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BT/BTA - Internal Keyway broaching system on CNC machines tools

GENERAL INFORMATION

The BT/BTA broaching systems have been developed to machine internal keyways inside blind or through holes using CNC machine tools.
By using BT/BTA broaching systems it is not necessary to change machine tool to complete the production process. After the turning, the milling, the drilling, etc. it is possible to proceed with the broaching operation of the internal keyway without taking the work-piece off the machine tool, which means a great saving in time and money, and the result of the machining will be much more precise.

We propose two different solution for the internal keyway machining. The first is the BT system, made of the insert holder and the insert, which is used on CNC machines (lathe, milling machines, machining centre) with a Y axis or on slotting machines. The perfect alignment between the tools and the work-piece is granted by the specific funcion of the CNC machine. The insert holder is available with cylindrical connection to the machine, two different measures in particular: Ø25 and Ø 32. The maximum broaching depth goes from 30 mm to 200 mm.

The second system is the BTA, made of the BT system (insert holder + insert) and the eccentric graduated bush. This "three tools broaching system" is useful when a machine tool without a Y axis is to be used. In this case, it is the eccentric graduated bush the one which guarantees the perfect alignment between the broaching tools and the work-piece. The alignment mistakes can be corrected by turning, clockwise or counterclockwise, the eccentric bush following the notches engraved on its collar. The eccentric graduated bush is available in three different measures of the outside diameter: 32 – 40 – 50 and the inside hole axis is shifted 0,5 mm from the bush axis.

The BTA broaching systems, which are patented, is a great solution in the field of the internal keyway machining on CNC.

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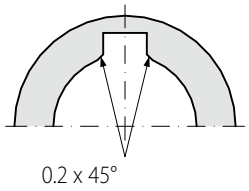
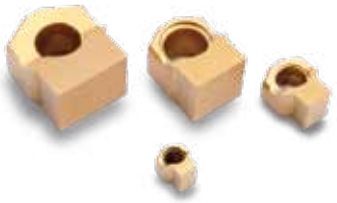
NSERTS FOR INTERNAL KEYWAYS (IN)

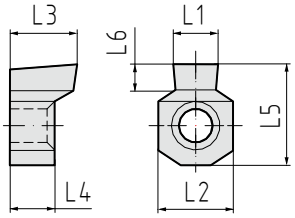
*Inserts are made in sintered steel with a TiN coating. The material and the coating give to the insert a great hardness and let it bear in the best way possible the great number of hits that are typical of this kind of machining. It's important to point out that for some inserts (in particular inserts with **P9 and H7** tolerances), a 0,2x45° chamfer can be realized. This chamfer prevents the flash from forming during the machining of the keyseat.*

Inserts can be re-grinded twice or three times. This feature reduces pro-duction costs. All insert sizes indicated in picture 1 are always available in stock.

Inserts are produced with metric and inches sizes.







picture 1 - INSERT FOR INTERNAL KEYWAY (IN)

misura metrica / *metric size*

ITEM (material) SINTERIZ.	*Tolerance*	L1 (mm)	L2 (mm)	L3 (mm)	L4 (mm)	L5 (mm)	L6 (mm)	UT
IN-02	**P9**	1,994	5	6,5	5	6	1,3	**UT-02**
	P9 SM						1,09	
	H7	2,010					1,3	
	H7 SM						1,09	
	D10	2,060					1,3	
	C11	2,120					1,3	
IN-03	**P9**	2,994	6,08	6,5	5	7,5	2	**UT-03**
	P9 SM						1,42	
	H7	3,010					2	
	H7 SM						1,42	
	D10	3,060					2	
	C11	3,120					2	
IN-04	**P9**	3,988	6,08	7	5	8	2,6	**UT-04**
	P9 SM						2,07	
	H7	4,012					2,6	
	H7 SM						2,07	
	D10	4,078					2,6	
	C11	4,145					2,6	
IN-05	**P9**	4,988	6,08	7	5	8	3	**UT-05**
	P9 SM						2,74	
	H7	5,012					3	
	H7 SM						2,74	
	D10	5,078					3	
	C11	5,145					3	
IN-06	**P9**	5,988	10,08	9	6	13,5	4	**UT-06**
	P9 SM						3	
	H7	6,012					4	
	H7 SM						3	
	D10	6,078					4	
	C11	6,145					4	
IN-08	**P9**	7,985	10,08	9	6	13,5	4,5	**UT-08**
	P9 SM						3,78	
	H7	8,015					4,5	
	H7 SM						3,78	
	D10	8,098					4,5	
	C11	8,170					4,5	
IN-10	**P9**	9,985	13,1	14	10	18,5	6	**UT-10**
	P9 SM						3,88	
	H7	10,015					6	
	H7 SM						3,88	
	D10	10,098					6	
	C11	10,170					6	

