

No. 319.3

Indexable
Milling
+Modular Series

AHU

High-Feed **Ultra End Mill**

AHUM

High-Feed **Ultra End Mill Modular Type**

AHUB

High-Feed **Ultra Bore Type**

$\varnothing 16 \sim \varnothing 63$ • High Feed Cutting



R 0.4
R 0.8
R 2.0

FW Fine Wall Finishing
Improved wall surface accuracy



Hitachi Tool Engineering Europe GmbH
www.high-feed-cutting.com



Indexable Milling Tools

AHUM | High-Feed Ultra End Mill Modular

AHU High Feed Ultra End Mill – Features



HIGH-FEED ULTRA END MILL

- 1 Main cutting forces are reduced by the unique high rake geometry
- 2 Ramp milling is possible
- 3 30% increased rigidity over conventional indexable end-mills due to the utilization of a special steel material and chip pocket geometry
- 4 Through tool coolant is available
- 5 New substrate and coating technology has been adopted which allows longer tool-life and the ability to use higher cutting speeds



HIGH-FEED ULTRA END MILL

- 1 Durch die einzigartige hochpositive Schneidengeometrie des AHU High Feed Ultra wird der Schnittdruck erheblich reduziert
- 2 Auch Fräseroperationen über Rampe sind möglich
- 3 Die Verwendung eines speziellen Stahls und einer neu entwickelten Spankammer-Geometrie erhöhte die Steifigkeit des AHU High Feed Ultra gegenüber konventionellen WSP-Haltern um 30%
- 4 Zusätzlich verfügt der AHU High Feed Ultra über innen liegende Kühlkanäle
- 5 Durch das neue Substrat der Wendeschneidplatten in Verbindung mit einer neuen Beschichtungs-technologie ermöglicht der AHU High Feed Ultra wesentlich höhere Schnittgeschwindigkeiten bei gleichzeitig längeren Standzeiten



HIGH-FEED ULTRA END MILL

- 1 Maggiore stabilità e minori forze di taglio grazie alla nuova geometria positiva della spoglia.
- 2 La fresatura in rampa è possibile
- 3 30 % maggiore rigidità a confronto con frese convenzionali grazie alla particolare geometria del collo rompitruciolo e una microfusione di acciaio del corpo fresa.
- 4 Refrigerante attraverso il corpo fresa disponibile
- 5 La combinazione dello sviluppo di una micrograna particolare con l'ultimo sviluppo di rivestimenti rende possibile un grande allungamento di vita dell'utensile e l'utilizzo di velocità di taglio più elevate.



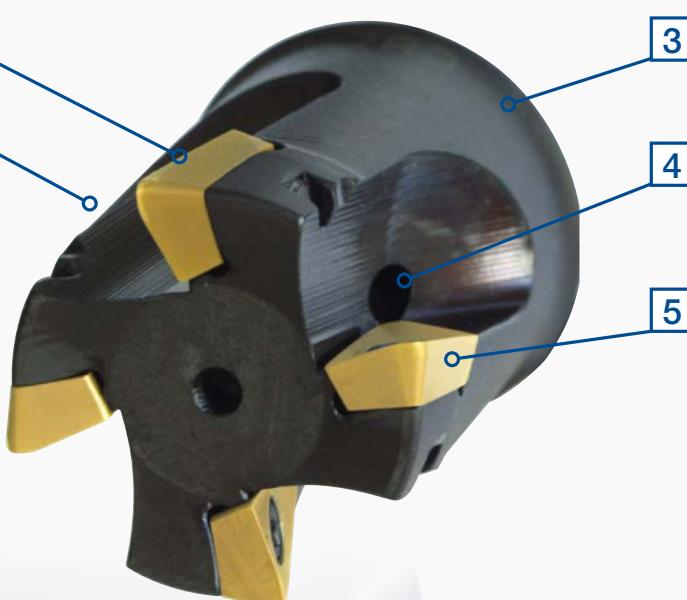
HIGH-FEED ULTRA END MILL

- 1 El esfuerzo de corte se reduce gracias a una exclusiva geometría altamente positiva.
- 2 Capaz de mecanizar en rampa
- 3 30% más de rigidez que herramientas de plaqueta convencionales gracias a la utilización de un acero especial y a la geometría del canal de evacuación de viruta
- 4 Dispone de canal de refrigeración interior.
- 5 La combinación de substratos y recubrimientos de ultima tecnología permite una mayor vida de herramienta y la capacidad de usar velocidades de corte mayores



