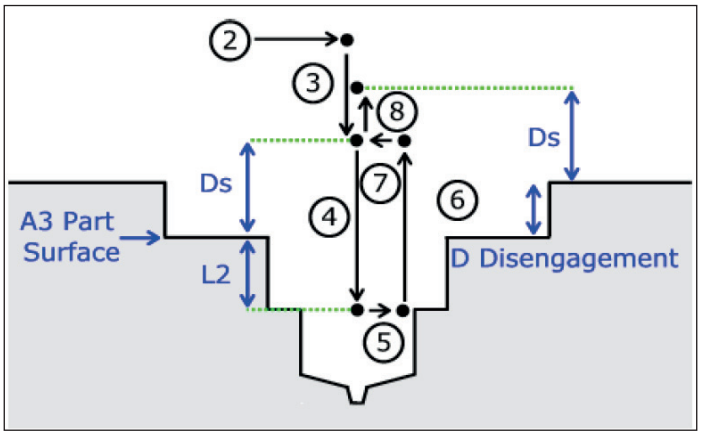
4.7 Bore - Stop/Rapid Out



Field Name	Description
Pattern Number	This field is the integer value of the hole pattern to be used in drilling the holes. Each hole pattern has a unique hole pattern that can be used here.
Approach Point	The following fields are used to defined the point that the machine will move to initially before the cycle begins.
A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.
A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Feedrate	This field defines a fixed feed rate to be used during the cycle. In ISO code, the F argument is used with G94 to set the feed rate in millimeters or inches per minute to the value specified in this field.
A3 Part Surface	This field defines the A3 coordinate at which the tool tip will be touching the part surface.
D Skip Dist. b/w Holes	This field sets the skip distance (or Disengagement distance) that it will back off by when moving to the next hole in addition to the *Ds Clearance Distance*. It will move to the *Ds Clearance Distance* first when finishing a drilling operation, and then move further back by the amount in this field. The final position moved to is *A3 part surface + Ds Clearance Dist. + D Disengagement.*

L2 Finish Depth	This is the depth the holes will be drilled.
Ecart Angular Position	This field defines the angle between the programmed and the physical angular position of the cutting edge.
EC Angle Indexation	This field defines the value of the indexing position. The default value is the last indexing position programmed.
EP Lateral Offset in Hole	This field defines the lateral backoff in the bottom on the hole on the indexing axis. The default value is 2 millimeters.
Cs Clearance Plane	When finished drilling every hole, this field defines the point along the tool axis that the machine will retract to.
Ds Clearance Dist.	When making a move from one hole to the next within a pattern, this field defines the distance between the part surface and tool tip. The part surface is defined within the pattern.

4.7.1 Cycle Steps



1	Move to approach point.
2	Move to first point as specified by pattern.
3	Move to A3 Part Surface + Ds Clearance Distance.
4	Move to A3 Part Surface - L2 Finish Depth.
5	Move to A3 Part Surface + Ds Clearance Distance.
6	Move to A3 Part Surface + Ds Clearance Distance + D Disengagement.
7	Move to next point as specified by pattern.
8	Repeat steps 3-7 until all points in pattern have been completed.
9	Move to Cs Clearance Plane.

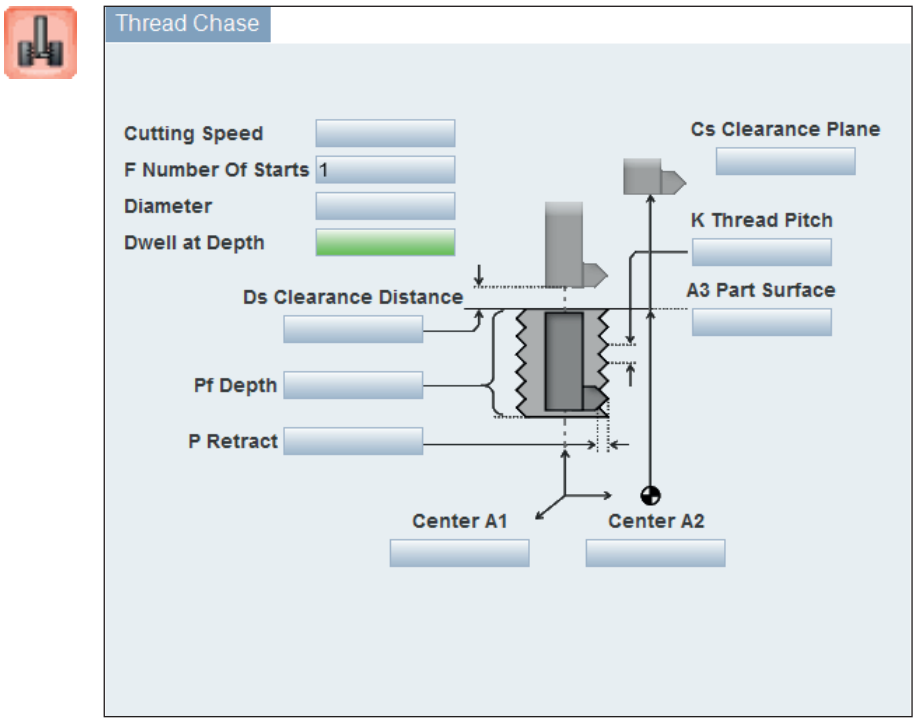
Page deliberately empty

Summary

Page deliberately empty

5 Threading Cycles

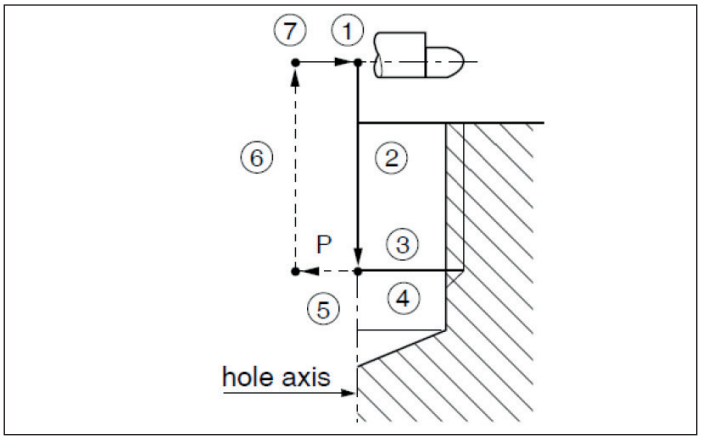
5.1 Thread Chase



Field Name	Description
Cutting Speed	This field is used to calculate the spindle speed for the cycle. Both this field and the Diameter field are used in the spindle speed calculation. The equation for the spindle speed is as follows: *Spindle Speed=318*(Cutting Speed in M/Min or Ft/min)/(Diameter)*.
F Number of Starts	This field defines the number of thread starts (1-9). If more than one thread start is defined, the machine will repeat the cycle steps shown below once for every thread start.
Diameter	This field is used to calculate the spindle speed for the cycle. Both this field and the Cutting Speed in M/Min field are used in the spindle speed calculation. The equation for the spindle speed is as follows: *SpindleSpeed=318*(Cutting Speed in M/Min or Ft/min)/(Diameter)*.
Dwell at Depth	This field defines how long the machine will dwell in seconds at the bottom of the hole (0.01 to 99.99 seconds). If left blank, the default dwell is 0 seconds.
Pf Depth	This field defines the desired drill depth from the part surface to the bottom of the hole.
P Retract	This field defines how far the machine will retract the tool from the crests before moving out of the hole. This field must be at least greater than the depth of the threads to allow for enough clearance.
K Thread Pitch	This field specifies the distance along the A3 axis between crests.

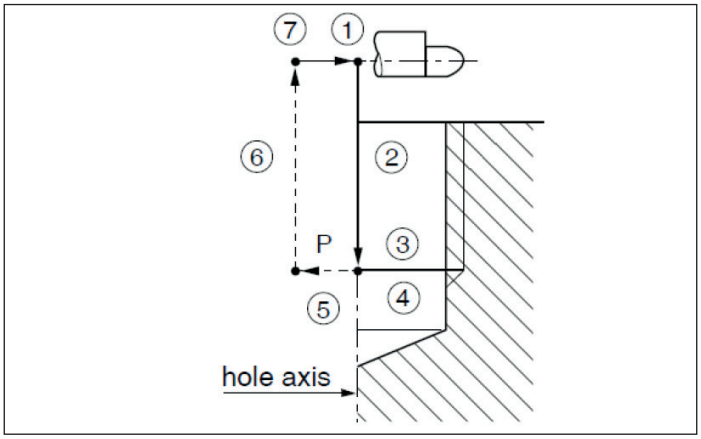
A3 Part Surface	This field specifies the absolute position of the part surface along the A3 axis. A3 refers to axis 3. The third axis is defined as the axis that is orthogonal to the work plane.
Center A1	This field specifies the center of the part along the first axis. A1 refers to axis 1. The first axis can be identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Center A2	This field specifies the center of the part along the second axis. A2 refers to axis 2. The second axis can be identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of thetext (A2).
Cs Clearance Plane	When finished drilling every hole, this field defines the point along the tool axis that the machine will retract to.
Ds Clearance Dist.	This field defines the distance between the part surface and tool tip. The machine will move to the sum of the A3 Surface Plane and Ds Clearance Dist. before beginning the drilling cycle.

5.1.1 Cycle Steps: Axis Movement



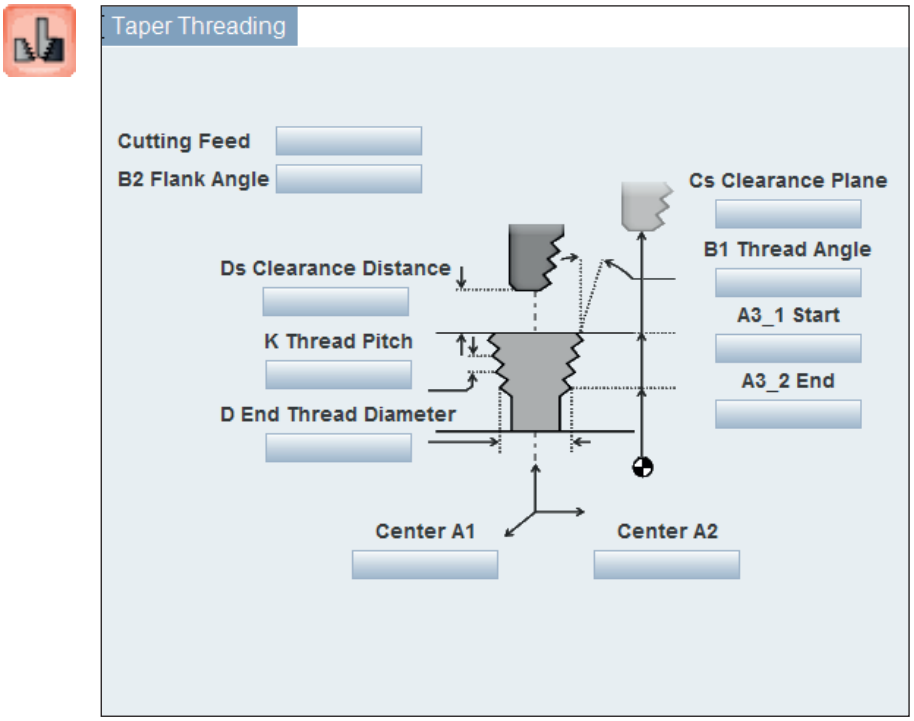
1	Move A1 and A2 axes to Center A1 and Center A2, move A3 axis to A3 Part Surface + Ds Clearance Dist.
2	Move to A3 Part Surface - Pf Depth.
3	Move A1 axis by P Retract.
4	Move to A3 Part Surface + Ds Clearance Dist.
5	Rapid repositioning of the tool to the hole center.

