XEBEC Back Burr Cutter & Path™
Instruction Manual
For Combined Lathe

Thank you for purchasing XEBEC Back Burr Cutter & Path.
Prior to use, please read this instruction manually carefully to fully understand the correct use.
Be sure to keep this instruction manual for future reference.

索引

XEBEC Back Burr Cutter & Path™ Instruction Manual (For Combined Lathe)

Notes for Using XEBEC Path
XEBEC Path may be used only by those customers who agree to the terms of use at the time of purchase. Under these terms, it is prohibited to use XEBEC Path with any tool other than XEBEC Back Burr Cutter. Transfer or provision of XEBEC Path to any third party is also prohibited.

Make sure to comply with the terms of use.

For Your Safety

Safety Precautions

Safety Precautions

The meanings of the indications and symbols related to matters which must be observed in order to ensure the safety of this product are as detailed below.

Warning and Caution Logos

⚠ WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury
⚠ CAUTION	CAUTION indicates practices that may cause injuries and damages

Symbols

Obey all safety messages that follow this symbol to avoid possible injury or death.

This is the safety alert symbol. It is used to alert you to potential physical injury hazards.

Operator Safety Protection

	⚠ WARNING
	Make sure that the product is free of any visible damage prior to use The product may break, and fragments may scatter if the product is used with any damage or excessive tool wear.
	Do not touch the product while it is in motion Make sure to isolate this product while in use by taking measures such as closing the door of the machine tool.
	If vibrations or any other abnormality occurs, discontinue use immediately. If the use of the product is continued with any abnormality, the product may break or fall off, possibly causing injury or loss of sight.
	Wear protective gloves and gears when touching the product If the cutting blades is touched with bare hands, there is risk of injury or burns.

Wear protective gears

Wear protective gears such as goggles, face mask, gloves, and earmuff when using this product. Furthermore, make sure to cover your skin with clothing.

Chips and Dust

Make sure to use a dust collector or other means to collect chips, dust, and other substances to prevent them from scattering into the surrounding.

Attention to the Work Area

- Install an enclosure so that persons other than the operator do not enter the work area, and ensure that all persons, if any, in the work area are wearing protective gears.
- In particular be careful that children do not enter the work area.
- Keep the floor of the work area clean at all times to prevent the risk of slipping or tripping on chips, dust, cutting fluids, coolant, or other substances.

- There is the risk of fire caused by heating, sparks, or other factor resulting from use of the product. Do not use the product close to a flammable liquid or in an explosive atmosphere. Also be sure to enact fire prevention measures.

Precautions for Setup and Installation

	WARNING
	Select the appropriate tool size. Select the appropriate tool size and set the projection length appropriately to avoid damages to the product, jig or the machine tool.
	During use, this product must be clamped firmly to the machine tool and the workpiece must be fixtured securely. If the workpiece moves during machining, the workpiece or this product may break, causing fragments to scatter.
	Before use, preform test with air cutting or simulation software to make sure there is no error with the Path. It there is any error, this product or the workpiece may break.
	Make sure to set the tool length offset at the tip of this product aligned with its centerline when using XEBEC Path. Setting the tool length offset at any point other than the tip of this product aligned with its centerline is dangerous as it may result in tool collision and accident.
	Minimize positional error and dimensional variance of holes to be deburred and make sure to position this product correctly. If the max allowed accumulated variance is exceeded, the edge quality after deburring will be affected. If this product is not positioned correctly, it may break.
	Make sure the tool runout is less than 0.01mm after the tool is clamped in the milling tool holder. If the tool runout is greater, this product may break when it is rotated or applied to the workpiece.
	Make sure that the positioning format (incremental) of the Path matches that of the machine tool. If the incorrect positioning format is used, this product, the machine tool and the fixture may break.

Pre-Use Inspection

	WARNING
	Select and use coolant or cutting fluid that is suitable for the purpose. Depending on the type of coolant or cutting fluid, there is a risk of fire caused by overheating, sparks, or other problem. If there is any risk of overheating or sparks, be sure to implement fire prevention measures.

	CAUTION
	Prior to the use of this product, make sure that there will be no tool collision. Select the appropriate tool size and set the projection length appropriately by taking into consideration the movement and the tool path of this product in use.

	CAUTION
	Adjust the direction of cutting fluid or coolant to ensure that it is applied to the cutting blades. If the cutting fluid or coolant is not applied sufficiently, the cutting blades may become overheated, and the tool life may be shortened.
	Minimize the burr size generated during the previous machining process. If the root thickness of the burrs is greater than the deburring amount (edge break length) of the Path, it may not be possible to remove the burrs completely.

Precautions for Use

	WARNING
	DO NOT use at excessive rotational speeds. The use of this product at any excessive rotational speed may cause it to break. Refer to the standard machining parameters for each tool size.
	DO NOT use this product in counterclockwise (CCW) rotation. This product must be used in clockwise (CW) rotation. Using this product in CCW rotation will result in damages.
	DO NOT use this product with hand tools. This product must be used with CNC machines. If used with any hand tool, it may break and cause injuries.
	DO NOT use this product for any purpose other than deburring or chamfering. This product is designed for deburring and chamfering. It may break if used for any other purpose.

	CAUTION
	Edges with gaps and openings If there is any gap or opening on the edge to be deburred, the cutting edge is more prone to chipping, and the tool life may be shortened.

Regular Maintenance

When replacing this product, remove any dirt from the milling tool holder and the shank, and keep them clean.

Introduction

Product Overview

XEBEC Back Burr Cutter and XEBEC Path are a dedicated cutter and customized path specifically for the purpose of removing burrs from cross hole edges that are generated by hole drilling.

Contents of the Product

The followings will be provided when you purchase XEBEC Back Burr Cutter and Path.

- XEBEC Back Burr Cutter

- XEBEC Path

  (Provided in a text file format)

- Path Code Sheet

Features

XEBEC Back Burr Cutter

- Made of micro-grain cemented carbide

  High cutting performance and long tool life
- Available in 2 variants: Heat-resistant AlTiCrN coated variant and sharp-edged uncoated variant

  AlTiCrN coated variant is suitable for difficult-to-cut materials such as medium tensile steel (S45C, AISI1045, C45), stainless steel, titanium and Inconel alloys.

  Uncoated variant features sharp cutting edges that are effective in preventing built-up edges and formation of secondary burrs, and it is suitable for plastics and aluminum (uncoated variant is available only in Regular Type).
- Blade shape is optimized for deburring

  Helical cutting edges for optimal cutting performance and prevention of secondary burrs
- 3 types of neck lengths

  Available in three types of neck lengths: Short Type, Regular Type, and Straight Type, making this tool suitable for wide range of edges.

  Short Type features 3 blades and a short neck length (only 3 times the Cutter diameter), enabling high feed rate and long tool life.

  Regular Type and Straight Type feature long neck lengths that enable long reach, making deburring of deep holes possible. Regular Type has the neck length 5 times of the Cutter diameter, and Straight Type 15 times of the Cutter diameter.

XEBEC Path

- Optimal tool paths for deburring

  Achieves uniform edge break without formation of secondary burrs.
- Supports deburring of various types of drilled holes such as orthogonal and off-center cross holes

  XEBEC Path enables deburring of orthogonal cross holes (examples: Target Edges to Deburr(P.14), Figure 1) which were previously difficult to deburr.
- Longer tool life for lower running costs

  The optimal tool path enables deburring with the minimum amount of cutting, thereby reducing tool wear caused by heat. Furthermore, the contact point of the cutting blades with the workpiece changes constantly during deburring, achieving long tool life.
- Quick deburring with minimum tool movement

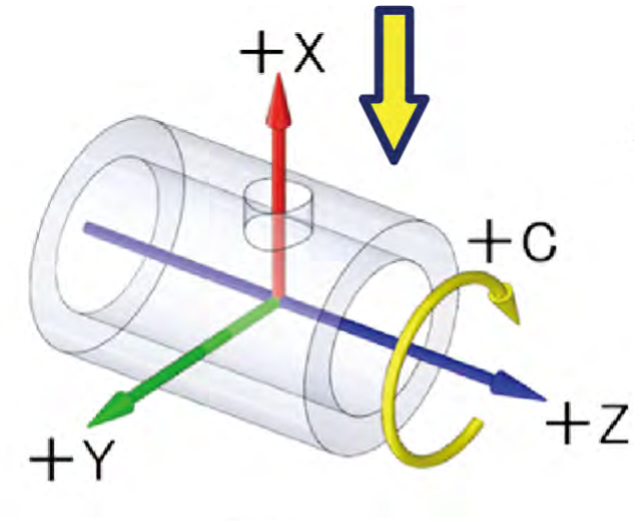
  Enables deburring in 1/5 - 1/10 the machining time required with a spring-loaded deburring tools.
- Enables deburring of multiple holes

  The long neck length enables deburring of multiple holes with one Cutter.

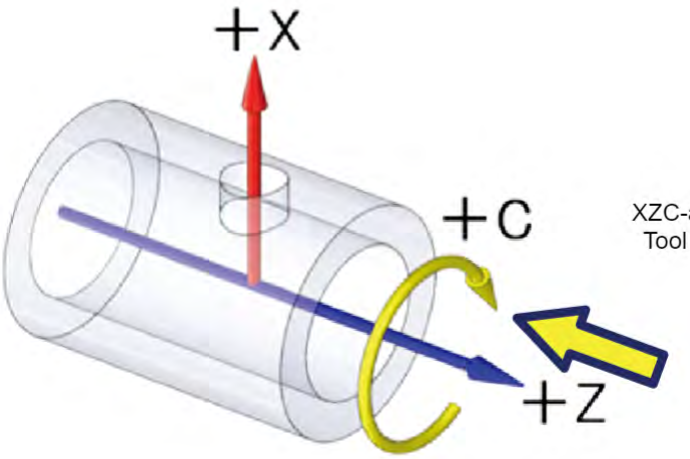
Applicable Equipment

XEBEC Path for XZY-axis lathes: Applicable with NC lathes with milling function that are capable of simultaneous 3-axis (XYZ) control.
XEBEC Path for XZC-axis lathes: Applicable with NC lathes with milling function that are capable of simultaneous 3-axis (XZC) control and polar interpolation.

Axis configuration of applicable lathes
The applicable tool directions; X-axis for XZY lathes and Z-axis for XZC lathes as shown in the figure below.
For machining centers, refer to the dedicated instruction manual.



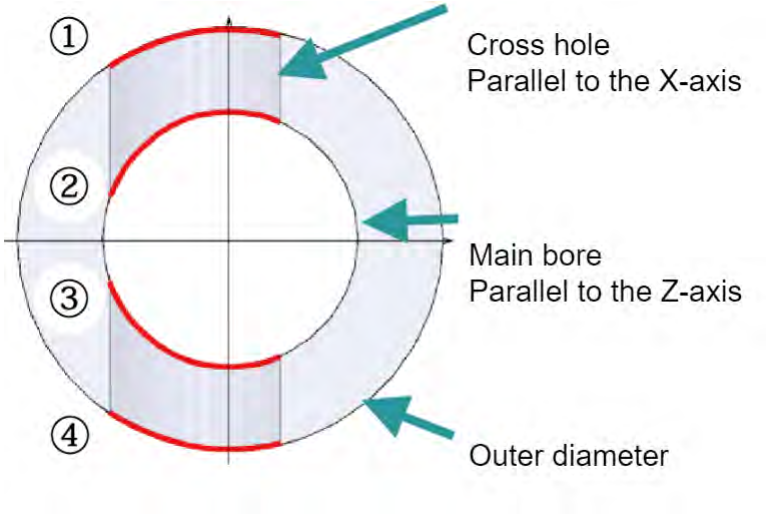
XZY-axis lathe:
Tool direction



XZC-axis lathe:
Tool direction

Target Edges to Deburr

The red lines in the Figure below are examples of the edges to be deburred.



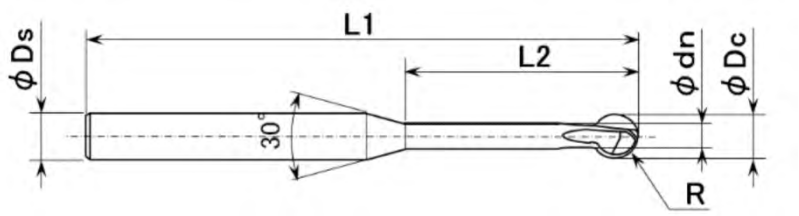
Depending on the configuration of cross holes, it may not be possible to create a Path.
For more information, please refer to the Path Code Sheet to be provided.