HIGH-FEED ULTRA END MILL

- 1 L'angle de dépouille très prononcé permet à lui seul de réduire la majeure partie des efforts de coupe.
- 2 L'usinage de rampes est possible (ramping).
- 3 Rigidité accrue de 30% par rapport aux fraises à plaquettes rapportées due à l'utilisation d'un acier spécial et à la forme des poches à copeaux.
- 4 Deux versions de corps sont disponibles : avec ou sans arrosage au centre.
- 5 Nous avons développés une nouvelle nuance et une nouvelle technologie de revêtement générant une durée de vie supérieure et une augmentation significative des vitesses de coupe.



HIGH-FEED ULTRA END MILL

- 1 Muitas forças de corte são reduzidas devido à sua geometria positiva
- 2 Fresagem em rampa é possível
- 3 30% aumento da rigidez comparado com plaquetes convencionais devido à utilização de um aço especial e geometria e do canal evacuação apara.
- 4 Dispõe de refrigeração interna
- 5 Nova tecnologia de substrato e revestimento de última geração que permite maior vida útil da ferramenta e possibilidade de usar em altas velocidades de corte.

AHU – Lineup & Content

Item	Type	D	Page	Item	Type	D	Page
AHUM-1016R-2	High-Feed Ultra End Mill Modular	16	4	JDMT-1003-R04	Inserts	-	5
AHUM-1020R-3		20		JDMT-1003-R04-FW			
AHUM-1025R-4		25		JDMT-1003-R08			
AHUM-1032R-5		32		JDMT-1003-R08-FW			
AHUB-1040RM-6		40		JDMT-1003-R20			
AHUB-1050RM-7	High-Feed Ultra Bore Type	50	4	JDET-1003-R04-FA		6.5-17	6
AHUB-1063RM-8		63		JDET-1003-R08-FA			
AHU-1016R-2		16		JDET-1003-R20-FA			
AHU-1020R-3	High-Feed Ultra End Mill	20	4	ASC	Carbide Shanks for Modular Mills	-	5
AHU-1025R-4		25		AS	Steel Shanks for Modular Mills		
AHU-1032R-5		32					

Indexable Milling Tools

AHU/AHUM/AHUB | High-Feed Ultra End Mill / Modular / Bore Type

AHU High Feed Ultra End Mill – New Insert Grades

TH (TiSiN) Nano PVD Coating

The new „Nano-composite“ coating material offers extraordinary heat resistance and hardness due to its new composite layer consisting of Nano-crystal material.

TB (TiBoN) Hybrid Coating

This new „Hybrid“ coating offers excellent lubrication under high temperature applications. It is the worlds first development to create this type of „Hybrid“ material

JP4020 & JM4060 Coating

Wider & thicker column morphology improves impact resistance. Higher adherence improves chipping and wear resistance. Substrate of JP4020 is micro grain for hardened material. Substrate of JM4060 is coarse grain for soft material.

SD5010 Coating

DLC coating grade for Aluminium, infinitely close to diamond. Low impurities coating provides stable tool life & high efficiency performance. New filtering technology enabled extremely smooth surface.

TH (TiSiN) Nano PVD-Beschichtung

Das neue „Nano-composite“-Beschichtungsmaterial, eine neuartige Misch-Beschichtung bestehend aus einem Nano-Kristall-Material, bietet eine bemerkenswert hohe Hitzebeständigkeit und Härte.

TB (TiBoN) Hybrid-Beschichtung

Diese neue, und bislang einmalige, „Hybrid“-Beschichtung bietet eine exzellente Schmierung bei Fräseroperationen mit hohen Temperaturen

JP4020 & JM4060 Beschichtung

Die breitere & dickere Säulenstruktur der Beschichtung erhöht die Schlagzähigkeit. Die erhöhte Haftfähigkeit verbessert die Resistenz gegenüber Absplittern und Verschleiß. Die JP4020 Feinstkorn-Beschichtung eignet sich für gehärtete Werkstoffe, die grobkörnigere JM4060 Beschichtung vor allem für weichere Materialien.

SD5010 Beschichtung

Diamant-ähnliche DLC-Beschichtung für die Bearbeitung von Aluminium. Die hohe Reinheit gewährleistet lange Werkzeuglebensdauer bei höchster Effizienz. Besonders glatte Oberfläche durch neuartige Filterungs-Technologie.