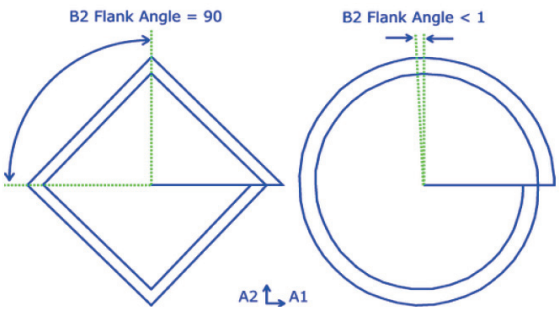
5.1.2 Cycle Steps: Dwells and Spindle Rotation



1	Rapid positioning of the chaser holder to the center of the hole then dwell for 1.2 seconds to start spindle rotation.
2	Infeed at the pitch programmed.
3	Dwell or two spindle rotations at the end of thread cutting.
4	Indexed spindle stop at position zero of the position encoder.
5	Rapid clearance by the value Pf in the axis of the plane and direction defined by themachine manufacturer.
6	Rapid retraction in the tool axis.
7	Rapid repositioning of the tool to the hole center and restart of spindle rotation.

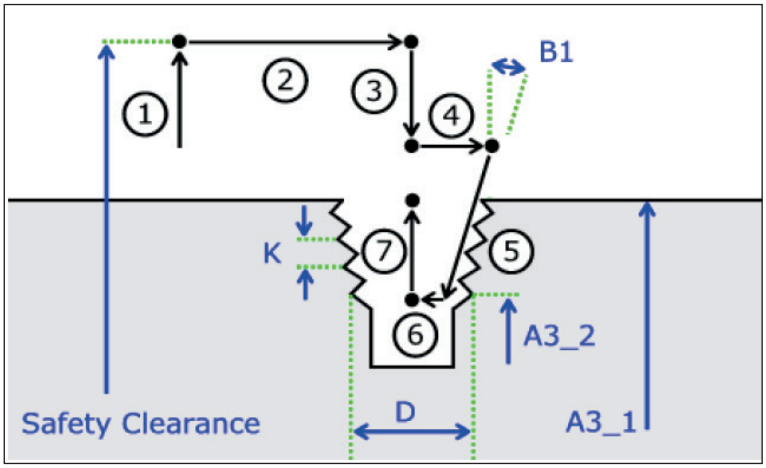
5.2 Taper Threading Cycle



Field Name	Description
Cutting Speed	This field defines a fixed feed rate to be used during the cycle. In ISO code, the F argument is used with G94 to set the feed rate in millimeters or inches per minute to the value specified in this field.
B2 Flank Angle	This field specifies the angle used to calculate each sequential linear move on the A1, A2, and A3 axes. When a full rotation has completed, the A3 axis will move down by exactly K Thread Pitch. For each move, the A3 axis will move down by exactly (K Thread Pitch)/(360)/(B2 FlankAngle). Circular interpolation is not used in this cycle. For example, if it is desired to drill a square shaped hole, B2 Flank Angle would be set to 90 degrees. In contrast, if it is desired to drill a circular hole, B2 Flank Angle would be set to a fraction of a degree. For further clarification, please see the figure below: 
K Thread Pitch	This field specifies the distance along the A3 axis between crests.
D End Thread Diameter	This field specifies the major diameter of the hole at the bottom of the hole. The major diameter includes the crests.

B1 Thread Angle	This field specifies the angle of the taper. Taking on values in the range of 0 to 90 degrees, this angle is defined as the angle from the A3 axis to the inner surface of the hole.
A3_1 Start	This field specifies the absolute position of the part surface along the A3 axis. A3 refers to axis 3. The third axis is defined as the axis that isorthogonal to the work plane.
A3_2 End	This field specifies the absolute position of the end of the hole along the A3 axis. A3 refers to axis 3. The third axis is defined as the axis that is orthogonal to the work plane.
Center A1	This field specifies the center of the part along the first axis. A1 refers to axis 1. The first axis can be identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Center A2	This field specifies the center of the part along the second axis. A2 refers to axis 2. The second axis can be identified by the letter in the *Pattern Plane* field on the *General Definition* page immediately to the left of thetext (A2).
Cs Clearance Plane	When finished drilling every hole, this field defines the point along the tool axis that the machine will retract to.
Ds Clearance Dist.	This field defines the distance between the part surface and tool tip. The machine will move to the sum of the A3 Surface Plane and Ds Clearance Dist. before beginning the drilling cycle.
D End Thread Diameter	This field specifies the major diameter of the hole at the bottom of the hole. The major diameter includes the crests.
Safety Clearance	This field specifies where the machine will move to in the A3 axis before starting the drilling cycle.

5.2.1 Cycle Steps



1	Move A3 axis to safety clearance.
2	Move A1 and A2 axes to Center A1 and Center A2.
3	Move A3 axis to *drilling position*.
4	Move A1 to D End Thread Diameter / 2 + tan (B1 Thread Angle)*(*drilling position* - A3_2 End).
5	Drill hole.
6	Reposition tool to center of hole.
7	Move A3 axis to A3_1 Start.
* Note: *drilling position* = A3_2 End + K Thread Pitch*(ROUNDUP[(A3_1 Start - A3_2 End)/(KThread Pitch)])	

Page deliberately empty

Page deliberately empty

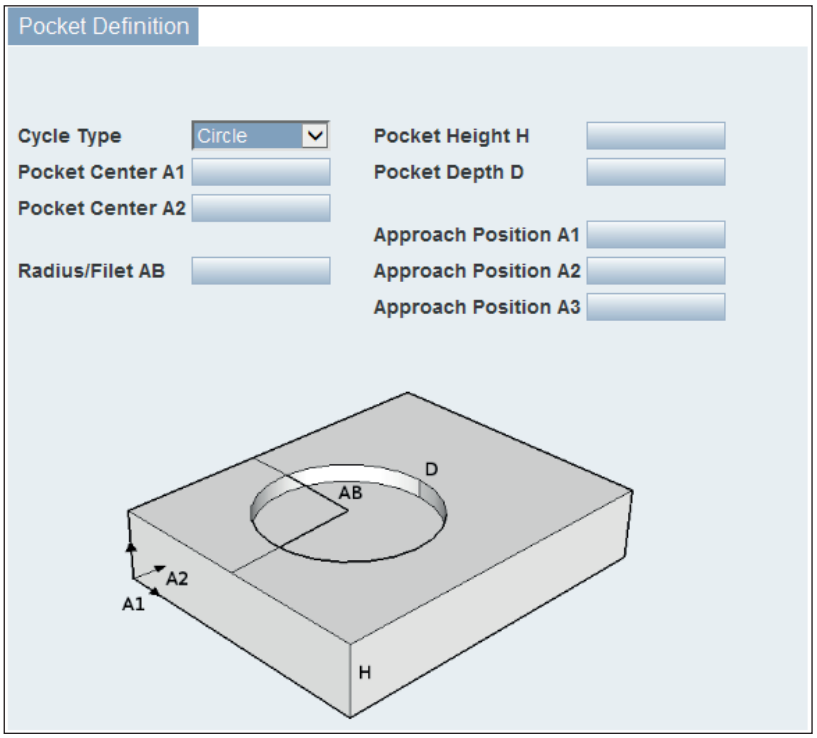
Summary

Page deliberately empty

6 Pocket Milling Cycles

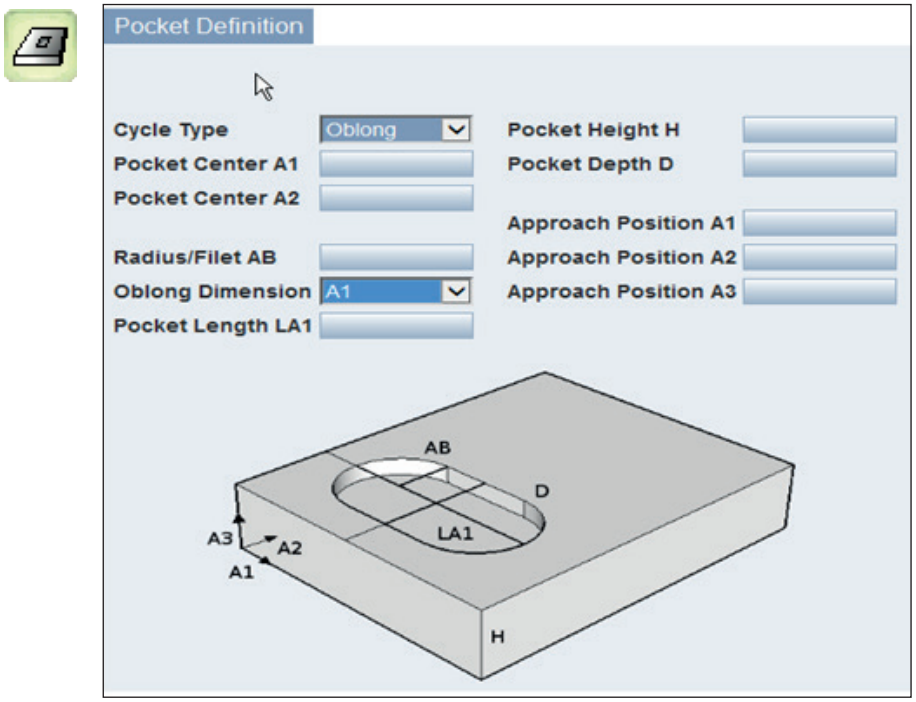
6.1 Pocket Definition

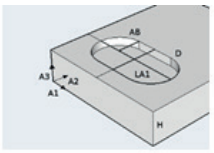
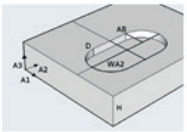
6.1.1 Circle cycle