ITEM (material) SINTERIZ.	*Tolerance.*	L1 (mm)	L2 (mm)	L3 (mm)	L4 (mm)	L5 (mm)	L6 (mm)	UT
IN-12	**P9**	11,982	13,1	14	10	18,5	6,5	**UT-12**
	P9 SM						3,89	
	H7	12,018					6,5	
	H7 SM						3,89	
	D10	12,120					6,5	
	C11	12,205					6,5	
IN-14	**P9**	13,982	18	14	10	22	7	**UT-14/16**
	P9 SM						4,71	
	H7	14,018					7	
	H7 SM						4,71	
	D10	14,120					7	
	C11	14,205					7	
IN-16	**P9**	15,982	18	14	10	22	8	**UT-14/16**
	P9 SM						5,53	
	H7	16,018					8	
	H7 SM						5,53	
	D10	16,120					8	
	C11	16,205					8	
IN-18	**P9 ***	17,982	26	18	10	30	9	**UT-18/25**
	P9 SM *						5,67	
	H7 *	18,018					9	
	H7 SM *						5,67	
	D10 *	18,120					9	
	C11 *	18,205					9	
IN-20	**P9 ***	19,978	26	18	10	30	10	**UT-18/25**
	P9 SM *						6,29	
	H7 *	20,021					10	
	H7 SM *						6,29	
	D10 *	20,149					10	
	C11 *	20,240					10	
IN-22	**P9 ***	21,978	26	18	10	30	11	**UT-18/25**
	P9 SM *						6,79	
	H7 *	22,021					11	
	H7 SM *						6,79	
	D10 *	22,149					11	
	C11 *	22,240					11	
IN-25	**P9 ***	24,978	26	18	10	30	12	**UT-18/25**
	P9 SM *						7,02	
	H7 *	25,021					12	
	H7 SM *						7,02	
	D10 *	25,149					12	
	C11 *	25,240					12	

continued >>

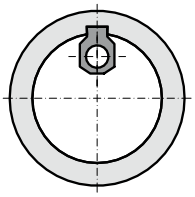
* *For these insert sizes, we recommend machining in two steps: roughing and finishing.*

inches

ITEM (material) SINTERED.	Tolerance	L1 (mm)	L1 (inch)	L2 (inch)	L3 (inch)	L4 (inch)	L5 (inch)	L6 (inch)	UT
IN-3/32"	**P9**	2,375	0,093	0,197	0,236	0,197	0,256	0,055	**UT-02**
	H7	2,391	0,094						
	D10	2,441	0,096						
	C11	2,501	0,098						
IN-1/8"	**P9**	3,163	0,124	0,236	0,276	0,197	0,315	0,091	**UT-03**
	H7	3,187	0,125						
	D10	3,253	0,128						
	C11	3,320	0,131						
IN-5/32"	**P9**	3,969	0,156	0,236	0,276	0,197	0,315	0,114	**UT-04**
	H7	3,981	0,157						
	D10	4,047	0,159						
	C11	4,114	0,162						
IN-3/16"	**P9**	4,750	0,187	0,236	0,276	0,197	0,315	0,130	**UT-05**
	H7	4,775	0,188						
	D10	4,841	0,191						
	C11	4,908	0,193						
IN-1/4"	**P9**	6,335	0,249	0,396	0,354	0,236	0,531	0,159	**UT-06**
	H7	6,365	0,251						
	D10	6,448	0,254						
	C11	6,520	0,257						
IN-9/32"	**P9**	7,129	0,281	0,396	0,354	0,236	0,531	0,169	**UT-08**
	H7	7,159	0,282						
	D10	7,242	0,285						
	C11	7,314	0,288						

