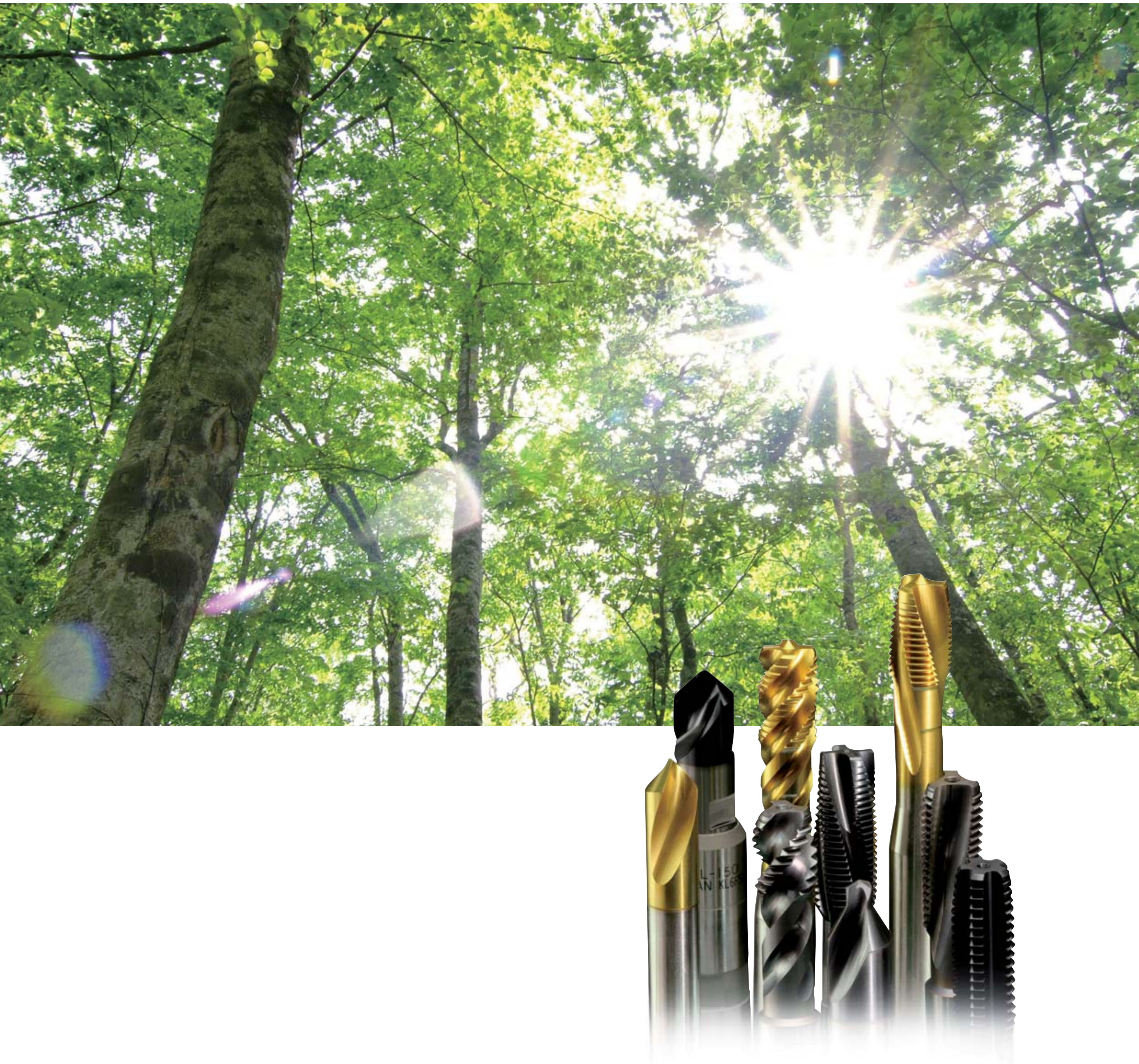
Quick Guide



Think threads with
YAMAWA

Introduction

About Yamawa

Founded in Japan in 1923, Yamawa has made the excellence in taps, dies and centering tools manufacturing as its core mission. Since its foundation, the organization has been focusing on the research and development of the best technologies becoming in this way a global reference for the manufacturing of threading solutions. Products and production process quality has been for over 90 years a milestone, which still distinguishes Yamawa from its competitors: triple quality control on 100% of production, regular calibration of the machinery and the warranty of correspondence to Yamawa's production norms on each tools produced.
Yamawa has been the first Japanese threading taps manufacturer to achieve ISO9001 certification. The company combines innovation of products and processes with high care for the environment and therefore has limited to the bare minimum the impact of its manufacturing plants and achieved ISO14001 in all the production sites.
Yamawa is headquartered in Tokyo and has 4 manufacturing sites distributed throughout Japan: Yonezawa, Fukushima, Aizu and Tsutsumi. With subsidiaries and commercial partners all over the world, Yamawa distributes its products globally and has reinforced the presence in Europe through the foundation of Yamawa Europe, based in Venezia-Mestre (Italy) which officially started operations on January 1st, 2016.

About this Quick Guide

The Quick Guide is a document designed to provide an introduction and summary of all the most important information included in our new general catalogue. The document presents a selection of all the main product lines arranged by work-piece material and the most relevant technical information:

- Simplified product search
- Easy access to technical information
- Light and handy printed edition

The Quick Guide is not meant to be a replacement of the catalogue but rather a complement to it as a taps quick selection tool.
The general catalogue is always the main choice to have an overview of the complete range and to access all the technical information.

All latest updates and documents in digital format are available at www.yamawa.eu.

Yamawa japanese factories

Yonezawa Plant

(ISO9001:1996) (ISO14001:2003)

Yonezawa is the main manufacturing plant of the Yamawa Group, this location is equipped with production lines and is the Quality Control Center. The plant obtained ISO9001 certification in 1996. Of the four Yamawa plants, the Yonezawa location has the longest history of manufacturing and the highest production capacity. Products include roll taps, spiral pointed, pipe and hand taps.
The Yonezawa Plant stepped ahead of our competitors by receiving ISO9001 before any other cutting tool manufacturers in Japan.

Fukushima Plant

(ISO9001:2000) (ISO14001:2002)

The Fukushima plant provides both tap production lines and in house facilities for the manufacturing of specialized production machine tools to produce the exceptional high quality cutting tools. This plant develops and manufactures special taps and die production equipments.
It also supplies these machines to our other manufacturing sites. Products include spiral fluted taps, dies and combined drills/countersinks as well as production machinery.

Aizu Plant

ISO9001:2000) (ISO14001:2002)

Equipped with the most sophisticated machine tools available, this plant is famous for its automation and robotized labor saving manufacturing processes. The plant is designed for mass production of the highest quality cutting tools and screw thread tools. Products include spiral fluted taps and carbide taps.

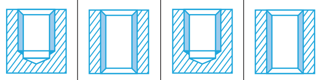
Tsutsumi Plant

(ISO9001:2011) (ISO14001:2011)

The Tsutsumi plant is the main tool blank manufacturing operation of Yamawa group. This location is also the testing center where Yamawa executes the innovation in metal machining and performance tests of the products for the Yamawa group.

CONTENTS

ISO Code



			Cutting taps		Roll taps	
Gr.	**Materials**	**Features**	**Page No.**			
P1	Free cutting steel and structural steel	Rm < 500 N/mm^2	8	12	38	38
P2	Carbon steel and low alloy steel	Rm 500-700 N/mm^2	8	12	38	38
P3	Medium alloy steel and heat treated steel	Rm 600-800 N/mm^2	8	12	38	38
P4	High alloy steel	Rm 800-1000 N/mm^2	8	12	38	38
P5	Tool steel	Rm 900-1200 N/mm^2	8	12	38	38
P6	High tensile strength steel	Rm 1200-1600 N/mm^2	8	12	-	-
M1	Ferritic stainless steel	Rm 400-700 N/mm^2	16	18	38	38
M2	Austenitic stainless steel - good machinability	Rm 500-750 N/mm^2	16	18	38	38
M3	Austenitic stainless steel - medium machinability	Rm 550-850 N/mm^2	16	18	38	38
M4	Austenitic stainless steel - low machinability	Rm 650-950 N/mm^2	16	18	-	-
M5	Martensitic stainless steel	Rm 800-1250 N/mm^2	-	-	-	-
K1	Grey cast iron	HB 150-250	20	22	-	-
K2	Nodular cast iron	HB 150-350	20	22	-	-
K3	Austenitic cast iron	HB 120-260	20	22	-	-
K4	ADI cast iron	HB 250-500	20	22	-	-
N1	Alluminium alloys < 12% Si		24	26	40	40
N2	Alluminium alloys > 12% Si		24	26	40	40
N3	Copper alloys		24	26	40	40
N4	Brass alloys and bronze alloys		24	26	-	-
N5	Plastic materials		-	-	-	-
N6	Fiber and composites		-	-	-	-
S1	Heat resistant super alloys - good machinability	HRC < 25	28	30	-	-
S2	Heat resistant super alloys - medium machinability	HRC 25-35	28	30	-	-
S3	Heat resistant super alloys - low machinability	HRC 35-45	28	30	-	-
S4	Low alloy Titanium - good machinability		-	-	-	-
S5	High alloy Titanium - medium machinability		28	30	-	-
H1	Hardened general steel	HRC 50-56	32	32	-	-
H2	Hardened bearing steel	HRC 54-62	32	32	-	-
H3	Hardened tool steel	HRC 60-65	32	32	-	-
H4	Hardened martensitic stainless steel	HRC 50-56	32	32	-	-
H5	Hardened white cast iron	HRC 48-55	32	32	-	-

Hardness conversion table

Conversion table from Rockwell C hardness of steel

Rockwell C Scale Hardness	Vickers Hardness	Brinell Hardness		Rockwell Hardness*2			Rockwell Superficial Hardness			Shore Hardness	Tensile Strength MPa*1	Rockwell C Scale Hardness*2
		Standard ball	Tungsten Carbide ball	A scale	B scale	D scale	15-N scale	30-N scale	45-N scale			
HRC	HV	HB		HRA	HRB	HRD	HS15N	HS30N	HS45N	HS	–	HRC
68	940	–	–	85.6	–	76.9	93.2	84.4	75.4	97	–	68
67	900	–	–	85.0	–	76.1	92.9	83.6	74.2	95	–	67
66	865	–	–	84.5	–	75.4	92.5	82.8	73.3	92	–	66
65	832	–	(739)	83.9	–	74.5	92.2	81.9	72.0	91	–	65
64	800	–	(722)	83.4	–	73.8	91.8	81.1	71.0	88	–	64
63	772	–	(705)	82.8	–	73.0	91.4	80.1	69.9	87	–	63
62	746	–	(688)	82.3	–	72.2	91.1	79.3	68.8	85	–	62
61	720	–	(670)	81.8	–	71.5	90.7	78.4	67.7	83	–	61
60	697	–	(654)	81.2	–	70.7	90.2	77.5	66.7	81	–	60
59	674	–	(634)	80.7	–	69.9	89.8	76.6	65.5	80	–	59
58	653	–	615	80.1	–	69.2	89.3	75.7	64.3	78	–	58
57	633	–	595	79.6	–	68.5	88.9	74.8	63.2	76	–	57
56	613	–	577	79.0	–	67.7	88.3	73.9	62.0	75	–	56
55	595	–	560	78.5	–	66.9	87.9	73.0	60.9	74	2075	55
54	577	–	543	78.0	–	66.1	87.4	72.0	59.8	72	2015	54
53	560	–	525	77.4	–	65.4	86.9	71.2	58.6	71	1950	53
52	544	(500)	512	76.8	–	64.6	86.4	70.2	57.4	69	1880	52
51	528	(487)	496	76.3	–	63.8	85.9	69.4	56.1	68	1820	51
50	513	(475)	481	75.9	–	63.1	85.5	68.5	55.0	67	1760	50
49	498	(464)	469	75.2	–	62.1	85.0	67.6	53.8	66	1695	49
48	484	451	455	74.7	–	61.4	84.5	66.7	52.5	64	1635	48
47	471	442	443	74.1	–	60.8	83.9	65.8	51.4	63	1580	47
46	458	432	432	73.6	–	60.0	83.5	64.8	50.3	62	1530	46
45	446	421	421	73.1	–	59.2	83.0	64.0	49.0	60	1480	45
44	434	409	409	72.5	–	58.5	82.5	63.1	47.8	58	1435	44
43	423	400	400	72.0	–	57.7	82.0	62.2	46.7	57	1385	43
42	412	390	390	71.5	–	56.9	81.5	61.3	45.5	56	1340	42
41	402	381	381	70.9	–	56.2	80.9	60.4	44.3	55	1295	41
40	392	371	371	70.4	–	55.4	80.4	59.5	43.1	54	1250	40
39	382	362	362	69.9	–	54.6	79.9	58.6	41.9	52	1215	39
38	372	353	353	69.4	–	53.8	79.4	57.7	40.8	51	1180	38
37	363	344	344	68.9	–	53.1	78.8	56.8	39.6	50	1160	37
36	354	336	336	68.4	(109.0)	52.3	78.3	55.9	38.4	49	1115	36
35	345	327	327	67.9	(108.5)	51.5	77.7	55.0	37.2	48	1080	35
34	336	319	319	67.4	(108.0)	50.8	77.2	54.2	36.1	47	1055	34
33	327	311	311	66.8	(107.5)	50.0	76.6	53.3	34.9	46	1025	33
32	318	301	301	66.3	(107.0)	49.2	76.1	52.1	33.7	44	1000	32
31	310	294	294	65.8	(106.0)	48.4	75.6	51.3	32.5	43	980	31
30	302	286	286	65.3	(105.5)	47.7	75.0	50.4	31.3	42	950	30
29	294	279	279	64.7	(104.5)	47.0	74.5	49.5	30.1	41	930	29
28	286	271	271	64.3	(104.0)	46.1	73.9	48.6	28.9	41	910	28
27	279	264	264	63.8	(103.0)	45.2	73.3	47.7	27.8	40	880	27
26	272	258	258	63.3	(102.5)	44.6	72.8	46.8	26.7	38	860	26
25	266	253	253	62.8	(101.5)	43.8	72.2	45.9	25.5	38	840	25
24	260	247	247	62.4	(101.0)	43.1	71.6	45.0	24.3	37	825	24
23	254	243	243	62.0	100.0	42.1	71.0	44.0	23.1	36	805	23
22	248	237	237	61.5	99.0	41.6	70.5	43.2	22.0	35	785	22
21	243	231	231	61.0	98.5	40.9	69.9	42.3	20.7	35	770	21
20	238	226	226	60.5	97.8	40.1	69.4	41.5	19.6	34	760	20
(18)	230	219	219	–	96.7	–	–	–	–	33	730	(18)
(16)	222	212	212	–	95.5	–	–	–	–	32	705	(16)
(14)	213	203	203	–	93.9	–	–	–	–	31	675	(14)
(12)	204	194	194	–	92.3	–	–	–	–	29	650	(12)
(10)	196	187	187	–	90.7	–	–	–	–	28	620	(10)
(8)	188	179	179	–	89.5	–	–	–	–	27	600	(8)
(6)	180	171	171	–	87.1	–	–	–	–	26	580	(6)
(4)	173	165	165	–	85.5	–	–	–	–	25	550	(4)
(2)	166	158	158	–	83.5	–	–	–	–	24	530	(2)
(0)	160	152	152	–	81.7	–	–	–	–	24	515	(0)

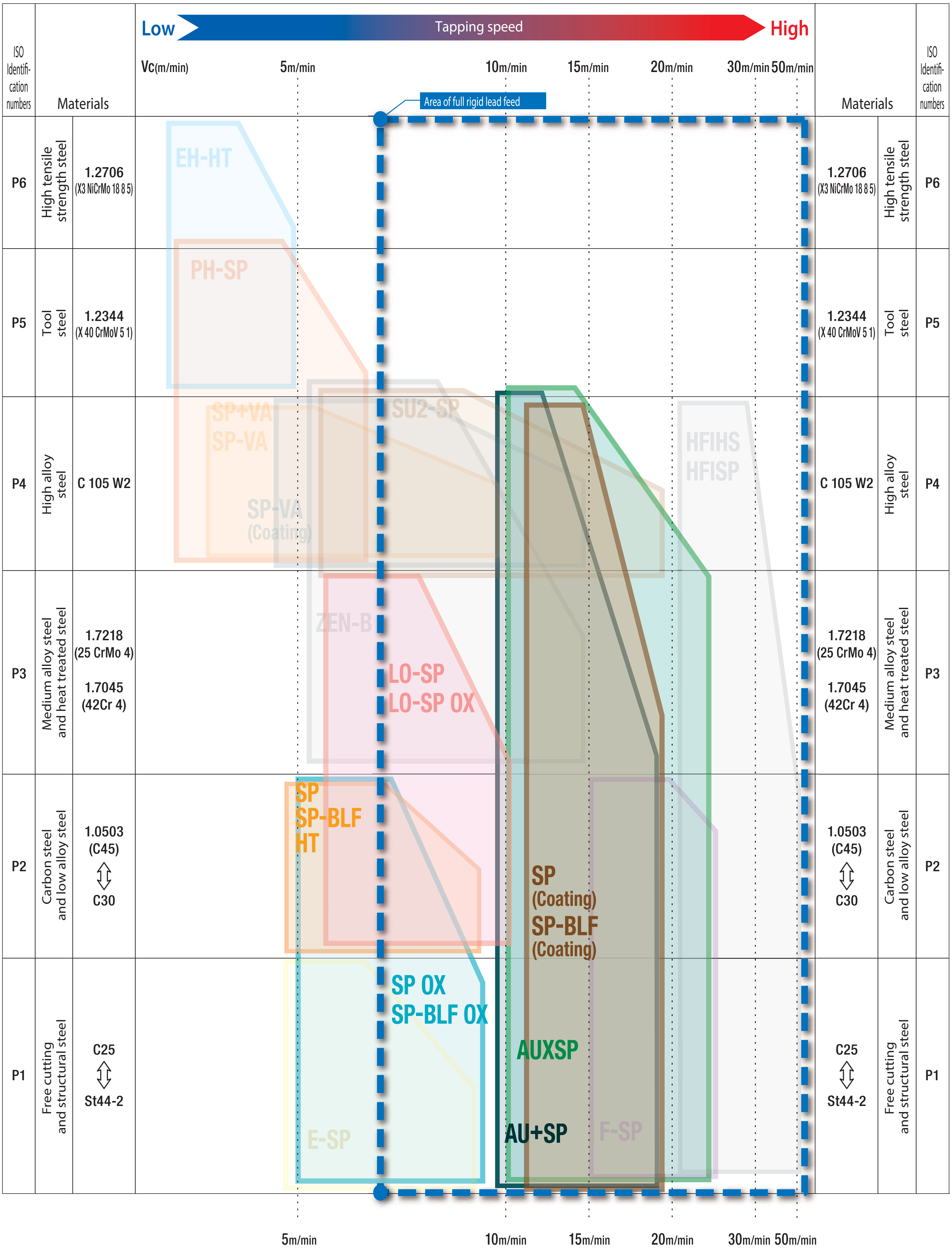
*1: 1Mpa=1N/mm^2
*2: In above table, numbers in parenthesis are only for reference.
This table is abstracted from SAE J 417.