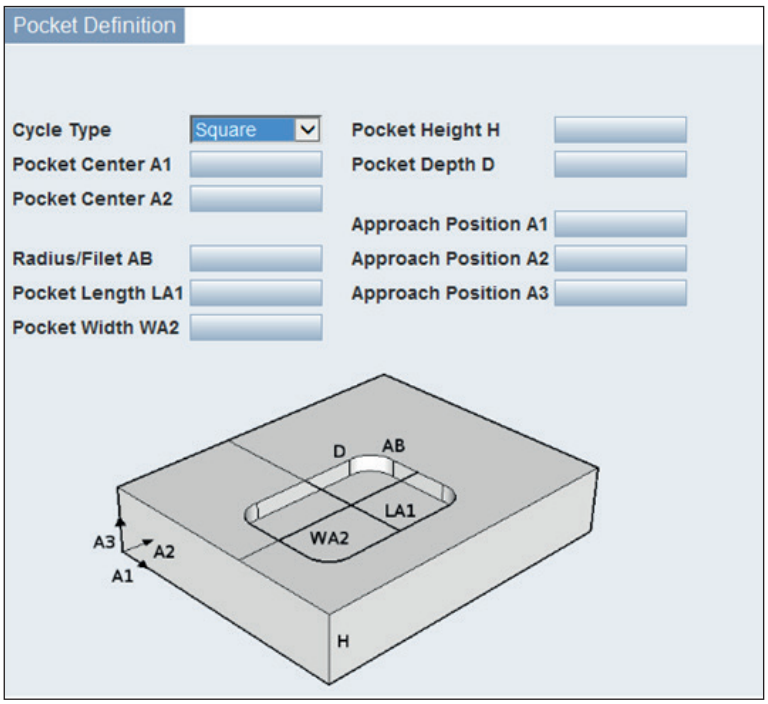
Field Name	Description
Cycle Type	Three type of pocket can be selected: - **Circle**, - Oblong - Square.
Pocket Center A1	This defines the center point of the pocket along the A1 axis as defined in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Pocket Center A2	This defines the center point of the pocket along the A2 axis as defined in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).
Radius/Filet AB	This field defines the radius of the corners in the pocket. The radius is defined along the A1 and A2 axes. The radius of the pocket should not be smaller than the radius of the tool.
Pocket Height H	This defines the A3 position at which the pocket height will start. This can also be referred to as the A3 Part Surface.
Pocket Depth D	This defines the depth of the pocket to be milled. The final absolute position of the milled pocket is *Pocket Height H - Pocket Depth D*.
Approach Position A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Approach Position A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Approach Position A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.

6.1.2 Oblong cycle



Field Name	Description
Cycle Type	Three type of pocket can be selected: - Circle, **- Oblong** - Square.
Pocket Center A1	This defines the center point of the pocket along the A1 axis as defined in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Pocket Center A2	This defines the center point of the pocket along the A2 axis as defined in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).
Radius/Filet AB	This field defines the radius of the corners in the pocket. The radius is defined along the A1 and A2 axes. The radius of the pocket should not be smaller than the radius of the tool.
Oblong dimension	Direction of pocket: A1  A2 
Pocket Lenght LA1	Length dimension of pocket.
Pocket Width WA2	Weight dimension of pocket.
Pocket Height H	This defines the A3 position at which the pocket height will start. This can also be referred to as the A3 Part Surface.
Pocket Depth D	This defines the depth of the pocket to be milled. The final absolute position of the milled pocket is *Pocket Height H - Pocket Depth D*.
Approach Position A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Approach Position A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Approach Position A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.

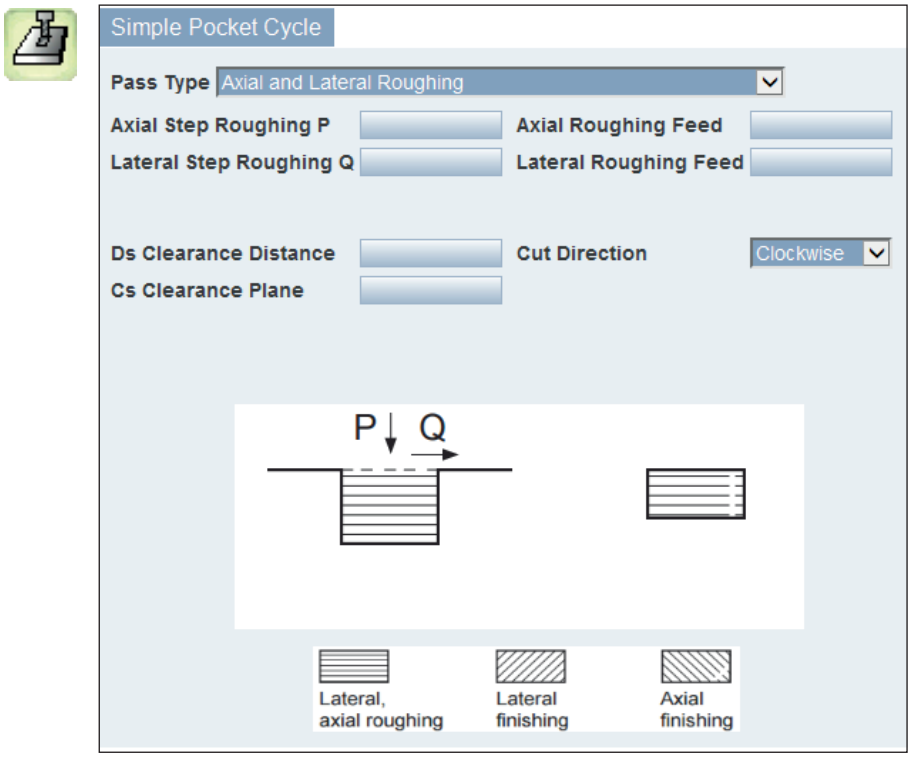
6.1.3 Square cycle



Field Name	Description
Cycle Type	Three type of pocket can be selected: - Circle, - Oblong - **Square**.
Pocket Center A1	This defines the center point of the pocket along the A1 axis as defined in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A1).
Pocket Center A2	This defines the center point of the pocket along the A2 axis as defined in the *Pattern Plane* field on the *General Definition* page immediately to the left of the text (A2).
Radius/Filet AB	This field defines the radius of the corners in the pocket. The radius is defined along the A1 and A2 axes. The radius of the pocket should not be smaller than the radius of the tool.
Pocket Lenght LA1	Length dimension of pocket.
Pocket Width WA2	Weight dimension of pocket.
Pocket Height H	This defines the A3 position at which the pocket height will start. This can also be referred to as the A3 Part Surface.
Pocket Depth D	This defines the depth of the pocket to be milled. The final absolute position of the milled pocket is *Pocket Height H - Pocket Depth D*.
Approach Position A1	Approach coordinate on the A1 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Approach Position A2	Approach coordinate on the A2 axis as defined by the *Pattern Plane* field on the *General Definition* page.
Approach Position A3	Approach coordinate on the A3 axis as defined by the *Pattern Plane* field on the *General Definition* page.