TH (TiSiN) Nano PVD Rivestimento

Il nuovo nano-rivestimento rende possibile una resistenza al calore e alla durezza straordinaria a causa di una nano-cristallo composizione dello strato.

TB (TiBoN) Hybrid Rivestimento

Il nuovo “Hybrid”-rivestimento rende possibile una lubrificazione straordinaria sotto temperature di taglio elevate. HITACHI TOOL ha sviluppato come prima azienda mondiale questo tipo di “Hybrid”-rivestimento (TiBoN).

I gradi JP4020 e JM4060

La morfologia colonnare più estesa e compatta migliora la resistenza all’impatto. Una maggiore aderenza migliora la resistenza all’usura ed alla scheggiatura. Il substrato del grado JP4020 è in micro grana per materiali temprati. Il substrato del grado JM4060 è a granulometria maggiorata per materiali più teneri.

Grado SD5010

Rivestimento DLC per Alluminio con caratteristiche similari al diamante. Il basso grado di impurità del rivestimento garantisce una durata tagliente stabile ed una efficiente performance. La nuova tecnologia di rivestimento permette una superficie tagliente estremamente liscia.

TH (TiSiN) Nano Recubrimiento PVD

El nuevo „Nano-Recubrimiento“ ofrece una extraordinaria dureza y resistencia al calor gracias a su composición basada en materiales Nano-Cristalinos.

TB (TiBoN) Recubrimiento Híbrido

Este nuevo recubrimiento „Híbrido“ ofrece una excelente lubricación en aplicaciones a altas temperaturas. Es el primer recubrimiento en el mundo que utiliza este tipo de material „Híbrido“

Recubrimiento JP4020 & JM4060

Su morfología de columna más amplia y gruesa mejora la resistencia al impacto. Una mayor adherencia incrementa la resistencia al mellado y al desgaste. El sustrato de la JP4020 es un micro-grano para materiales templados y el de la JP4060 es de grano grueso para materiales blandos.

Recubrimiento SD5010

El recubrimiento DLC para aluminio es infinitamente cercano al diamante. Su bajo contenido en impurezas proporciona a la herramienta estabilidad, duración y un rendimiento altamente eficaz.

La nueva tecnología de filtrado permite obtener una superficie extremadamente uniforme.

TH (TiSiN) Revêtement Nano PVD

Le nouveau revêtement „Nano-composite“ apporte une extraordinaire résistance en terme de dureté et de température grâce à sa structure Nano-crystalline.

TB (TiBoN) Revêtement Hybride

Ce nouveau revêtement „Hybride“ apporte un excellent coefficient de glissement lors d’opérations générant de hautes températures. Ce développement est une première mondiale, en effet, jusqu’à ce jours personne n’avait encore créé de matière « Hybride ».

Revêtements JP4020 & JM4060

La morphologie colonnaire plus épaisse et plus large améliore la résistance aux impacts. Une adhérence plus importante, améliorant les phénomènes d’écaillage et de résistance à l’usure. Le substrat du JP4020 est un substrat micro grain dédié aux aciers traités. Le substrat du JM4060 est un substrat avec une grosse granulométrie dédié aux matériaux tendres.

Revêtement SD5010

La nuance utilisée avec le revêtement DLC pour l’Aluminium, est infinitement proche du diamant. Le faible nombre d’impuretés apporte une durée de vie stable & de très hautes performances. Notre nouvelle technologie de filtrage permet une surface extrêmement homogène et lisse.

TH (TiSiN) Nano PVD Revestimento

O novo Nano- revestimento oferece uma extraordinária dureza e resistência ao calor devido a sua camada composta por materiais Nano-cristal.

TB (TiBoN) Revestimento Híbrido

Este novo revestimento “Híbrido” oferece excelente lubrificação sob aplicações de alta temperatura é primeiro revestimento a ser criado no Mundo com este tipo de material “Híbrido”

JP4020 & JM4060 Revestimento

Estrutura maior & espessa melhora a resistência ao impacto
Maior aderência melhora a resistência à quebra e ao desgaste.
Substrato do JP4020 é um micro grão para material mais duro.
O substrato JM4060 é um grão mais tenaz para material macio.