Explanation of icons

HSSE	Class E High Speed Steel
HSS OX	High Speed Steel Oxidizing
HSSE OX	Class E High Speed Steel Oxidizing
HSSE NX	Class E High Speed Steel Nitriding/Oxidizing
HSSE NI	Class E High Speed Steel Nitriding
HSSE Coating	Class E High Speed Steel Coated
HSS-Co	Cobalt High Speed Steel
HSS-Co Coating	Cobalt High Speed Steel Coated
HSS-P NI	Powder High Speed Steel Nitriding
HSS-P Coating	Powder High Speed Steel Coated
HSS-P OX	Powder High Speed Steel Oxidizing
HSS-P NX	Powder High Speed Steel Nitriding / Oxidizing
HF	Ultra-fine micro grain cemented carbide
HF Coating	Ultra-fine micro grain cemented carbide Coated
	For blind hole with through coolant hole
	For through hole with radial coolant hole
Synchronized	For synchronized feeding

CUTTING TAPS APPLICATIONS

ISO P Steel



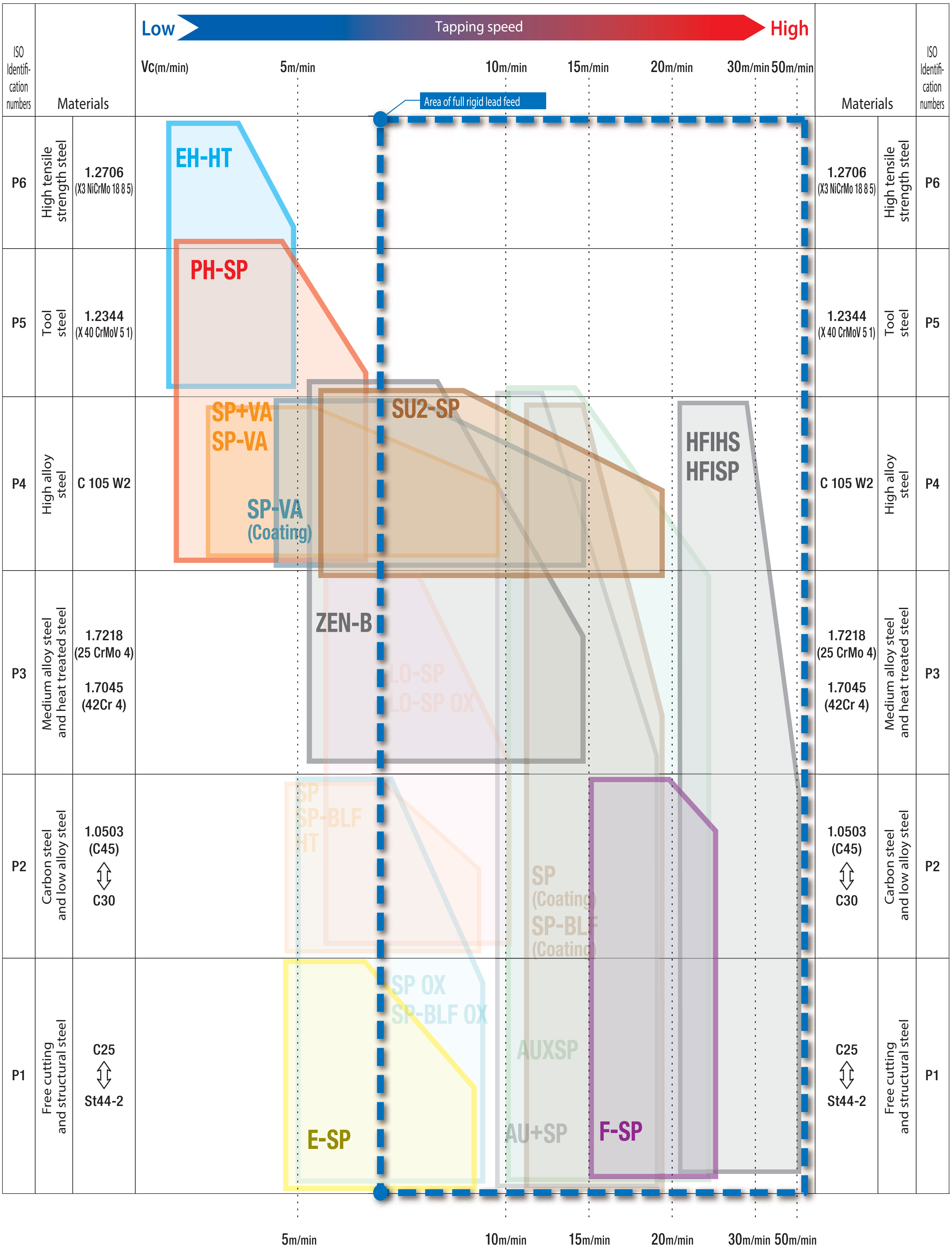
An image telling possible applications

Part 1 - General purpose and universal

	GENERAL PURPOSE									UNIVERSAL		
	HT	LO-SP	LO-SP	SP	SP	SP	SP-BLF	SP-BLF	SP-BLF	AU+SP	AUXSP	
	HSSE	HSSE	HSSE OX	HSSE	HSSE OX	HSSE Coating	HSSE	HSSE OX	HSSE Coating	HSSE Coating	HSSE Coating Synchronized	

Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available

	HT	LO-SP	LO-SP	SP	SP	SP	SP-BLF	SP-BLF	SP-BLF	AU+SP	AUXSP	
M	M2~48 135	M2~30 70	M2~30 73	M2~48 53	M2~48 60	M2~24 58	M3~39 83	M3~39 86	M3~24 85	M3~20 66	M6~12 67	
MF	MF3~48 135	MF8~24 70	MF5~30 73	MF7~48 53	MF4~48 60	MF8~22 58				MF8~20 66	MF8~12 67	
UNC/UNF	No. 4~1.3/4 141			No. 4~1.3/4 55	No. 4~1.3/4 62							
G/Rp	1/16~1.1/2 143 576	1/8~1 71	1/8~1 74	1/16~1.1/2 56 579	1/16~1.1/2 63	1/8-1/2 58						
BSW				1/8~1.3/4 326	3/16~1 335							
NPT/NPTF	1/16~2 305 308			1/16~1 594								
Rc	1/16~4 551			1/16~2 558								
NPS/NPSF	1/8~1 310 311											
PG	7~36 143											

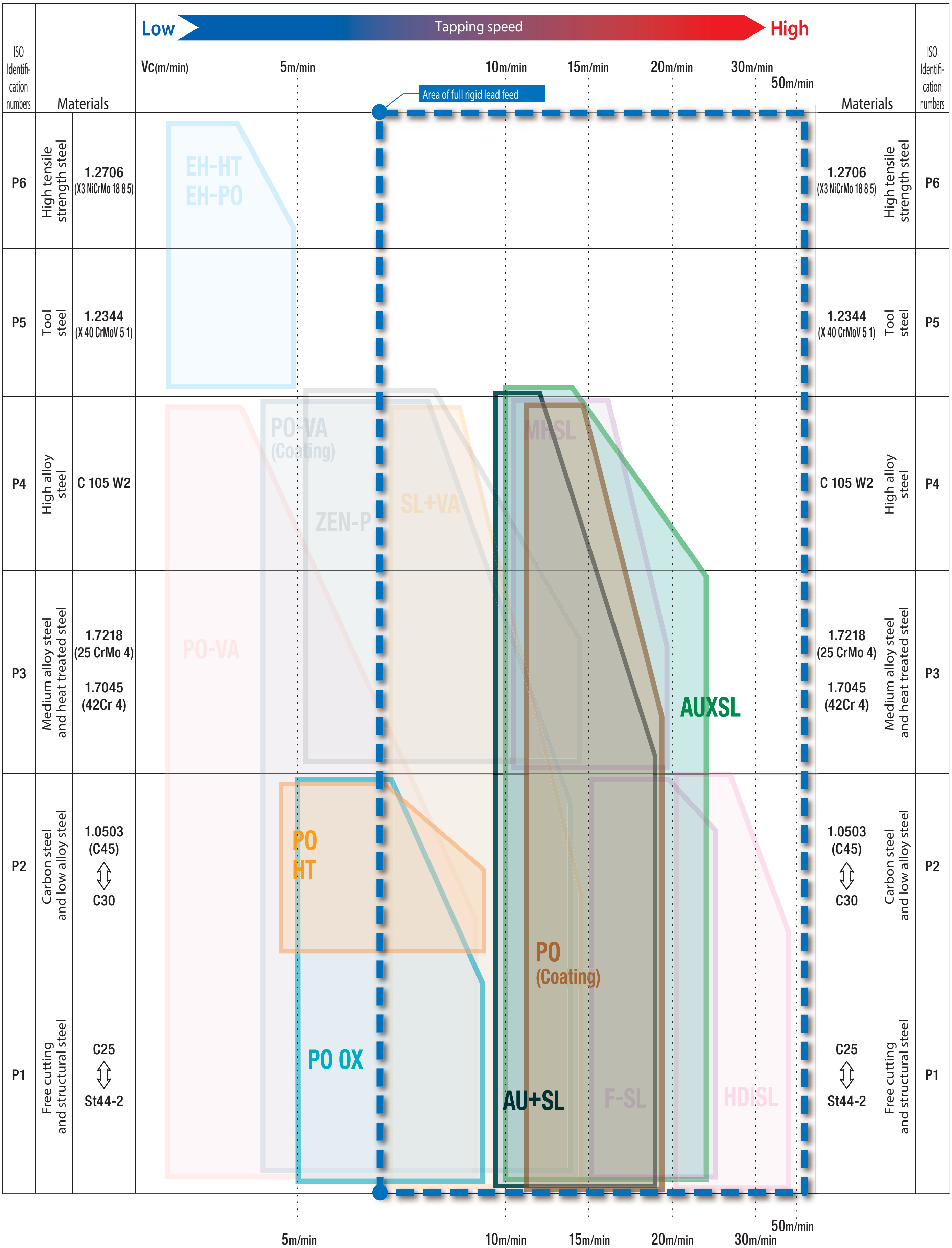


An image telling possible applications

Part 2 - Special purpose and high speed

	SPECIAL PURPOSE								HIGH SPEED			
	E-SP	SP-VA	SP-VA	SP+VA	SU2-SP	ZEN-B	PH-SP	EH-HT	F-SP	HFISP	HFIHS	
	HSSE OX	HSSE OX	HSSE Coating	HSSE OX	HSSE Coating Synchronized	HSS-P OX Synchronized	HSSE OX	HSS-Co	HSSE Coating Synchronized	HSS-Co Coating Synchronized	HSS-Co Coating Synchronized	
M	M3~24 77	M2~36 79	M3~20 82	M3~12 78	M3~24 87	M3~24 89	M3~30 75	M3~24 145	M3~12 93	M6~20 95	M6~20 94	
MF	MF10~24 361	MF8~24 80			MF10~24 356	MF8~16 89	MF8~30 75	MF8~16 145	MF10~12 93	MF10~20 95	MF10~20 94	
UNC/UNF		No. 4~2 80				No. 4~1 90		No. 4~3/4 271	No. 4~3/4 220			
G/Rp		1/8~3/4 81			1/8~3/4 87		1/8~1/2 76	1/8~1/2 146				
BSW		3/16~1 354										
NPT/NPTF		1/16~1 302 303						1/8~3/4 304				
Rc												
NPS/NPSF												
PG												

Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available



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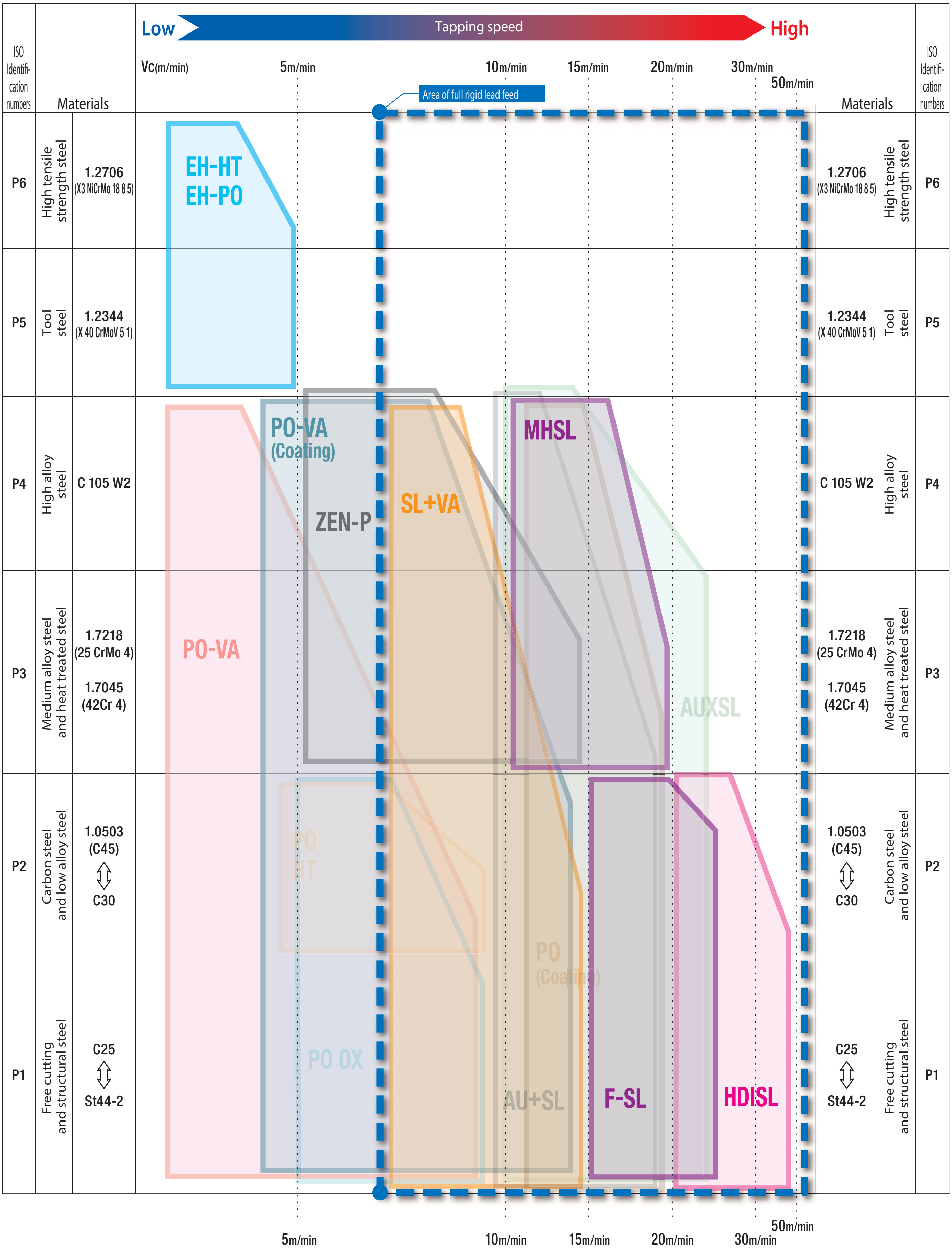
Part 1 - General purpose and universal

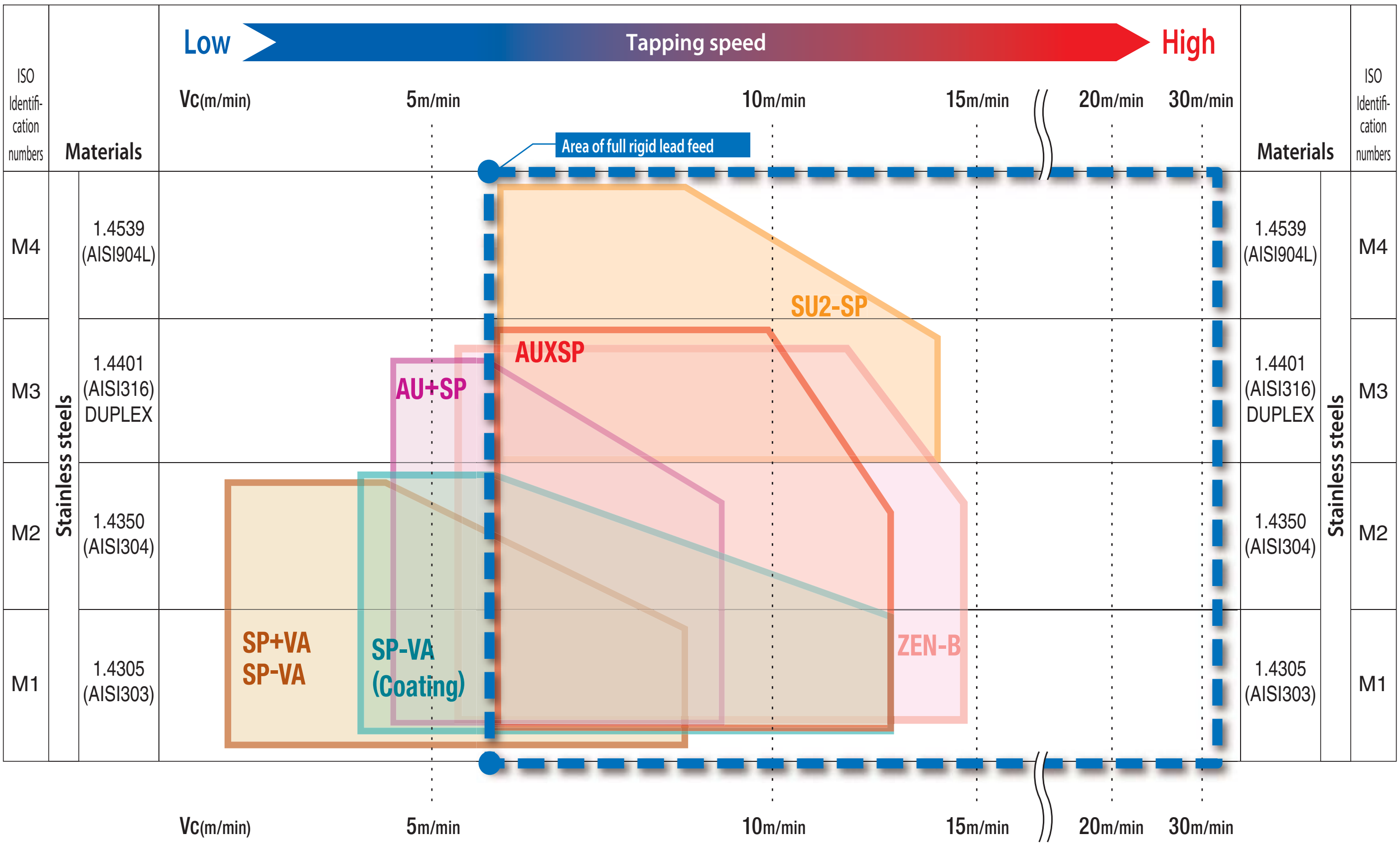
	GENERAL PURPOSE				UNIVERSAL							
	HT	PO	PO	PO	AU+SL	AUXSL						
	HSSE	HSSE	HSSE OX	HSSE Coating	HSSE Coating	HSSE Coating Synchronized						
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M2~48 135	M1.4~48 115	M2~48 122	M2~24 117	M3~12 107	M6~12 108						
MF	MF3~48 135	MF4~48 115	MF4~48 122	MF8~20 117	MF8~12 107	MF8~12 108						
UNC/UNF	No. 4~1.3/4 141	No. 4~1.3/4 117	No. 4~1.3/4 124									
G/Rp	1/16~1.1/2 143 576	1/16~1.1/2 118 401	1/16~1.1/2 125	1/8~1/2 118								
BSW		1/8~1.1/2 401										
NPT/NPTF	1/16~2 305 308											
Rc	1/16~4 551											
NPS/NPSF	1/8~1 310 311											
PG	7~36 143											