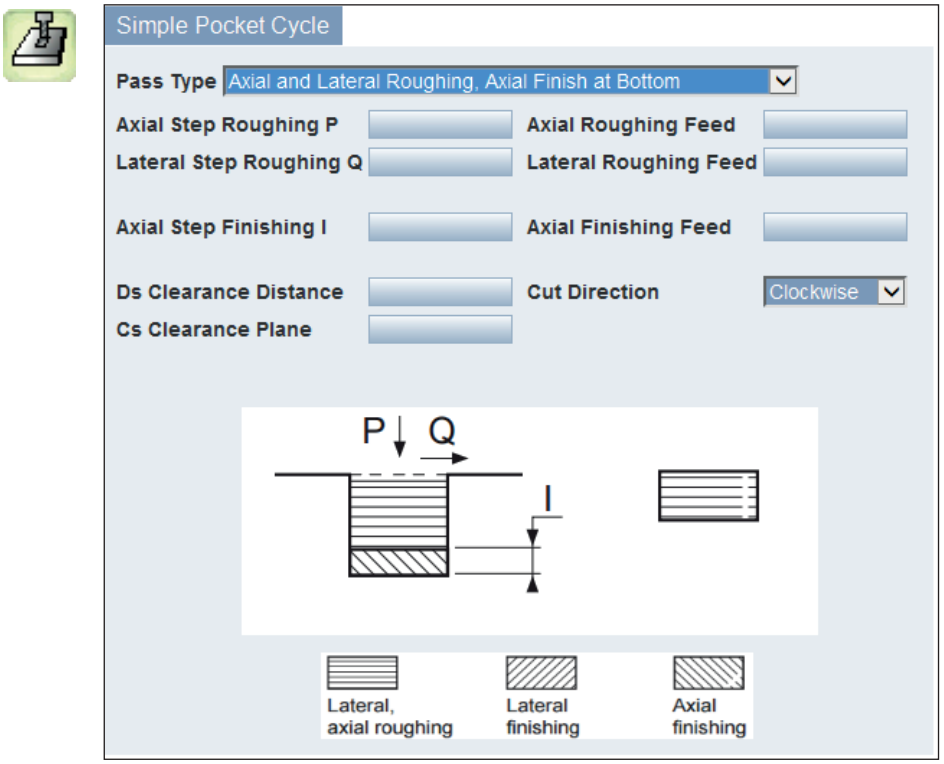
6.2 Simple Pocket Cycle

6.2.1 Axial and Lateral Roughing cycle



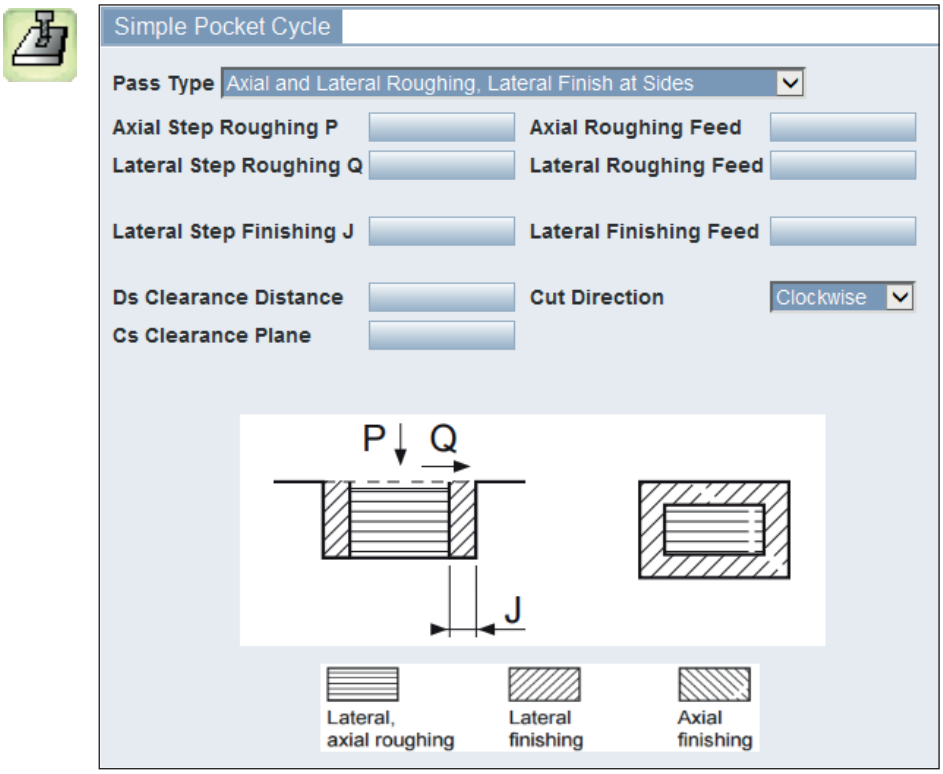
Field Name	Description
Pass Type	Selection type of working.
Axial Step Roughing P	This defines the step in the axial plane (A3) for how far to move with each pass of the Pocket Definition pattern during the roughing phase.
Axial Roughing Feed	This defines the feedrate at which it will move from one Axial Step Height to the next during the roughing passes.
Lateral Step Roughing Q	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for each pass at the same Axial Step during the roughing phase.
Lateral Roughing Feed	This defines the feedrate at which it will move from one Lateral Step point to the next. It also defines the feedrate which will be used when during the roughing passes.
Ds Clearance Distance	When making an initial move to the Pocket Height, this field defines the distance between the part surface and tool tip. The Pocket Height is defined within the Pocket Definition.
Cs Clearance Plane	When finished milling the pocket, this field defines the point along the tool axis that the machine will retract to.
Cut Direction	This defines the direction (CW or CCW) the tool will take along the path in order to mill the pocket.

6.2.2 Axial and Lateral Roughing, Axial Finish at Bottom cycle



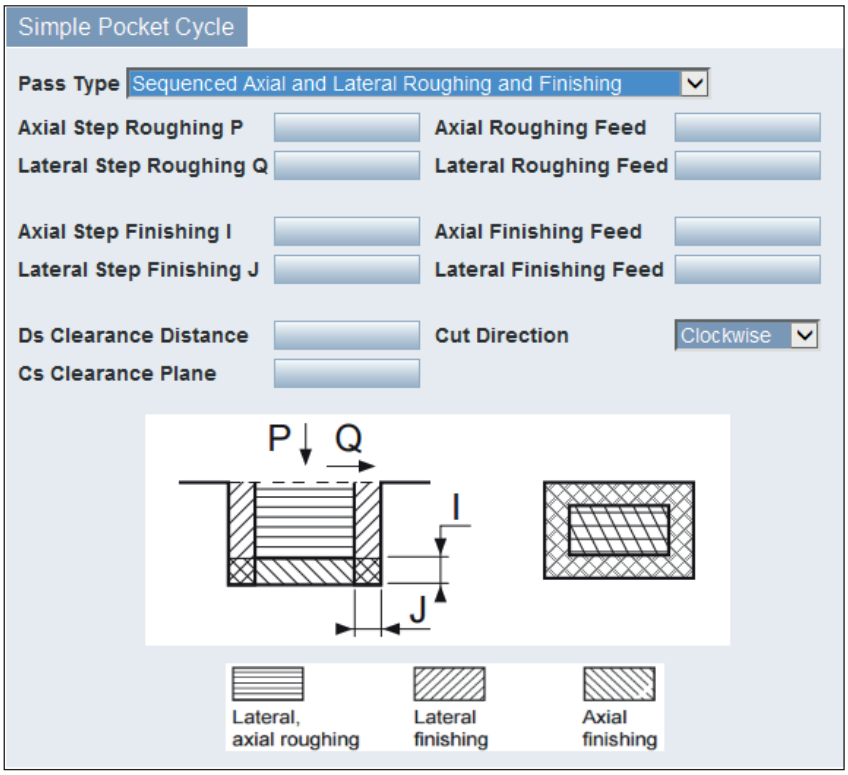
Field Name	Description
Pass Type	Selection type of working.
Axial Step Roughing P	This defines the step in the axial plane (A3) for how far to move with each pass of the Pocket Definition pattern during the roughing phase.
Axial Roughing Feed	This defines the feedrate at which it will move from one Axial Step Height to the next during the roughing passes.
Lateral Step Roughing Q	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for each pass at the same Axial Step during the roughing phase.
Lateral Roughing Feed	This defines the feedrate at which it will move from one Lateral Step point to the next. It also defines the feedrate which will be used when during the roughing passes.
Axial Step Finishing I	This defines the final step in the axial plane (A3) for how far to move with the last pass of the Pocket Definition pattern during the finishing phase.
Axial Finishing Feed	This defines the feedrate at which it will move to the last Axial Step Height during the finishing pass.
Ds Clearance Distance	When making an initial move to the Pocket Height, this field defines the distance between the part surface and tool tip. The Pocket Height is defined within the Pocket Definition.
Cs Clearance Plane	When finished milling the pocket, this field defines the point along the tool axis that the machine will retract to.
Cut Direction	This defines the direction (CW or CCW) the tool will take along the path in order to mill the pocket.

6.2.3 Axial and Lateral Roughing, Lateral Finish at Sides cycle



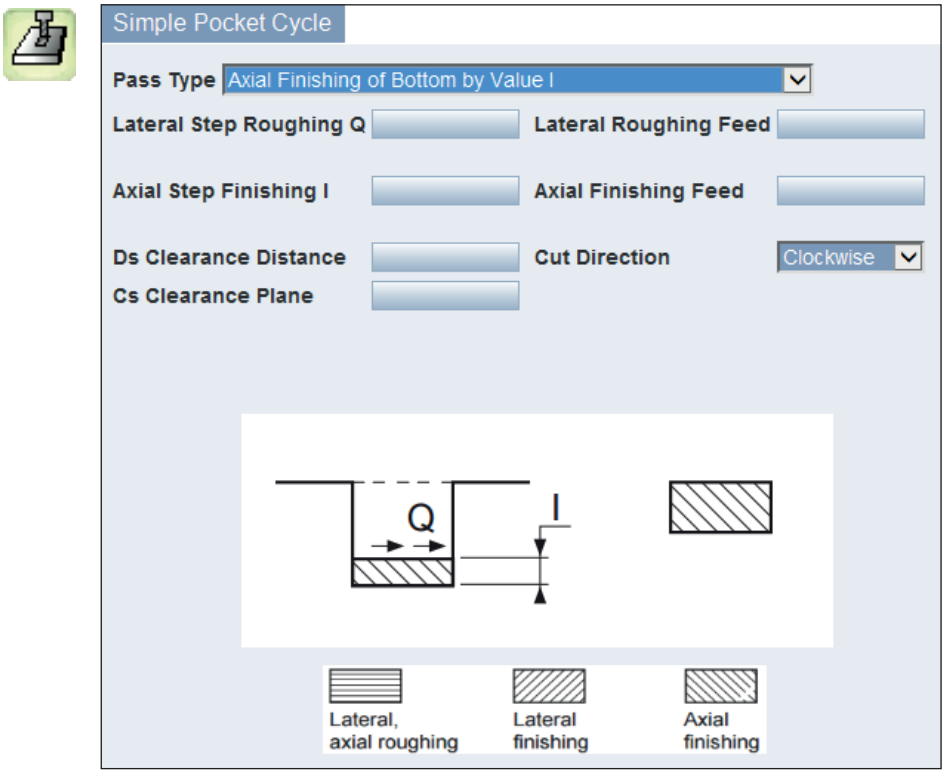
Field Name	Description
Pass Type	Selection type of working.
Axial Step Roughing P	This defines the step in the axial plane (A3) for how far to move with each pass of the Pocket Definition pattern during the roughing phase.
Axial Roughing Feed	This defines the feedrate at which it will move from one Axial Step Height to the next during the roughing passes.
Lateral Step Roughing Q	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for each pass at the same Axial Step during the roughing phase.
Lateral Roughing Feed	This defines the feedrate at which it will move from one Lateral Step point to the next. It also defines the feedrate which will be used when during the roughing passes.
Lateral Step Finishing J	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for the last pass at the same Axial Step during the finishing phase.
Lateral Finishing Feed	This defines the feedrate at which it will move to the last Lateral Step point during the finishing pass.
Ds Clearance Distance	When making an initial move to the Pocket Height, this field defines the distance between the part surface and tool tip. The Pocket Height is defined within the Pocket Definition.
Cs Clearance Plane	When finished milling the pocket, this field defines the point along the tool axis that the machine will retract to.
Cut Direction	This defines the direction (CW or CCW) the tool will take along the path in order to mill the pocket.

6.2.4 Sequenced Axial and Lateral Roughing and Finishing cycle



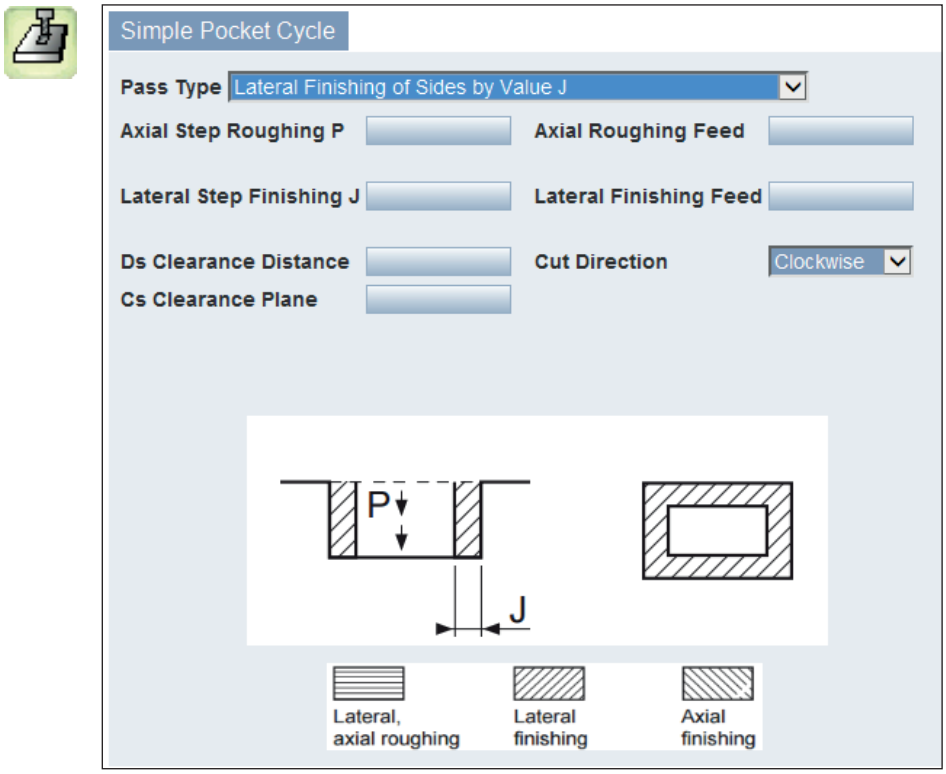
Field Name	Description
Pass Type	Selection type of working.
Axial Step Roughing P	This defines the step in the axial plane (A3) for how far to move with each pass of the Pocket Definition pattern during the roughing phase.
Axial Roughing Feed	This defines the feedrate at which it will move from one Axial Step Height to the next during the roughing passes.
Lateral Step Roughing Q	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for each pass at the same Axial Step during the roughing phase.
Lateral Roughing Feed	This defines the feedrate at which it will move from one Lateral Step point to the next. It also defines the feedrate which will be used when during the roughing passes
Axial Step Finishing I	This defines the final step in the axial plane (A3) for how far to move with the last pass of the Pocket Definition pattern during the finishing phase.
Axial Finishing Feed	This defines the feedrate at which it will move to the last Axial Step Height during the finishing pass.
Lateral Step Finishing J	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for the last pass at the same Axial Step during the finishing phase.
Lateral Finishing Feed	This defines the feedrate at which it will move to the last Lateral Step point during the finishing pass.
Ds Clearance Distance	When making an initial move to the Pocket Height, this field defines the distance between the part surface and tool tip. The Pocket Height is defined within the Pocket Definition.
Cs Clearance Plane	When finished milling the pocket, this field defines the point along the tool axis that the machine will retract to.
Cut Direction	This defines the direction (CW or CCW) the tool will take along the path in order to mill the pocket.