Product Specifications

XEBEC Back Burr Cutter Specifications

AlTiCrN Coated Steel P Stainless Steel M Cast Iron K Superalloys S Non-ferrous Metals N

[Short / Regular Type]



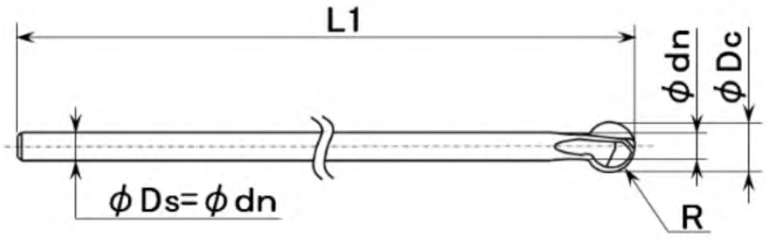
	Product Code	Cutter Radius R (mm)	Cutter Diameter ΦDc (mm)	Neck Diameter Φdn (mm)	Neck Length L2 (mm)	Overall Length L1 (mm)	Shank Diameter ΦDs (mm)	Number of Blades
Short Type	XC-08-AS-3F	0.4	0.8	0.48	3	60	3	3
	XC-13-AS-3F	0.65	1.3	0.78	5	60	3	3
	XC-18-AS-3F	0.9	1.8	1.1	6	60	3	3
	XC-23-AS-3F	1.15	2.3	1.4	7.5	70	3	3
	XC-28-AS-3F	1.4	2.8	1.7	9	70	4	3
	XC-33-AS-3F	1.65	3.3	2.0	10.5	70	4	3
	XC-38-AS-3F	1.9	3.8	2.4	12	70	4	3
	XC-48-AS-3F	2.4	4.8	3.0	15	70	6	3
	XC-58-AS-3F	2.9	5.8	3.5	18	70	6	3
	XC-78-AS-3F	3.9	7.8	4.7	24	100	8	3
	XC-98-AS-3F	4.9	9.8	5.9	30	120	10	3

	Product Code	Cutter Radius R (mm)	Cutter Diameter ΦDc (mm)	Neck Diameter Φdn (mm)	Neck Length L2 (mm)	Overall Length L1 (mm)	Shank Diameter ΦDs (mm)	Number of Blades
Regular Type	XC-08-A	0.4	0.8	0.48	5	60	3	2

	Product Code	Cutter Radius R (mm)	Cutter Diameter ΦDc (mm)	Neck Diameter Φdn (mm)	Neck Length L2 (mm)	Overall Length L1 (mm)	Shank Diameter ΦDs (mm)	Number of Blades
	XC-13-A	0.65	1.3	0.78	8	60	3	2
	XC-18-A	0.9	1.8	1.1	10	60	3	2
	XC-23-A	1.15	2.3	1.4	12.5	70	3	2
	XC-28-A	1.4	2.8	1.7	15	70	4	2
	XC-33-A	1.65	3.3	2.0	17.5	70	4	2
	XC-38-A	1.9	3.8	2.4	20	70	4	2
	XC-48-A	2.4	4.8	3.0	25	70	6	2
	XC-58-A	2.9	5.8	3.5	30	70	6	2
	XC-78-A	3.9	7.8	4.7	40	100	8	3
	XC-98-A	4.9	9.8	5.9	50	120	10	3

ALTiCrN Coated Steel P Stainless Steel M Cast Iron K Superalloys S Non-ferrous Metals N

[Straight Type]

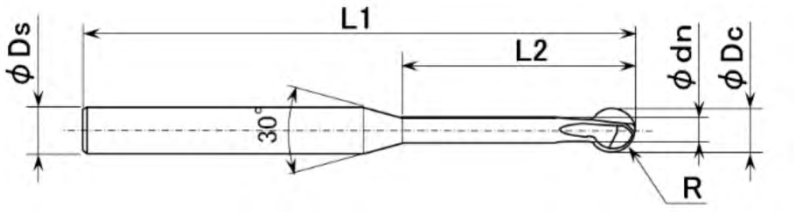


	Product Code	Cutter Radius R (mm)	Cutter Diameter ΦDc (mm)	Neck Diameter Φdn (mm)	Neck Length L2 (mm)	Overall Length L1 (mm)	Shank Diameter ΦDs (mm)	Number of Blades
Straight Type	XC-18-B	0.9	1.8	1.1	-	50	1.1	2
	XC-23-B	1.15	2.3	1.4	-	60	1.4	2
	XC-28-B	1.4	2.8	1.7	-	70	1.7	2
	XC-33-B	1.65	3.3	2.0	-	80	2.0	2

	Product Code	Cutter Radius R (mm)	Cutter Diameter ΦDc (mm)	Neck Diameter Φdn (mm)	Neck Length L2 (mm)	Overall Length L1 (mm)	Shank Diameter ΦDs (mm)	Number of Blades
	XC-38-B	1.9	3.8	2.4	-	85	2.4	2
	XC-48-B	2.4	4.8	3.0	-	105	3.0	2
	XC-58-B	2.9	5.8	3.5	-	120	3.5	2
	XC-78-B	3.9	7.8	4.7	-	150	4.7	3
	XC-98-B	4.9	9.8	5.9	-	180	5.9	3

Uncoated Non-ferrous Metals N Plastics O

[Regular Type]



	Product Code	Cutter Radius R (mm)	Cutter Diameter ΦDc (mm)	Neck Diameter Φdn (mm)	Neck Length L2 (mm)	Overall Length L1 (mm)	Shank Diameter ΦDs (mm)	Number of Blades
Regular Type	XC-08-A-N	0.4	0.8	0.48	5	60	3	2
	XC-13-A-N	0.65	1.3	0.78	8	60	3	2
	XC-18-A-N	0.9	1.8	1.1	10	60	3	2
	XC-23-A-N	1.15	2.3	1.4	12.5	70	3	2
	XC-28-A-N	1.4	2.8	1.7	15	70	4	2
	XC-33-A-N	1.65	3.3	2.0	17.5	70	4	2
	XC-38-A-N	1.9	3.8	2.4	20	70	4	2
	XC-48-A-N	2.4	4.8	3.0	25	70	6	2
	XC-58-A-N	2.9	5.8	3.5	30	70	6	2

	Product Code	Cutter Radius R (mm)	Cutter Diameter ΦDc (mm)	Neck Diameter Φdn (mm)	Neck Length L2 (mm)	Overall Length L1 (mm)	Shank Diameter ΦDs (mm)	Number of Blades
	XC-78-A-N	3.9	7.8	4.7	40	100	8	3
	XC-98-A-N	**4.9**	**9.8**	**5.9**	**50**	**120**	10	3

⚠ CAUTION	Cautions Regarding the Settings of XEBEC Back Burr Cutter ● If this product is used without considering the risk of tool collision or if a wrong size tool is used, the product, jig, and machine may be damaged. Therefore, make sure to check the dimensions before use. ● Make sure to set the tool projection length appropriately for the workpiece when clamping this product with a milling tool holder. ● Clamp this product firmly with the milling tool holder so that it does not move during use. ● Make sure the tool runout is less than 0.01mm after the tool is clamped in the milling tool holder. ● Set the tool length offset at the tip of this product to ensure that the tool path works as it is designed to. ▸ Tool Length Offset(P.27) ● To prevent tool collision, minimize positional error and dimensional variance of holes to be deburred and make sure to position this product correctly.

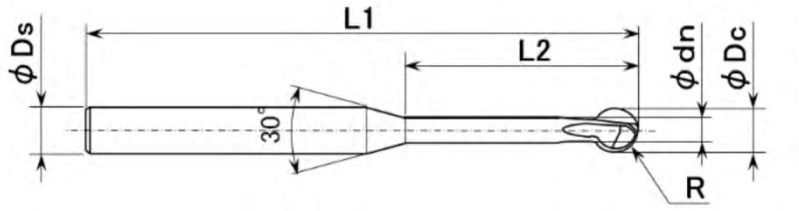
XEBEC Back Burr Cutter Standard Machining Parameters

MEMO

- Rotational speed and feed rate are a guide for initial use.
- To improve the machining result, take steps such as adjusting the rotational speed and feed rate, or select another Path for a different deburring amount (edge break length).
- If vibration or abnormal noise is detected, or if the max rotational speed or feed rate of the machine is below the parameters listed in the table, lower them both at the same rate to be within the machine's capability.
- Different types of cross holes are defined according to their configurations. Please refer to the page below for the appropriate settings for each cross hole type.
  ▸ **Cross Hole Types**(P.36)
- The uniformity of the edge break improves by turning on Advanced Preview Control of the machine tool.
- Optimize Machining Parameters
  There may be risk of secondary burrs depending on the configuration of the cross hole. To minimize this risk, keep the tool projection length as short as possible. In case secondary burrs form, reduce the feed rate to 50% of the standard machining parameter and work with the smallest deburring amount (edge break length).

ALTiCrN Coated

[Short / Regular Type]



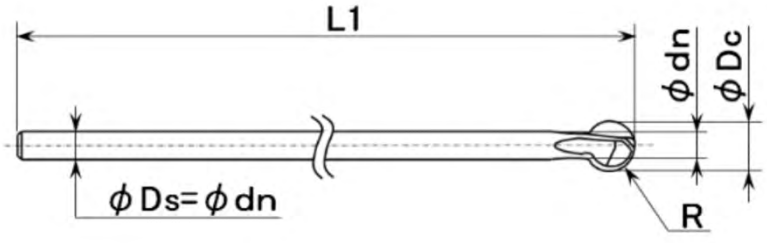
				Steel P / Stainless Steel M / Cast Iron K / Superalloys S		Non-ferrous Metals N	
	Product Code	Cutter Diameter ΦDc (mm)	Tool Projection Length (mm)	Rotational Speed n (min^{-1})	Feed Rate Vf (mm/min)	Rotational Speed n (min^{-1})	Feed Rate Vf (mm/min)
Short Type	XC-08-AS-3F	0.8	**3Dc**	20000	**1080**	20000	**1170**
	XC-13-AS-3F	1.3	**3Dc**	20000	**1080**	20000	**1170**
	XC-18-AS-3F	1.8	**3Dc**	20000	**1080**	20000	**1170**
	XC-23-AS-3F	2.3	**3Dc**	15000	**1350**	18000	**1710**
	XC-28-AS-3F	2.8	**3Dc**	12500	**1800**	15000	**2520**
	XC-33-AS-3F	3.3	**3Dc**	10600	**1890**	12700	**2250**

				Steel P / Stainless Steel M / Cast Iron K / Superalloys S		Non-ferrous Metals N	
	XC-38-AS-3F	3.8	**3Dc**	9200	**2160**	11000	**2880**
	XC-48-AS-3F	4.8	**3Dc**	7200	**1980**	8500	**2880**
	XC-58-AS-3F	5.8	**3Dc**	6000	**1620**	7000	**2160**
	XC-78-AS-3F	7.8	**3Dc**	4500	**1620**	5400	**1920**
	XC-98-AS-3F	9.8	**3Dc**	3600	**1320**	4300	**1560**

				Steel P / Stainless Steel M / Cast Iron K / Superalloys S		Non-ferrous Metals N	
	Product Code	Cutter Diameter ΦDc (mm)	Tool Projection Length (mm)	Rotational Speed n (min^{-1})	Feed Rate Vf (mm/min)	Rotational Speed n (min^{-1})	Feed Rate Vf (mm/min)
Regular Type	**XC-08-A**	0.8	**5Dc**	20000	**600**	20000	**650**
	XC-13-A	1.3	**5Dc**	20000	**600**	20000	**650**
	XC-18-A	1.8	**5Dc**	20000	**600**	20000	**650**
	XC-23-A	2.3	**5Dc**	15000	**750**	18000	**950**
	XC-28-A	2.8	**5Dc**	12500	**1000**	15000	**1400**
	XC-33-A	3.3	**5Dc**	10600	**1050**	12700	**1250**
	XC-38-A	3.8	**5Dc**	9200	**1200**	11000	**1600**
	XC-48-A	4.8	**5Dc**	7200	**1100**	8500	**1600**
	XC-58-A	5.8	**5Dc**	6000	**900**	7000	**1200**
	XC-78-A	7.8	**5Dc**	4500	**1350**	5400	**1600**
	XC-98-A	9.8	**5Dc**	3600	**1100**	4300	**1300**

ALTiCrN Coated

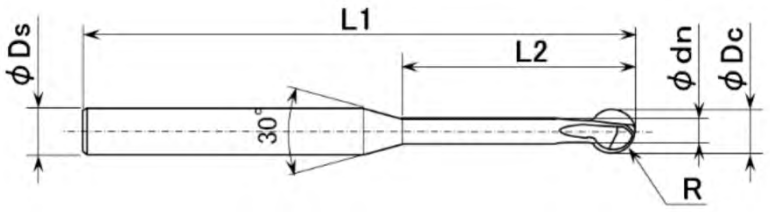
[Straight Type]