An image telling possible applications

Part 2 - Special purpose, high performance and high speed

	SPECIAL PURPOSE						HIGH PERFORMANCE	HIGH SPEED				
	PO-VA	PO-VA	SL+VA	ZEN-P	EH-PO	EH-HT	MHSL	F-SL	HDISL			
	HSSE OX	HSSE Coating	HSSE OX	HSS-P NX Synchronized	HSS-Co	HSS-Co	HSS-Co Coating Synchronized	HSSE Coating Synchronized	HSS-Co Coating Synchronized			
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M2~36 127	M2~20 129	M3~12 102	M3~24 130	M3~24 126	M3~24 145	M6~12 105	M3~12 110	M6~20 111			
MF	MF8~24 127			MF10~16 130	MF8~20 126	MF8~16 145	MF10~16 105	MF10~12 110	MF10~20 111			
UNC/UNF	No. 4~2 128			No. 6~1 130		No. 4~3/4 271		No. 4~3/4 224				
G/Rp						1/8~1/2 146						
BSW	3/16~3/4 417											
NPT/NPTF						1/8~3/4 304						
Rc												
NPS/NPSF												
PG												



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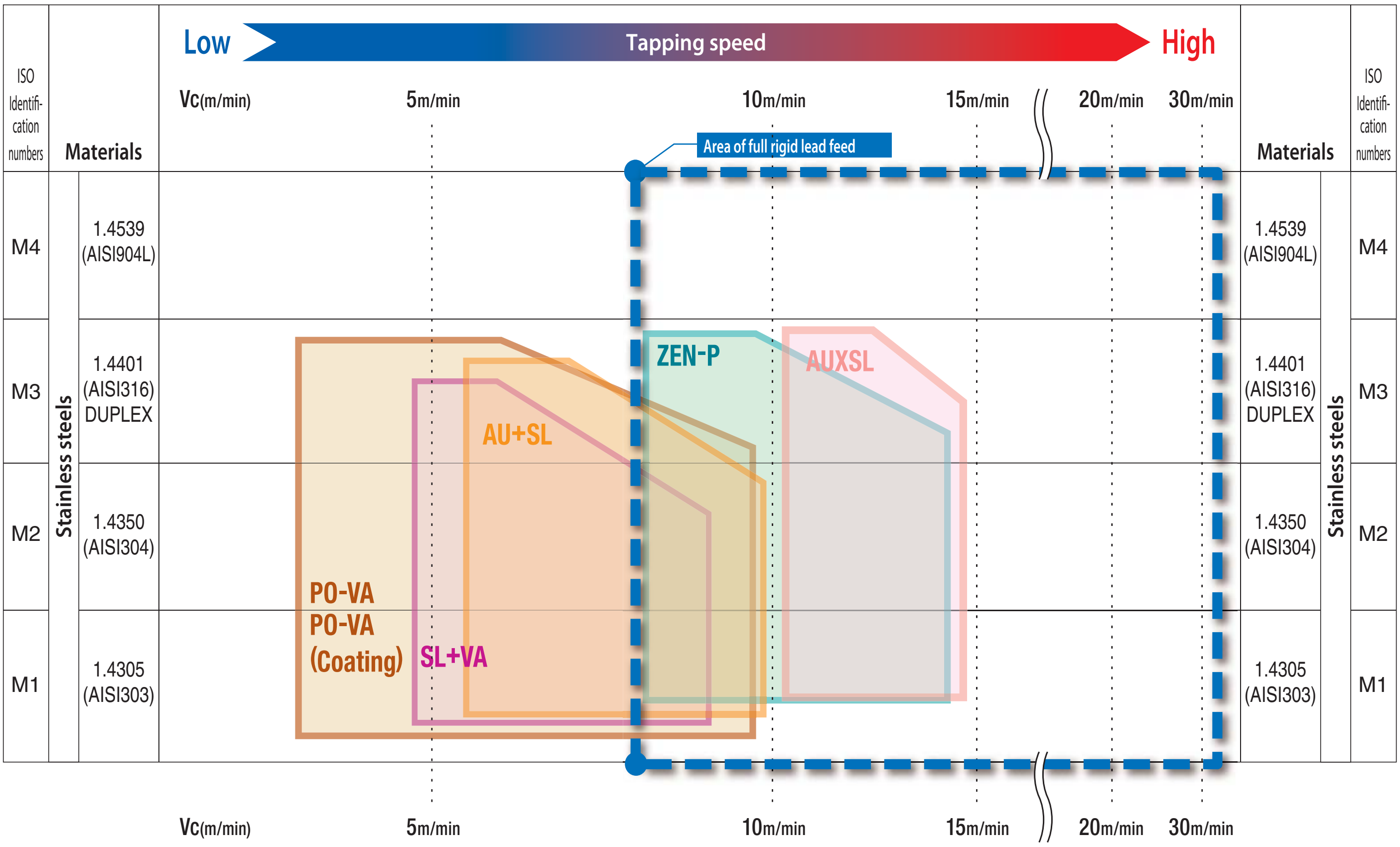
	UNIVERSAL		SPECIAL PURPOSE									
	AU+SP	AUXSP	SP-VA	SP-VA	SP+VA	SU2-SP	ZEN-B					
	HSSE Coating	HSSE Coating Synchronized	HSSE OX	HSSE Coating	HSSE OX	HSSE OX Synchronized	HSS-P OX Synchronized					
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M3~20 66	M6~12 67	M2~36 79	M3~20 82	M3~12 78	M3~24 87	M3~24 89					
MF	MF8~20 66	MF8~12 67	MF8~24 80			MF10~24 356	MF8~16 89					
UNC/UNF			No. 4~2 80				No. 4~1 90					
G			1/8~3/4 81			1/8~3/4 87						
BSW			3/16~1 354									
NPT/NPTF			1/16~1 302 303									
STI (EG) UNC/UNF							No. 2~1/2 218					



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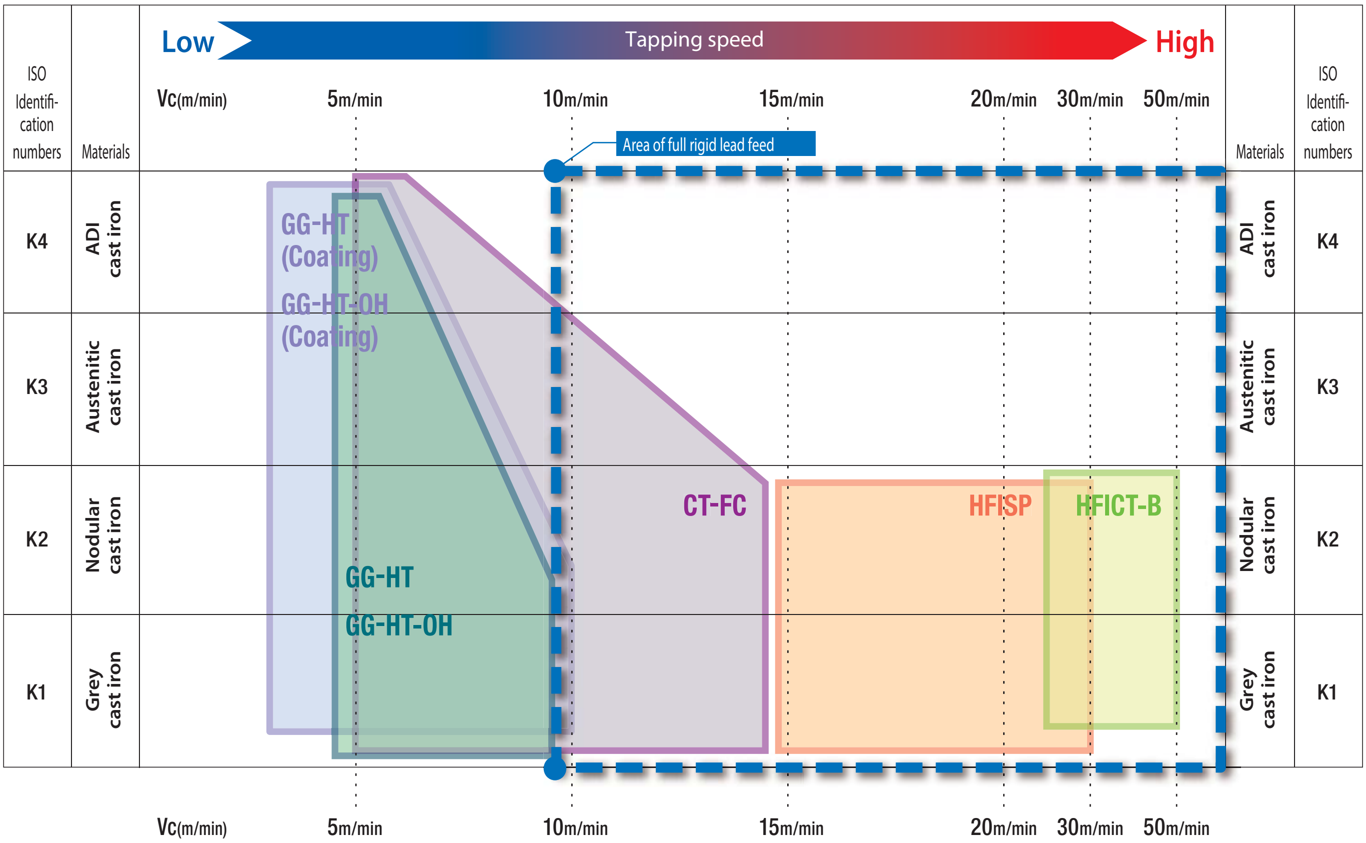
	UNIVERSAL		SPECIAL PURPOSE									
	AU+SL	AUXSL	PO-VA	PO-VA	SL+VA	ZEN-P						
	HSSE Coating	HSSE Coating, Synchronized	HSSE OX	HSSE Coating	HSSE OX	HSS-P NX, Synchronized						

Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available

	AU+SL	AUXSL	PO-VA	PO-VA	SL+VA	ZEN-P						
M	M3~12 107	M6~12 108	M2~36 127	M2~20 129	M3~12 102	M3~24 130						
MF	MF8~12 107	MF8~12 108	MF8~24 127			MF10~16 130						
UNC/UNF			No. 4~2 128			No. 6~1 130						
BSW			3/16~3/4 417									
NPT/NPTF												
STI (EG) UNC/UNF						No. 2~1/2 249						



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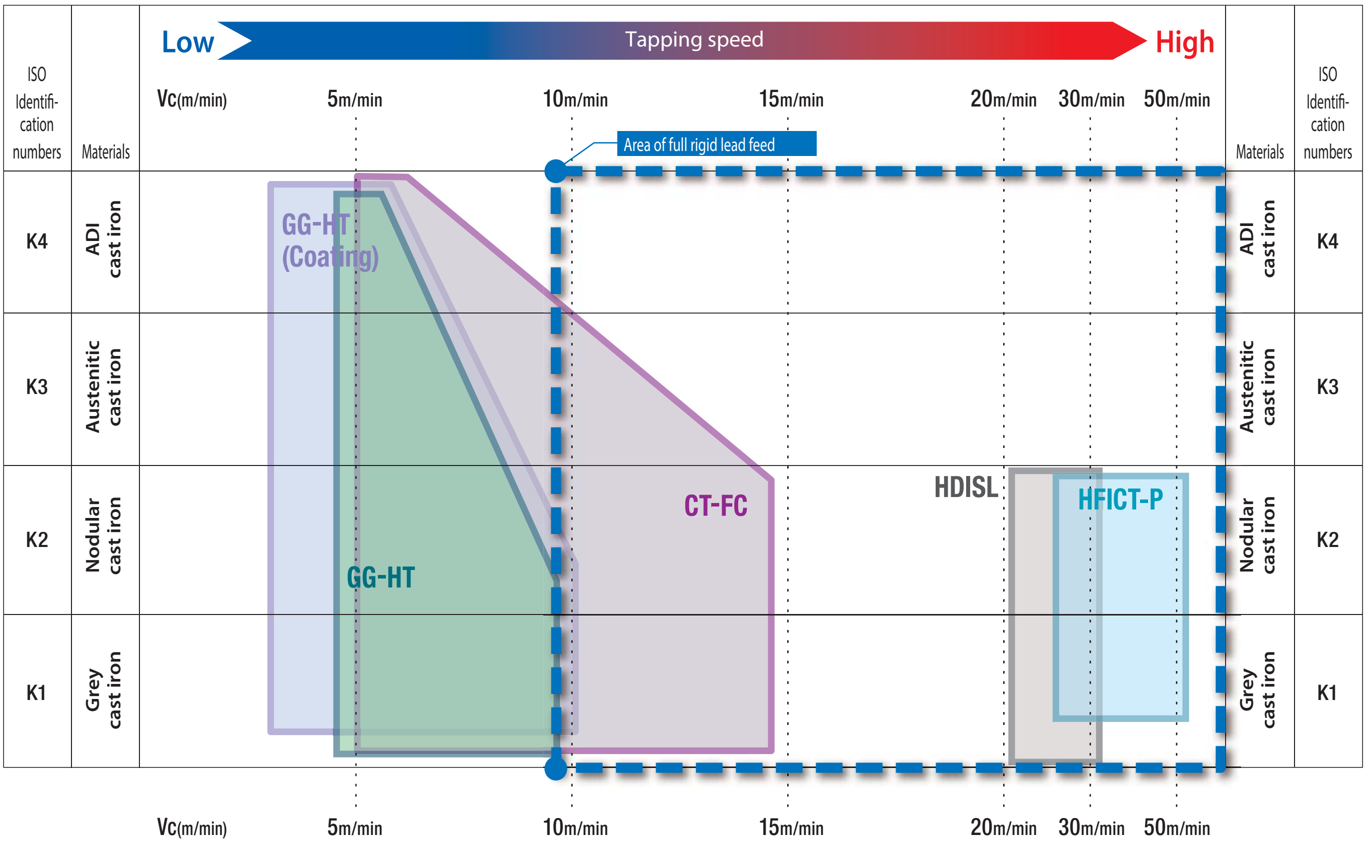
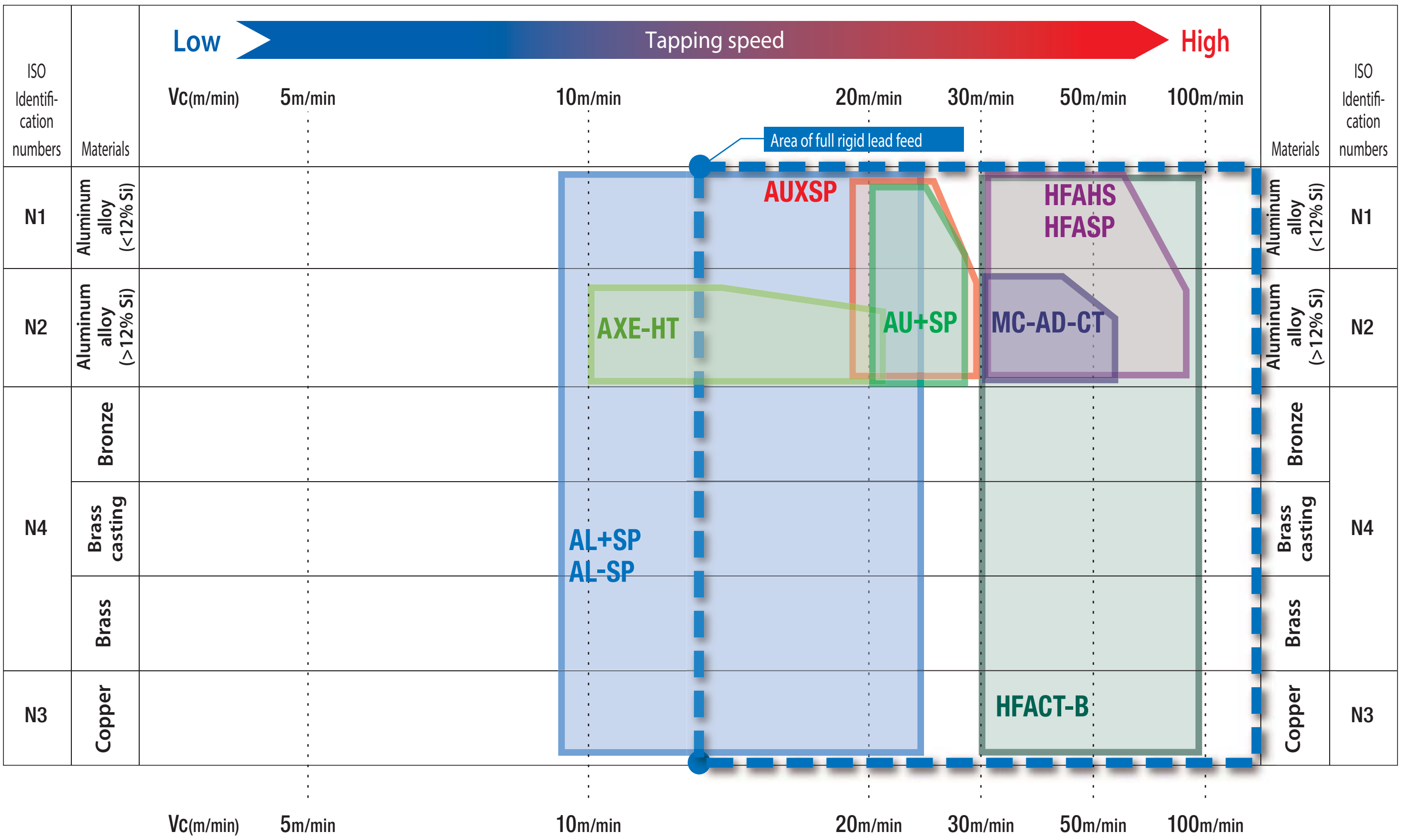
	SPECIAL PURPOSE					HIGH SPEED						
	GG-HT	GG-HT	GG-HT-OH	GG-HT-OH	CT-FC	HFISP	HFICT-B					
	HSSE NI	HSSE Coating	HSSE NI	HSSE Coating	HF	HSS-Co Coating, Synchronized	HF Coating, Synchronized					
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M3~24 147	M3~24 149	M6~20 151	M6~20 152	M3~16 158	M6~20 95	M6~12 493					
MF	MF8~24 147	MF8~24 149	MF8~22 151	MF8~22 152	MF8~16 277	MF10~20 95	MF10~12 493					
UNC/UNF	1/4~3/4 264				No. 10~5/8 278							
G/Rp	1/8~1 148	1/8~1/2 150			1/8~1 590 581							
NPT/NPTF	1/8~2 307 309											
Rc	1/16~2 571				1/8~1 573							