6.2.5 Axial Finishing of Bottom by Value I cycle



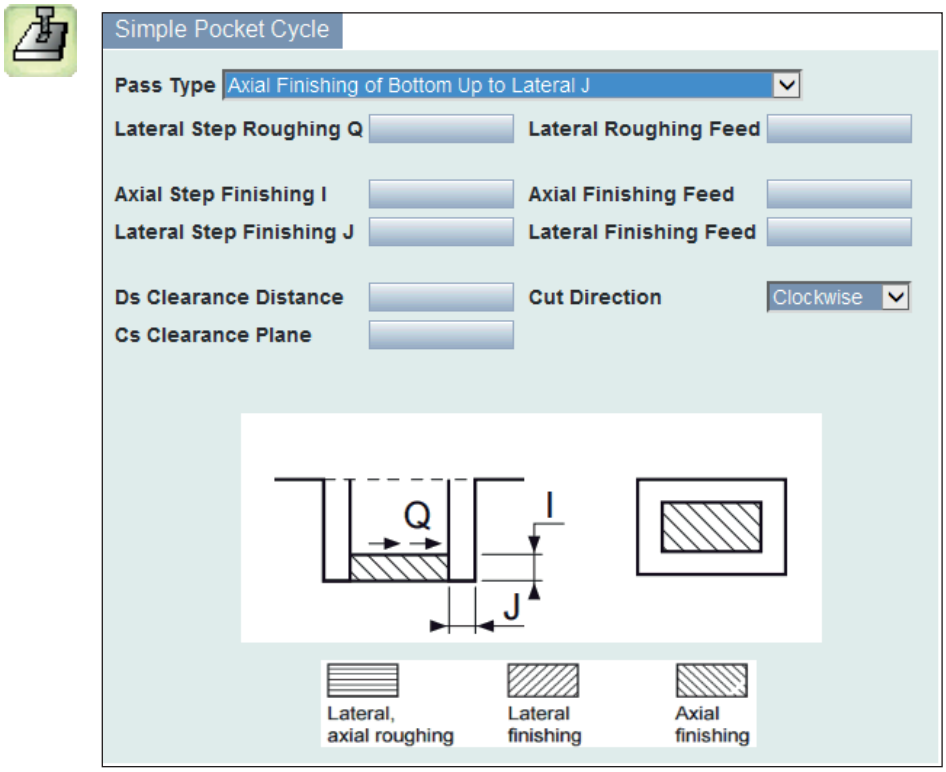
Field Name	Description
Pass Type	Selection type of working.
Lateral Step Roughing Q	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for each pass at the same Axial Step during the roughing phase.
Lateral Roughing Feed	This defines the feedrate at which it will move from one Lateral Step point to the next. It also defines the feedrate which will be used when during the roughing passes.
Axial Step Finishing I	This defines the final step in the axial plane (A3) for how far to move with the last pass of the Pocket Definition pattern during the finishing phase.
Axial Finishing Feed	This defines the feedrate at which it will move to the last Axial Step Height during the finishing pass.
Ds Clearance Distance	When making an initial move to the Pocket Height, this field defines the distance between the part surface and tool tip. The Pocket Height is defined within the Pocket Definition.
Cs Clearance Plane	When finished milling the pocket, this field defines the point along the tool axis that the machine will retract to.
Cut Direction	This defines the direction (CW or CCW) the tool will take along the path in order to mill the pocket.

6.2.6 Lateral Finishing of Sides by Value J cycle



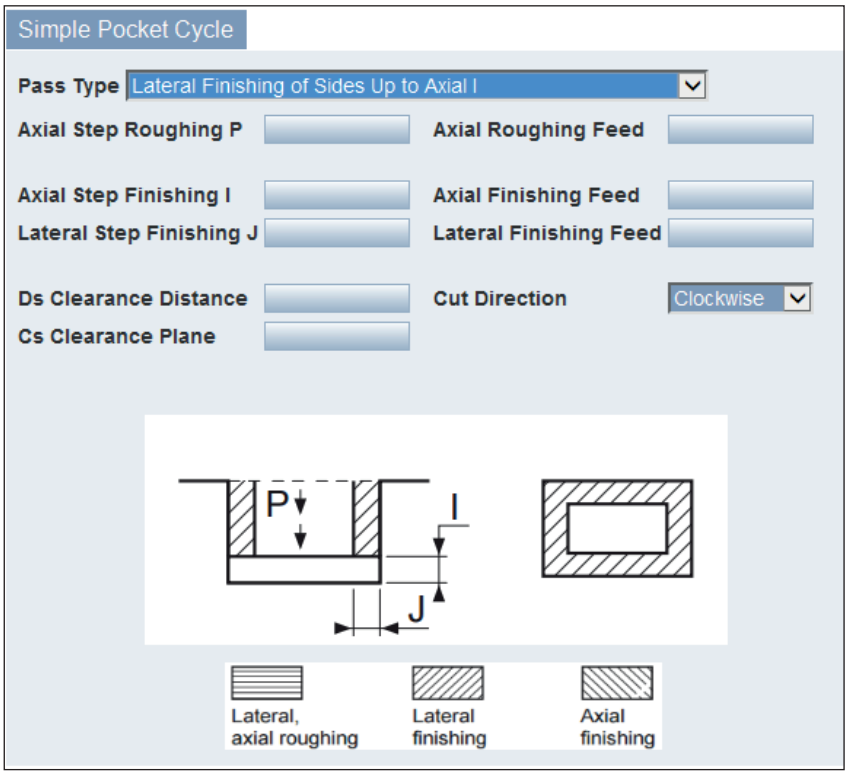
Field Name	Description
Pass Type	Selection type of working.
Axial Step Roughing P	This defines the step in the axial plane (A3) for how far to move with each pass of the Pocket Definition pattern during the roughing phase.
Axial Roughing Feed	This defines the feedrate at which it will move from one Axial Step Height to the next during the roughing passes.
Lateral Step Finishing J	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for the last pass at the same Axial Step during the finishing phase.
Lateral Finishing Feed	This defines the feedrate at which it will move to the last Lateral Step point during the finishing pass.
Ds Clearance Distance	When making an initial move to the Pocket Height, this field defines the distance between the part surface and tool tip. The Pocket Height is defined within the Pocket Definition.
Cs Clearance Plane	When finished milling the pocket, this field defines the point along the tool axis that the machine will retract to.
Cut Direction	This defines the direction (CW or CCW) the tool will take along the path in order to mill the pocket.

6.2.7 Axial Finishing of Bottom Up to Lateral J cycle



Field Name	Description
Pass Type	Selection type of working.
Lateral Step Roughing Q	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for each pass at the same Axial Step during the roughing phase.
Lateral Roughing Feed	This defines the feedrate at which it will move from one Lateral Step point to the next. It also defines the feedrate which will be used when during the roughing passes.
Axial Step Finishing I	This defines the final step in the axial plane (A3) for how far to move with the last pass of the Pocket Definition pattern during the finishing phase.
Axial Finishing Feed	This defines the feedrate at which it will move to the last Axial Step Height during the finishing pass.
Lateral Step Finishing J	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for the last pass at the same Axial Step during the finishing phase.
Lateral Finishing Feed	This defines the feedrate at which it will move to the last Lateral Step point during the finishing pass.
Ds Clearance Distance	When making an initial move to the Pocket Height, this field defines the distance between the part surface and tool tip. The Pocket Height is defined within the Pocket Definition.
Cs Clearance Plane	When finished milling the pocket, this field defines the point along the tool axis that the machine will retract to.
Cut Direction	This defines the direction (CW or CCW) the tool will take along the path in order to mill the pocket.

6.2.8 Lateral Finishing of Sides Up to Axial I cycle



Field Name	Description
Pass Type	Selection type of working.
Lateral Step Roughing P	This defines the step in the axial plane (A3) for how far to move with each pass of the Pocket Definition pattern during the roughing phase.
Axial Roughing Feed	This defines the feedrate at which it will move from one Axial Step Height to the next during the roughing passes.
Axial Step Finishing I	This defines the final step in the axial plane (A3) for how far to move with the last pass of the Pocket Definition pattern during the finishing phase.
Axial Finishing Feed	This defines the feedrate at which it will move to the last Axial Step Height during the finishing pass.
Lateral Step Finishing J	This defines the lateral increment (along A1 and A2) for which the pocket cycle will increase for the last pass at the same Axial Step during the finishing phase.
Lateral Finishing Feed	This defines the feedrate at which it will move to the last Lateral Step point during the finishing pass.
Ds Clearance Distance	When making an initial move to the Pocket Height, this field defines the distance between the part surface and tool tip. The Pocket Height is defined within the Pocket Definition.
Cs Clearance Plane	When finished milling the pocket, this field defines the point along the tool axis that the machine will retract to.
Cut Direction	This defines the direction (CW or CCW) the tool will take along the path in order to mill the pocket.