				Steel P Stainless Steel M Cast Iron K Superalloys S		Non-ferrous Metals N	
	Product Code	Cutter Diameter ΦDc (mm)	Tool Projection Length (mm)	Rotational Speed n (min^{-1})	Feed Rate Vf (mm/min)	Rotational Speed n (min^{-1})	Feed Rate Vf (mm/min)
Straight Type	XC-18-B	1.8	**6Dc**	9700	**480**	9700	**480**
			10Dc	4400	**220**	4400	**220**
			15Dc	2200	**110**	2200	**110**
	XC-23-B	2.3	**6Dc**	7900	**480**	7900	**480**
			10Dc	3500	**220**	3500	**220**
			15Dc	2200	**110**	2200	**110**
	XC-28-B	2.8	**6Dc**	6200	**620**	6200	**620**
			10Dc	2800	**220**	2800	**220**
			15Dc	2200	**110**	2200	**110**
	XC-33-B	3.3	**6Dc**	5400	**460**	5400	**460**
			10Dc	2400	**190**	2400	**190**
			15Dc	1900	**95**	1900	**95**
	XC-38-B	3.8	**6Dc**	4600	**460**	4600	**460**
			10Dc	2000	**160**	2000	**160**
			15Dc	1600	**80**	1600	**80**
	XC-48-B	4.8	**6Dc**	3600	**360**	3600	**360**
			10Dc	1600	**120**	1600	**120**
			15Dc	1300	**60**	1300	**60**
	XC-58-B	5.8	**6Dc**	3000	**300**	3000	**300**
			10Dc	1300	**100**	1300	**100**
			15Dc	1000	**50**	1000	**50**
	XC-78-B	7.8	**6Dc**	1600	**240**	1600	**240**
			10Dc	650	**70**	650	**70**
			15Dc	200	**10**	200	**10**
	XC-98-B	9.8	**6Dc**	1300	**200**	1300	**200**
			10Dc	500	**50**	500	**50**
			15Dc	200	**10**	200	**10**

Uncoated

[Regular Type]



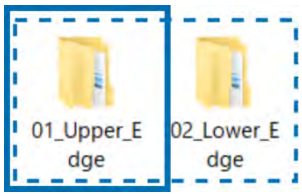
				Non-ferrous Metals N Plastics O	
Regular Type	Product Code	Cutter Diameter ΦDc (mm)	Tool Projection Length	Rotational Speed n (min^{-1})	Feed Rate Vf (mm/min)

				Non-ferrous Metals N Plastics O	
			(mm)		
	XC-08-A-N	0.8	**5Dc**	20000	**650**
	XC-13-A-N	1.3	**5Dc**	20000	**650**
	XC-18-A-N	1.8	**5Dc**	20000	**650**
	XC-23-A-N	2.3	**5Dc**	18000	**950**
	XC-28-A-N	2.8	**5Dc**	15000	**1400**
	XC-33-A-N	3.3	**5Dc**	12700	**1250**
	XC-38-A-N	3.8	**5Dc**	11000	**1600**
	XC-48-A-N	4.8	**5Dc**	8500	**1600**
	XC-58-A-N	5.8	**5Dc**	7000	**1200**
	XC-78-A-N	7.8	**5Dc**	5400	**1600**
	XC-98-A-N	9.8	**5Dc**	4300	**1300**

XEBEC Path Data Format

XEBEC Path data is stored in sperate folders as shown below.

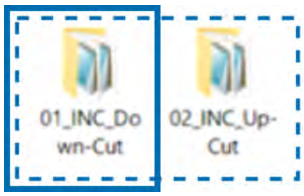
■First Folder Level
Contains folders for each target edge (Upper Edge / Lower Edge) to be deburred



▼

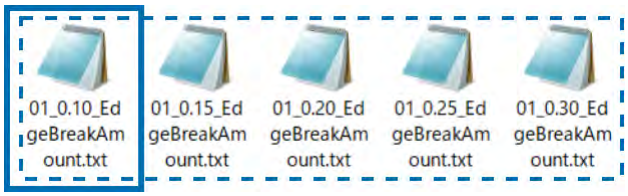
■Second Folder Level
Contains folders for following data sets

- Incremental (INC) Down Cut
- Incremental (INC) Up Cut



▼

■Third Folder Level
Contains a set of five XEBEC Paths in .txt format, each corresponding to a specific deburring amount (edge break length)

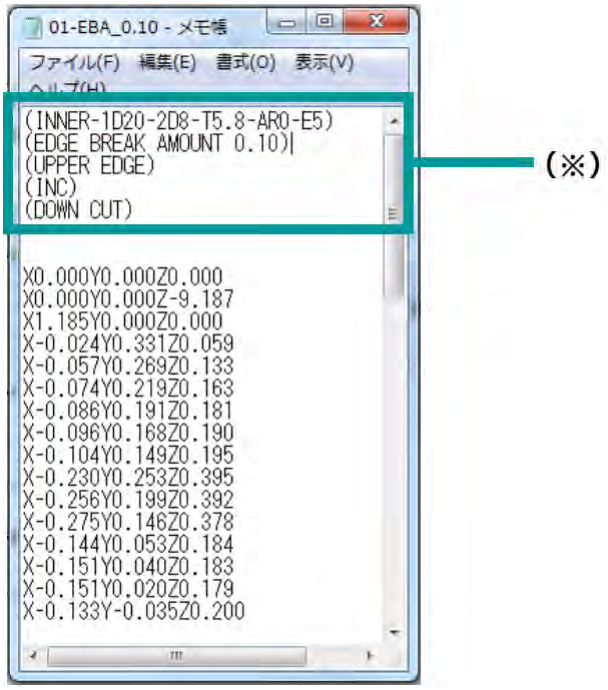


▼

■Text File (.txt)
Specifications are listed at the top in parentheses ( )

▸点群データ上部のコメント例

Check to make sure that the Path data is correct for the target edge to deburr.



MEMO

For XEBEC Path for XZC-axis lathes, the data set exist only for the Upper Edge of both Outer and Inner Diameter cross holes. In that case, a total of 10 text files is provided.

Data Example

For example, a total of 20 text files are included for an Inner Diameter cross hole.

- First Folder Level (2 Folders)

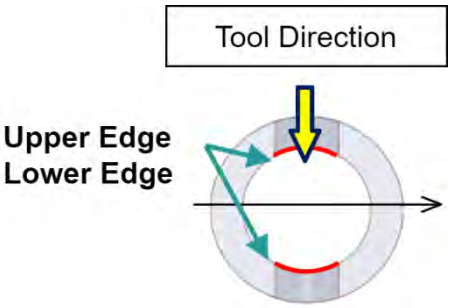
  Upper Edge and Lower Edge

- Second Folder Level (2 Folders)

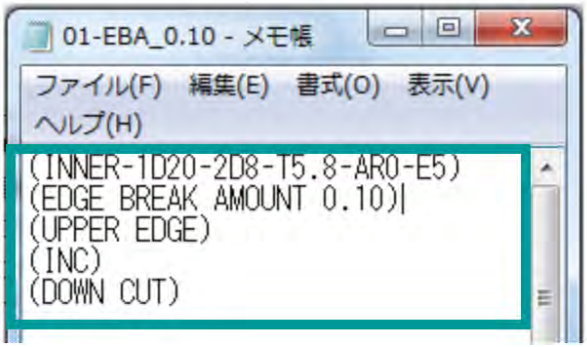
  Incremental (INC) Up Cut / Down Cut

- Third Folder Level (5 Text Files)

  Each text file corresponds to a specific deburring amount (edge break length)



Examples of XEBEC Path Specifications



Example: On-center/Off-center Cross Hole XZY Machine Axis

(INNER-1D20-2D10-T5.8-E5)；

(EDGE BREAK AMOUNT 0.10)；

(DIAMETR)；

(UPPER EDGE)；

(INC) ；

(DOWN CUT)；

Example: Orthogonal Cross Hole XZC Machine Axis

(INNER-1D20-2D10-T5.8-E5)；

(EDGE BREAK AMOUNT 0.10)；

(DIAMETR)；

(UPPER EDGE)；

(INC) ；

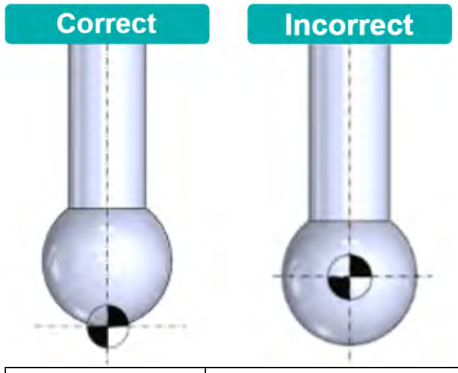
(DOWN CUT)；

Specifications	Descriptions

(INNER-1D20-2D10-T5.8-E5)；	INNER: Inner Edge [OUTER: Outer Edge] 1D20: Main Bore or Outer Diameter Φ20mm 2D10: Cross Hole Diameter Φ10mm T5.8: Cutter Diameter Φ5.8mm E5: Offset +5mm from the Main Bore or Outer Diameter Axis
(EDGE BREAK AMOUNT 0.10)；	Deburring Amount 0.10mm
(DIAMETR)；	X-axis Controller Mode: Diameter [RADIUS: Radius]
(UPPER EDGE)；	Upper Edge [LOWER: Lower Edge]
(INC) ；	Positioning Format: Incremental
(DOWN CUT)；	Down Cut Machining [UP CUT: Up Cut Machining]

Specifications in the table above are applicable to XEBEC Path for XZY lathes and XZC lathes

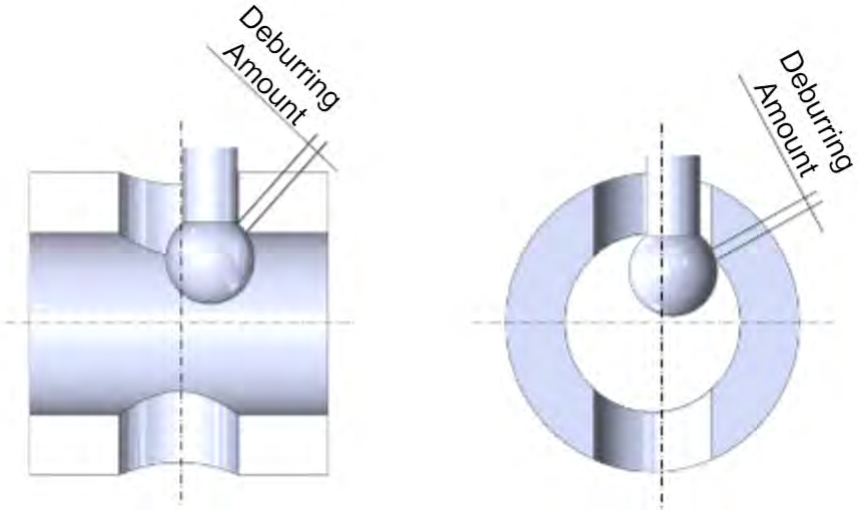
Tool Length Offset



⚠CAUTION	Make sure to set the tool length offset at the tip of this product aligned with its centerline when using XEBEC Path. Setting the tool length offset at any point other than the tip of this product aligned with its centerline is dangerous as it may result in tool collision and accident.

Max Allowed Accumulated Variance (mm)

Make sure to take into consideration the tolerance build up and the total of positional and dimensional variance when selecting the deburring amount (edge break length) from the set of five that provided.



- If the actual hole diameter is large due to dimensional variance or if there is the positional variance, the Cutter may not contact the edge. In that case, try the Path data for a larger deburring amount.
- If the actual hole diameter is small due to dimensional variance, the deburring amount may become excessive. In that case, try the Path data for a smaller deburring amount.