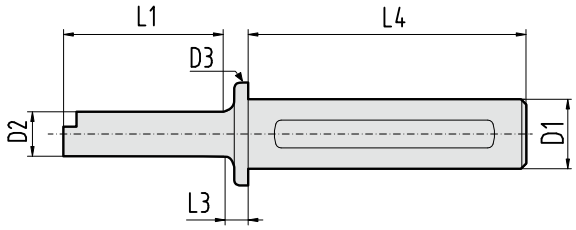
continued >>

ITEM (material) SINTERED.	Tolerance	L1 (mm)	L1 (inch)	L2 (inch)	L3 (inch)	L4 (inch)	L5 (inch)	L6 (inch)	UT
IN-5/16"	**P9**	7,923	0,312	0,396	0,354	0,236	0,531	0,188	**UT-08**
	H7	7,953	0,313						
	D10	8,036	0,316						
	C11	8,108	0,319						
IN-3/8"	**P9**	9,510	0,374	0,516	0,551	0,394	0,728	0,250	**UT-10**
	H7	9,540	0,376						
	D10	9,623	0,379						
	C11	9,695	0,382						
IN-7/16"	**P9**	11,095	0,437	0,516	0,551	0,394	0,728	0,250	**UT-12**
	H7	11,131	0,438						
	D10	11,233	0,442						
	C11	11,318	0,446						
IN-1/2"	**P9**	12,682	0,499	0,516	0,551	0,394	0,728	0,300	**UT-12**
	H7	12,718	0,501						
	D10	12,820	0,505						
	C11	12,905	0,508						
IN-9/16"	**P9**	14,270	0,562	0,709	0,551	0,394	0,866	0,275	**UT-14/16**
	H7	14,306	0,563						
	D10	14,408	0,567						
	C11	14,493	0,571						
IN-5/8"	**P9**	15,857	0,624	0,709	0,551	0,394	0,866	0,312	**UT-14/16**
	H7	15,893	0,626						
	D10	15,995	0,630						
	C11	16,080	0,633						
IN-3/4"	**P9**	19,028	0,749	1,024	0,709	0,394	1,181	0,393	**UT-18/25**
	H7	19,071	0,751						
	D10	19,199	0,756						
	C11	19,290	0,759						



INSERT HOLDER FOR INTERNAL KEYWAYS (UT)

The insert holder is made in hardened and quenched steel: these treatments assure a great resistance to compression.
The insert holder (UT) isavailable with two cylindrical connection to the machine tool: 25mm and 32 mm. For each connection two machining length are available: a standard length and a long one, indicated in the table with the letter "-L". All insert holder sizes indicated in the table are always available in stock.

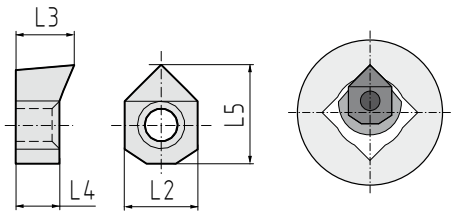


picture 2

ITEM (material) HARDENED	SHANK	L1 (mm)	L3 (mm)	L4 (mm)	D1 (mm)	D2 (mm)	D3 (mm)
UT-02	**25**	25	9	90	25	6	30
	25-L	34,5					
	32	25		100	32		37
	32-L	34,5					
UT-03	**25**	30	9	90	25	8	30
	25-L	40					
	32	30		100	32		37
	32-L	40					
UT-04	**25**	40	9	90	25	10	30
	25-L	56					
	32	40		100	32		37
	32-L	56					
UT-05	**25**	46	9	90	25	12	30
	25-L	66					
	32	46		100	32		37
	32-L	66					
UT-06	**25**	56	9	90	25	16	30
	25-L	81					
	32	56		100	32		37
	32-L	81					
UT-08	**25**	68	9	90	25	20	30
	25-L	100					
	32	68		100	32		37
	32-L	100					
UT-10	**25**	86	9	90	25	25	32
	25-L	126					
	32	86		100	32		37
	32-L	126					
UT-12	**25**	104	9	90	25	30	35
	25-L	161					
	32	104		100	32		37
	32-L	161					
UT-14/16	**25**	126	9	90	25	35	37
	25-L	180					
	32	126		100	32		37
	32-L	180					
UT-18/25	**32**	140	9	100	32	40	45
	32-L	200					

INSERTS FOR INTERNAL SQUARE PROFILES

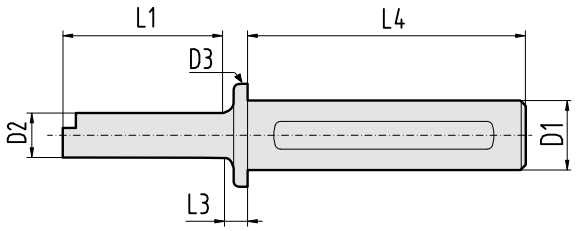
This series of tools is used to produce internal squares. Each insert can make squares of different sizes (e.g. insert IN-SQ-27/37 can make squares from 27 to 37mm A/F). The size of the bore must have a diameter 5% bigger than the size of the square.