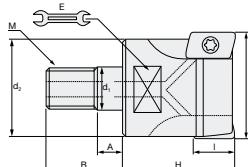
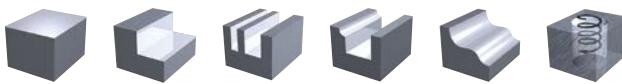
SD5010 Revestimento

DLC grau de revestimento muito perto do diamante para o alumínio. Baixas impurezas no revestimento permitem ter uma vida da ferramenta estável e alta eficiência e desempenho. Nova Tecnologia de adesão permite ter uma superfície muita lisa.

Indexable Milling Tools

AHUM | High-Feed Ultra End Mill Modular

Q max High Efficient	▽ Roughing	No. of Teeth 2–5
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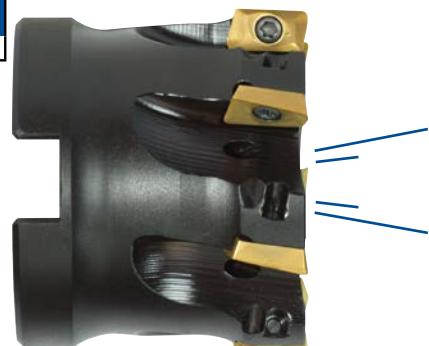
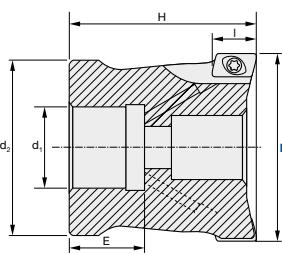
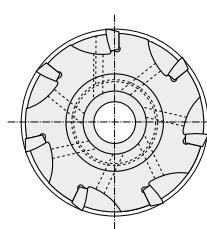
D	-0.05 / -0.2	Torque on screw:
CR	+0.08 / -0.08	1.3 Nm

Modular Type													Inserts
ID Code	Item Code	Stock	Flutes	D	I	H	d ₁	M	d ₂	A	B	E	Inserts
FH 525	AHUM-1016R-2		2	16		25	8.5	M8	13		16	10	JDMT-1003-R..-/FW
FH 526	AHUM-1020R-3	■	3	20		30	10.5	M10	18	5.5	18	15	JDET-1003-R..-/FA
FH 527	AHUM-1025R-4		4	25		35	12.5	M12	21		20	17	
FH 528	AHUM-1032R-5		5	32		40	17	M16	29	6	22	22	

■ = Stock | Germany

AHUB | High-Feed Ultra Bore Type

Q max High Efficient	▽ Roughing	No. of Teeth 6–8
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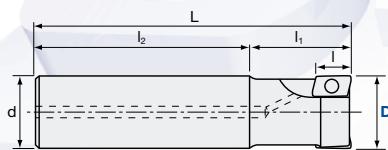
D	-0.05 / -0.2	Torque on screw:
CR	+0.08 / -0.08	1.3 Nm

Bore Type													Inserts
ID Code	Item Code	Stock	Flutes	D	I	H	d ₁	d ₂	E				Inserts
FH 534	AHUB-1040RM-6		6	40		16	32	19					JDMT-1003-R..-/FW
FH 535	AHUB-1050RM-7	■	7	50		40							JDET-1003-R..-/FA
FH 536	AHUB-1063RM-8		8	63		22	47	20					

■ = Stock | Germany

AHU | High-Feed Ultra End Mill

Q max High Efficient	▽ Roughing	No. of Teeth 2–5
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D	-0.05 / -0.2	Torque on screw:
CR	+0.08 / -0.08	1.3 Nm

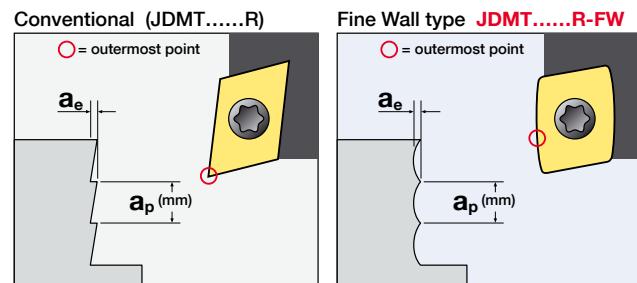
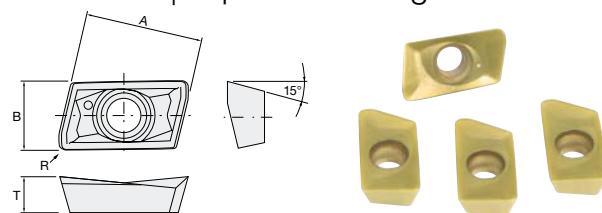
Shank Type													Inserts
ID Code	Item Code	Stock	Flutes	D	I	l ₁	l ₂	L	d				Inserts
FH 506	AHU-1016R-2		2	16		30	70	100	16				JDMT-1003-R..-/FW
FH 507	AHU-1020R-3	■	3	20		80	80	110	20				JDET-1003-R..-/FA
FH 508	AHU-1025R-4		4	25		35	85	120	25				
FH 509	AHU-1032R-5		5	32		45	130	130	32				