Product Code	Cutter Diameter ΦDc (mm)	Deburring Amount (mm)					Max Allowed Accumulated Variance (mm)
		①	②	③	④	⑤	
XC-08-A	0.8	0.02	0.04	0.06	0.08	0.10	**0.03**
XC-13-B	1.3	0.04	0.06	0.08	0.10	0.12	**0.05**
XC-18-A, XC-18-B	1.8	0.07	0.09	0.11	0.13	0.15	**0.08**
XC-23-A, XC-23-B	2.3	0.07	0.09	0.11	0.13	0.15	**0.09**
XC-28-A, XC-28-B	2.8	0.08	0.11	0.14	0.17	0.20	**0.10**
XC-33-A, XC-33-B	3.3	0.08	0.11	0.14	0.17	0.20	**0.11**
XC-38-A, XC-38-B	3.8	0.09	0.13	0.17	0.21	0.25	**0.12**
XC-48-A, XC-48-B	4.8	0.10	0.15	0.20	0.25	0.30	**0.15**
XC-58-A, XC-58-B	5.8	0.10	0.15	0.20	0.25	0.30	**0.18**
XC-78-A, XC-78-B	7.8	0.10	0.15	0.20	0.25	0.30	**0.24**
XC-98-A, XC-98-B	9.8	0.10	0.15	0.20	0.25	0.30	**0.34**

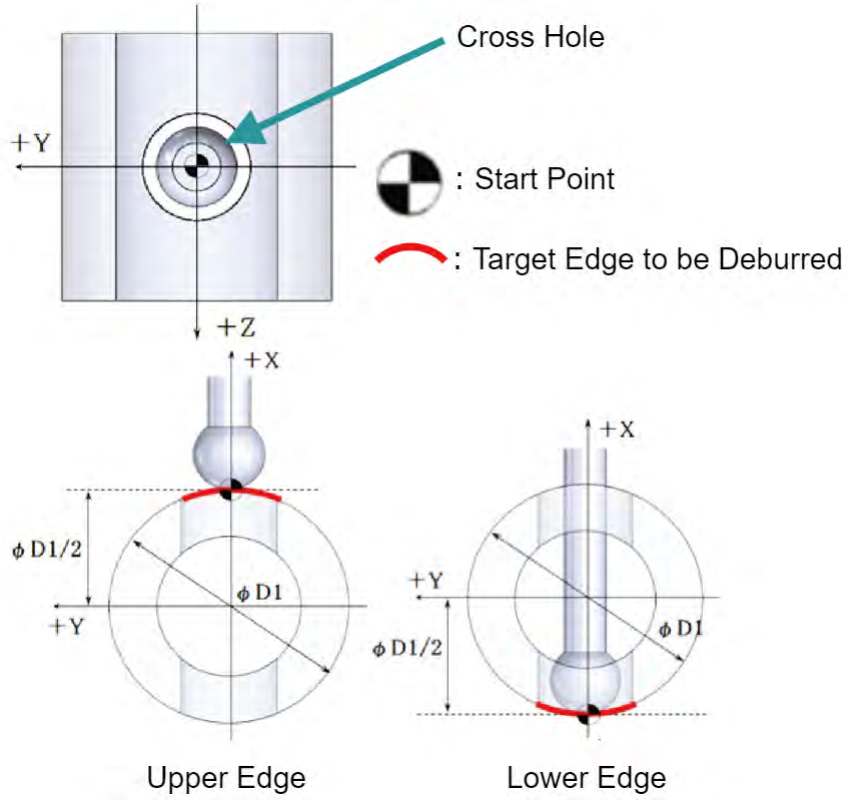
Start Point

Start Point refers to the initial tool position from which XEBEC Back Burr Cutter and Path is to begin the deburring operation. Program the tool position so that the centerline and the tip of the Cutter is precisely aligned with the Start Point that we specify. XEBEC Path should run once the Cutter is brought precisely at this position. Please note that the Start Point position is not customizable.
Make sure that the X-axis controller mode (diameter or radius) of the Path matches that of the machine tool.

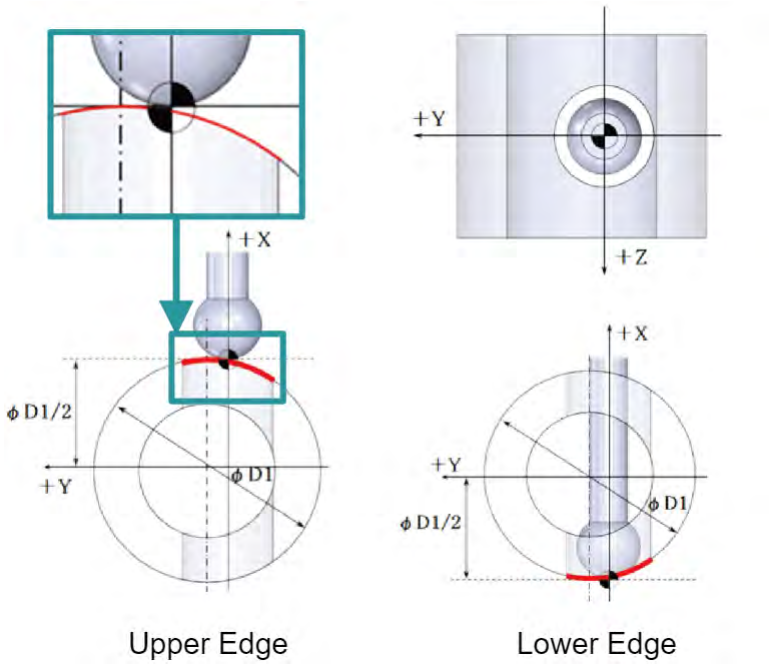
The followings are examples of the Start Point in deburring Outer Diameter Edge with XEBEC Path for XZY lathes.
For the Start Point of other cross hole types, please refer to "Specifications of Cross Hole Types(P.35)".

- The Start Point is at the center of the Cross Hole in the YZ plane.
- Along the X-axis, it is as indicated in the figures below.

Example: On-Center Cross Hole



Example: Off-Center Cross Hole



Upper Edge Lower Edge

How to Implement XEBEC Path (XZY Lathes)

This section offers an example of implementing XEBEC Path into the machining program. G-codes and all other details are based on MELDAS controls. Make sure to use appropriate codes for your machine tool.

Machining Operations

- Workpiece Shape

  Outer Diameter Φ30mm × Inner Diameter Φ20mm

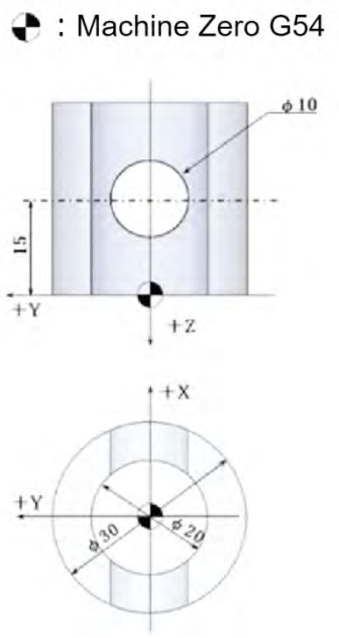
- Previous Operation

  Drilled a Φ10mm hole that crosses orthogonally and on-center with the centerline of the workpiece

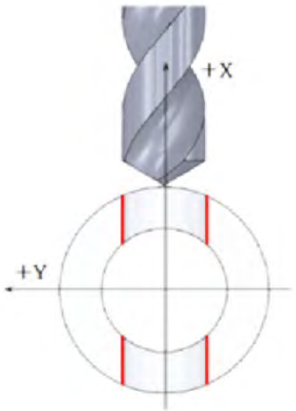
- Target Edge to be Deburred

  Upper and Lower edges of the inner diameter at the intersection of the Φ10 hole and the Φ20 hole

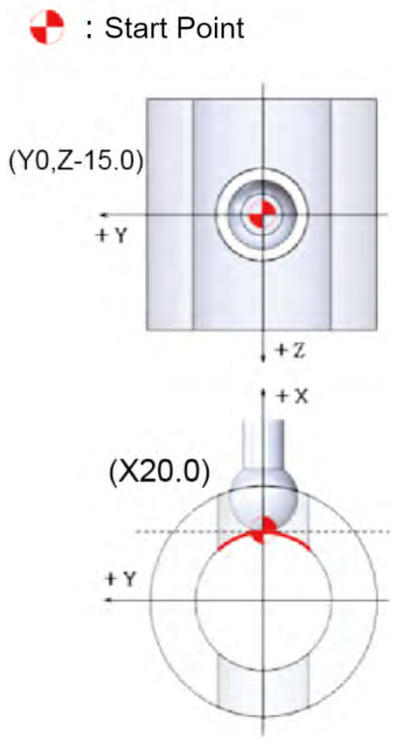
Workpiece



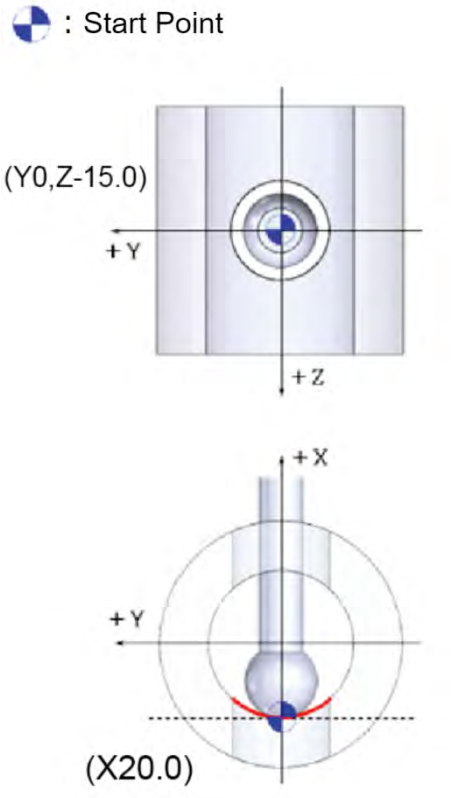
OP 1: Drilling



OP 2: Deburring Upper Edge



OP 3: Deburring Lower Edge



Program Overview

Main Program	
O0001（MAIN PROG）；	
G0G18；	Select XY plane
N1(10DRILL/T1H1)；	Drilling the Φ10 hole
M05；	
M69；	Main spindle unclamp
G98M45；	Feed per minute and C-axis engage
G00G28H0.0；	Return C-axis to machine zero
G28V0.0；	Return Y-axis to machine zero
G00T0101；	Call T01 drill and tool length offset
G54X40.0Z50.0C0.0；	Set the work offset zero position
G97S5000M13；	Milling rotation in CW direction
Z-15.0Y0.0M08；	Position XY axes at the hole center
M68；	Main spindle clamp
G83X-40.0R-2.0F500；	Spot drilling cycle G83
G80；	Cancel drilling cycle
G00X40.0Z50.0M69；	Main spindle unclamp
G28U0.0W0.0M05；	Return XZ axes to machine zero
M09；	
M01；	
N2（5.8BURRS CUTTER/T0202）；	Deburring operation
M05；	
M69；	Main spindle unclamp
G98M45；	Feed per minute and C-axis engage
G00G28H0.0；	Return C-axis to machine zero
G28V0.0；	Return Y-axis to machine zero
G00T0202；	Call T02 Back Burr Cutter and tool length offset
G54X40.0Z50.0C0.0；	Set the work offset zero position
G97S6000M13；	Milling rotation in CW direction
Z-15.0Y0.0M08；	Position ZY axes at the Start Point for Upper Edge
M68；	Main spindle clamp
G01X20.0F3000；	Position X-axis at the Start Point for Upper Edge
F1000；	Set feed rate for the deburring operation
M98P0002；	Call subprogram O0002 (XEBEC Path for Upper Edge)
G01Z-15.0Y0.0F3000；	Position ZY axes at the Start Point
X-20.0；	Position X-axis at the Start Point for Lower Edge
F1000；	Set feed rate for the deburring operation
M98P0003；	Call subprogram O0003 (XEBEC Path for Lower Edge)
G00X40.0；	
Z50.0M69；	Main spindle unclamp
G28U0.0W0.0M05；	Return XZ axes to machine zero
M09；	
M01；	
M30；	Program end

Upper Edge Deburring Subprogram	
O0002（UPPER EDGE SUB PROG）；	
U0.000V0.000W0.000；	XEBEC Path
U-11.293V0.000W0.000；	
U0.000V2.564W0.000；	
U0.017V-0.027W0.434；	
U0.046V-0.077W0.409；	
U-0.072V0.126W0.390；	
U-0.048V0.080W0.419；	
U-0.017V0.028W0.442；	
U0.000V-2.564W0.000；	
U11.293V0.000W0.000；	
M99；	Return to main program

Lower Edge Deburring Subprogram	
O0003（LOWER EDGE SUB PROG）；	
U0.000V0.000W0.000；	XEBEC Path
U-0.307V0.000W0.000；	
U0.000V2.564W0.000；	
U-0.017V-0.027W0.434；	
U-0.046V-0.077W0.409；	
U0.072V0.126W0.390；	
U0.048V0.080W0.419；	
U0.017V0.028W0.442；	
U0.000V-2.564W0.000；	
U0.307V0.000W0.000；	
M99；	Return to main program

- Make sure to use appropriate codes for the X-axis and Y-axis controller modes (diameter or radius).
- Implementation is similar for XZC lathes, bur in case of XZC lathe, make sure to turn on polar interpolation prior to Back Burr Cutter codes.