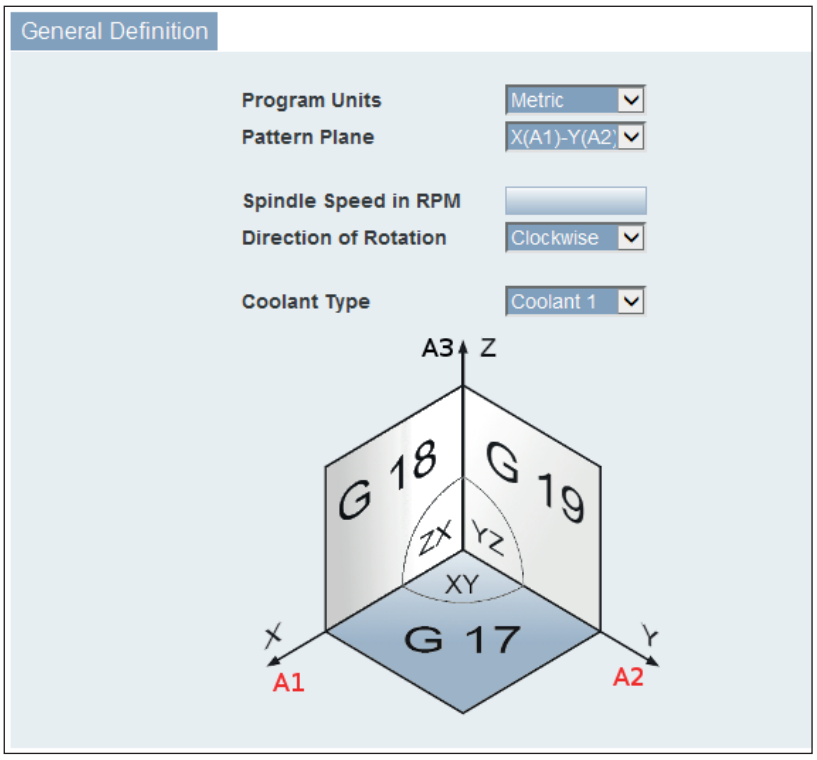
Page deliberately empty

Summary

Page deliberately empty

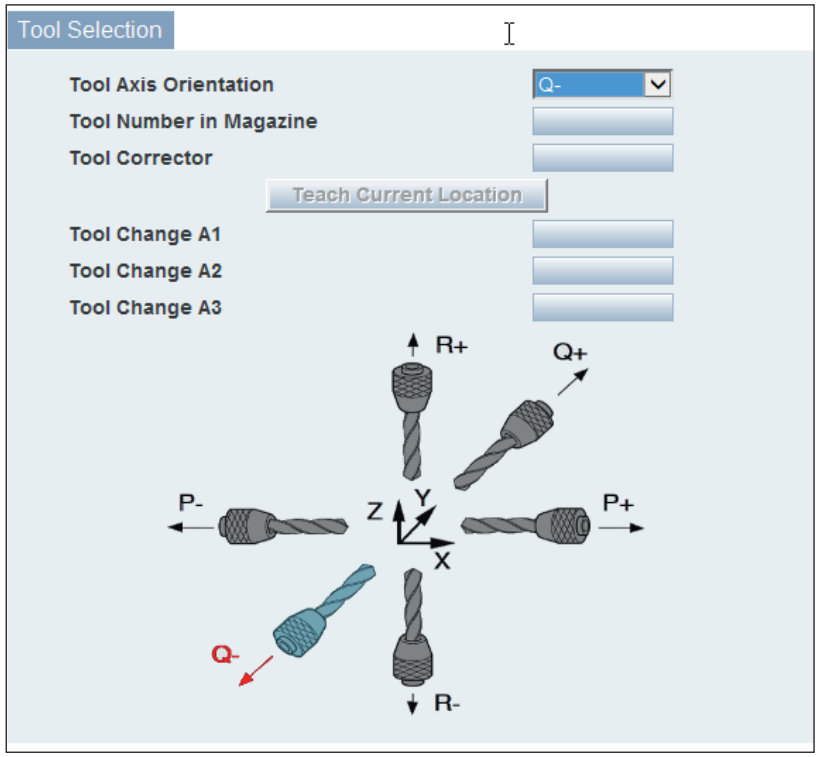
7 Miscellaneous Functions

7.1 General Definition



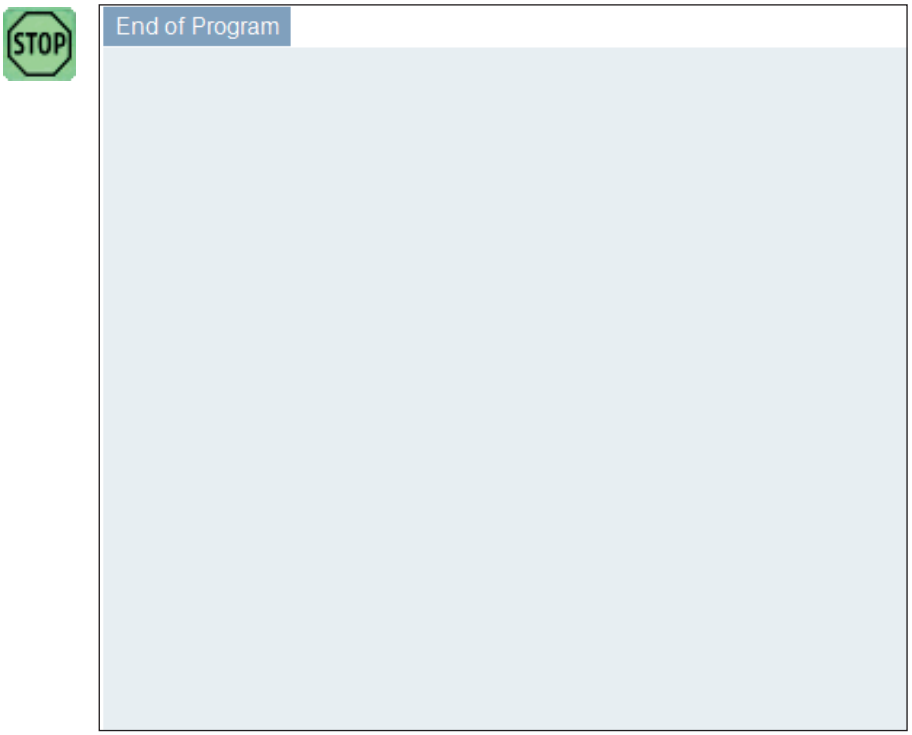
Field Name	Description
Program Units	This field allows the programmer to set up their program in Inch or MM.
Pattern Plane	This field allows the programmer to select the operating plane for the program. This selection defines which axes (X, Y, and Z) will be associated with program axes A1, A2, and A3. The selections are: • **ZA1-XA2** - G18 • **YA1-ZA2** - G19 • **XA1-YA2** - G17.
Spindle Speed in RPM	This field is for entering the RPMs of the spindle for M3 and M4.
Direction of Rotation	This field allows the programmer to select between CW and CCW spindle rotation.
Coolant Type	This field allows the programmer to select between the following options: • **Coolant 1** - Output M7 • **Coolant 2** - Output M8 • **No Coolant** - Output M9.

7.2 Tool Selection



Field Name	Description
Tool Axis Orientation	This field allows the programmer to select their tool axis orientation used in the program. The options are: • **Q-** • **Q+** • **R-** • **R+** • **P-** • **P+**
Tool Number in Magazine	This field defines which Tool Number is used in the program. It is programmed with a Tool Change M6.
Tool Corrector	This field defines which Tool Offset Number (1-32) is to be used in the program.
Tool Change A1	This field defines the tool changer location for A1 as defined in the *Pattern Plane* field on the *General Definition* page immediately to the leftof the text (A1).
Tool Change A2	This field defines the tool changer location for A2 as defined in the *Pattern Plane* field on the *General Definition* page immediately to the leftof the text (A2).
Tool Change A3	This field defines the tool changer location for A2 as defined in the *Pattern Plane* field on the *General Definition* page immediately to the leftof the text (A3).

7.3 End of Program

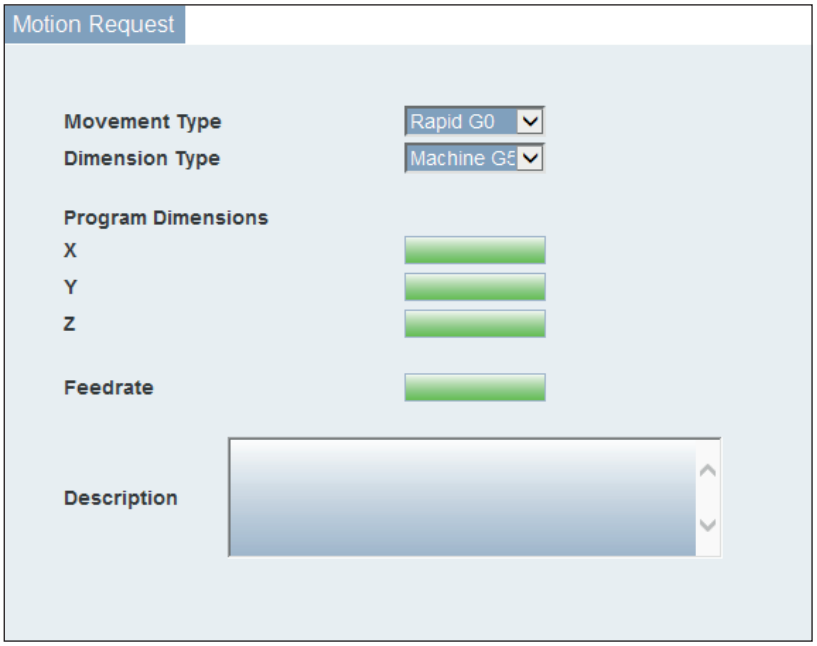


End of Program defined:

- calling of the ISO end of program (M02)

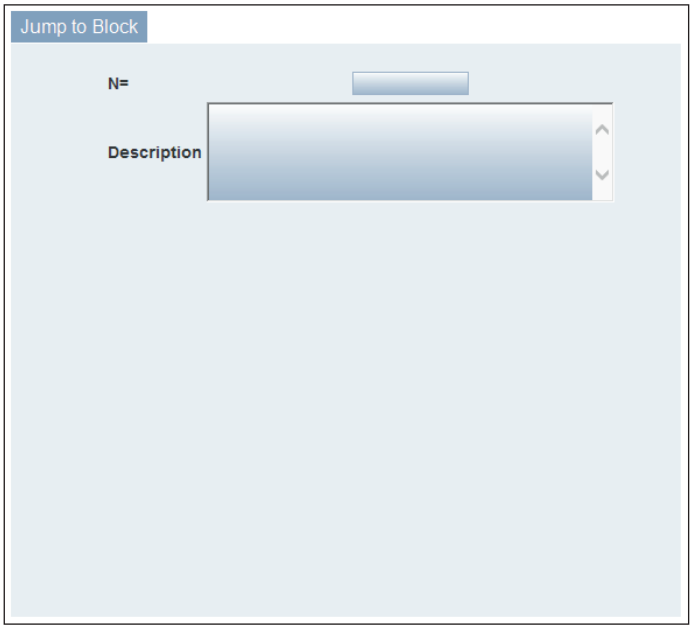
There are no entry fields to use on this page, it is only intended as a placeholder at the end of thecreated program. Select the End of Program block and add to end of the program blocks. Save andtransfer the file to the CNC, the M2 will automatically be added to the end of the output.