■ = Stock | Germany

ASC | Carbide Shanks for Modular Mills & **AS** | Steel Shanks for Modular Mills: page 6 ➔

Indexable Milling Tools

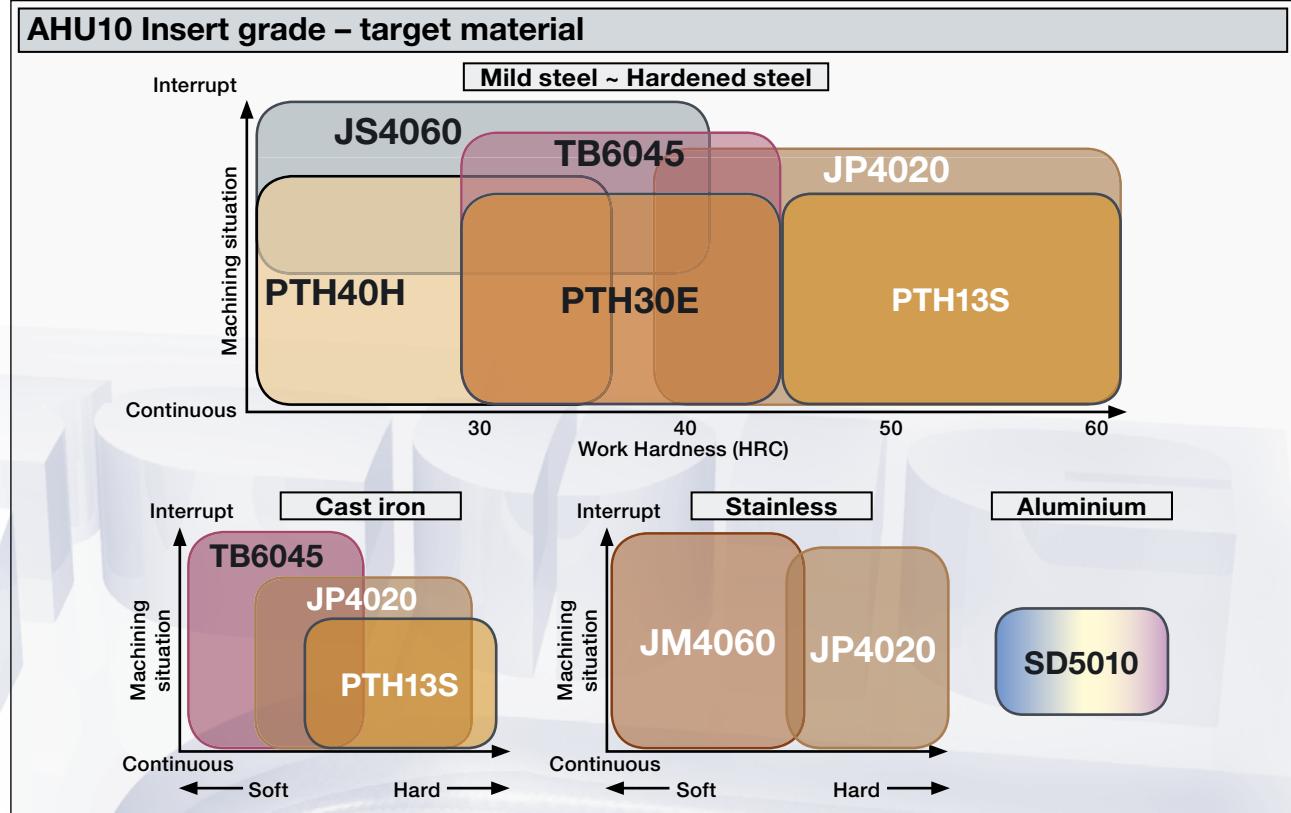
INSERTS | Improved cutting surface



Item Code	Tolerance Class	Grade								Size		
		SD5010	JS4060	JM4060	PTH40H	PTH30E	TB6045	PTH13S	JP4020			
JDMT-1003-R04	M	0.4					WF633	WF634	WF637	11	6.1	3.5
JDMT-1003-R04-FW		0.4-FW			WF696							
JDMT-1003-R08		0.8	WF701	WF702	WF636	WF631	WF635	WF638	WF700			
JDMT-1003-R08-FW		0.8-FW	WF698	WF699								
JDMT-1003-R20		2.0	WF704	WF705		WF632			WF703			
JDET-1003-R04-FA	E	0.4-FA	WF706							11	6.1	3.5
JDET-1003-R08-FA		0.8-FA	WF707									
JDET-1003-R20-FA		2.0-FA	WF708									

SD5010: DLC coated grade for Aluminium

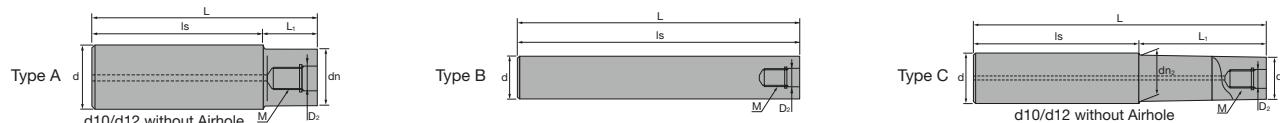
SD5010	PVD · For Aluminium
JS4060	PVD · For carbon steels < 35HRC
JM4060	PVD · For stainless steels & carbon steels < 35HRC
PTH40H	PVD · For carbon steels < 35HRC
PTH30E	PVD · General steels for 30–40 HRC
TB6045	PVD · General steels for 30–40 HRC / Recommended for dry cutting
PTH13S	PVD · For pre-hardened steels 40–55 HRC
JP4020	PVD · For pre-hardened steels 40–55 HRC



Clamp Screw		Wrench	
ID Code	Item-Code	ID Code	Item-Code
ET175	250-141	ET013	104-T8

Indexable Milling Tools

ASC | Carbide Shanks for Modular Mills



Carbide Shank													
	ID Code	Item Code	D ₂	M	L	L ₁	ls	dn	dn ₂	d	Type		
Without Airhole	FH137	ASC10-6.5-74-24	6.5	M6	74	24	50	9.3	-	10	A		