Specifications of Cross Hole Types

Cross Hole Types


MEMO

The cross hole type of your workpiece is indicated in the Path Code Sheet to be provided separately.


MEMO

Polar interpolation enables 3-axis simultaneous control of XZC axes for milling the contours of the workpiece.
Turn on the polar interpolation with G12.1 or G112 (MELDAS G codes) after the tool rotation is turned on.
While polar interpolation is turned on, the XZ motions of the tool is synchronized with the spindle (C-axis) rotation.

Type	Description	Configuration	Edge Configuration	Machine Axis	Polar Coordinate Function	Example
AY	Orthogonal Cross Hole - Outer Diameter (Cross Hole < Outer Diameter)	On-center Off-center	Upper/Lower	XZY	–	Type AY: Orthogonal Cross Hole - Outer Diameter (Cross Hole < Outer Diameter) XZY Machine Axis(P.38)
BY	Orthogonal Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore)	On-center Off-center	Upper/Lower	XZY	–	Type BY: Orthogonal Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore) XZY Machine Axis(P.39)
CY	Flat Surface Hole	N/A	Front/Back	XZY	–	Type CY: Flat Surface Hole XZY Machine Axis(P.40)
GY	Slotted Hole Parallel with Main Bore Axis - Outer Diameter	On-center Off-center	Upper	XZY	–	Type GY and HY: Slotted Hole Parallel with Main Bore Axis - Outer/Inner Diameter XZY Machine Axis(P.41)
HY	Slotted Hole Parallel with Main Bore Axis - Inner Diameter	On-center Off-center	Upper	XZY	–	
IY	Slotted Hole Perpendicular with Main Bore Axis - Outer Diameter	N/A	Upper	XZY	–	Type IY and JY: Slotted Hole Perpendicular with Main Bore Axis - Outer/Inner Diameter XZY Machine Axis(P.42)
JY	Slotted Hole Perpendicular with Main Bore Axis - Inner Diameter	On-center Off-center	Upper	XZY	–	
KY	Orthogonal Cross Hole - Inner Diameter (Cross Hole ＞ Main Bore)	On-center Off-center	Front/Rear	XZY	–	Type KY: Orthogonal Cross Hole - Inner Diameter (Cross Hole ＞ Main Bore) XZY Machine Axis(P.43)
LY	Broken Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore)	Off-center	–	XZY	–	Type LY: Broken Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore) XZY Machine Axis(P.44)

Type	Description	Configuration	Edge Configuration	Machine Axis	Polar Coordinate Function	Example
MY	Broken Cross Hole - Inner Diameter (Cross Hole ＞ Main Bore)	Off-center	–	XZY	–	Type MY: Broken Cross Hole - Inner Diameter (Cross Hole ＞ Main Bore) XZY Machine Axis(P.45)
AC	Orthogonal Cross Hole - Outer Diameter (Cross Hole ＜ Outer Diameter)	On-center Off-center	Upper	XZC	Polar Interpolation	Type AC: Orthogonal Cross Hole - Outer Diameter (Cross Hole ＜ Outer Diameter) XZC Machine Axis(P.46)
BC	Orthogonal Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore)	On-center Off-center	Upper	XZC	Polar Interpolation	Type BC: Orthogonal Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore) XZC Machine Axis(P.47)
CC	Main Bore	–	Front/Back	XZC	Polar Interpolation	Type CC: Main Bore XZC Machine Axis(P.48)
GC	Slotted Hole Parallel with Main Bore Axis - Outer Diameter	–	Upper	XZC	Polar Interpolation	Type GC and HC: Slotted Hole Parallel with Main Bore Axis - Outer/Inner Diameter XZC Machine Axis(P.49)
HC	Slotted Hole Parallel with Main Bore Axis - Inner Diameter	On-center Off-center	Upper	XZC	Polar Interpolation	
KC	Orthogonal Cross Hole - Inner Diameter (Cross Hole ＞ Main Bore)	On-center Off-center	Upper/Lower	XZC	Polar Interpolation	Type KC: Orthogonal Cross Hole - Inner Diameter (Cross Hole ＞ Main Bore) XZC Machine Axis(P.50)

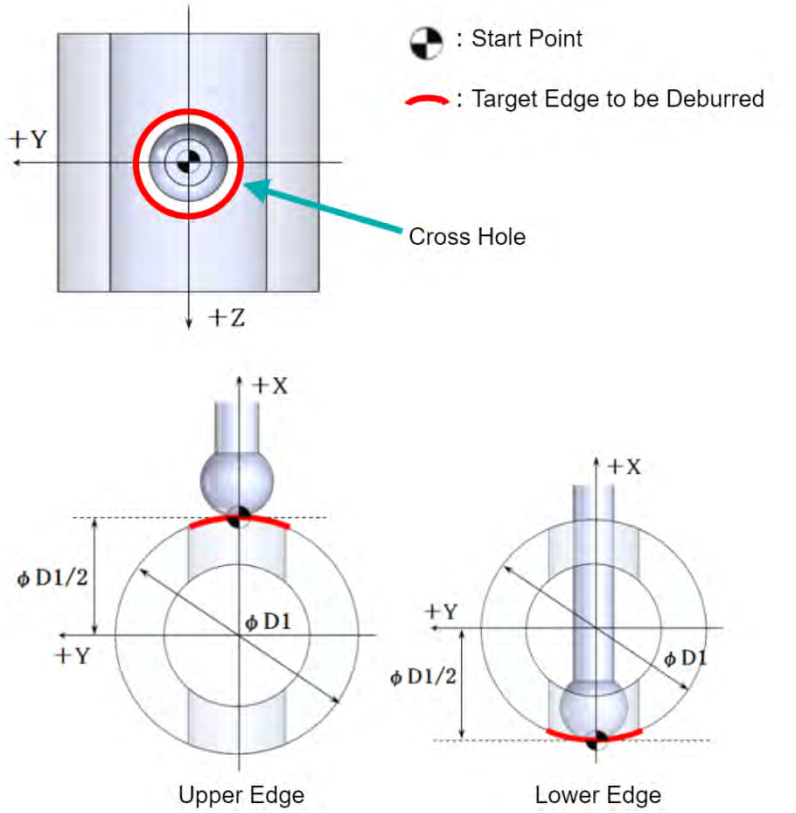
XEBEC Path for Tapped Holes

Type	Description	Configuration	Edge Configuration	Machine Axis	Polar Coordinate Function	Example
PY	Tapped Orthogonal Cross Hole (Cross Hole ≦ Main Bore)	On-center Off-center	Upper	XZY	–	**Type PY: Tapped Orthogonal Cross Hole (Cross Hole ≦ Main Bore)**(P.51)
QY	Tapped Flat Surface Cross Hole	–	Back	XZY	–	**Type QY: Tapped Flat Surface Cross Hole Back Edge**(P.53)
QC	Tapped Flat Surface Cross Hole	–	Back	XZC	–	**Type QC: Tapped Flat Surface Cross Hole Back Edge**(P.55)

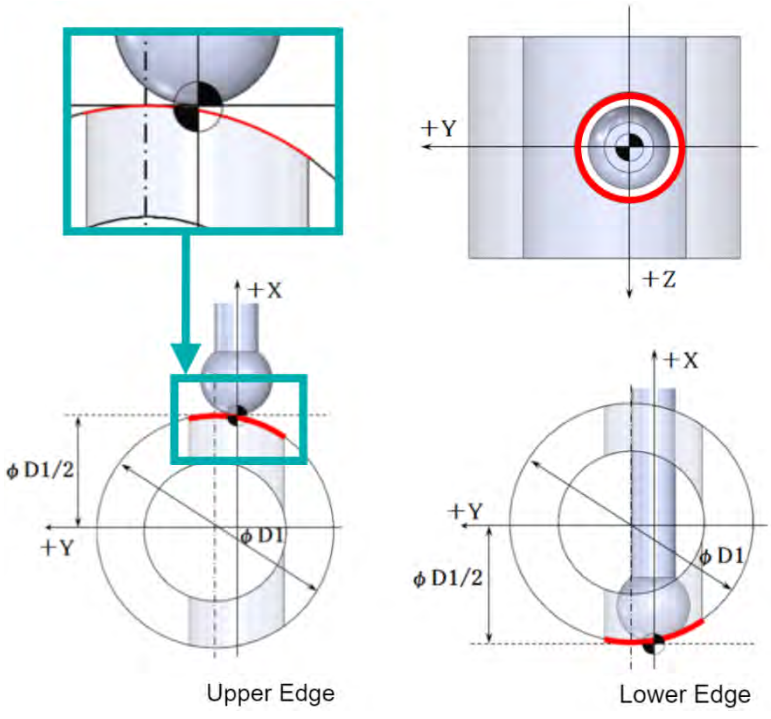
Type AY: Orthogonal Cross Hole - Outer Diameter (Cross Hole < Outer Diameter) XZY Machine Axis

The Start Point is at the center of the Cross Hole in the YZ plane. Along the X-axis, it is as indicated in the figures below.

Example: On-center



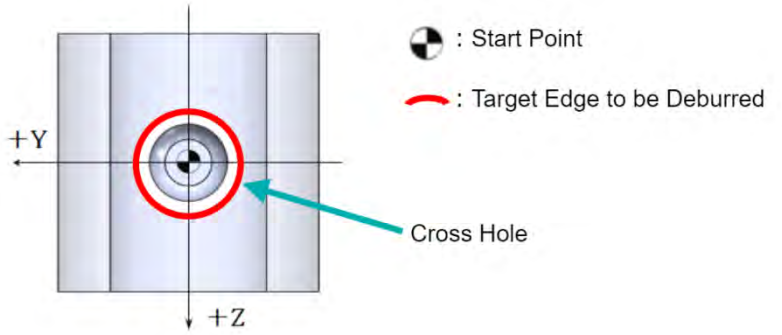
Example: Off-center

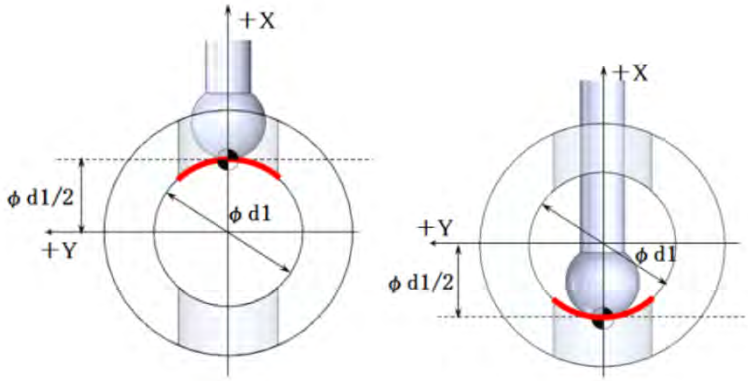


Type BY: Orthogonal Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore) XZY Machine Axis

The Start Point is at the center of the Cross Hole in the YZ plane. Along the X-axis, it is as indicated in the figures below.