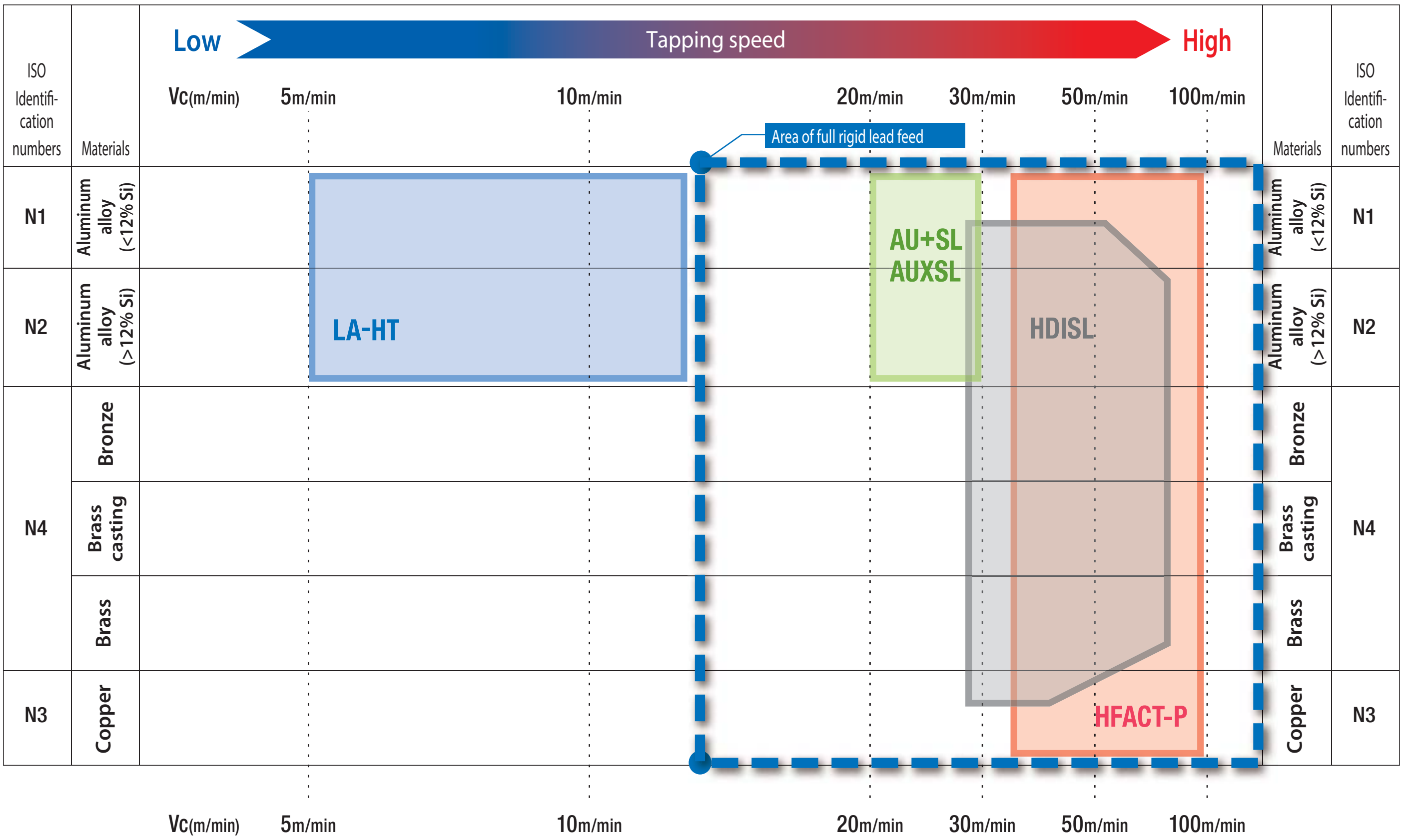
An image telling possible applications

	SPECIAL PURPOSE			HIGH SPEED	
	GG-HT	GG-HT	CT-FC	HDISL	HFICT-P
	HSSE NI	HSSE Coating	HF	HSS-Co Coating, Synchronized	HF Coating, Synchronized
					
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available				
M	M3~24 147	M3~24 149	M3~16 158	M6~20 111	M6~12 492
MF	MF8~24 147	MF8~24 149	MF8~16 277	MF10~20 111	MF10~12 492
UNC/UNF	1/4~3/4 264		No. 10~5/8 278		
G/Rp	1/8~1 148	1/8~1/2 150	1/8~1 590 581		
NPT/NPTF	1/8~2 307 309				
Rc	1/16~2 571		1/8~1 573		



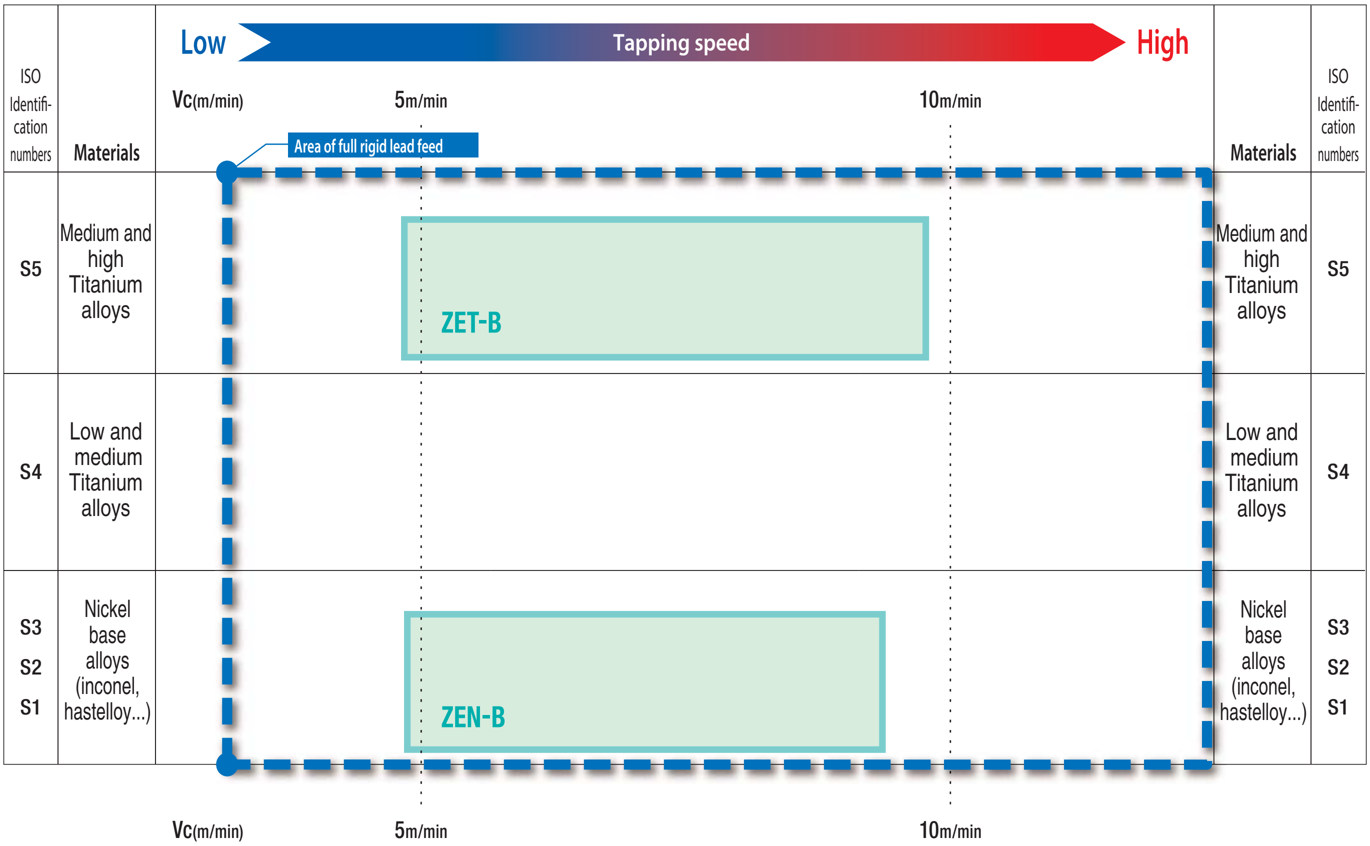
An image telling possible applications

	UNIVERSAL		SPECIAL PURPOSE		HIGH PERFORMANCE		HIGH SPEED					
	AU+SP	AUXSP	AL+SP	AL-SP	AXE-HT	MC-AD-CT	HFASP	HFAHS	HFACT-B			
	HSSE Coating	HSSE Coating Synchro nized	HSSE NI	HSSE NI	HSS-P Coating Synchro nized	HF Coating Synchro nized	HSS-Co Coating Synchro nized	HSS-Co Coating Synchro nized	HF Coating Synchro nized			
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M3~20 66	M6~12 67	M2~6 69	M8~16 69	M6~12 155	M6~12 487	M6~12 97	M6~12 96	M6~12 491			
MF	MF8~20 66	MF8~12 67		MF10~16 366	MF8~12 155	MF10~12 487	MF10~12 97	MF10~12 96	MF10~12 491			
UNC/UNF				No. 2~1/2 205								
STI (EG) M				3~24 367								



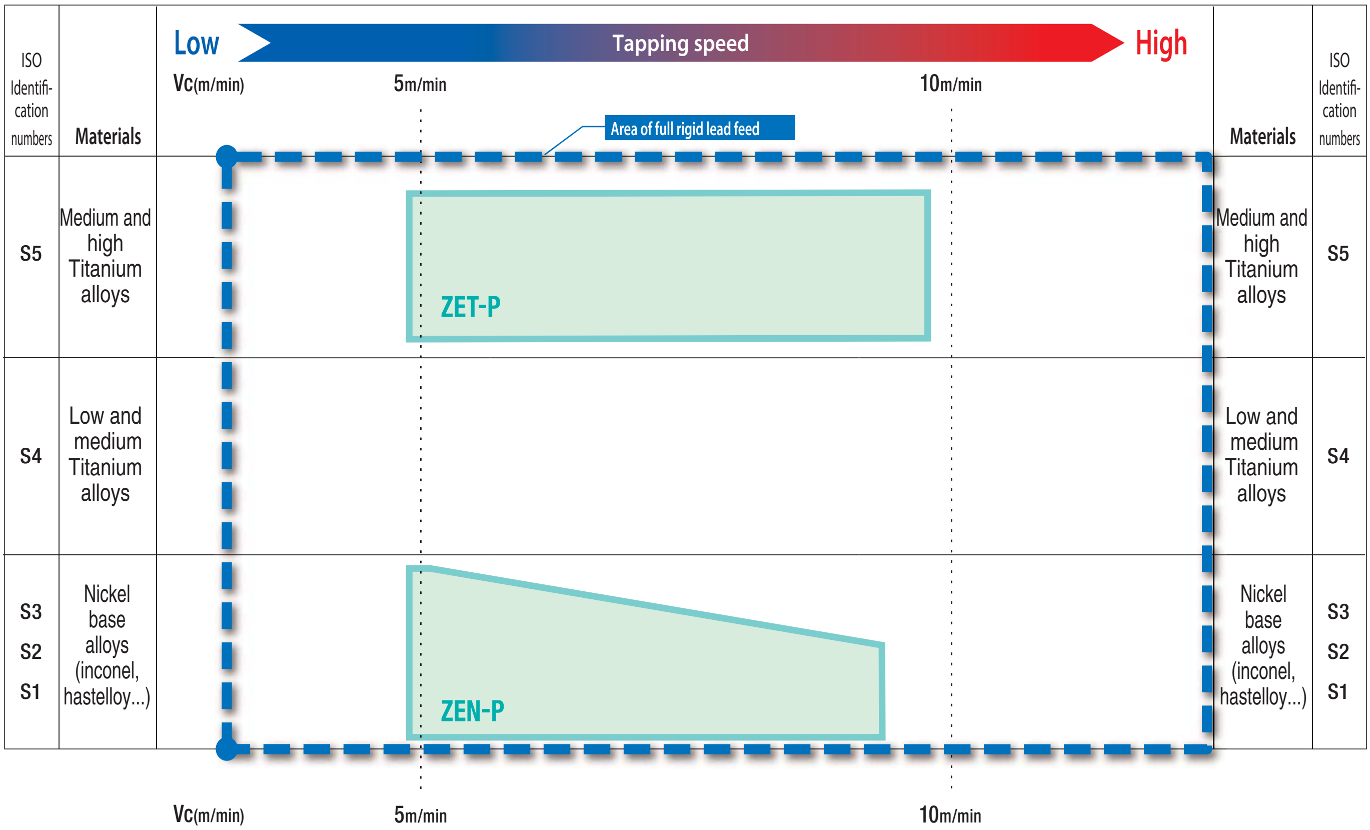
An image telling possible applications

	UNIVERSAL		SPECIAL PURPOSE	HIGH SPEED								
	AU+SL	AUXSL	LA-HT	HDISL	HFACT-P							
	HSSE Coating	HSSE Coating Synchro nized	HSSE NI	HSS-Co Coating Synchro nized	HF Coating Synchro nized							
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M3~12 107	M6~12 108	M3~16 153	M6~20 111	M6~12 490							
MF	MF8~12 107	MF8~12 108	MF8~24 464	MF10~20 111	MF10~12 490							
STI (EG) M			2.6~24 467									
STI (EG) UNC/UNF			No. 4~3/4 468									



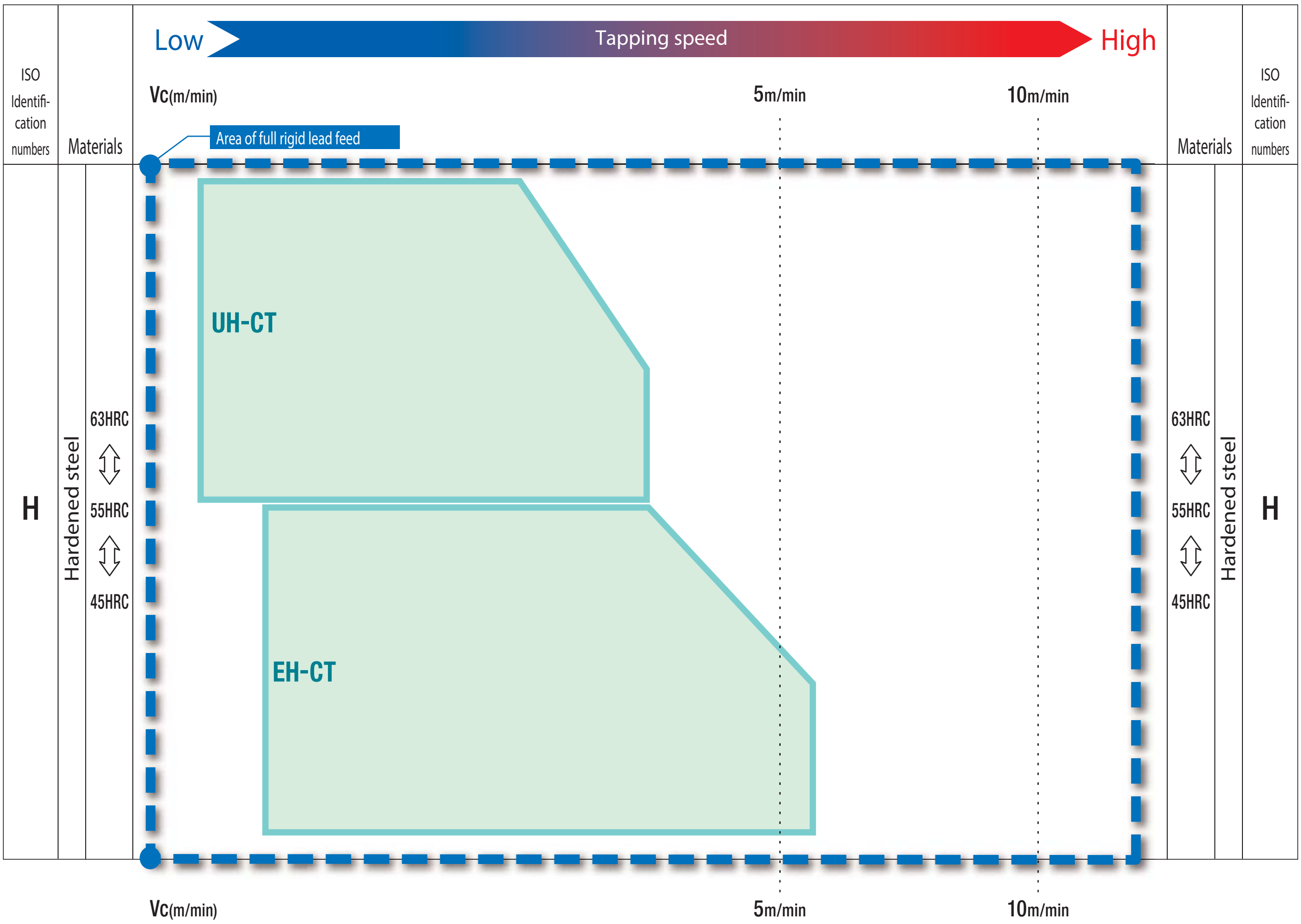
An image telling possible applications

	SPECIAL PURPOSE											
	ZEN-B	ZET-B										
	HSS-P OX Synchro nized	HSS-P NI Synchro nized										
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M3~24 89	M3~24 91										
MF	MF8~16 89	MF8~16 91										
UNC/UNF	No. 4~1 90	No. 4~3/4 92										
STI (EG) UNC/UNF	No. 2~1/2 218											



An image telling possible applications

	SPECIAL PURPOSE											
	ZEN-P	ZET-P										
	HSS-P NX Synchro nized	HSS-P NI Synchro nized										
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M3~24 130	M3~16 109										
MF	MF10~16 130	MF8~16 109										
UNC/UNF	No. 6~1 130	No. 2~3/4 222										
STI (EG) UNC/UNF	No. 2~1/2 249											



An image telling possible applications

	SPECIAL PURPOSE											
	EH-CT	**UH-CT**										
	HF Coating Synchro nized	HF Coating Synchro nized										
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M3~12 161	M3~20 163										
MF		MF10~20 489										

FORMING TAPS APPLICATIONS

Introduction to Thread Forming Taps (Roll Taps)

Thread Forming Taps are the tools used for producing internal threads by a thread forming process. Currently, Yamawa's Thread Forming Taps have a good reputation by being used in many areas. They are widely used along with the diversity of workpieces and with the change into miniaturization of workpieces. Followings are the characteristics and features of Thread Forming Taps (Roll Taps) which are not available with cutting taps.

Features of Roll Taps

- Tapping without producing chips. They are suitable for blind hole tapping. In producing internal threads with no chips, they save you a time for chip disposal.
- Roll taps are stronger than cutting taps due to their design. The effect of fluteless design gives a large cross-section area to the tap, and there is no worry of chip jamming, which makes Roll taps very tough against breakage.
- Roll taps produce excellent pitch diameter well within pitch diameter tolerances. Material deformation process produces the internal threads with good surface finish as well as precise pitch diameter.
- High efficiency and tool life. The configuration of the lobes at the crests of the tap threads makes high speed tapping possible and extends tool life compared with cutting type taps. The addition of a supplemental tap surface treatment, such as Oxidizing, Nitriding, TiN, and TiCN can extend tool life 2 to 20 times over an uncoated (bright) tap performance.

Points to note during a Roll tapping operation

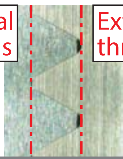
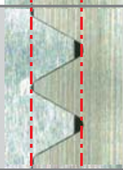
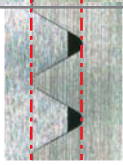
- Tapping torque is 2 to 3 times larger than that of cutting type taps.
- Roll tapping is only applicable to materials producing stringy chips.
- The deviation of hole size before tapping should be about 5% of pitch. The control of hole size before tapping should be more severe than that of cutting type taps.
- The selection of lubricants is important to prevent sticking or welding.
- Burrs at the face of an internal thread are larger than those produced by cutting type taps. In some cases it is necessary to take additional countersink processing at the top of hole.
- In the minor diameter of internal thread, U-shape form (Tine form) at the hole entrance can be seen. U-shape form is never seen when using cutting type taps.