	FH254	ASC10-6.5-84-34			84	34	90						
	FH255	ASC10-6.5-114-24			114	49	65						
	FH138	ASC10-6.5-114-49			74	24	50						
	FH139	ASC12-6.5-74-24			94	44	50	11	11.5	12	C		
	FH256	ASC12-6.5-94-44			129	24	105						
	FH257	ASC12-6.5-129-24				64	65						
	FH140	ASC12-6.5-129-64											
With Airhole	FH141	ASC16-8.5-95-30	8.5	M8	95	30	65	14.5	15.5	16	A		
	FH258	ASC16-8.5-120-55			120	55							
	FH142	ASC16-8.5-140-75			140	75							
	FH260	ASC16-8.5-160-30			160	30	130						
	FH259	ASC16-8.5-160-95			160	95	65						
	FH143	ASC20-10.5-120-50	10.5	M10	120	50	70	18	-	20	C		
	FH261	ASC20-10.5-170-90Z			170	90	80	18.5	19.5				
	FH144	ASC20-10.5-220-50			220	50	170	18	-				
	FH262	ASC20-10.5-220-120Z			220	120	100	18.5	19.5				
	FH263	ASC20-10.5-270-150Z			270	150	120						
	FH264	ASC20-10.5-270-50Z			270	50	220						
With Airhole	FH145	ASC25-12.5-145-65	12.5	M12	145	65	80	23	-	25	A		
	FH146	ASC25-12.5-265-65			265		200						
	FH265	ASC25-12.5-215-115			215	115	100						
	FH266	ASC25-12.5-265-145			265	145	120						
	FH268	ASC25-12.5-315-65			315	65	250						
	FH267	ASC25-12.5-315-195			315	195	120						
	FH147	ASC32-17-160-80	17	M16	160	80	80	28	32	A			
	FH269	ASC32-17-260-140			260	140	120						
	FH148	ASC32-17-310-80			310	80	230						
	FH270	ASC32-17-360-240			360	240	120						

UK SUPER Lock milling chucks or shrink-fit holders can be used.

DE SUPER Lock Aufnahmen oder Schrumpffutter können verwendet werden.