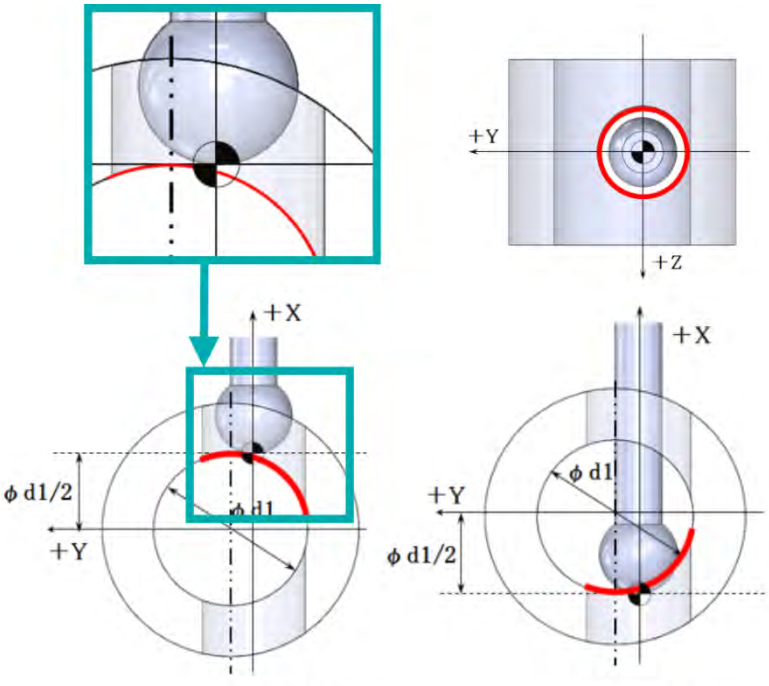
Example: On-center





Upper Edge Lower Edge

Example: Off-center

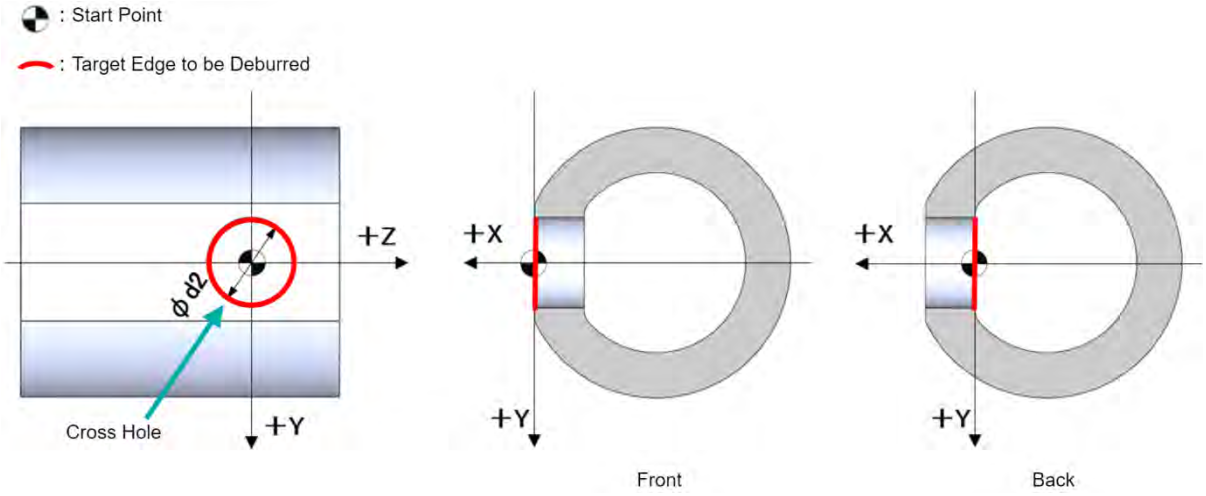


Upper Edge Lower Edge

Type CY: Flat Surface Hole XZY Machine Axis

The Start Point is at the center of the Cross Hole in the YZ plane. Along the X-axis, it is as indicated in the figures below.

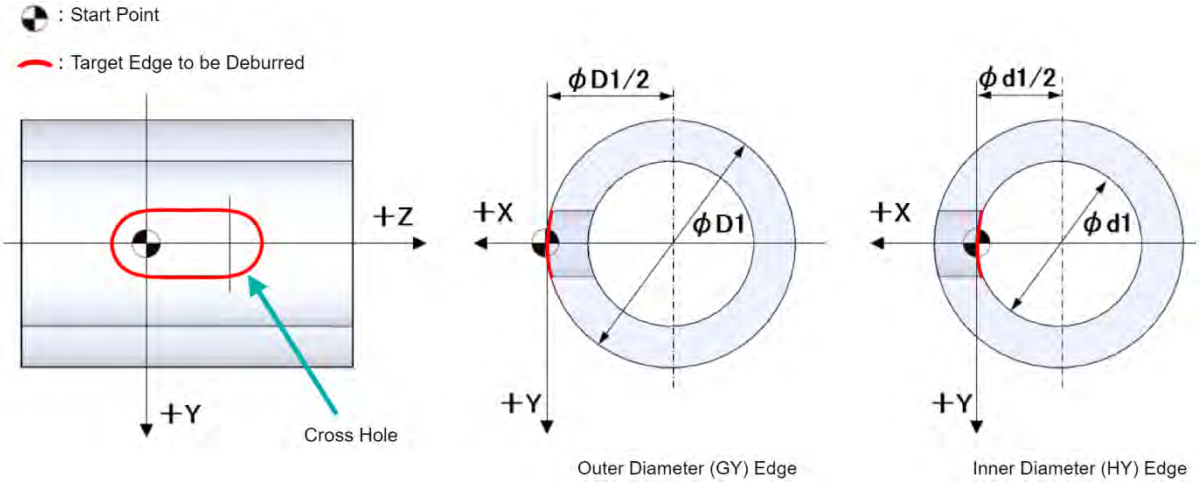
Example: Flat Surface Hole



Type GY and HY: Slotted Hole Parallel with Main Bore Axis - Outer/Inner Diameter XZY Machine Axis

The Start Point is at the center of the Radius R in the YZ plane at the -Z side. Along the X-axis, it is as indicated in the figures below.

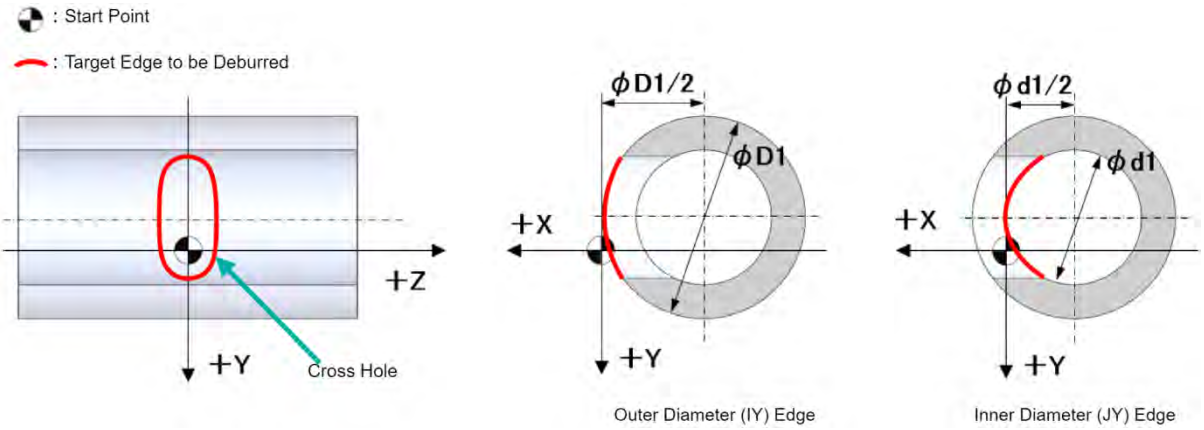
Example: Slotted Hole Parallel with Main Bore Axis - Outer/Inner Diameter



Type IY and JY: Slotted Hole Perpendicular with Main Bore Axis - Outer/Inner Diameter XZY Machine Axis

The Start Point is at the center of the Radius R in the YZ plane at the +Y side. Along the X-axis, it is as indicated in the figures below.

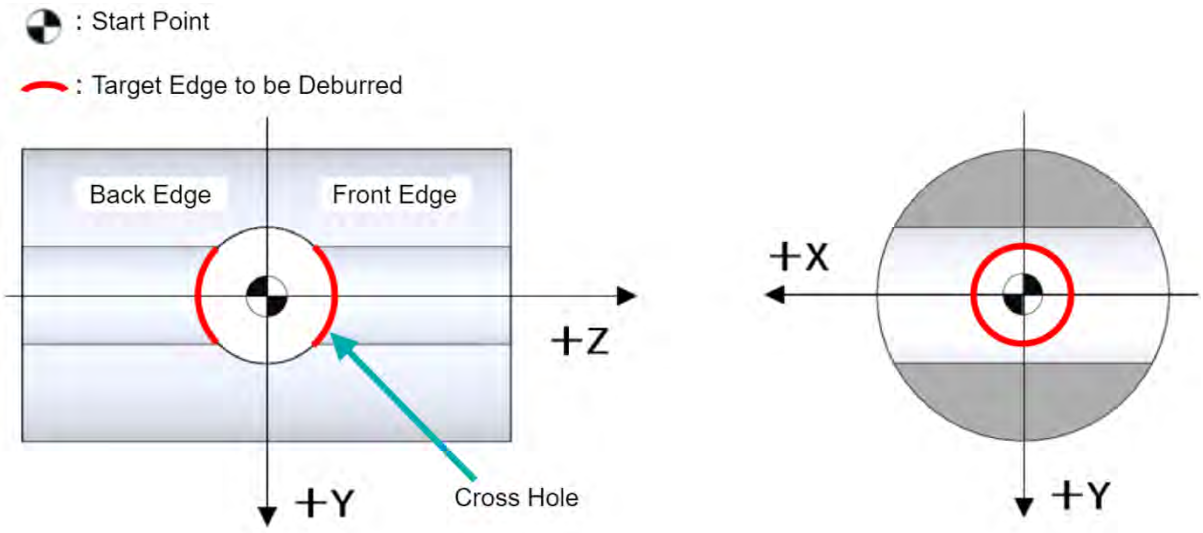
Example: Slotted Hole Perpendicular with Main Bore Axis - Outer/Inner Diameter



Type KY: Orthogonal Cross Hole - Inner Diameter (Cross Hole > Main Bore) XZY Machine Axis

The Start Point is at the center of the Cross Hole in the YZ plane. Along the X-axis, it is as indicated in the figures below.

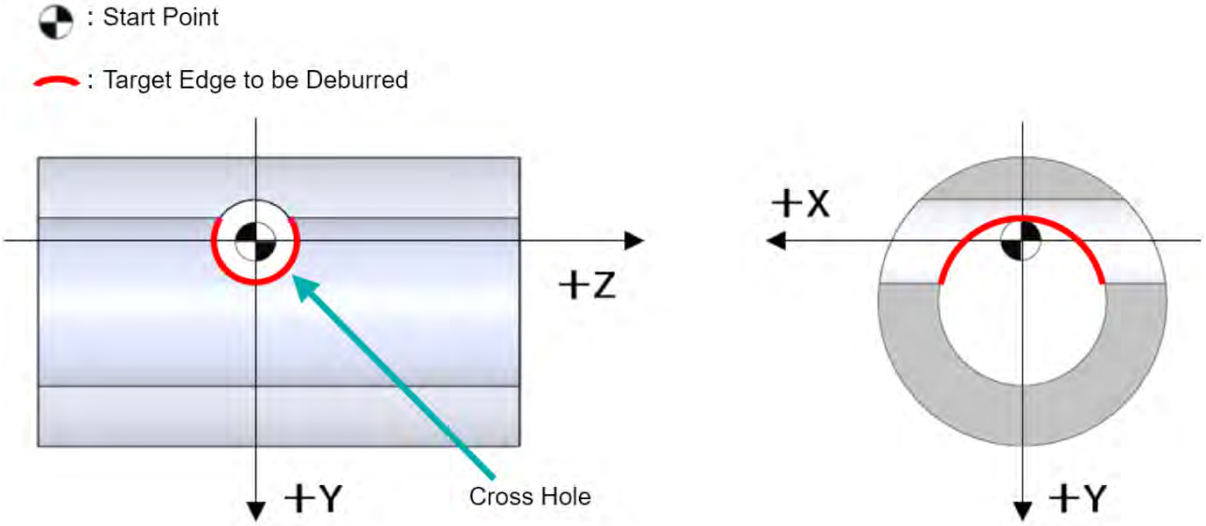
Example: Orthogonal Cross Hole - Inner Diameter (Cross Hole > Main Bore)



Type LY: Broken Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore) XZY Machine Axis

The Start Point is at the center of the Cross Hole in the YZ plane. Along the X-axis, it is as indicated in the figures below.