Selection of Yamawa Roll Taps

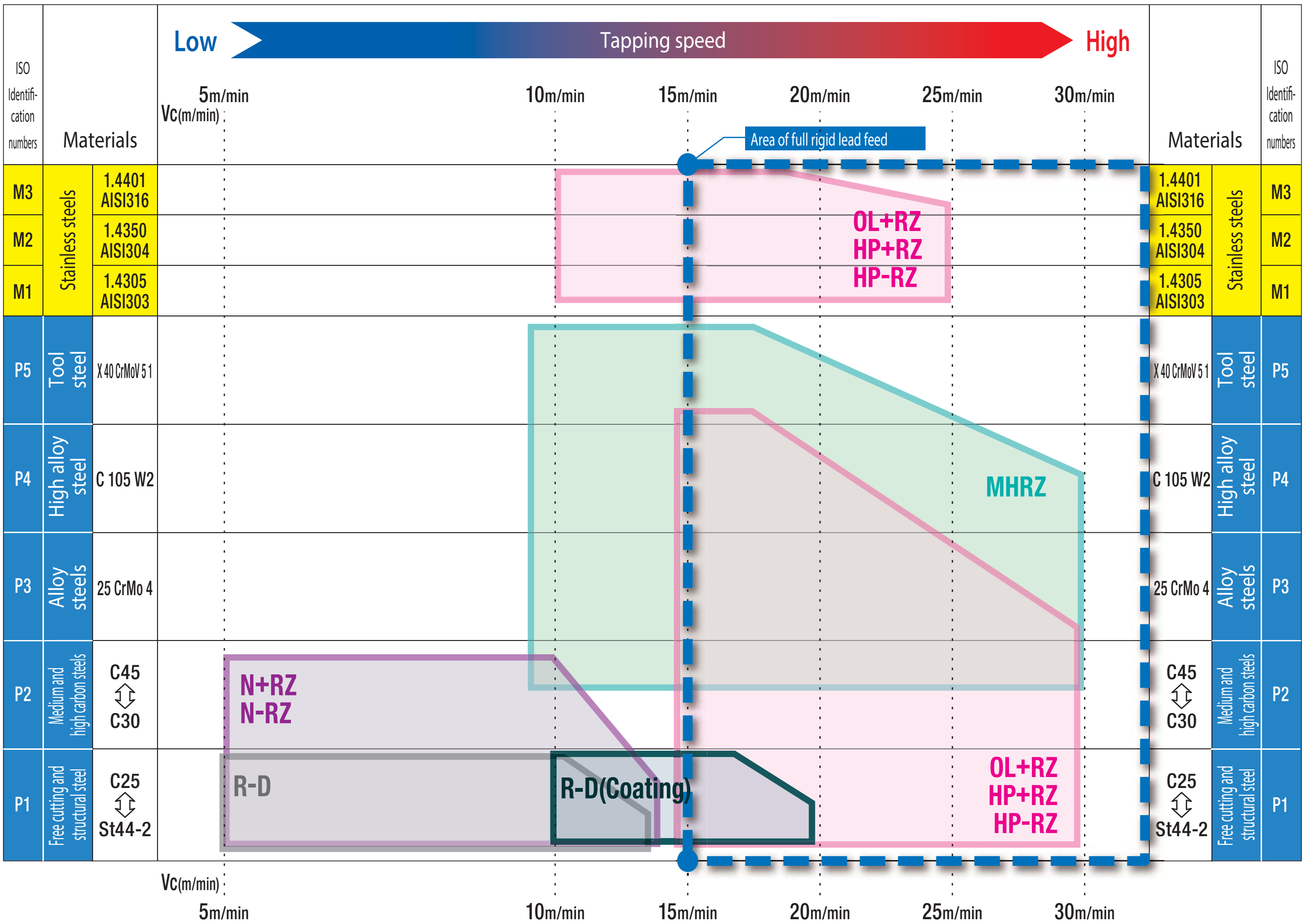
- Types of Roll Taps. Yamawa produces various types of Roll Taps which include General purpose taps, Special purpose taps for non-ferrous and steel, as well as special purpose taps with surface treatment for the specified applications. To provide for longer tool life, specially developed premium materials are also used together with physical vapor deposition coating (PVD) such as TiN and TiCN. In particular, OL-RZ is superior product developed for dry machining with regards to tapping environment and performance.
- Tap Materials. Yamawa's standard tap material is SKH58 designed for improving torque, superior anti-friction properties as well as toughness. To extend tool life, we use SKH56, or SKH10(Powder HSS) which is the best tap material for antifriction.
- Tolerance Class. Using the datum 12.7μm in a step form, in accordance with ANSI standard GH class, we made up Yamawa's G class system. The differences in materials being Roll tapped, as well as hole size, contribute to differences in thread forming. Yamawa offers 2 to 3 oversized tap tolerance classes in order to achieve the most suitable internal thread pitch diameter size.
- Chamfer length. Chamfer lengths: 2 pitches for blind hole use and 4 pitches for through hole use. Basically 4 pitches have longer tool life than 2 pitches because force applied on one blade at 4 pitch chamfer is smaller than that at 2 pitch chamfer. However, it is difficult to say about tool life in a few words because each different tapping condition influences the tool life.

■ Shape of internal threads and the ratio of thread engagement affected by bored hole diameter

Compared with the basic height of thread engagement, the actual height of the thread engagement is called "thread engagement ratio" in percentage.
Depending on the bored hole diameter, internal threads and thread engagement ratio will change.
In tapping, the tapping condition must be chosen by referring to the thread engagement ratio.
The portion of material to be formed can be reduced by selecting the largest possible bored hole diameter. In this way the load on taps is reduced, decreasing tap's wear and damage.

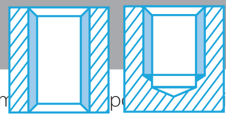
S50C, minor diameter of threads cut M24x3 minor dia tolerance of internal threads φ20.752~φ21.252	
【S50C internal threads cut ①】 M24x3 bored hole size : φ20.652 minor dia tolerance of internal threads NG thread engagement ratio: 103.1%	
【S50C internal threads cut ③】 M24x3 bored hole size : φ21.000 minor dia tolerance of internal threads: Middle thread engagement ratio: 92.4%	
【S50C internal threads cut ⑤】 M24x3 bored hole size : φ21.352 minor dia tolerance of internal threads NG thread engagement ratio: 81.5%	

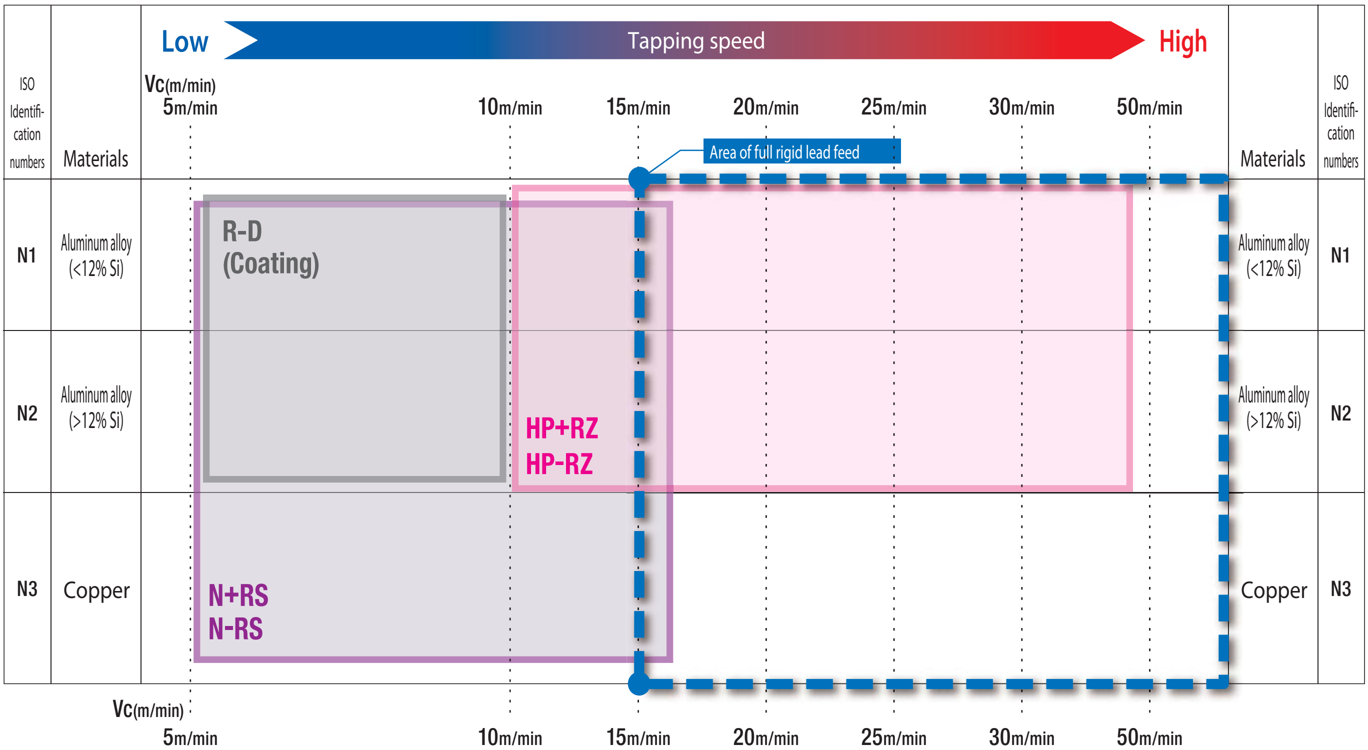
Aluminum, minor diameter of threads formed M25x2 minor dia tolerance of internal threads φ22.835~φ23.210	
【Aluminum, internal threads formed ①】 M25x2 bored hole size : φ23.903 minor diameter of finished internal threads : 22.723mm minor dia tolerance of internal threads NG thread engagement ratio: 105.2%	
【Aluminum, internal threads formed ③】 M25x2 bored hole size : φ24.042mm minor diameter of finished internal threads : 23.067mm minor dia tolerance of internal threads : Middle thread engagement ratio: 89.3%	
【Aluminum, internal threads formed ⑤】 M25x2 bored hole size : φ24.240mm minor diameter of finished internal threads : 23.462mm minor dia tolerance of internal threads NG thread engagement ratio: 71.0%	



An image telling possible applications

	GENERAL PURPOSE		SPECIAL PURPOSE		HIGH PERFORMANCE							
	R-D	R-D	N+RZ	N-RZ	OL+RZ	HP+RZ	HP-RZ	MHRZ				
	HSSE	HSSE Coating	HSSE OX	HSSE OX	HSS-P Coating	HSS-P Coating	HSS-P Coating	HSS-Co Coating				
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M2~16 166	M2~16 166	M2~6 170	M8~16 170	M3~6 171	M2~6 172	M8~16 172	M6~10 175				
MF				MF2~20 497			MF10~16 173	MF10~14 175				
UNC/UNF				No. 0~1/2 283	No. 2~1/4 290		No. 0~1/2 292					
G	1/8~3/8 166	1/8~3/8 166										



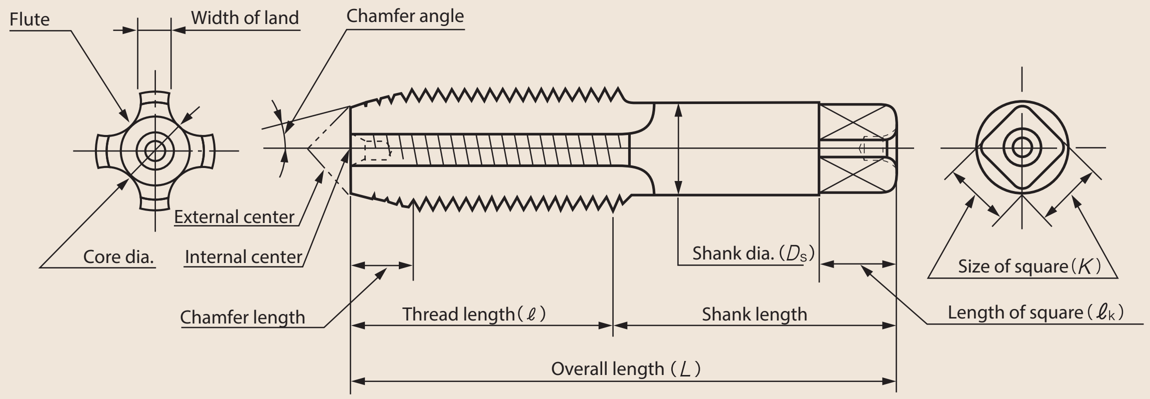


An image telling possible applications

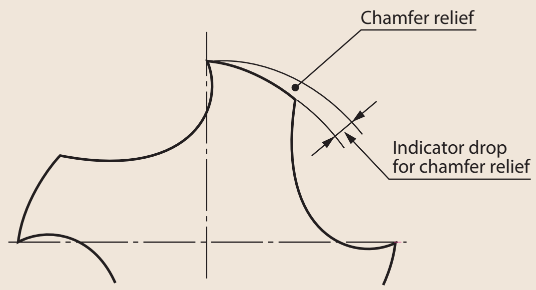
	GENERAL PURPOSE	SPECIAL PURPOSE		HIGH PERFORMANCE								
	R-D	N+RS	N-RS	HP+RZ	HP-RZ							
	HSSE Coating	HSSE OX	HSSE OX	HSS-P Coating	HSS-P Coating							
												
	Please refer to Yamawa general catalogue page for a complete view on sizes, tolerances and chamfers available											
M	M2~16 166	M2~6 169	M8~12 169	M2~6 172	M8~16 172							
MF			MF2~20 503		MF10~16 173							
UNC/UNF			No. 0~1/2 287		No. 0~1/2 292							
G	1/8~3/8 166											
STI (EG) M			3~12 507									

TECHNICAL INFORMATION

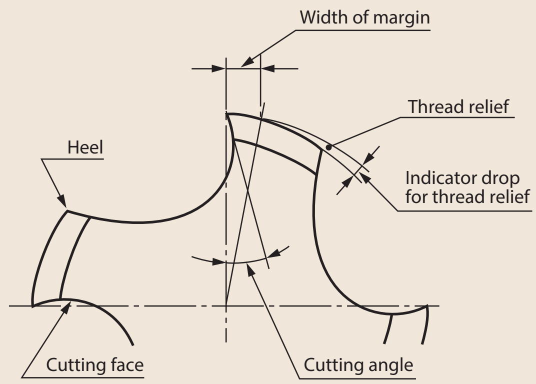
1. Terminology of Taps



■ Chamfer relief



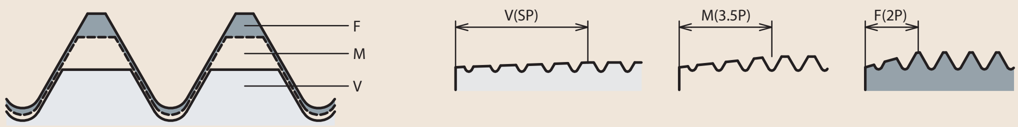
■ Thread relief and cutting angle



Edge angle, including chamfer relief, thread relief, cutting angle and others, as well as heat treatment, have important functions affecting workpiece shape, tool life, surface finish of internal screw thread, and so on.

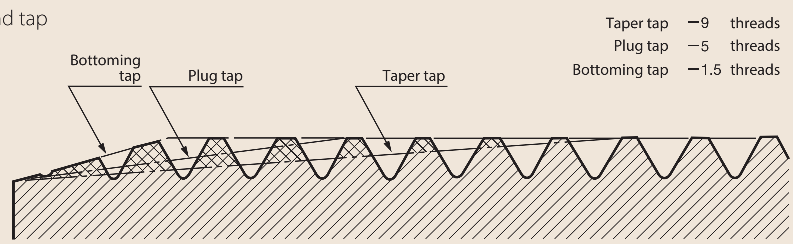
■ Chamfer of hand tap

○DIN series



Serial taps come in sets of three or two to complete screw threads by cutting work materials in incremental steps.
The first tap (V) and the second tap (M) cut screw threads under size.
Then, the third tap (F) completes the screw threads.

○Hand tap

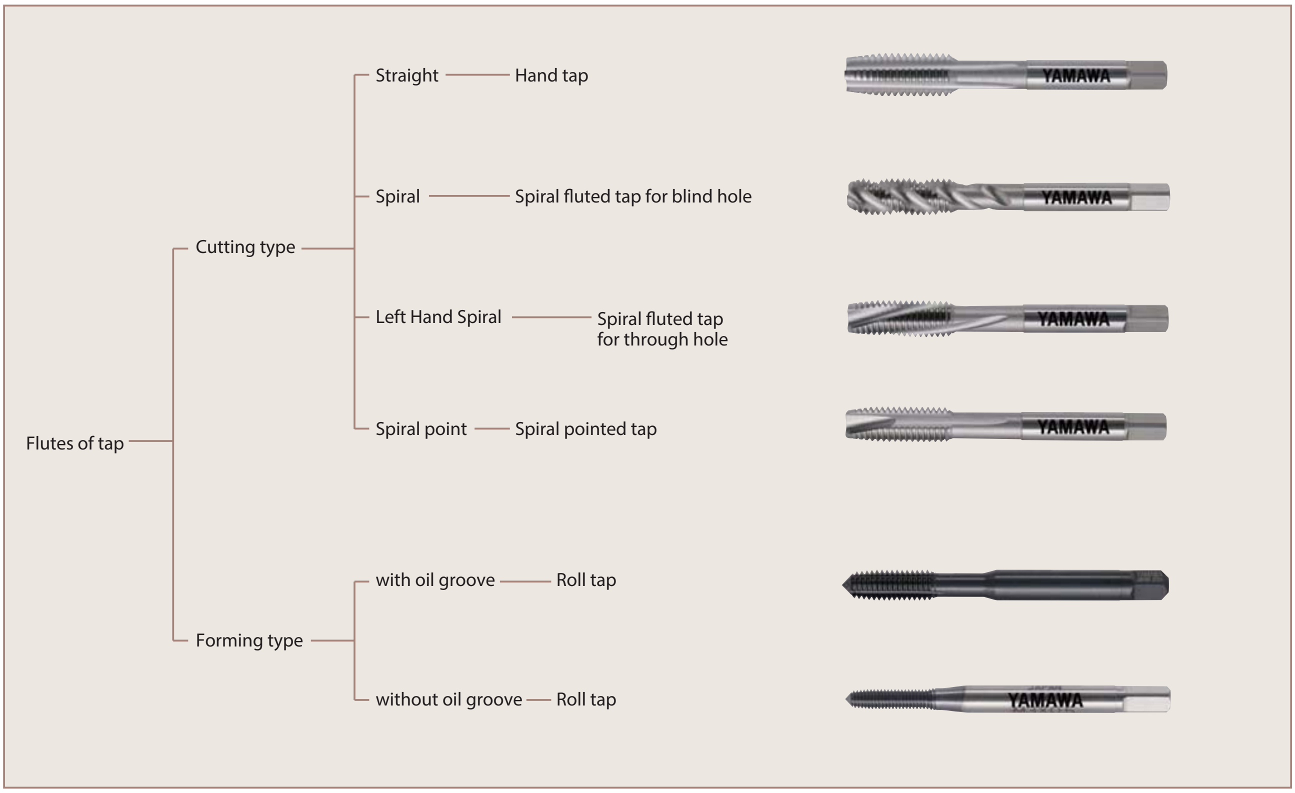


In general, tap chamfer is the most important part of taps to create internal thread. The function of full thread part of taps is to make a guidance.

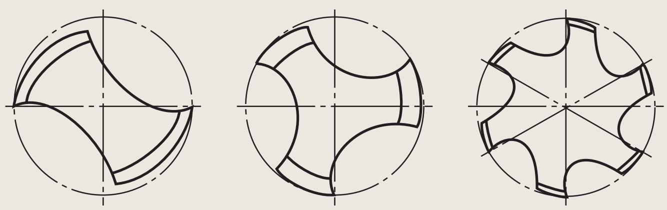
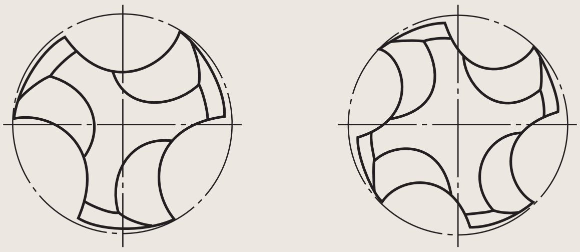
2. Flutes

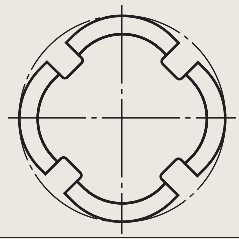
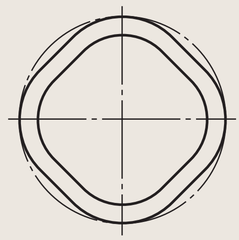
Major functions of flutes are:

1) Chips' pocket, 2) lubricant supply route, 3) rake angle formation, 4) to determine cutting amount in relation to the number of chamfer threads. And all are very important. Taps' flutes are classified into following groups by tapping methods, fluting method, tapping direction, and hand of screw thread.