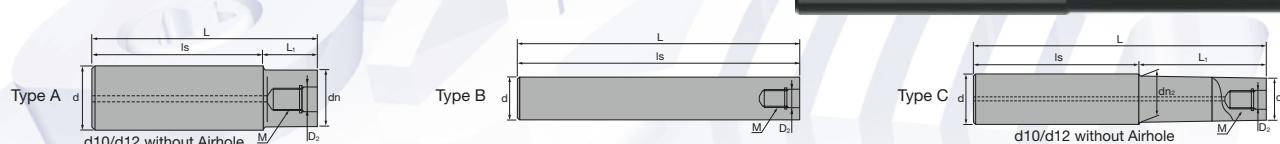
IT Possono essere utilizzati mandrini a forte serraggio SUPER Lock.

ES Aptos para amarrar en portapinzas SUPER Lock.

FR Les attaches SUPER Lock peuvent être utilisés.

PT Cones hidráulicos de grande aperto e aperto térmico podem ser usados.

AS | Steel Shanks for Modular Mills



Steel Shank											
	ID Code	Item Code	D ₂	M	L	L ₁	ls	dn	dn ₂	d	Type
Without Airhole	FH131	AS10-6.5-74-0	6.5	M6	74	-	74	-	-	10	B
	FH132	AS12-6.5-84-4			84	4	80	11	-	12	A
With Airhole	FH133	AS16-8.5-95-15	8.5	M8	95	15	80	14.5	15.5	16	C
	FH134	AS20-10.5-100-20			100	20		18	-	20	A
	FH271	AS25-12.5-115-35			115	35		23	23	25	
	FH272	AS32-17-110-30			110	30		28	28	32	

UK SUPER Lock milling chucks can be used.

DE SUPER Lock Aufnahmen können verwendet werden.

IT Possono essere utilizzati mandrini a forte serraggio SUPER Lock.

ES Aptos para amarrar en portapinzas SUPER Lock.

FR Les attaches SUPER Lock peuvent être utilisés.

PT Cones hidráulicos de grande aperto e aperto térmico podem ser usados.

Indexable Milling Tools

AHUM | High-Feed Ultra End Mill Modular

- ▶ **For further information about Modular Chucks please see our brochure *Indexable Modular Series No. 328.2***
- ▶ **Weitere Informationen über Modulare Werkzeugaufnahmen finden Sie in unserem Prospekt *Indexable Modular Series No. 328.2***
- ▶ **Per maggiori informazioni riguardanti la gamma dei mandrini avvitabili consultate il catalogo *Indexable Modular Series No. 328.2***
- ▶ **Para obtener más información sobre conos modulares consulte nuestro folleto *Indexable Modular Series No. 328.2***
- ▶ **Pour de plus amples informations concernant les attaches modulaires, voyez SVP notre brochure *Indexable Modular Series No. 328.2***
- ▶ **Para mais informações sobre Cones Modulares consulte o nosso folheto *Indexable Modular Series No. 328.2***



Ramping / Helical Milling

UK Ramping

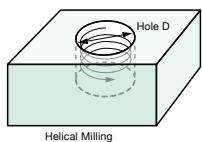
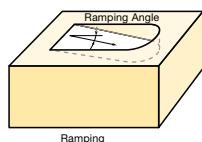
Ramping is possible please use the following data for direct milling without pre-drilling any starter holes.

Germany Fräsoperationen über Rampe

Für Fräsoperationen über Rampe nutzen Sie bitte die nachfolgend abgebildeten Schnittwerte für die direkte Bearbeitung ohne Startlochbohrung.

Italy Lavorazioni in rampa

È possibile lavorare in rampa senza alcun preforo. Usate per questa lavorazione i seguenti dati.



Spain Rampa

El mecanizado en rampa es posible. Por favor, utilizar las condiciones siguientes para mecanizado directo sin pretaladrado.

France Usinage de rampes

Cette application est possible, utilisez, les données suivantes pour un fraisage direct, sans avant trou.

Portugal Rampa

A fresagem em rampa é possível. Por favor utilizar as condições seguintes em maquinado directa sem pré-furo.