7.4 Motion Request



Field Name	Description
Movement Type	This field defines the type of motion. The options are: • Rapid G0 • Linear G01 • Arc CW G02 • Arc CCW G03
Dimension Type	This field defines the dimension type of movement. The options are: • Incremental G91 • Absolute G90 • Machine G52
Program Dimensions	The following fields are used to define the points for each axis where motion is required.
X	Value to move X to.
Y	Value to move Y to.
Z	Value to move Z to.
Feedrate	Feedrate of motion in mm/min or inch/min.
Description	This field allows the programmer to enter a comment that will be output with the ISO code.

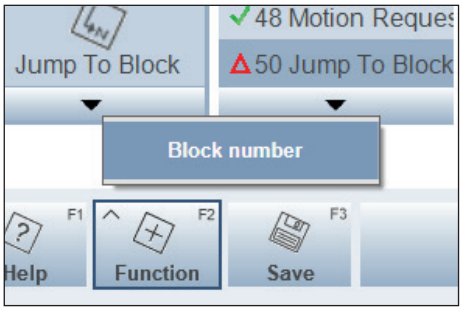
7.5 Jump to Block

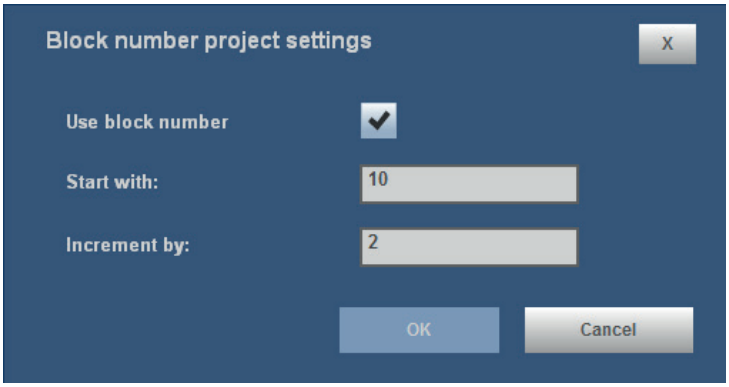


Field Name	Description
N=	Jump to block Nxxxx, within this program. This is a jump without return.
Description	This field allows the programmer to enter a comment that will be output with the ISO code.

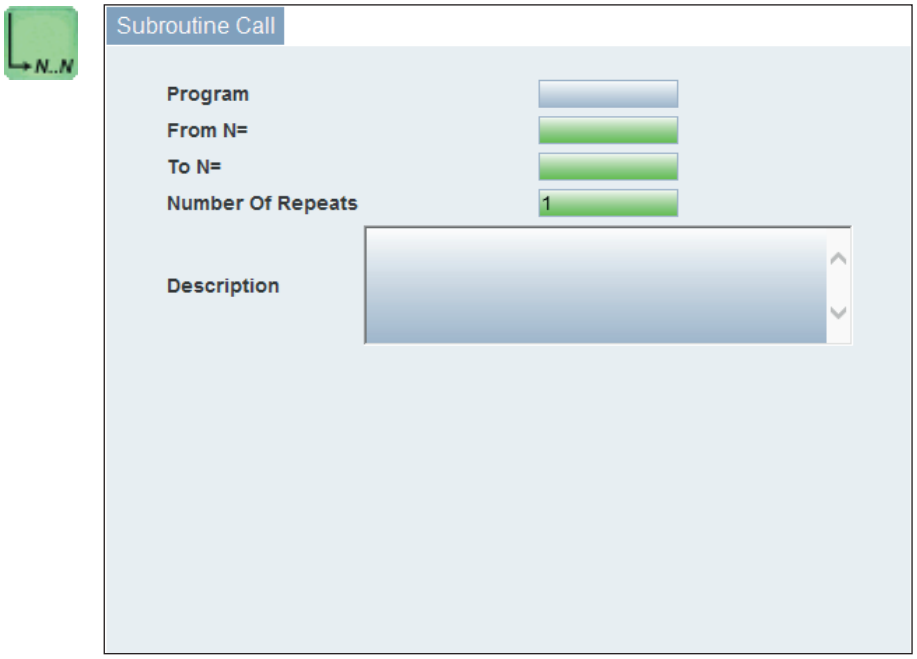
7.5.1 Block number

Up version 4.1.30.00 the new softkey “Block number” is available, an automatic numbering is added of the blocks by the software that can be used as jump’s target.





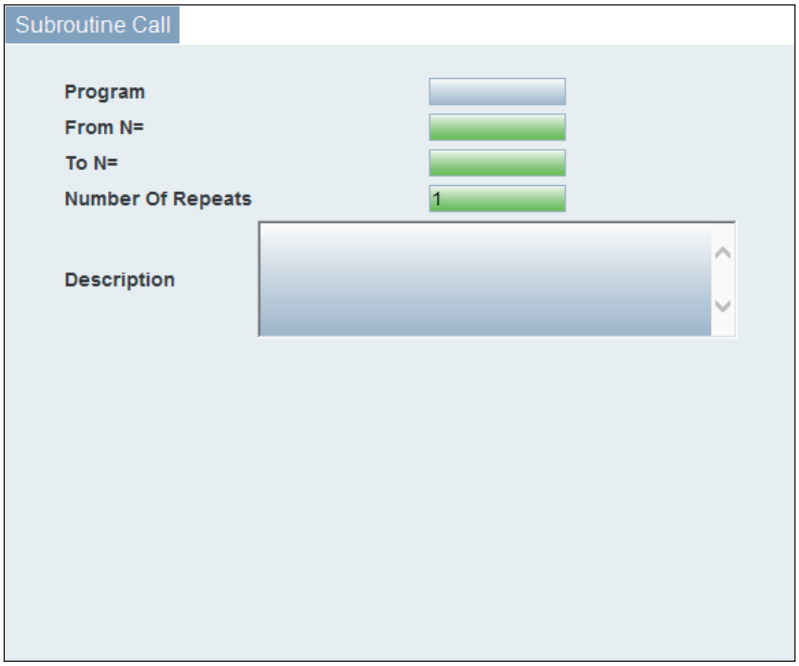
7.6 Sequence Call



Field Name	Description
From N=	Jump to block Nxxxx, within this program. This is a jump with return.
To N=	This defines the block Nxxxx that is the end of the jump sequence.
Number of Repeats	This field defines the number of times the sequence call is repeated.
Description	This field allows the programmer to enter a comment that will be output with the ISO code.

See note (7.5.1) Up version 4.1.30.00 - Available a new softkey “Block number”.

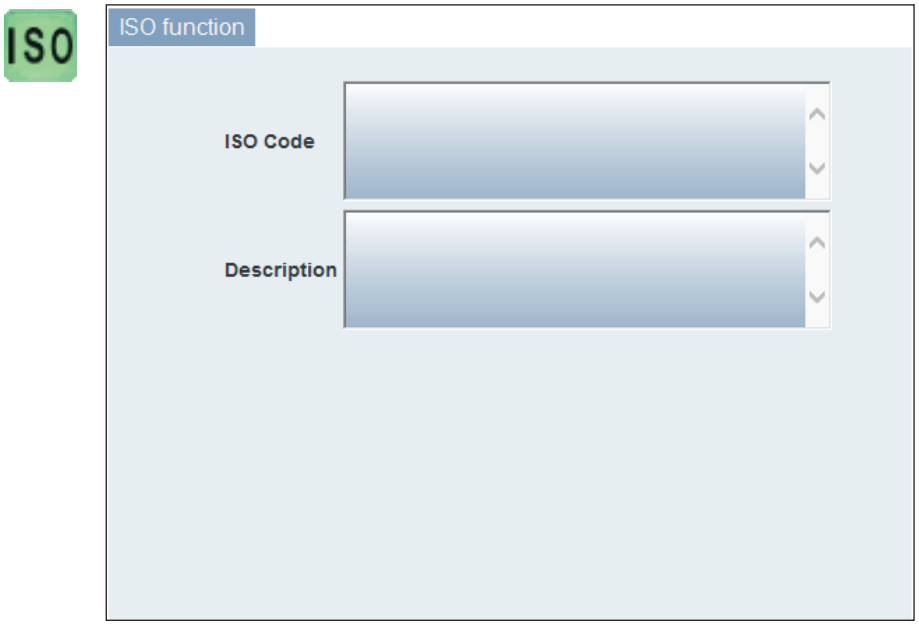
7.7 Subroutine Call



Field Name	Description
Program	This field defines the subroutine program that is to be called.
From N=	Jump to block Nxxxx, within the program in the Program field. This is a jump with return.
To N=	This defines the block Nxxxx that is the end of the jump sequence within the program defined in the Program field.
Number of Repeats	This field defines the number of times the program sequence call is repeated.
Description	This field allows the programmer to enter a comment that will be output with the ISO code.

See note (7.5.1) Up version 4.1.30.00 - Available a new softkey “Block number”.

7.8 ISO Function



Field Name	Description
ISO Code	This field allows the programmer to enter lines of additional ISO code that will be output with the rest of the ISO code when the program is created.
Description	This field allows the programmer to enter a comment that will be output with the ISO code.