Type of Flute

Flute \ Type of Taps	Cutting type
Straight Flute Spiral Flute	
Spiral Point Flute	

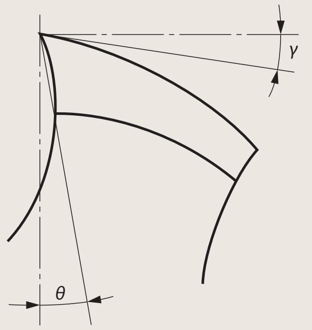
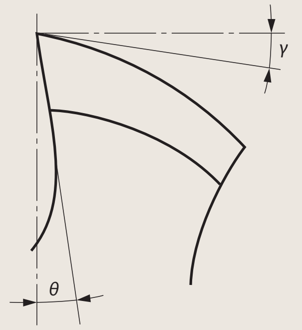
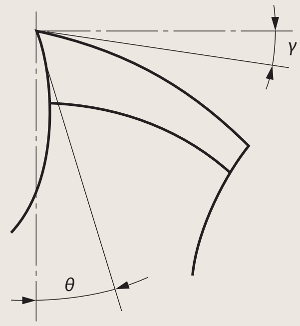
Flute \ Type of Taps	Forming type
With oil groove	
Without oil groove	

In general, the number of flutes for cutting type taps are usually increased as O.D. becomes larger. However, it is also influenced by tap's strength and rigidity, the accomodation of chip, the amount of cutting, and lubricant supply system.

3. Edge angle and Cutting allowance of taps

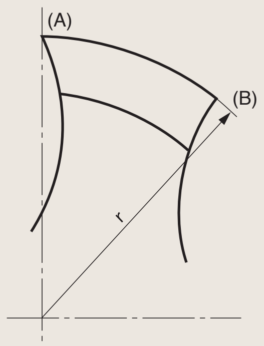
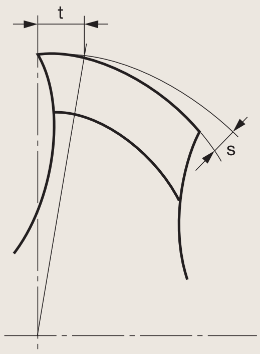
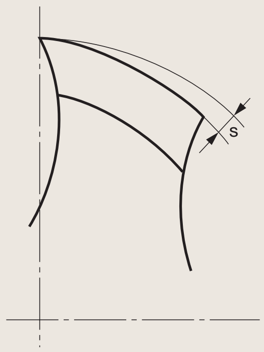
Cutting angle and Chamfer relief angle

θ: Cutting angle γ: Chamfer relief angle

Chordal Hook Angle	Rake Angle	Tangential Hook Angle
		
Cutting angle of hook face. The angle between the center line passing the cutting edge and the straight line linking the cutting edge with the thread root.	Cutting angle of rake face. The angle between the center line passing the cutting edge and the straight line linking the cutting edge with thread root.	Cutting angle of hook face. The angle between the center line passing the cutting edge and the straight line tangent to the rake face on the cutting edge.

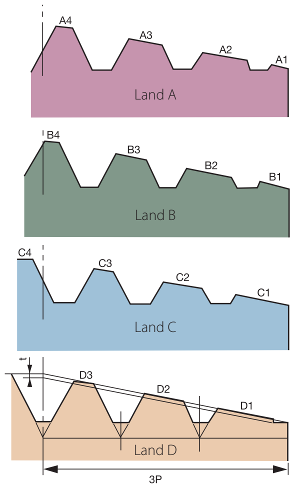
Thread relief

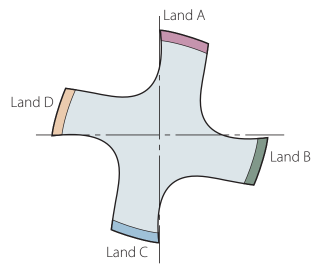
S: Indicator drop for thread relief

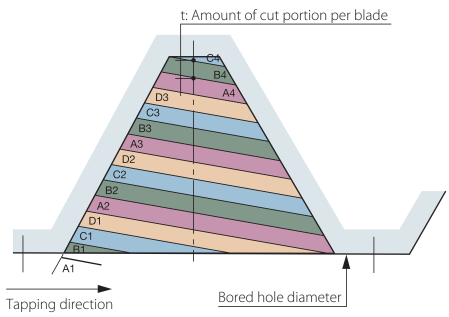
Concentric-unrelieved	Con-eccentric thread relief	Eccentric thread relief
		
No relief exists at land. Start (A) and heel (B) of thread land have same concentricy.	Radial relief in the thread form starts at the back of a concentric margin.	Radial relief in the thread form starts at the cutting edge and continues to the heel.

The amount of cut portion

Please refer to the pictures shown.
In such taps as have 4 flutes and 3 thread chamfer, the cutting operation progresses in order from the edge of A1, B1, C1, D1…A2, B2…A4. Tap end is usually smaller than the size of bored hole, and A1 may not make any cutting operation.







4. Recommended Tapping Speeds

Tapping Speeds

Following usage conditions affect tapping speeds: kind of taps, workpieces, number of chamfered threads, materials, hole condition and fluid. It is necessary to select the suitable tapping speed by paying attention to these conditions.
When work material has excellent workability, when there is a little depth of tapping, or when tapping fluid can be sufficient, select rather higher tapping speed. When workability of work material is unknown, to be safe, try nearly the lowest tapping speed at first, and then increase the speed gradually.

- Following speed is basically for the cutting condition under the use of insoluble cutting oil. Under the use of water soluble cutting oil, please choose 30% slower speed.

Unit : m/min

Workpiece Materials		Tapping Speed				
		Spiral Fluted	Spiral Pointed	Roll Taps	Straight Fluted	Cemented Carbide
Low Carbon Steels	SS400 S10C~S25C	8~15	10~20	8~15	6~10	—
Medium Carbon Steels	S25C~S45C	6~12	8~14	7~12	5~9	—
High Carbon Steels	S45C~S58C	5~10	8~12	5~10	5~8	—
Alloy Steels	SCM・SNCM	5~10	7~10	5~10	5~8	—
Thermal refined steels	20~45HRC	3~5	4~7	—	3~6	—
Stainless Steels	SUS	3~8	4~9	6~15	3~7	—
Tool Steels	SKD	5~8	6~10	—	5~9	—
Cast Steels	SC	6~10	8~13	—	6~10	—
Cast Irons	FC	—	—	—	12~17	15~25
Ductile Cast Irons	FCD	5~10	5~10	—	5~8	12~20
Coppers	Cu	8~12	8~13	25~35	7~11	15~33
Brass · Brass Casting	Bs・BsC	11~22	13~25	25~35	10~20	23~33
Phosphor Bronze · Phosphor Bronze Casting	PB・PBC	8~15	10~18	25~35	8~15	18~33
Wrought Aluminum	Al	15~25	20~25	25~35	15~20	23~40
Aluminum Alloy Castings	AC・ADC	11~22	12~24	15~25	10~20	15~25
Magnesium Alloy Castings	MC	7~15	10~20	—	7~15	12~20
Zinc Alloy Diecastings	ZDC	7~15	10~20	15~25	7~15	12~20
Thermosetting Plastic	Bakelite (Phenol-PF)	11~17	12~18	—	10~15	15~25
Thermoplastic resin	PVC, Nylon	11~17	12~18	—	10~15	15~25
Titanium Alloys	Ti-6Al-4V etc	6~9	6~9	—	—	—
Nickel Base Alloys	Hastelloy, Inconel, Waspaloy	3~6	3~6	—	—	—

Formula

Tapping Speed (Vc)

$$Vc = \frac{\pi \cdot Dc \cdot n}{1000} \ (m/min)$$

n : Revolution of tap (min^{-1})
π : 3.14
Dc : Nominal dia. of tap (mm)

Revolution of tap (n)

$$n = \frac{1000 \cdot Vc}{\pi \cdot Dc} \ (min^{-1})$$

Vc : Tapping Speed (m/min)
Dc : Nominal dia. of tap (mm)
π : 3.14

5. Bored hole size before tapping (for thread cutting)

for Metric Threads

unit: mm

Size	Minor diameter of internal threads (D_1)		Bored hole size (ref.)
	Max.	Min.	
M1 ×0.25	(0.785)	(0.729)	0.77
M1 ×0.2	(0.821)	(0.783)	0.81
M1.1×0.25	(0.885)	(0.829)	0.87
M1.1×0.2	(0.921)	(0.883)	0.91
M1.2×0.25	(0.985)	(0.929)	0.97
M1.2×0.2	(1.021)	(0.983)	1.01
M1.4×0.3	(1.142)	(1.075)	1.13
M1.4×0.2	(1.221)	(1.183)	1.21
M1.6×0.35	1.321	1.221	1.30
M1.6×0.2	(1.421)	(1.383)	1.41
*M1.7×0.35	1.421	1.321	1.40
*M1.7×0.2	1.521	1.483	1.51
M1.8×0.35	1.521	1.421	1.50
M1.8×0.2	(1.621)	(1.583)	1.61
M2 ×0.4	1.679	1.567	1.65
M2 ×0.25	(1.785)	(1.729)	1.77
M2.2×0.45	1.838	1.713	1.81
M2.2×0.25	(1.985)	(1.929)	1.97
*M2.3×0.4	1.979	1.867	1.95
*M2.3×0.25	2.085	2.029	2.07
M2.5×0.45	2.138	2.013	2.11
M2.5×0.35	2.221	2.121	2.20
*M2.6×0.45	2.238	2.113	2.21
*M2.6×0.35	2.321	2.221	2.30
M3 ×0.5	2.599	2.459	2.56
M3 ×0.35	2.721	2.621	2.70
M3.5×0.6	3.010	2.850	2.97
M3.5×0.35	3.221	3.121	3.20
M4 ×0.7	3.422	3.242	3.38
M4 ×0.5	3.599	3.459	3.56
M4.5×0.75	3.878	3.688	3.83
M4.5×0.5	4.099	3.959	4.06
M5 ×0.8	4.334	4.134	4.28
M5 ×0.5	4.599	4.459	4.56
M5.5×0.5	5.099	4.959	5.06
M6 ×1	5.153	4.917	5.09
M6 ×0.75	5.378	5.188	5.33
*M6 ×0.5	5.599	5.459	5.56
M7 ×1	6.153	5.917	6.09
M7 ×0.75	6.378	6.188	6.33
*M7 ×0.5	6.599	6.459	6.56
M8 ×1.25	6.912	6.647	6.85
M8 ×1	7.153	6.917	7.09
M 8×0.75	7.378	7.188	7.33
*M 8×0.5	7.599	7.459	7.56
M 9×1.25	7.912	7.647	7.85
M 9×1	8.153	7.917	8.09
M 9×0.75	8.378	8.188	8.33
M10×1.5	8.676	8.376	8.60
M10×1.25	8.912	8.647	8.85
M10×1	9.153	8.917	9.09
M10×0.75	9.378	9.188	9.33
*M10×0.5	9.599	9.459	9.56
M11×1.5	9.676	9.376	9.60
M11×1	10.153	9.917	10.10
M11×0.75	10.378	10.188	10.33
*M11×0.5	10.599	10.459	10.56
M12×1.75	10.441	10.106	10.4
M12×1.5	10.676	10.376	10.6
M12×1.25	10.912	10.647	10.85
M12×1	11.153	10.917	11.09
*M12×0.5	11.599	11.459	11.56
M14×2	12.210	11.835	12.1
M14×1.5	12.676	12.376	12.6
M14×1	13.153	12.917	13.09
M15×1.5	13.676	13.376	13.60
M15×1	14.153	13.917	14.09
M16×2	14.210	13.835	14.1
M16×1.5	14.676	14.376	14.6
M16×1	15.153	14.917	15.09
M17×1.5	15.676	15.376	15.60
M17×1	16.153	15.917	16.09
M18×2.5	15.744	15.294	15.6
M18×2	16.210	15.835	16.1
M18×1.5	16.676	16.376	16.6
M18×1	17.153	16.917	17.09
M20×2.5	17.744	17.294	17.6

The recommended tap drill sizes indicated above are for 6H Metric Threads.
• D_1: Minor diameter of 6H internal thread. The Minor diameters D_1 shown in ( ) are of 5H for coarse threads and of 4H • 5H for fine threads.

Size	Minor diameter of internal threads (D_1)		Bored hole size (ref.)
	Max.	Min.	
M20×2	18.210	17.835	18.1
M20×1.5	18.676	18.376	18.6
M20×1	19.153	18.917	19.09
M22×2.5	19.744	19.294	19.6
M22×2	20.210	19.835	20.1
M22×1.5	20.676	20.376	20.6
M22×1	21.153	20.917	21.09
M24×3	21.252	20.752	21.1
M24×2	22.210	21.835	22.1
M24×1.5	22.676	22.376	22.6
M24×1	23.153	22.917	23.09
M25×2	23.210	22.835	23.1
M25×1.5	23.676	23.376	23.6
M25×1	24.153	23.917	24.09
M26×1.5	24.676	24.376	24.6
M27×3	24.252	23.752	24.1
M27×2	25.210	24.835	25.1
M27×1.5	25.676	25.376	25.6
M27×1	26.153	25.917	26.09
M28×2	26.210	25.835	26.1
M28×1.5	26.676	26.376	26.6
M28×1	27.153	26.917	27.09
M30×3.5	26.771	26.211	26.6
M30×3	27.252	26.752	27.1
M30×2	28.210	27.835	28.1
M30×1.5	28.676	28.376	28.6
M30×1	29.153	28.917	29.09
M32×2	30.210	29.835	30.1
M32×1.5	30.676	30.376	30.6
M33×3.5	29.771	29.211	29.6
M33×3	30.252	29.752	30.1
M33×2	31.210	30.835	31.1
M33×1.5	31.676	31.376	31.6
M35×1.5	33.676	33.376	33.6
M36×4	32.270	31.670	32.1
M36×3	33.252	32.752	33.1
M36×2	34.210	33.835	34.1
M36×1.5	34.676	34.376	34.6

• D_1: Minor diameter of 6H internal thread.

unit: mm

Size	Minor diameter of internal threads (D_1)		Bored hole size (ref.)
	Max.	Min.	
M38×1.5	36.676	36.376	36.6
M39×4	35.270	34.670	35.1
M39×3	36.252	35.752	36.1
M39×2	37.210	36.835	37.1
M39×1.5	37.676	37.376	37.6
M40×3	37.252	36.752	37.1
M40×2	38.210	37.835	38.1
M40×1.5	38.676	38.376	38.6
M42×4.5	37.799	37.129	37.6
M42×4	38.270	37.670	38.1
M42×3	39.252	38.752	39.1
M42×2	40.210	39.835	40.1
M42×1.5	40.676	40.376	40.6
M45×4.5	40.799	40.129	40.6
M45×4	41.270	40.670	41.1
M45×3	42.252	41.752	42.1
M45×2	43.210	42.835	43.1
M45×1.5	43.676	43.376	43.6
M48×5	43.297	42.587	43.1
M48×4	44.270	43.670	44.1
M48×3	45.252	44.752	45.1
M48×2	46.210	45.835	46.1
M48×1.5	46.676	46.376	46.6
M50×3	47.252	46.752	47.1
M50×2	48.210	47.835	48.1
M50×1.5	48.676	48.376	48.6
M52×5	47.297	46.587	47.1
M52×4	48.270	47.670	48.1
M52×3	49.252	48.752	49.1
M52×2	50.210	49.835	50.1
M52×1.5	50.676	50.376	50.6
M55×4	51.270	50.670	51.1
M55×3	52.252	51.752	52.1
M55×2	53.210	52.835	53.1
M55×1.5	53.676	53.376	53.6
M56×5.5	50.796	50.046	50.6
M56×4	52.270	51.670	52.1
M56×3	53.252	52.752	53.1
M56×2	54.210	53.835	54.1
M56×1.5	54.676	54.376	54.6

Bored hole size before tapping (for thread cutting)

■ for Metric Threads

unit: mm

Size	Minor diameter of internal threads (D_1) Max.	Minor diameter of internal threads (D_1) Min.	Bored hole size (ref.)
M58 × 4	54.270	53.670	54.1
M58 × 3	55.252	54.752	55.1
M58 × 2	56.210	55.835	56.1
M58 × 1.5	56.676	56.376	56.6
M60 × 5.5	54.796	54.046	54.6
M60 × 4	56.270	55.670	56.1
M60 × 3	57.252	56.752	57.1
M60 × 2	58.210	57.835	58.1
M60 × 1.5	58.676	58.376	58.6
M62 × 4	58.270	57.670	58.1
M62 × 3	59.252	58.752	59.1
M62 × 2	60.210	59.835	60.1
M62 × 1.5	60.676	60.376	60.6
M64 × 6	58.305	57.505	58.1
M64 × 4	60.270	59.670	60.1
M64 × 3	61.252	60.752	61.1
M64 × 2	62.210	61.835	62.1
M64 × 1.5	62.676	62.376	62.6
M65 × 4	61.270	60.670	61.1
M65 × 3	62.252	61.752	62.1
M65 × 2	63.210	62.835	63.1
M65 × 1.5	63.676	63.376	63.6
M68 × 6	62.305	61.505	62.1
M68 × 4	64.270	63.670	64.1
M68 × 3	65.252	64.752	65.1
M68 × 2	66.210	65.835	66.1
M68 × 1.5	66.676	66.376	66.6
M70 × 6	64.305	63.505	64.1
M70 × 4	66.270	65.670	66.1
M70 × 3	67.252	66.752	67.1
M70 × 2	68.210	67.835	68.1
M70 × 1.5	68.676	68.376	68.6
M72 × 6	66.305	65.505	66.1
M72 × 4	68.270	67.670	68.1
M72 × 3	69.252	68.752	69.1

Size	Minor diameter of internal threads (D_1) Max.	Minor diameter of internal threads (D_1) Min.	Bored hole size (ref.)
M72 × 2	70.210	69.835	70.1
M72 × 1.5	70.676	70.376	70.6
M75 × 4	71.270	70.670	71.1
M75 × 3	72.252	71.752	72.1
M75 × 2	73.210	72.835	73.1
M75 × 1.5	73.676	73.376	73.6
M76 × 6	70.305	69.505	70.1
M76 × 4	72.270	71.670	72.1
M76 × 3	73.252	72.752	73.1
M76 × 2	74.210	73.835	74.1
M76 × 1.5	74.676	74.376	74.6
M78 × 2	76.210	75.835	76.1
M80 × 6	74.305	73.505	74.1
M80 × 4	76.270	75.670	76.1
M80 × 3	77.252	76.752	77.1
M80 × 2	78.210	77.835	78.1
M80 × 1.5	78.676	78.376	78.6
M82 × 2	80.210	79.835	80.1
M85 × 6	79.305	78.505	79.1
M85 × 4	81.270	80.670	81.1
M85 × 3	82.252	81.752	82.1
M85 × 2	83.210	82.835	83.1
M90 × 6	84.305	83.505	84.1
M90 × 4	86.270	85.670	86.1
M90 × 3	87.252	86.752	87.1
M90 × 2	88.210	87.835	88.1
M95 × 6	89.305	88.505	89.1
M95 × 4	91.270	90.670	91.1
M95 × 3	92.252	91.752	92.1
M95 × 2	93.210	92.835	93.1
M100 × 6	94.305	93.505	94.1
M100 × 4	96.270	95.670	96.1
M100 × 3	97.252	96.752	97.1
M100 × 2	98.210	97.835	98.1

• D_1: Minor diameter of 6H internal thread.