ITEM material)	WORKING ARE			L2 (mm)	L3 (mm)	L4 (mm)	L5 (mm)	UT
SINTERED.		mm	inches					
IN-SQ-16/19	*min*	16	0,629	10	8	6	12,5	UT-SQ-16/19
	max	19	0,748					
IN-SQ-19/27	*min*	19	0,748	13	13	10	17	UT-SQ-19/27
	max	27	1,062					
IN-SQ-27/37	*min*	27	1,062	18	14	10	22	UT-SQ-27/37
	max	37	1,456					
IN-SQ-37/50	*min*	37	1,456	26	18	10	30	UT-SQ-37/50
	max	50	1,968					

INSERT HOLDER FOR INTERNAL SQUARE PROFILES

The insert holder is made in hardened and quenched steel: these treatments assure a great resistance to compression.

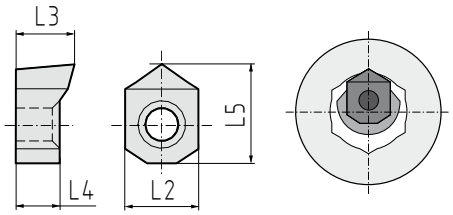


ITEM material)	SHANK	L1 (mm)	L3 (mm)	L4 (mm)	D1 (mm)	D2 (mm)	D3 (mm)
HARDENED							
UT-SQ-16/19	**25**	52	9	90	25	15	30
	32			100	32		38
UT-SQ-19/27	**25**	86	9	90	25	18,50	30
	32			100	32		38
UT-SQ-27/37	**25**	100	9	90	25	25	30
	32			100	32		38
UT-SQ-37/50	**32**	140	9	100	32	35	45

For particularly hard materials (HRC> 30) we can supply inserts and insert holders to make squares of smaller dimensions.

INSERTS FOR INTERNAL HEXAGONAL PROFILES

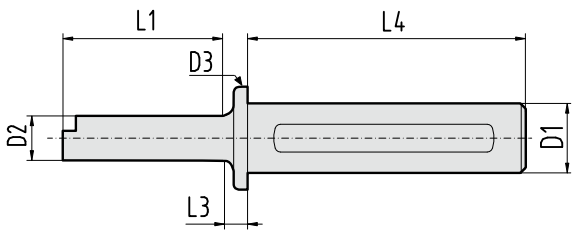
This series of tools is used to produce internal hexagons. Each insert can make hexagons of different sizes (e.g. insert IN-HEX-28/37 can produce hexagons from 28 to 37mm A/F). The size of the bore must have a diameter 2% bigger than the size of the hexagon.



ITEM material)	WORKING ARE			L2 (mm)	L3 (mm)	L4 (mm)	L5 (mm)	UT
SINTERED.		mm	inches					
IN-HEX-17/28	*min*	17	0,669	10	9	6	13,5	UT-HEX-17/28
	max	28	1,102					
IN-HEX-28/37	*min*	28	1,102	13	14	10	18,5	UT-HEX-28/37
	max	37	1,456					
IN-HEX-37/45	*min*	37	1,456	18	14	10	22	UT-HEX-37/45
	max	45	1,771					
IN-HEX-45/70	*min*	45	1,771	26	16	10	30	UT-HEX-45/70
	max	70	2,755					

GB INSERT HOLDER FOR INTERNAL HEXAGONAL PROFILES

The insert holder is made in hardened and quenched steel: these treatments assure a great resistance to compression.



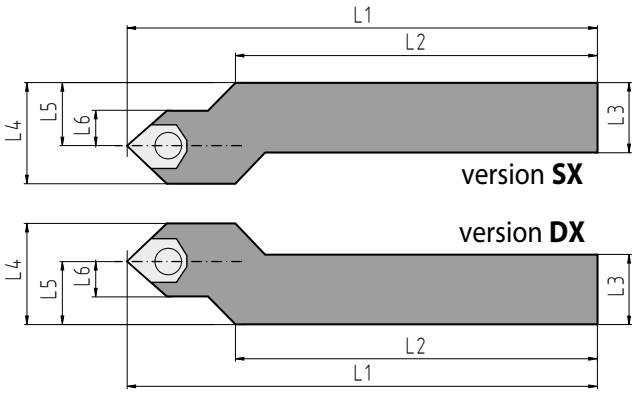
ITEM material)	SHANK	L1 (mm)	L3 (mm)	L4 (mm)	D1 (mm)	D2 (mm)	D3 (mm)
HARDENED							
UT-HEX-17/28	**25**	56	9	90	25	15	30
	32			100	32		38
UT-HEX-28/37	**25**	86	9	90	25	25	30
	32			100	32		38
UT-HEX-37/45	**25**	126	9	90	25	35	45
	32			100	32		45
UT-HEX-45/70	**32**	140	9	100	32	40	45

For particularly hard materials (HRC> 30) we can supply inserts and insert holders to make hexagons of smaller dimensions.