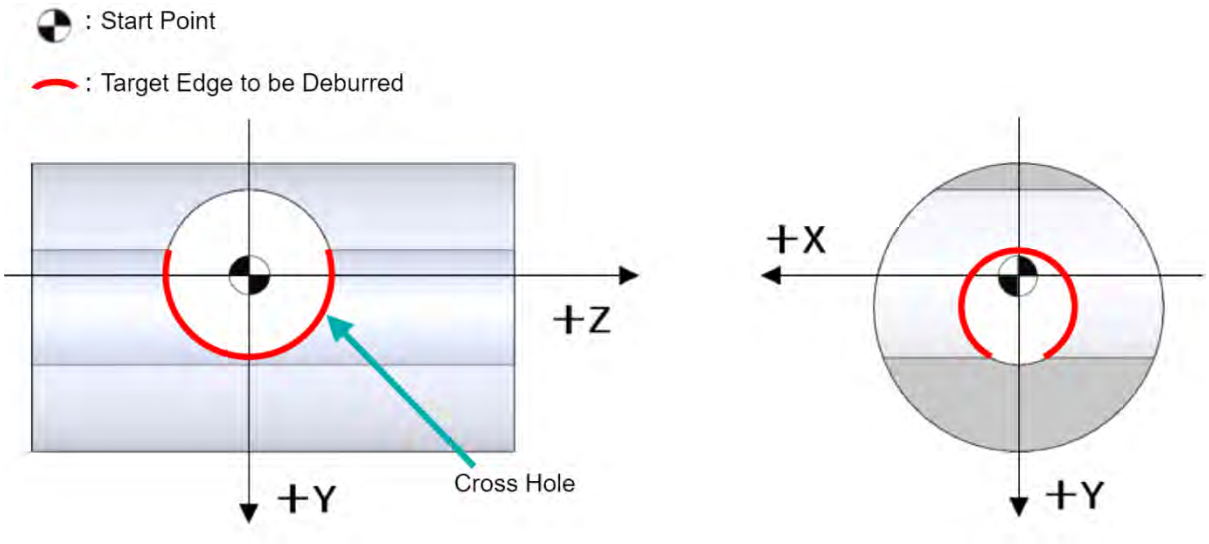
Example: Broken Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore)



Type MY: Broken Cross Hole - Inner Diameter (Cross Hole > Main Bore) XZY Machine Axis

The Start Point is at the center of the Cross Hole in the YZ plane. Along the X-axis, it is as indicated in the figures below.

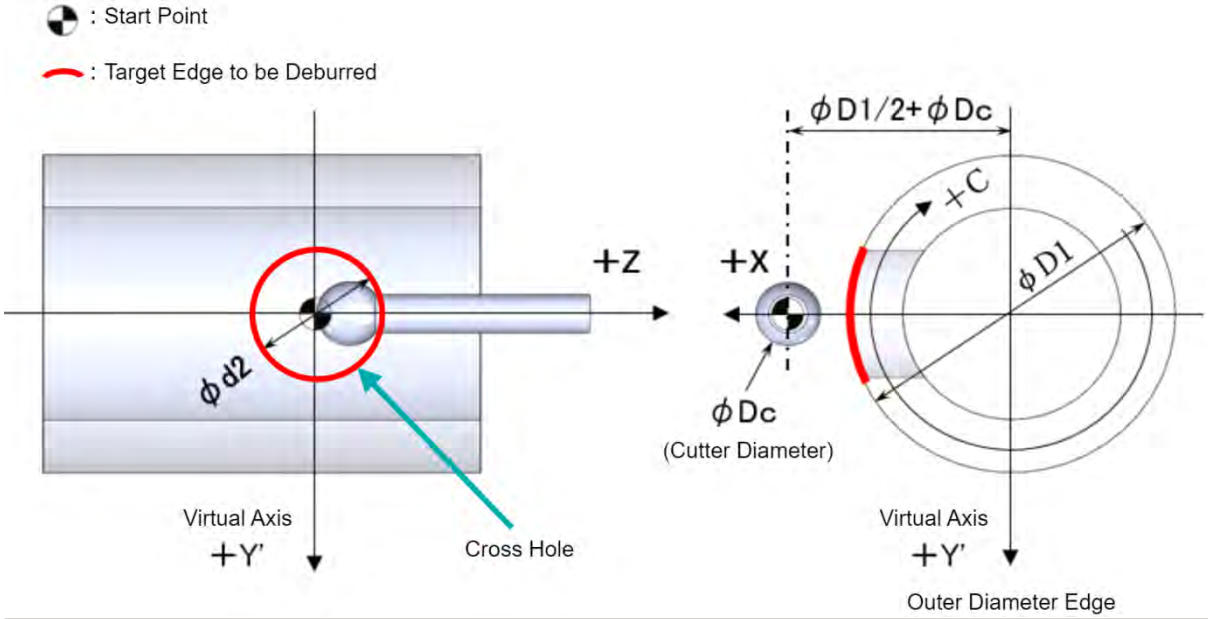
Example: Broken Cross Hole - Inner Diameter (Cross Hole > Main Bore)



Type AC: Orthogonal Cross Hole - Outer Diameter (Cross Hole ＜ Outer Diameter) XZC Machine Axis

The X coordinate of the Start Point is at a position away from the outer diameter as described in the figure below. The Z coordinate aligns the Cutter tip with the cross hole center. Make sure to align the cross hole axis and the X-axis on the +X side.
Make sure to turn on polar interpolation when using XEBEC Path for XZC lathes.

Example: Orthogonal Cross Hole - Outer Diameter (Cross Hole ＜ Outer Diameter)



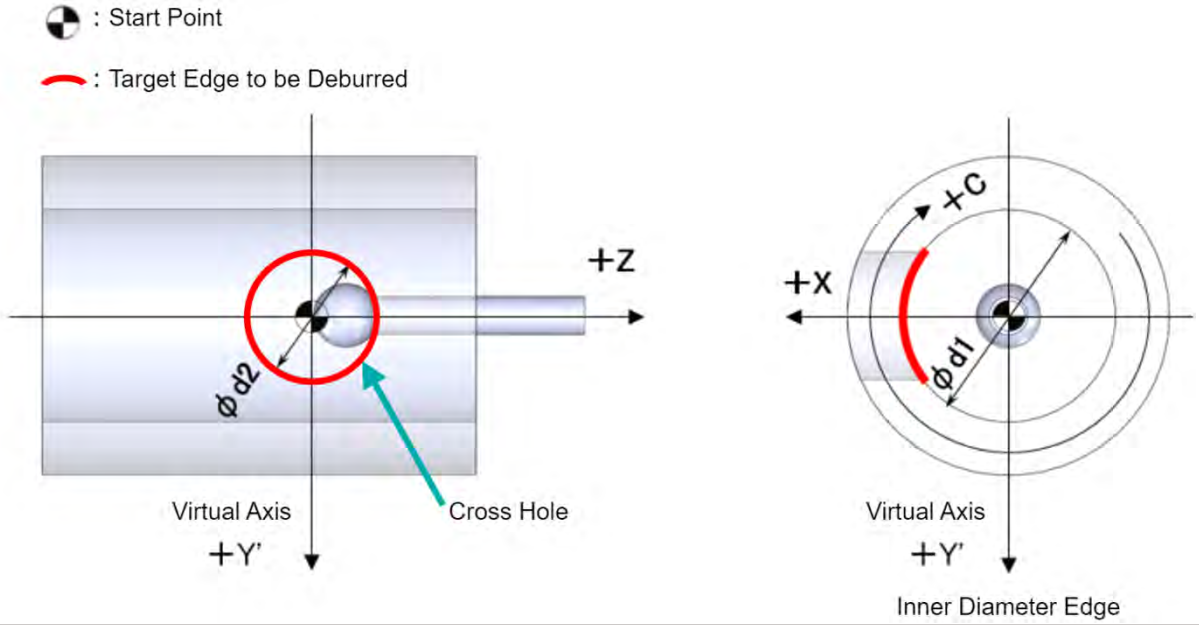
MEMO

Make sure to align the cross hole axis and the X-axis on the +X side.

Type BC: Orthogonal Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore) XZC Machine Axis

The X coordinate of the Start Point is at aligned with the main bore axis as described in the figure below. The Z coordinate aligns the Cutter tip with the cross hole center. Make sure to align the cross hole axis and the X-axis on the +X side.
Make sure to turn on polar interpolation when using XEBEC Path for XZC lathes.

Example: Orthogonal Cross Hole - Inner Diameter (Cross Hole ≦ Main Bore)



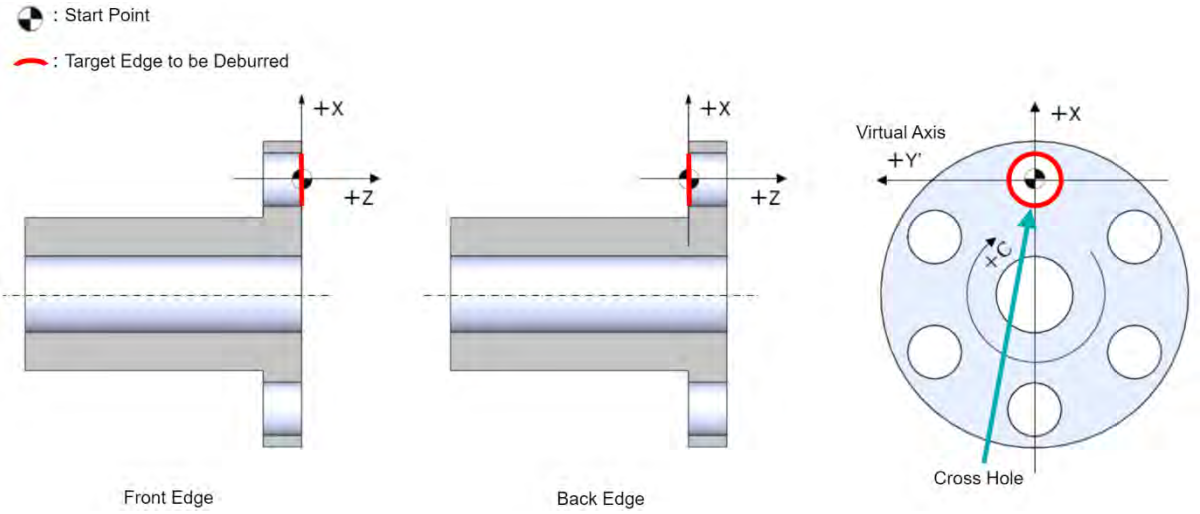
MEMO

Make sure to align the cross hole axis and the X-axis on the +X side.

Type CC: Main Bore XZC Machine Axis

The Start Point is at the center of the Main Bore in the XC plane. The Z coordinate is aligned with the Target Edge to be Deburred.

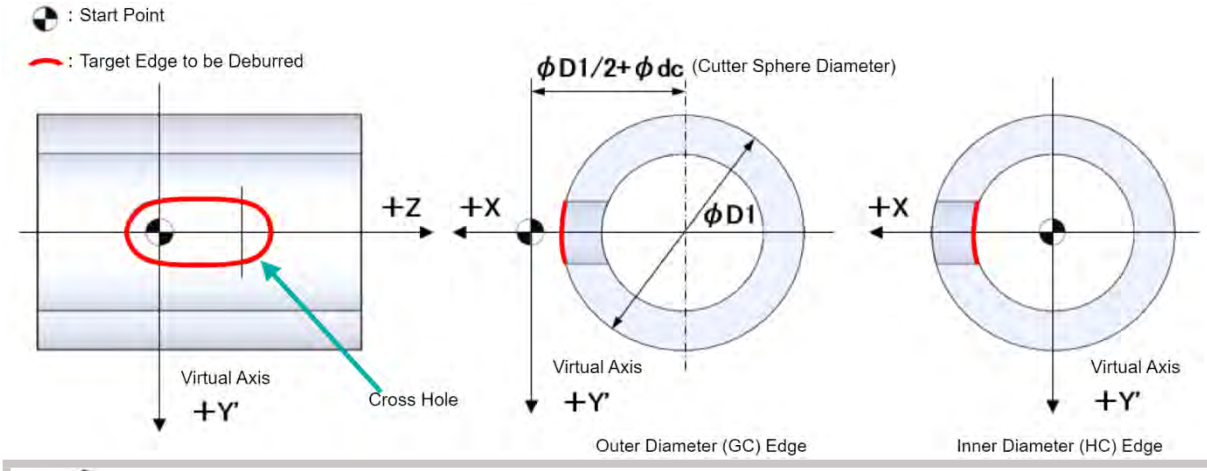
Example: Main Bore



Type GC and HC: Slotted Hole Parallel with Main Bore Axis - Outer/Inner Diameter XZC Machine Axis

The X coordinate of the Start Point is at a position away from the outer diameter as described in the figure below. The Z coordinate aligns the Cutter tip with the center of the radius R. Make sure to align the cross hole axis and the X-axis on the +X side.