for Unified Threads

Unit : mm

Size	Minor diameter of internal threads (D_1)		Bored hole size (ref.)
	Max.	Min.	
No. 0 - 80UNF	1.305	1.182	1.27
No. 1 - 64UNC	1.582	1.425	1.54
No. 1 - 72UNF	1.612	1.474	1.58
No. 2 - 56UNC	1.871	1.695	1.83
No. 2 - 64UNF	1.912	1.756	1.87
No. 3 - 48UNC	2.146	1.941	2.09
No. 3 - 56UNF	2.197	2.025	2.15
No. 4 - 40UNC	2.385	2.157	2.33
No. 4 - 48UNF	2.458	2.271	2.41
No. 5 - 40UNC	2.697	2.487	2.64
No. 5 - 44UNF	2.740	2.551	2.69
No. 6 - 32UNC	2.895	2.642	2.83
No. 6 - 40UNF	3.022	2.820	2.97
No. 8 - 32UNC	3.530	3.302	3.47
No. 8 - 36UNF	3.606	3.404	3.55
No.10 - 24UNC	3.962	3.683	3.89
No.10 - 32UNF	4.165	3.963	4.12
No.12 - 24UNC	4.597	4.344	4.53
No.12 - 28UNF	4.724	4.496	4.67
No.12 - 32UNEF	4.826	4.623	4.78
1/4 - 20UNC	5.257	4.979	5.19
1/4 - 28UNF	5.588	5.360	5.53
1/4 - 32UNEF	5.689	5.487	5.64
5/16 - 18UNC	6.731	6.401	6.65
5/16 - 24UNF	7.035	6.782	6.97
5/16 - 32UNEF	7.264	7.087	7.22
3/8 - 16UNC	8.153	7.798	8.07
3/8 - 24UNF	8.636	8.382	8.57
3/8 - 32UNEF	8.864	8.662	8.81
7/16 - 14UNC	9.550	9.144	9.5
7/16 - 20UNF	10.033	9.729	9.96
7/16 - 28UNEF	10.337	10.135	10.29
1/2 - 13UNC	11.023	10.592	10.9
1/2 - 20UNF	11.607	11.329	11.54
1/2 - 28UNEF	11.938	11.710	11.88
9/16 - 12UNC	12.446	11.989	12.3
9/16 - 18UNF	13.081	12.751	13.00
9/16 - 24UNEF	13.385	13.132	13.32

Size	Minor diameter of internal threads (D_1)		Bored hole size (ref.)
	Max.	Min.	
5/8 - 11UNC	13.868	13.386	13.8
5/8 - 18UNF	14.681	14.351	14.60
5/8 - 24UNEF	14.986	14.732	14.92
3/4 - 10UNC	16.840	16.307	16.7
3/4 - 16UNF	17.678	17.323	17.59
3/4 - 20UNEF	17.957	17.679	17.89
7/8 - 9UNC	19.761	19.177	19.6
7/8 - 14UNF	20.675	20.270	20.6
7/8 - 20UNEF	21.132	20.854	21.06
1 - 8UNC	22.606	21.971	22.5
1 - 12UNF	23.571	23.114	23.5
1 - 14UNS	23.825	23.445	23.7
1 - 20UNEF	24.307	24.029	24.24
1 1/8 - 7UNC	25.349	24.638	25.2
1 1/8 - 8UN	25.781	25.146	25.6
1 1/8-12UNF	26.746	26.289	26.6
1 1/8-18UNEF	27.381	27.051	27.30
1 1/4 - 7UNC	28.524	27.813	28.4
1 1/4 - 8UN	28.956	28.321	28.8
1 1/4-12UNF	29.921	29.464	29.8
1 1/4-18UNEF	30.556	30.226	30.47
1 3/8 - 6UNC	31.115	30.353	30.9
1 3/8 - 8UN	32.131	31.496	32.0
1 3/8-12UNF	33.096	32.639	33.0
1 3/8-18UNEF	33.731	33.401	33.65
1 1/2 - 6UNC	34.290	33.528	34.1
1 1/2 - 8UN	35.306	34.671	35.2
1 1/2-12UNF	36.271	35.814	36.2
1 1/2-18UNEF	36.906	36.576	36.82
1 5/8 - 8UN	38.481	37.846	38.3
1 5/8-12UN	39.446	38.989	39.3
1 5/8-18UNEF	40.081	39.751	40.00
1 3/4 - 5UNC	39.827	38.964	39.6
1 3/4 - 8UN	41.656	41.021	41.5
1 3/4-12UN	42.621	42.164	42.5
2 - 4.5UNC	45.593	44.679	45.4
2 - 8UN	48.006	47.371	47.9
2 - 12UN	48.971	48.514	48.9

• The recommended tap drill sizes indicated above are for ANSI B1.1 Class 2B UNC, UNF, UNEF, UN & UNS threads.

Bored hole size before tapping (for thread cutting)

■ for Helical Coil Wire Thread Inserts, Metric Threads

unit: mm

Nominal size	Bored hole size Max.	Bored hole size Min.	Bored hole size (ref.)
STI M 2 ×0.4	2.16	2.10	2.15
STI M 2.5×0.45	2.68	2.60	2.66
STI M 2.6×0.45	2.78	2.70	2.76
STI M 3 ×0.5	3.20	3.12	3.18
STI M 4 ×0.7	4.30	4.17	4.27
STI M 5 ×0.8	5.33	5.16	5.29
STI M 6 ×1	6.42	6.25	6.38
STI M 8 ×1.25	8.52	8.31	8.47
STI M10 ×1.5	10.62	10.37	10.56
STI M10 ×1.25	10.52	10.31	10.47
STI M10×1	10.42	10.25	10.38
STI M12×1.75	12.73	12.43	12.66
STI M12×1.5	12.62	12.37	12.56
STI M12×1.25	12.52	12.31	12.47
STI M14×2	14.83	14.49	14.75
STI M14×1.5	14.62	14.37	14.56
STI M14×1.25	14.52	14.31	14.47
STI M16×2	16.83	16.49	16.75
STI M16×1.5	16.62	16.37	16.56
STI M18×2.5	19.04	18.58	18.93
STI M18×1.5	18.62	18.37	18.56
STI M20×2.5	21.04	20.58	20.93
STI M20×1.5	20.62	20.37	20.56
STI M22×2.5	23.04	22.58	22.93
STI M22×1.5	22.62	22.37	22.56
STI M24×3	25.25	24.70	25.11
STI M24×1.5	24.62	24.37	24.56

• The figures listed above are according to the data provided by helical coil wire insert manufacturers

■ for Helical Coil Wire Thread Inserts, Unified Threads

unit: mm

Size	Minor diameter of internal threads (D_1) Max.	Minor diameter of internal threads (D_1) Min.	Bored hole size (ref.)
STI No. 2 - 56 UNC	2.440	2.284	2.40
STI No. 4 - 40 UNC	3.180	2.985	3.13
STI No. 4 - 48 UNF	3.121	2.962	3.08
STI No. 5 - 40 UNC	3.487	3.315	3.44
STI No. 6 - 32 UNC	3.878	3.678	3.83
STI No. 6 - 40 UNF	3.817	3.645	3.77
STI No. 8 - 32 UNC	4.523	4.339	4.48
STI No. 8 - 36 UNF	4.498	4.321	4.45
STI No. 10 - 24 UNC	5.283	5.055	5.23
STI No. 10 - 32 UNF	5.184	4.999	5.14
STI No. 12 - 24 UNC	5.943	5.715	5.89
STI 1/4 - 20 UNC	6.868	6.625	6.81
STI 1/4 - 28 UNF	6.720	6.546	6.68
STI 5/16 - 18 UNC	8.488	8.243	8.43
STI 5/16 - 24 UNF	8.351	8.167	8.31
STI 3/8 - 16 UNC	10.126	9.868	10.06
STI 3/8 - 24 UNF	9.931	9.754	9.89
STI 7/16 - 14 UNC	11.783	11.507	11.71
STI 7/16 - 20 UNF	11.584	11.387	11.53
STI 1/2 - 13 UNC	13.393	13.122	13.33
STI 1/2 - 20 UNF	13.172	12.975	13.12
STI 5/8 - 11 UNC	16.672	16.376	16.60
STI 5/8 - 18 UNF	16.385	16.180	16.33
STI 3/4 - 16 UNF	19.608	19.393	19.55

■ for Whitworth Threads

unit: mm

Size	Minor diameter of internal threads (D1) Max.	Minor diameter of internal threads (D1) Min.	Bored hole size (ref.)
* 1/8 W 40	(2.591)	(2.362)	2.53
* 3/16 W 24	(3.744)	(3.406)	3.66
1/4 W 20	5.204	4.914	5.13
5/16 W 18	6.670	6.340	6.59
3/8 W 16	8.113	7.733	8.02
7/16 W 14	9.508	9.048	9.4
1/2 W 12	10.830	10.310	10.7
9/16 W 12	12.418	11.898	12.3
5/8 W 11	13.817	13.257	13.7
3/4 W 10	16.778	16.178	16.6
7/8 W 9	19.691	19.031	19.5
1 W 8	22.514	21.814	22.3

• D_1: Minor diameter of JIS Class 2 internal thread.
• Whitworth Threads have been eliminated from JIS.
• *Marked sizes are in accordance with BSW.

■ for Sewing Machine Threads

unit: mm

Size	Minor diameter of internal threads (D_1) Max.	Minor diameter of internal threads (D_1) Min.	Bored hole size (ref.)
1/16 SM 80	1.281	1.211	1.26
5/64 SM 64	1.593	1.513	1.57
3/32 SM 56	1.936	1.841	1.91
3/32 SM 100	2.156	2.081	2.14
1/8 SM 40	2.551	2.421	2.52
1/8 SM 44	2.605	2.485	2.58
9/64 SM 40	2.948	2.818	2.92
11/64 SM 40	3.742	3.612	3.71
3/16 SM 24	3.658	3.498	3.62
3/16 SM 28	3.844	3.684	3.80
3/16 SM 32	3.980	3.820	3.94
3/16 SM 40	4.138	4.008	4.11
7/32 SM 32	4.774	4.614	4.73
15/64 SM 28	5.055	4.875	5.01
1/4 SM 24	5.266	5.086	5.22
1/4 SM 40	5.726	5.596	5.69

for Pipe Threads

○PS, Rp

unit: mm

Size	Minor Diameter of JIS internal thread (D1)		Bored hole size (ref.)
	Max.	Min.	
PS 1/16 - 28	6.632	6.490	6.60
PS 1/8 - 28	8.637	8.495	8.60
PS 1/4 - 19	11.549	11.341	11.50
PS 3/8 - 19	15.054	14.846	15.00
PS 1/2 - 14	18.773	18.489	18.7
PS 3/4 - 14	24.259	23.975	24.2
PS 1 - 11	30.472	30.110	30.4
PS 1 1/4-11	39.133	38.771	39.0
PS 1 1/2-11	45.026	44.664	44.9
PS 2 - 11	56.837	56.475	56.8

○PF, G

unit: mm

Size	Minor Diameter of JIS internal thread (D1)		Bored hole size (ref.)
	Max.	Min.	
PF 1/16 - 28	6.843	6.561	6.77
PF 1/8 - 28	8.848	8.566	8.78
PF 1/4 - 19	11.890	11.445	11.78
PF 3/8 - 19	15.395	14.950	15.28
PF 1/2 - 14	19.172	18.631	19.0
PF 5/8 - 14	21.128	20.587	21.0
PF 3/4 - 14	24.658	24.117	24.5
PF 7/8 - 14	28.418	27.877	28.3
PF 1 - 11	30.931	30.291	30.8
PF 1 1/8-11	35.579	34.939	35.4
PF 1 1/4-11	39.592	38.952	39.4
PF 1 1/2-11	45.485	44.845	45.3
PF 1 3/4-11	51.428	50.788	51.3
PF 2 - 11	57.296	56.656	57.1

for American Standard Pipe Thread

unit: mm

Size	Minor diameter of internal threads		Bored hole size (ref.)
	Max.	Min.	
NPSC 1/8 - 27	8.813	8.636	8.77
NPSC 1/4 - 18	11.592	11.329	11.53
NPSC 3/8 - 18	14.919	14.656	14.85
NPSC 1/2 - 14	18.501	18.161	18.4
NPSC 3/4 - 14	23.835	23.495	23.7
NPSC 1 - 11.5	29.903	29.490	29.8

unit: mm

Size	Minor diameter of internal threads		Bored hole size (ref.)
	Max.	Min.	
NPSM 1/8 - 27	9.246	9.094	9.21
NPSM 1/4 - 18	12.217	11.888	12.13
NPSM 3/8 - 18	15.554	15.317	15.49
NPSM 1/2 - 14	19.278	18.974	19.2
NPSM 3/4 - 14	24.638	24.334	24.5
NPSM 1 - 11.5	30.759	30.506	30.7

for Dryseal American Standard Pipe Thread

unit: mm

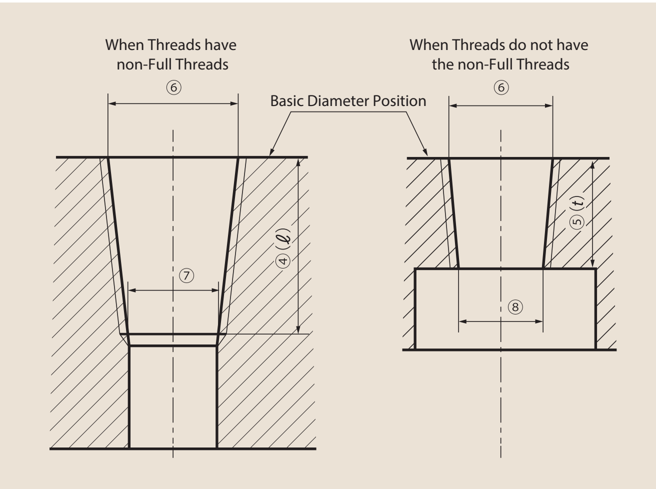
Size	Minor diameter of internal threads		Bored hole size (ref.)
	Max.	Min.	
NPSF 1/8 - 27	8.740	8.652	8.72
NPSF 1/4 - 18	11.363	11.232	11.33
NPSF 3/8 - 18	14.803	14.672	14.77
NPSF 1/2 - 14	18.288	18.118	18.2
NPSF 3/4 - 14	23.634	23.465	23.5
NPSF 1 - 11.5	29.669	29.464	29.6

■ Recommended Bored Hole Size Table for Taper Pipe Threads (PT)

Remarks during tapping

- PT internal threads have R design on their crests. The taps should cut threads with their thread root.

Size	Thread Standards				Minor Diameter			Recommended Bored Hole Sizes (reference)		reference	
	Basic Diameter	Basic Diameter Position	Effective Thread Length (Minimum)		Pipe End (Workpiece Face) (Basic Diamater)	When Threads have non-Full Threads	When Threads do not have the non-Full Threads	Maximum Size of Straight Bored Hole		Tap	
		Pipe End				Position away from Pipe End by ℓ	Position away from Pipe End by t			Basic Diameter Position, ℓg	
	Tolerance in radial direction	Tolerance in axial direction c	When Threads have non-Full Threads[1] ℓ	When Threads do not have the non-Full Threads[1] t	Basic Size	Basic Size	Basic Size	When Threads have non-Full Threads	When Threads do not have the non-Full Threads	Long Thread Type	Short Thread Type
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫
PT 1/16 - 28	±0.071	±1.13	6.2	4.4	6.561	6.174	6.286	6.1	6.2	13.0	10.5
PT 1/8 - 28	±0.071	±1.13	6.2	4.4	8.566	8.179	8.291	8.1	8.2	13.0	10.5
PT 1/4 - 19	±0.104	±1.67	9.4	6.7	11.445	10.858	11.026	10.7	10.9	21.0	12.5
PT 3/8 - 19	±0.104	±1.67	9.7	7.0	14.950	14.344	14.513	14.2	14.4	21.0	14.0
PT 1/2 - 14	±0.142	±2.27	12.7	9.1	18.631	17.837	18.062	17.6	17.9	25.0	17.0
PT 3/4 - 14	±0.142	±2.27	14.1	10.2	24.117	23.236	23.480	23.0	23.3	25.0	19.0
PT 1 - 11	±0.181	±2.89	16.2	11.6	30.291	29.279	29.566	29.0	29.3	32.0	22.0
PT 1 1/4 - 11	±0.181	±2.89	18.5	13.4	38.952	37.796	38.115	37.6	37.9	32.0	24.5
PT 1 1/2 - 11	±0.181	±2.89	18.5	13.4	44.845	43.689	44.008	43.5	43.8	32.0	25.5
PT 2 - 11	±0.181	±2.89	22.8	16.9	56.656	55.231	55.600	55.0	55.4	35.0	28.0



Remarks 1. Opening of Internal Thread (Face of workpiece) is Basic Diameter Position.

Remarks 2. Effective Thread Length has 2 types, with non-Full Thread Type and without non-Full Thread Type.

Remarks 3. Concerning bored hole shape, considering load on taps, taper bored hole is recommended.

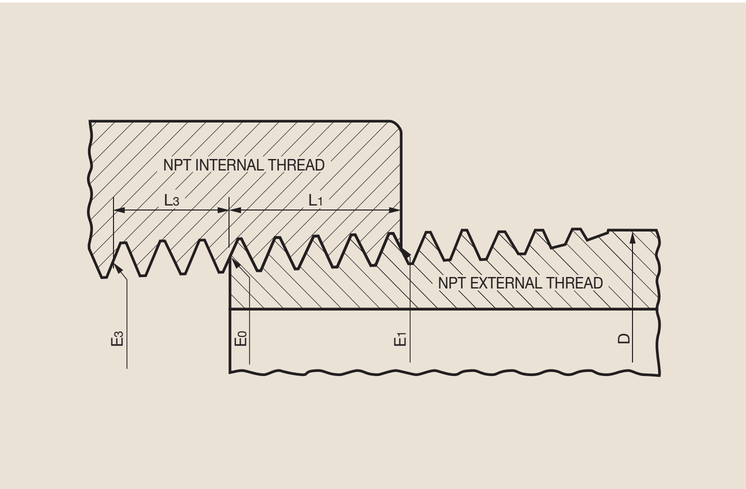
Remarks 4. When applying taper bored hole, by referring to values shown in columns ②·⑥~⑧, prepare the taper hole by using pipe reamer (1/16 taper). By referring to values shown in columns ⑨ and ⑩, select the drill diameter before reaming by taking reamer's margin into account.

Remarks 5. When preparing straight bored hole, by referring to values shown in columns ⑨ and ⑩, select drill diameter.