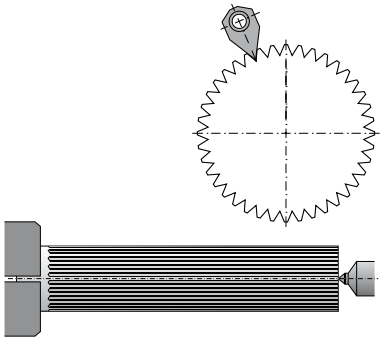
INSERT HOLDER FOR EXTERNAL PROFILES (UTE DX - UTE SX)

Anytime it is necessary to hold the part with the tailstock too, external machinings can be produced using a specific insert holder (UTE).
Two versions are available (fig.3):

- Insert holder for external machinings right (UTE DX)
- Insert holder for external machinings left (UTE SX)



picture 3

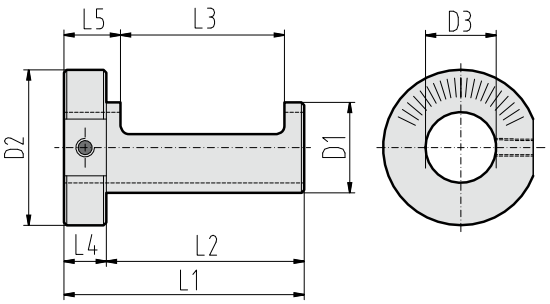


ITEM material HARDENED	L1 (mm)	L2 (mm)	L3 (mm)	L4 (mm)	L5 (mm)	L6 (mm)
UTE 20-DX	150	110	20x20	32,50	20	12,5
UTE 20-SX	150	110	20x20	32,50	20	12,5
UTE 25-DX	150	110	25x25	37,50	25	12,5
UTE 25-SX	150	110	25x25	37,50	25	12,5

ECCENTRIC BUSH (B)

It's the main innovation the BTA system brings in the braoching machinig of keyways with CNC machine tools without Y axis. Thanks to its graduated scale ingraved in the collar it's possible to correctevery simmetry mistake may be occured during the keyway machinig. Thanks to the shift of the inside hole as to the bush central axis (0,5 mm) the insert holder field of action goes from +0,5 m mto -0,5 mm.
Every notch on the graduated scale corresponds to a 0,03 mm turn of the insert. The bush is made in hardned steel for tools and grinded. The available outside diameters fo the bush are: 32 mm, 40 mm and 50 mm (with H7 tolerance).
By Customer's request BRIGHETTI MECCANICA SRL can supply this bush with a VDI connection or sizes in inches.
This adjustable graduated bush is covered by regular patent.
To help finding the correct tools for a machining, let's make the example of a 4 mm keyway, 35 mm long with a H7 tolerance:

> Insert with L1=4; the code is IN-4-H7
> Insert holder: the code is UT-4-32 or UT-4-25 if the eccentric bush is necessary:
> The code for the bush is B-40 or B-32 respectively



ITEM	Ø D1 (H7) (mm)	L1 (mm)	L2 (mm)	L3 (mm)	L4 (mm)	L5 (mm)	D2 (mm)	D3 (mm)
B-32	32	85	70	58	15	20	48	25
B-40	40	95	80	66	15	20	55	32
B-50	50	115	100	75	15	20	65	32

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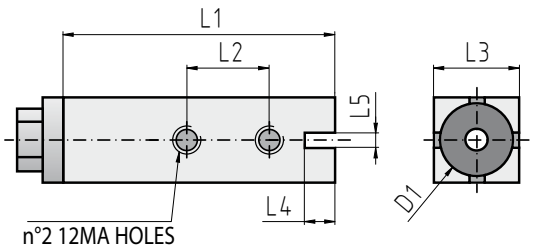
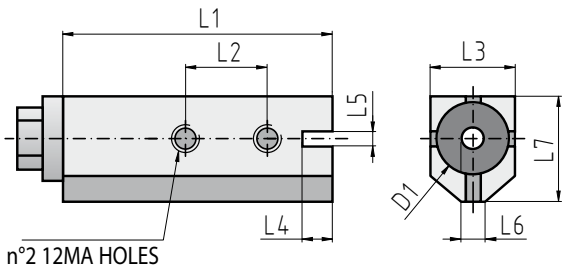
ADAPTORS FOR SLOTTING MACHINES