Page deliberately empty

Page deliberately empty

Summary

Page deliberately empty

8 Building an NUMmill Program

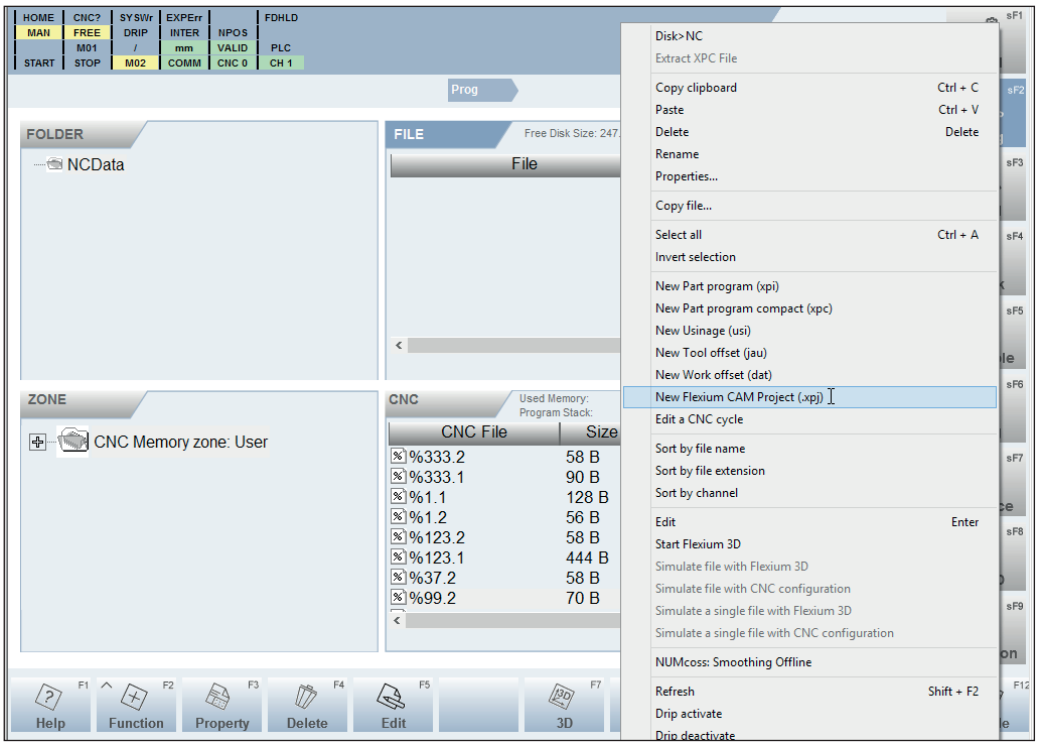
NUMmill programs can be easily created through the sF2 programming screen.
The steps needed for creating a program from scratch are as follows:

- Creating a New Part Program
- Saving and Activating a Program.

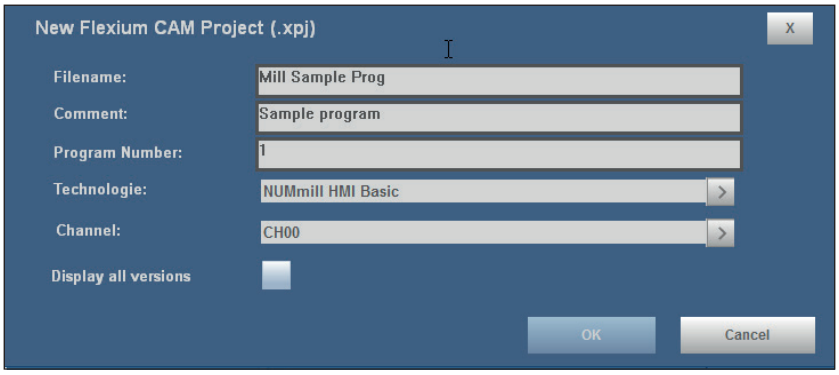
8.1 Creating a New Part Program

Once the NUM Milling Technology is installed, a program can be created using a *Flexium CAM Project file (.xpj)*.

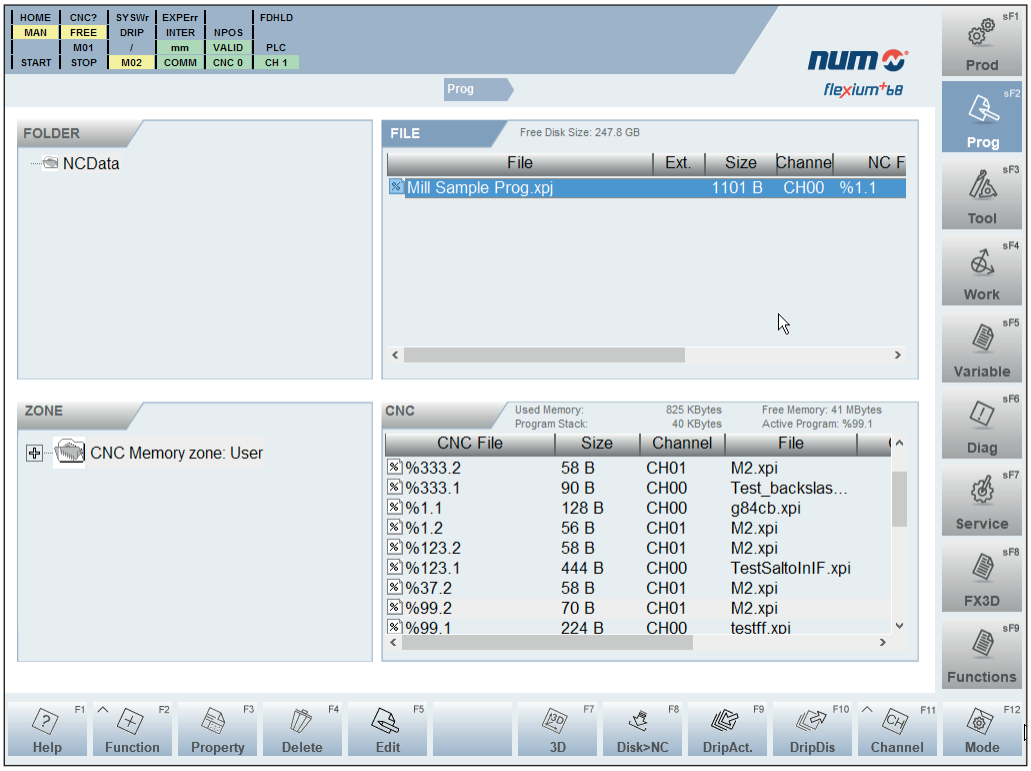
This file can be created with the *sF2 Programming page*. By right clicking on the PC side of the programming screen, you can select to create a *New Flexium CAM Project (.xpj)*.



Program information such as *Filename, Comment, Program Number* and *type of Technology* can then be entered in the following window:



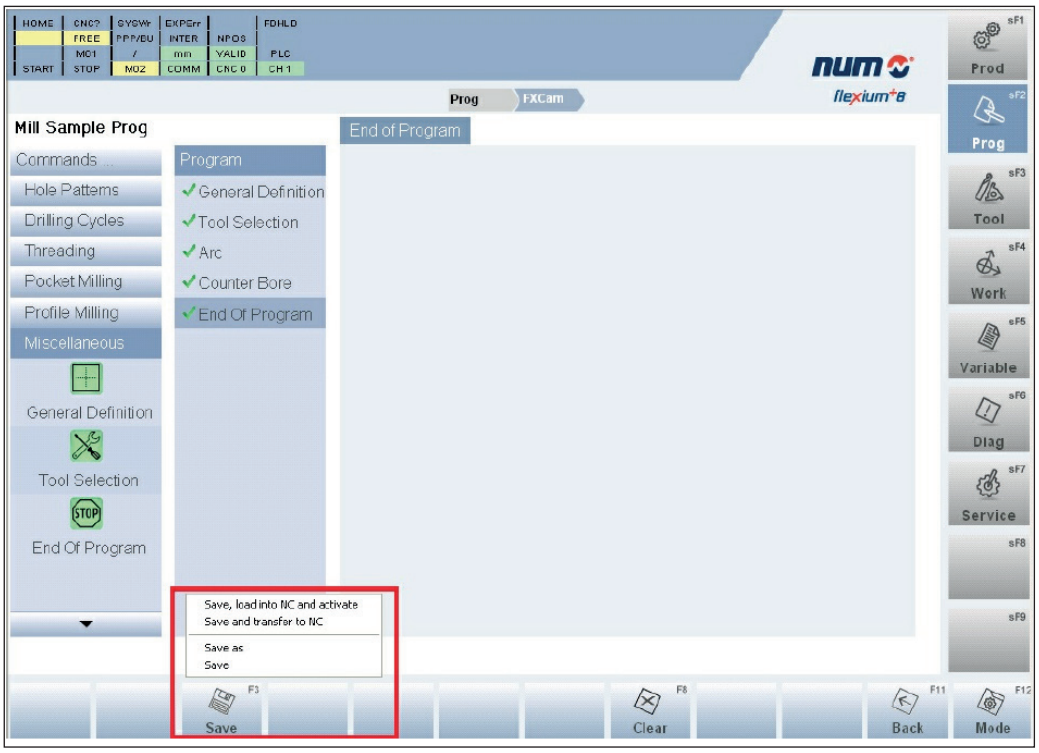
You will then see the program that was created in the list of programs available to edit. By double clicking on it, you can edit it.



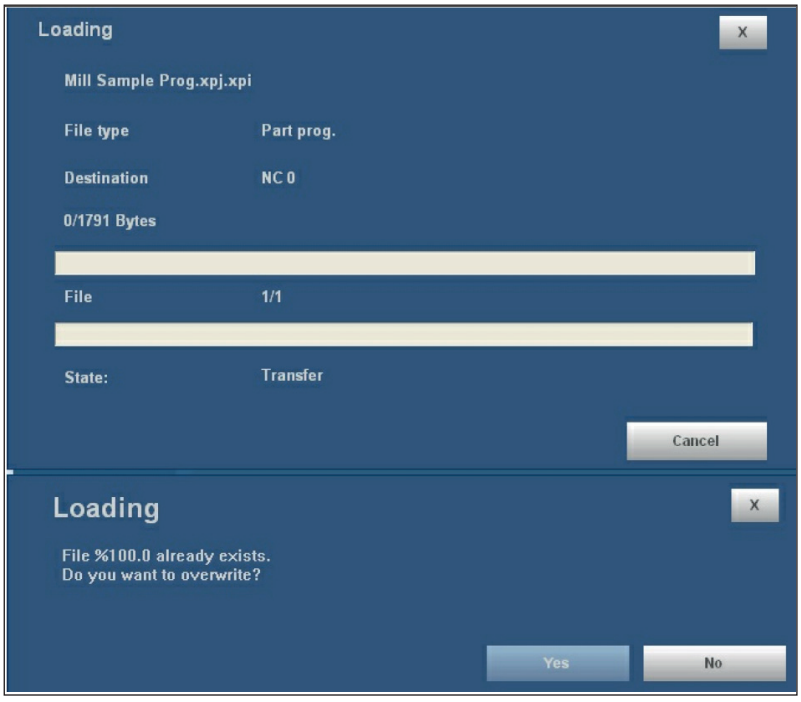
8.2 Saving and Activating a Program

Using the previous chapters in the manual to add and edit the blocks within your part program, you can then save and activate your program for execution on the machine when the program is finalized.

To do this, select the *Save button* from the *Tool Bar*. The following popup window will appear, and you can select which action to perform.



If *Save and transfer to NC or Save*, *load into NC* and activate is selected, then a transfer window will appear and display the status of the program transfer. It will also ask the user to overwrite a program if it already exists:



Page deliberately empty

Page deliberately empty

Published by NUM Spa

Via F. Somma 62
20012 Cuggiono (MI) (Italy)
Tel. : +39 02 979 691
website: www.num.com

Printed December 2020

CNC HighEnd Applications