Example: Slotted Hole Parallel with Main Bore Axis - Outer/Inner Diameter



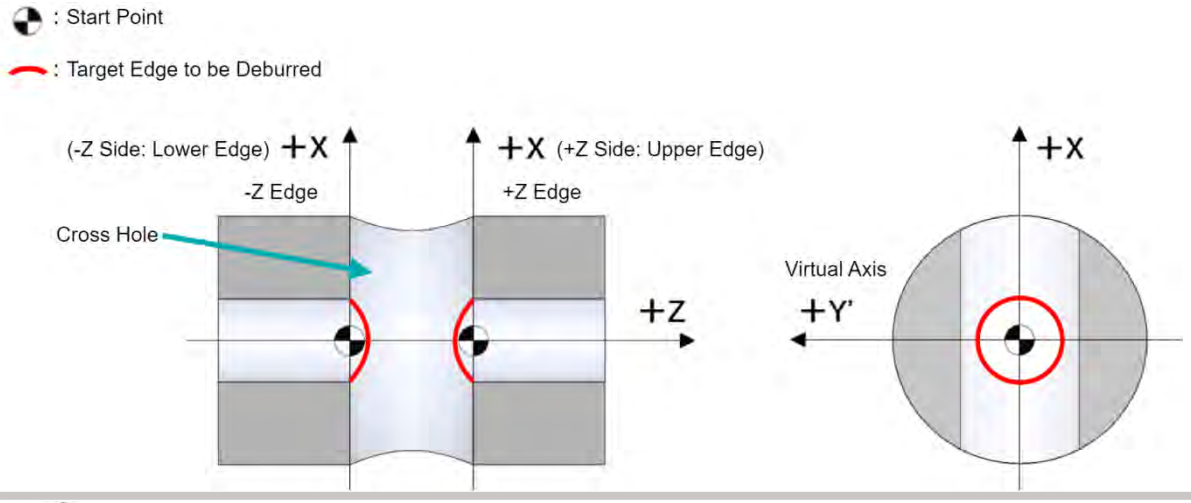
MEMO

Make sure to align the cross hole axis and the X-axis on the +X side.

Type KC: Orthogonal Cross Hole - Inner Diameter (Cross Hole > Main Bore) XZC Machine Axis

The Start Point along the X-axis is at the center of the Main Bore. Along the Z-axis, it is as indicated in the figures below. Make sure to align the cross hole axis and the X-axis.

Example: Orthogonal Cross Hole - Inner Diameter (Cross Hole > Main Bore)



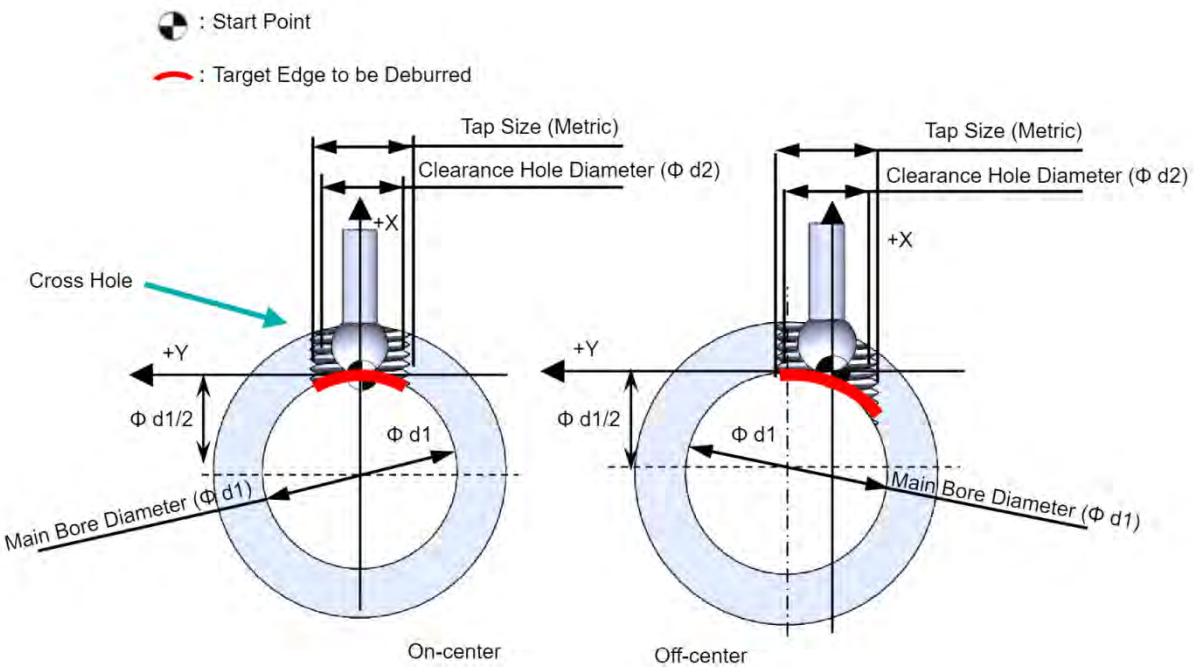
MEMO

Make sure to align the cross hole axis and the X-axis.

Type PY: Tapped Orthogonal Cross Hole (Cross Hole ≦ Main Bore)

The Start Point is at the center of the Cross Hole in the YZ plane. Along the X-axis, it is as indicated in the figures below.

Example: Tapped Orthogonal Cross Hole (Cross Hole ≦ Main Bore)



Content of XEBEC Path for Tapped Holes (Pre & Fin)

Pre Path: to be used on the clearance hole prior to tapping

- Pre Path forms a large edge break at the exit of the clearance hole, to suppress formation of burrs during tapping
- It performs edge breaking in three passes rather than in a single pass to reduce cutting resistance.

Fin (Finish) Path: to be used after tapping to finish

- Fin Path forms edge break length of 0.02mm after tapping.
- It removes burrs that are generated during the tapping operation.

⚠ CAUTION	Do not use Fin Path if you are using a roll tap There is a risk of tool collision if Fin Path is used on a inner thread created by a roll tap, due to the deformation of the inner diameter resulting from roll tapping.

Steps to Use XEBEC Path for Tapped Holes

1. Drill the clearance hole
2. Use Pre Path to break edge
3. Tapping
4. Use Fin Path to finish

Alternative Steps to Shorten the Cycle Time

1. Drill the clearance hole
2. Use Fin Path to break edge
3. Tapping

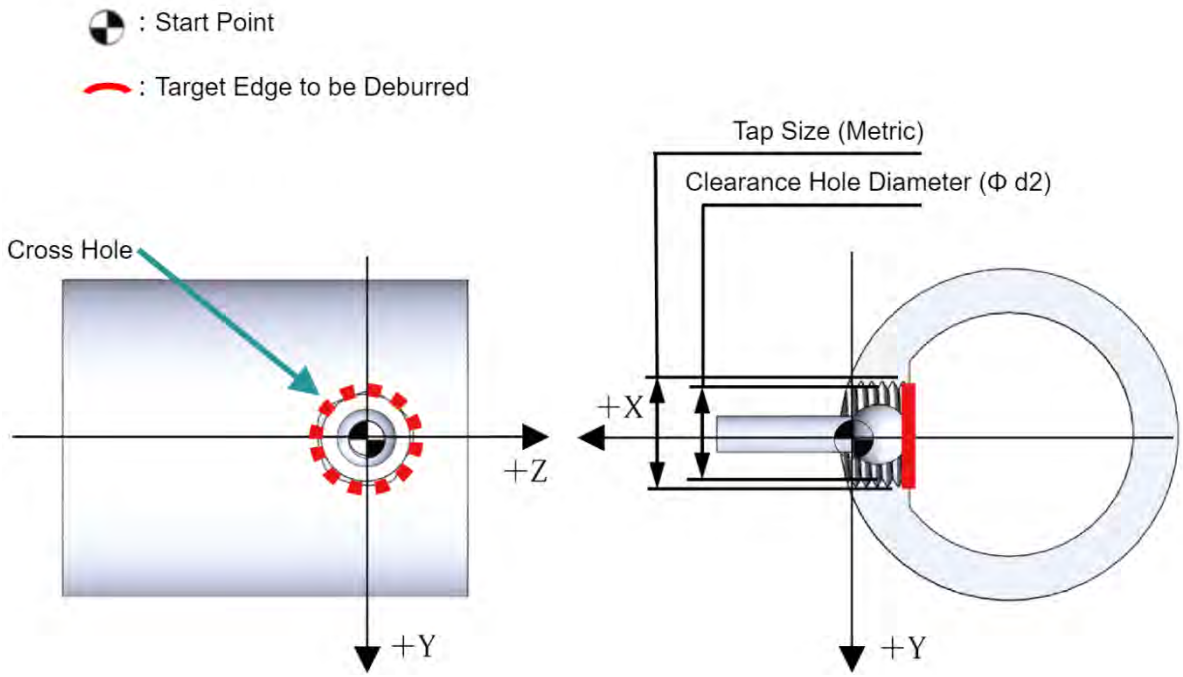

MEMO

When omitting Pre Path and using Fin Path only, the Cutter will need to remove a greater amount of material as it travels in the radial direction initially from the Start Point, prior to breaking the edge. For safety, reduce the initial feed rate in the radial direction. After that, continue at the recommended feed rate.

Type QY: Tapped Flat Surface Cross Hole Back Edge

The Start Point is at the center of the Cross Hole in the YZ plane. Along the X-axis, it is as indicated in the figures below.

Example: Tapped Flat Surface Cross Hole Back Edge



Content of XEBEC Path for Tapped Holes (Pre & Fin)

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Steps to Use XEBEC Path for Tapped Holes

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3. Tapping
4. Use Fin Path to finish

Alternative Steps to Shorten the Cycle Time

1. Drill the clearance hole
2. Use Fin Path to break edge
3. Tapping


MEMO

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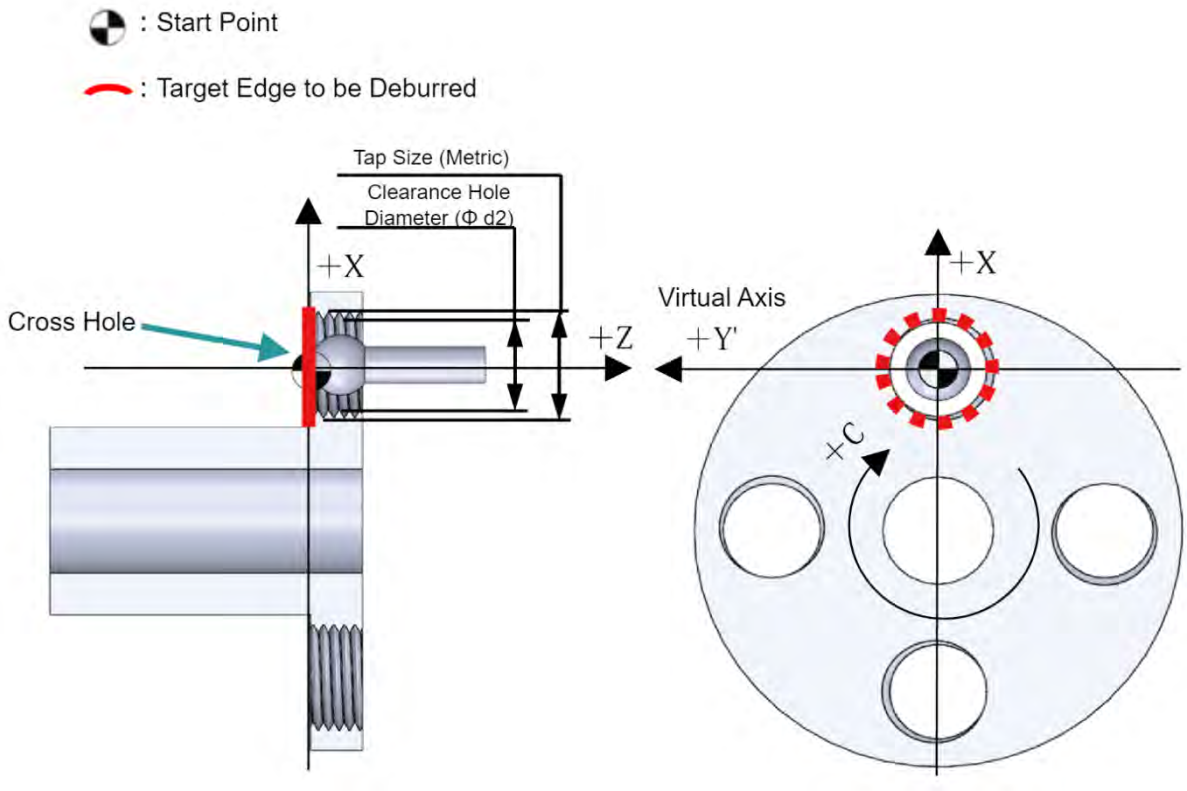
Type QC: Tapped Flat Surface Cross Hole Back Edge

The Start Point is at the center of the Cross Hole in the XC plane. The Z coordinate is aligned with the Target Edge to be Deburred.

Example: Tapped Flat Surface Cross Hole Back Edge



Content of XEBEC Path for Tapped Holes (Pre & Fin)

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XEBEC TECHNOLOGY CO.,LTD.
Fuerte Kojimachi 1・7 Building , 1-7-25, Koujimachi, Chiyoda-ku, Tokyo, 102-0083, Japan
TEL. +81-3-3239-3481　FAX. +81-3-5211-8964

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