Tool Diameter D mm	D 16	D 20	D 25	D 32	D 40	D 50	D 63
Max Ramp Angle°	4°	3°	2.5°	2°	1.5°	1°	1°
Hole D (mm)	21~29	29~37	39~47	53~61	68~80	85~100	107~126

The electronic Hitachi Tool product catalogue



P50QF | Production50 QuickFinder **The Quickly-Finding Software for Tools and Tool Accessories**

Die Software zum schnellen Finden von Werkzeugen und Zubehör

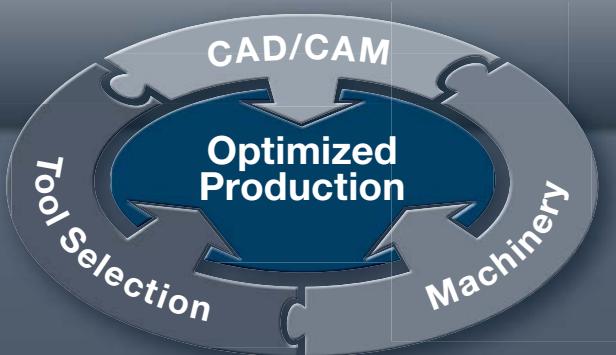
- Real-time search with catalogue browser
- Cutting conditions calculation with project planning
- Shop system
- Online update

- Suche in Echtzeit mit Katalog-Browser
- Schnittwerte-Berechnung mit Projektierung
- Bestellsystem
- Online-Update
- Komplett in Deutsch & Englisch

The electronic Hitachi Tool product catalogue



Quickly find the tools you need for best performance in machining


www.production50.com

Function Buttons / Funktions-Schaltflächen: Brochure, Conditions, Grades, Calculator, Into Basket, Related.

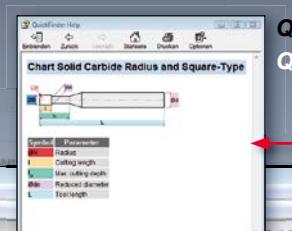
3. Cutting Conditions / Recommended: Overhang, Standing, High Depth, LOA Load, Finishing.

Modification n / Modification VI: Vc, Recommended, Modification n, Modification VI.

Process Information: Title: Moderate feed per tooth; Comment: semi finishing.

Selected product / Ausgewähltes Produkt: EP372 ETM-4080-20

ID code	Item code	Z	ØD	ØR	CR	In	Ø	I	Ødn	L	Ød	Grade	Inserts1	Inserts2	Inserts3
EP597	ETMP-4040-40-10	4	4	1.2	15	1	40	1	6	90	6				
EP370	ETM-4050-12	4	5	1.2	15	10				70	6				
EP598	ETMP-4050-30-12	4	5	1.2	30	1	7.5			90	6				
EP599	ETMP-4050-40-12	4	5	1.2	40	1	7.5			100	6				
EP590	ETMP-4050-50-12	4	5	1.2	50	1	7.5			110	8				
EP211	ETM-4050-15	4	6	1.5	15	2				90	6				
EP279	ETMHN-4060-30-15	4	6	1.5	30	9	5.7			75	6				
EP280	ETMHN-4060-42-15	4	6	1.5	42	9	5.7			80	6				
EP381	ETMHN-4060-54-15	4	6	1.5	54	9	5.7			100	6				
EP601	ETMP-4060-40-15	4	6	1.5	40	1	9			100	8				
EP002	ETMP-4060-55-15	4	6	1.5	55	1	9			110	8				
EP603	ETMP-4060-67-15	4	6	1.5	67	1	9			125	8				
EP372	ETM-4080-20	4	8	2			15			100	8				
EP392	ETMLN-4080-40-20	4	8	2	40	12	7.6	85	8						
EP393	ETMLN-4080-55-20	4	8	2	55	12	7.6	100	8						
EP394	ETMLN-4080-72-20	4	8	2	72	12	7.6	120	8						
EP373	ETM-4100-20	4	10	2			20			110	10				



QuickFinder Help: Details of tools etc.
QuickFinder Hilfe: Werkzeugdetails usw.



Filtering by contour shape
Gefiltert nach Bearbeitungs-Kontur



Additional search parameters
Zusätzliche Parameter-Suche

Download: www.hitachitool-eu.com/quickfinder

Always up to date: Please check our P50 QuickFinder



Product Range

Solid Carbide End Mills

microEndMill

HD COATING

Epoch21

CBN
Cubic Boron Nitride

MINIATURE

3D-Cut

Indexable Milling Tools

**Indexable
Milling**

WHNSB Drills

**WHNSB
NONSTEP BORER**

Milling Chucks

**Milling
Chucks**

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