Thanks to an adaptor, BT system is suitable for slotting machines as well. Insert holders are fastened inside the adaptors by two M12x8 screws. The timing pin (L4xL5) assures the perfect alignment between the holder and the machining axis. Adaptors are available in two different models:

1) *Square adaptor (AD) available in three sizes (L3) (pic.4)*
2) *Prismatic adaptor (ADP) available in two sizes (L3) (pic.5)*



picture 4



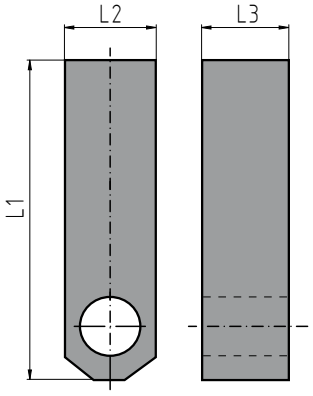
picture 5

ITEM	*Size (mm) / Weight (gr)*								
	L1	L2	L3	L4	L5	L6	L7	D1	Peso
AD-35	140	40	35	10	6	/	/	25	500
AD-40	140	50	40	10	6	/	/	32	600
AD-50	170	50	50	10	6	/	/	32	2200

ITEM	*Size (mm) / Weight (gr)*								
	L1	L2	L3	L4	L5	L6	L7	D1	gr
ADP-35	140	40	35	10	6	10	41,5	25	600
ADP-40	140	50	40	10	6	10	50	32	700

ALIGNMENT PLATES FOR MILLING MACHINES

Alignment plates are used to assure the correct concentricity between the tools and the piece on a machining center. The alignment plate is installed on the holder in the insert-seat; thanks to its shape, it is possible to check the correct alignment between the BT/BTA and the reference axes, with a simple gauge. Alignment plates are available in five different sizes, each suitable for one particular insert holder:



ITEM	L1 (mm)	L2 (mm)	L3 (mm)	*Tools*
PN-1	6	50	8	UT/UTS-3, UT/UTS-4, UT/UTS-5
PN-2	10	50	8	UT/UTS-6, UT/UTS-8
PN-3	13	60	10	UT/UTS-10, UT/UTS-12
PN-4	18	70	10	UT/UTS-14/16
PN-5	26	70	10	UT/UTS-18/25

Examples .

Key machining:
L1 = 6 мм
Depth = 30 мм

Material to machine	*Machining time* (sec)	*Insert life* (n°pcs.)
oft alloys: *> alluminium* *> AVP - AVP*	20"/30"	6000/7000
Average hard alloys: *> cast iron* *> C40 - C40*	40"/50"	400/500
Hard steel: *> hardened steels* *> stainless steel*	60"	200/300

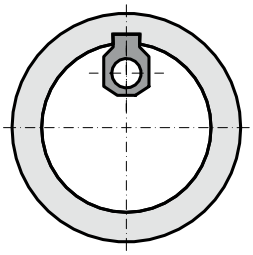


figura 1 - *picture 1*

BT/BTA system can be used to machine inner splines and involute splines.

Inner involute spline machining:
Z = 20
AP = 30°

Material to machine	*Machining time* (sec)	*Insert life* (n°pcs.)
Soft alloys: *> alluminium* *> AVP - AVP*	2'	200/300
Average hard alloys: *> cast iron* *> C40 - C40*	4'/5'	20/25
- Hard steel: *> hardened steels* *> stainless steel*	5'/6'	10/15

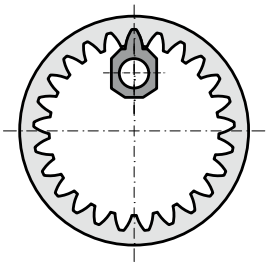


figura 2 - *picture 2*

Down below there are our suggestions about machining parameters with regards to the material to machine.
V = Cutting speed (mt/min)
I = Cutting feed (mm)

Material to machine	V (mt/min)	I (mm)
Soft alloys: *> alluminium* *> AVP - AVP*	12	0,15 / 0,20
Average hard alloys: *> cast iron* *> C40 - C40*	7	0,05 / 0,12
Hard steel: *> hardened steels* *> stainless steel*	5	0,03 / 0,05