Recommended Bored Hole Size Table for American Taper Pipe Threads (NPT)

unit: mm

Size	L1	L3	L1+L3	Minor Diameter						Bored Hole Size (reference)	reference
				Pipe End (Basic Diameter Position)			Position away from Pipe End by (L1+L3)				Tap
				Maximum Value	Minimum Value	Tolerance	Maximum Value	Minimum Value	Tolerance	Maximum Size of Straight Bored Hole	Basic Diameter Position ℓg
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫
NPT 1/16 - 27	4.064	2.822	6.886	6.510	6.388	0.122	6.080	5.958	0.122	6.05	12.00
NPT 1/8 - 27	4.102	2.822	6.924	8.857	8.736	0.122	8.425	8.303	0.122	8.39	12.05
NPT 1/4 - 18	5.786	4.234	10.020	11.514	11.357	0.157	10.888	10.730	0.157	10.85	17.45
NPT 3/8 - 18	6.096	4.234	10.330	14.953	14.796	0.157	14.308	14.150	0.157	14.27	17.65
NPT 1/2 - 14	8.128	5.443	13.571	18.485	18.323	0.163	17.637	17.475	0.163	17.60	22.85
NPT 3/4 - 14	8.611	5.443	14.054	23.831	23.668	0.163	22.952	22.790	0.163	22.91	22.95
NPT 1 - 11.5	10.160	6.627	16.787	29.868	29.696	0.173	28.819	28.647	0.173	28.78	27.40
NPT 1 1/4 - 11.5	10.668	6.627	17.295	38.625	38.452	0.173	37.544	37.372	0.173	37.50	28.10
NPT 1 1/2 - 11.5	10.668	6.627	17.295	44.695	44.522	0.173	43.614	43.441	0.173	43.57	28.40
NPT 2 - 11.5	11.074	6.627	17.701	56.732	56.560	0.173	55.626	55.454	0.173	55.58	28.00

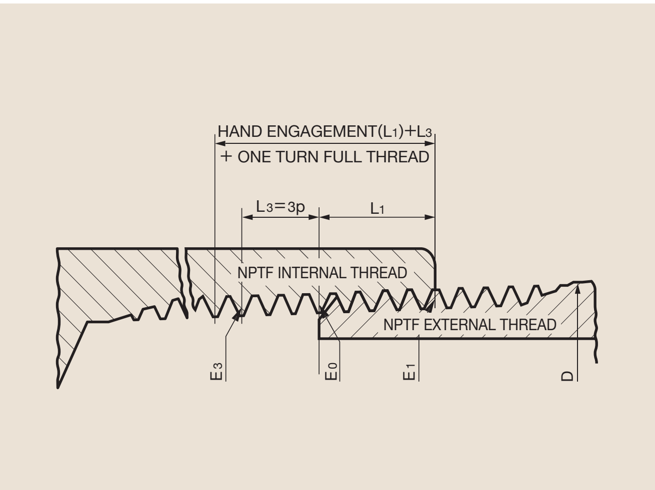


Remarks 1. Pipe End is Basic Diameter Position (E1).
Remarks 2. Effective Thread Length is the length away from Pipe End by (L1+L3).
Remarks 3. Concerning bored hole shape, considering load on taps, taper bored hole is recommended.
Remarks 4. When applying taper bored hole, by referring to values in shown columns ⑤, ⑥ and ⑧, ⑨, prepare the taper hole by using pipe reamer (1/16 taper). By referring to values shown in column ⑪, select the drill diameter before reaming by taking reamer's margin into account.
Remarks 5. When preparing straight bored hole, by referring to values shown in column ⑪, select drill diameter.

Recommended Bored Hole Size Table for American Dryseal Taper Pipe Threads (NPTF)

unit: mm

Size	L1	L3 (3P)	L1+L3+1P	Minor Diameter						Bored Hole Size (reference)	reference Tap
				Pipe End (Basic Diameter Position)			Position of (L1+L3+1P)				
				Maximum Value	Minimum Value	Tolerance	Maximum Value	Minimum Value	Tolerance	Maximum Size of Straight Bored Hole	Basic Diameter Position ℓg
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫
NPTF 1/16 - 27	4.064	2.822	7.827	6.505	6.414	0.091	6.015	5.923	0.091	5.99	12.00
NPTF 1/8 - 27	4.102	2.822	7.865	8.852	8.761	0.091	8.362	8.270	0.091	8.34	12.05
NPTF 1/4 - 18	5.786	4.234	11.431	11.484	11.397	0.086	10.770	10.684	0.086	10.75	17.45
NPTF 3/8 - 18	6.096	4.234	11.741	14.923	14.836	0.086	14.189	14.103	0.086	14.17	17.65
NPTF 1/2 - 14	8.128	5.443	15.386	18.419	18.333	0.086	17.459	17.373	0.086	17.44	22.85
NPTF 3/4 - 14	8.611	5.443	15.868	23.764	23.678	0.086	22.773	22.687	0.086	22.75	22.95
NPTF 1 - 11.5	10.160	6.627	18.996	29.812	29.726	0.086	28.625	28.538	0.086	28.60	27.40
NPTF 11/4 - 11.5	10.668	6.627	19.504	38.569	38.483	0.086	37.350	37.263	0.086	37.33	28.10
NPTF 11/2 - 11.5	10.668	6.627	19.504	44.639	44.552	0.086	43.420	43.334	0.086	43.40	28.40
NPTF 2 - 11.5	11.074	6.627	19.910	56.677	56.590	0.086	55.432	55.345	0.086	55.41	28.00



Remarks 1. Pipe End is Basic Diameter Position (E1).
Remarks 2. Effective Thread Length is the length away from Pipe End by (L1+L3+1P).
Remarks 3. Concerning bored hole shape, considering load on taps, taper bored hole is recommended.
Remarks 4. When applying taper bored hole, by referring to values shown in columns ⑤, ⑥ and ⑧, ⑨, prepare the taper hole by using pipe reamer (1/16 taper). By referring to values in shown column ⑪, select the drill diameter before reaming by taking reamer's margin into account.
Remarks 5. When preparing straight bored hole, by referring to values shown in column ⑪, select drill diameter.

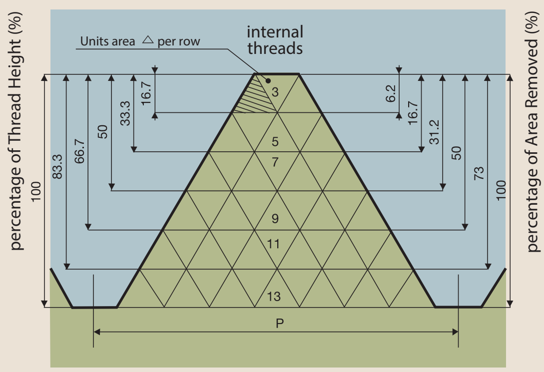
Percentage of Thread Engagement & Relation between Percentage of Thread Height and Area Removed at A Thread Height

Percentage of Thread Engagement

$$\frac{\text{Basic Major Dia.} - \text{Hole Size Before Tapping}}{2\times(\text{Basic Thread Overlap})} \times 100$$

Basic Thread Overlap

Metric & Unified Thread	0.5413P
Whitworth Thread	0.5664P
Pipe Thread (Rc, Rp, G, PT, PS, PF)	0.6403P
	P=Pitch



As shown above, when the thread height increases, the amount of material to be removed increases rapidly, so it is an advantage to tap users to keep the hole size (thread minor diameter) as large as possible.

6. Bored hole size before tapping (for thread forming)

for Metric Threads

unit: mm

Size	Class	Hole size depending on percentage of thread engagement			ref. Minor diameter of internal threads (5H/6H)	
		100%	90%	80%	Max.	Min.
M1× 0.25	G4	0.89	0.90	0.92	0.785	0.729
	G5	0.90	0.91	0.93		
M1.2× 0.25	G4	1.09	1.10	1.11	0.983	0.929
	G5	1.10	1.11	1.13		
M1.4×3	G4	1.26	1.28	1.30	1.142	1.075
	G5	1.28	1.29	1.31		
M1.6×0.35	G4	1.43	1.44	1.46	1.321	1.221
	G5	1.44	1.46	1.48		
M1.7×0.35	G4	1.52	1.54	1.56	1.421	1.321
	G5	1.54	1.56	1.58		
	G6	1.55	1.57	1.59		
M1.8×0.35	G4	1.62	1.64	1.66	1.521	1.421
	G5	1.64	1.66	1.68		
M2×0.4	G4	1.79	1.81	1.83	1.679	1.567
	G5	1.80	1.82	1.84		
	G6	1.81	1.83	1.86		
M2×0.25	G4	1.89	1.90	1.91	1.785	1.729
	G5	1.90	1.91	1.93		
M2.2×0.45	G5	1.98	2.00	2.02	1.838	1.713
M2.3×0.4	G4	2.09	2.11	2.13	1.979	1.867
	G5	2.10	2.12	2.14		
	G6	2.11	2.13	2.16		
M2.5×0.45	G5	2.27	2.30	2.32	2.138	2.013
	G6	2.29	2.31	2.44		
M2.5×0.35	G5	2.34	2.36	2.37	2.221	2.121
M2.6×0.45	G5	2.37	2.40	2.42	2.238	2.113
	G6	2.39	2.41	2.44		
M2.6×0.35	G5	2.44	2.45	2.47	2.321	2.221
M3×0.5	G5	2.75	2.78	2.80	2.599	2.459
	G6	2.76	2.79	2.82		
	G7	2.77	2.80	2.83		
	G8	2.79	2.81	2.84		
M3×0.35	G5	2.79	2.84	2.86	2.721	2.621
M3.5×0.6	G5	3.19	3.22	3.25	3.010	2.850
	G6	3.20	3.23	3.26		
	G7	3.21	3.24	3.28		
M3.5×0.35	G5	3.32	3.34	3.36	3.221	3.121
	G6	3.33	3.35	3.37		
M4×0.7	G5	3.65	3.67	3.71	3.422	3.242
	G6	3.65	3.69	3.72		
	G7	3.66	3.70	3.74		
	G8	3.67	3.71	3.75		
M4×0.5	G5	3.75	3.77	3.80	3.599	3.459
	G6	3.76	3.79	3.81		

Size	Class	Hole size depending on percentage of thread engagement			ref. Minor diameter of internal threads (5H/6H)	
		100%	90%	80%	Max.	Min.
M5×0.8	G5	4.57	4.62	4.66	4.334	4.134
	G6	4.59	4.63	4.67		
	G7	4.60	4.64	4.68		
	G8	4.61	4.65	4.70		
M5×0.5	G7	4.77	4.80	4.82	4.599	4.459
M6×1	G5	5.46	5.51	5.57	5.153	4.917
	G6	5.47	5.53	5.58		
	G7	5.49	5.54	5.59		
	G8	5.50	5.55	5.61		
M6×0.75	G6	5.61	5.65	5.69	5.378	5.188
	G7	5.62	5.66	5.70		
M6×0.5	G6	5.76	5.78	5.81	5.599	5.459
M7×1	G6	6.47	6.52	6.58	6.153	5.917
	G7	6.48	6.54	6.59		
M7×0.75	G7	6.62	6.66	6.70	6.378	6.188
M8×1.25	G7	7.36	7.43	7.49	6.912	6.647
	G8	7.37	7.44	7.51		
M8×1	G7	7.48	7.54	7.59	7.153	6.917
M8×0.75	G7	7.62	7.66	7.70	7.378	7.188
M10×1.5	G7	9.22	9.30	9.38	8.676	8.376
	G8	9.23	9.31	9.39		
M10×1.25	G7	9.35	9.42	9.49	8.912	8.647
	G8	9.37	9.43	9.50		
M10×1	G7	9.48	9.53	9.59	9.153	8.917
M12×1.75	G8	11.09	11.19	11.28	10.441	10.106
	G9	11.11	11.20	11.29		
M12×1.5	G8	11.22	11.30	11.38	10.676	10.376
	G9	11.23	11.31	11.39		
M12×1.25	G8	11.35	11.42	11.49	10.912	10.647
	G9	11.36	11.43	11.50		
M12×1	G7	11.47	11.53	11.58	11.153	10.917
M14×2	G9	12.97	13.07	13.18	12.210	11.835
	G10	12.98	13.09	13.19		
M14×1.5	G9	13.22	13.31	13.39	12.676	12.376
M14×1	G8	13.48	13.54	13.59	13.153	12.917
M16×2	G9	14.96	15.07	15.18	14.210	13.835
	G10	14.97	15.08	15.19		
M16×1.5	G9	15.22	15.30	15.38	14.676	14.376
M16×1	G8	15.48	15.53	15.59	15.153	14.917
M18×1.5	G9	17.22	17.30	17.38	16.676	16.376
M20×2.5	G11	18.72	18.86	18.99	17.744	17.294
M20×1.5	G9	19.21	19.29	19.37	18.676	18.376
	G10	19.22	19.31	19.39		

for Unified Threads

unit: mm

Size	Class	Recommended hole size (mm)		Thread engage-ment ratio (Estimation %)	ref. Minor diameter of internal threads (2B)	
		Max.	Min.		Max.	Min.
No.2-56UNC	2BX	2.04	1.96	65~100	1.871	1.695
No.2-64UNF	2BX	2.06	1.98	65~100	1.912	1.756
No.3-48UNC	2BX	2.35	2.25	65~100	2.146	1.941
No.3-56UNF	2BX	2.37	2.29	65~100	2.197	2.025
No.4-40UNC	2BX	2.64	2.54	70~100	2.385	2.157
No.4-48UNF	2BX	2.68	2.59	70~100	2.458	2.271
No.5-40UNC	2BX	2.97	2.87	70~100	2.697	2.487
No.5-44UNF	2BX	2.99	2.90	70~100	2.740	2.551
No.6-32UNC	2BX	3.22	3.11	75~100	2.895	2.642

Size	Class	Recommended hole size (mm)		Thread engage-ment ratio (Estimation %)	ref. Minor diameter of internal threads (2B)	
		Max.	Min.		Max.	Min.
No.6-40UNF	2BX	3.29	3.19	70~100	3.022	2.820
No.8-32UNC	2BX	3.89	3.78	75~100	3.530	3.302
No.8-36UNF	2BX	3.91	3.81	75~100	3.606	3.404
No.10-24UNC	2BX	4.44	4.30	75~100	3.962	3.683
No.10-32UNF	2BX	4.53	4.44	80~100	4.165	3.963
No.12-24UNC	2BX	5.07	4.96	80~100	4.597	4.344
No.12-28UNF	2BX	5.13	5.03	80~100	4.724	4.496
1/4-20UNC	2BX	5.86	5.73	80~100	5.257	4.979
1/4-28UNF	2BX	6.00	5.91	80~100	5.588	5.360

for GAS Threads

Size	Class	Recommended hole size (mm)		Thread engagement ratio (Estimation %)
		Max.	Min.	
G1/8-28	G6	9.34	9.22	80~100
G1/4-19	G8	12.64	12.42	80~100
G3/8-19	G8	16.08	15.91	80~100

7. Materials used for Cutting Tools

Materials

We have been seeking the best materials used for cutting tools since the company establishment because the performance of tools are depending on the selection of materials used. Major materials used in our company are listed below.

- (1) Taps
  - HSS: Equivalent to SKH58, SKH51, SKH56
Powder HSS (SKH10, High Vanadium High cobalt material)
  - Carbide: Cemented Carbide Materials of ultra micro grain
- (2) Dies
  - HSS: SKH51, SKH56
  - Alloy Tool Steel: SKS2, SKS21, SKS3, SKS31
- (3) Center Drills and Centering Tools
  - HSS: SKH51, SKH56
Powder HSS (SKH10, High Vanadium High cobalt material)
  - Carbide: Cemented Carbide Materials of ultra micro grain

*For product's improvement, material may be changed without notice.

Circumstance of tools' materials

Tensile strength, heat resistance, corrosion resistance and accuracy are the important features required of tool's materials. These requirements have been changing due to miniaturization and lightening of parts.

And manufacturing methods, as well, have been changing because of necessity of economical efficiency such as saving process/cycle time while parts become hard-to-machine type and their hardness increases.

As a result, the demand of industrial tools by users has become very tough.

For example, higher wear resistance and chipping resistance are required in the area of hardness, and heavy cutting process or high-speed cutting are required in the area of cycle time.

Moreover, product accuracy with its rigidity, laborsaving brought by uniformity, and systematic reliability are highly required.

Therefore, technological improvement of tool steels never stops developing so that they satisfy users needs.

❍ The major materials used for taps are already listed in the chart, but those materials are ready to develop from conventional alloy tool steels and current high speed steel into next generation materials such as cemented carbide and cermet materials.

New materials are developed even in high-speed tool steel area, such as SKH51 and SKH58 from SKH2, and they are moving into high performance materials, such as high vanadium, cobalt, and powder HSS made of high vanadium and high cobalt contents.

❍ As the material for round dies, were alloy tool steels mostly used because of the relationship with the use of adjustable round dies. However, for the hard-to-machine material. die material has been shifted into High Speed Steel.

❍ Major materials for center drills and centering tools are high speed steel materials, but they have been shifting to cobalt type or even cemented carbide from SKH51.

We keep on seeking to develop our technology to meet user's needs and are trying to find the best materials in collaboration with steel manufacturers.

Chemical composition of the materials specified in JIS

Classification	Symbols	Chemical composition									
		C	Si	Mn	P	S	Cr	Mo	W	V	Co
W type HSS	SKH 2	0.73～0.83	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	—	17.20～18.70	1.00～1.20	—
	SKH 3	0.73～0.83	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	—	17.00～19.00	0.80～1.20	4.50～ 5.50
	SKH 4	0.73～0.83	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	—	17.00～19.00	1.00～1.50	9.00～11.00
	SKH10	1.45～1.60	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	—	11.50～13.50	4.20～5.20	4.20～ 5.20
Mo type HSS	SKH51	0.80～0.88	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	4.70～ 5.20	5.90～ 6.70	1.70～2.10	—
	SKH52	1.00～1.10	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	5.50～ 6.50	5.90～ 6.70	2.30～2.80	—
	SKH53	1.15～1.25	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	4.70～ 5.20	5.90～ 6.70	2.70～3.20	—
	SKH54	1.25～1.40	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	4.20～ 5.00	5.20～ 6.00	3.70～4.20	—
	SKH55	0.87～0.95	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	4.70～ 5.20	5.90～ 6.70	1.70～2.10	4.50～ 5.00
	SKH56	0.85～0.95	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	4.70～ 5.20	5.90～ 6.70	1.70～2.10	7.00～ 9.00
	SKH57	1.20～1.35	≦0.45	≦0.4	≦0.030	≦0.030	3.80～4.50	3.20～ 3.90	9.00～10.00	3.00～3.50	9.50～10.50
	SKH58	0.95～1.05	≦0.7	≦0.4	≦0.030	≦0.030	3.50～4.50	8.20～ 9.20	1.50～ 2.10	1.70～2.20	—
	SKH59	1.05～1.15	≦0.7	≦0.4	≦0.030	≦0.030	3.50～4.50	9.00～10.00	1.20～ 1.90	0.90～1.30	7.50～ 8.50

Classification	Symbols	Usage	Cross chart		
			AISI	VDEH	ISO
W type HSS	SKH 2	Tools for general cutting and other kinds of tools.	T 1	S18-0-1	S1（HS18-0-1）
	SKH 3	Tools for high speed heavy cutting and other kinds of tools.	T 4	S18-1-2-5	S7（HS18-1-1-5）
	SKH 4	Tools for cutting hard -to-machine materials and other kinds of tools.	T 5	S18-1-2-10	S6（HS18-0-1-10）
	SKH10	Tools for cutting ultra hard-to-machine materials and other kinds of tools.	T15	—	S9（HS12-1-5-5）
Mo type HSS	SKH51	General cutting tools from which toughness is particularly required, and other kinds of tools.	M 2	S6-5-2	S4（HS6-5-2）
	SKH52	Tools for cutting high hardness material from which comparatively high toughness is required and other kinds of tools.	M 3-1	—	—
	SKH53		M 3-2	S6-5-3	S5（HS6-5-3）
	SKH54	Tools for cutting ultra hard-to-machine materials and other kinds of tools.	M 4	—	—
	SKH55	High speed cutting tools from which comparatively high toughness is required and other kinds of tools.	M35	S6-5-2-5	S8（HS6-5-2-5）
	SKH56		M36	—	—
	SKH57	Tools for cutting ultra hard-to-machine materials and other kinds of tools.	—	S10-4-3-10	S10（HS10-4-3-10）
	SKH58	General cutting tools from which toughness is particularly required, and other kinds of tools.	M 7	S2-9-2	S2（HS2-9-2）
	SKH59	High speed heavy cutting tools from which comparatively high toughness is required, and other kinds of tools.	M42	S2-10-1-8	S11（HS2-9-1-8）

The standard of HSS material is specified in JIS. But there are many HSS materials which standard is not specified in JIS. Recently even the kind of HSS-P is getting wider and various. Besides, SKH10, SKH53, SKH57 and their equivalents, such Hi vanadium/ hi cobalt material as contains 4-12% vanadium and 8-11% cobalt is now being manufactured. Material engineering will be developed rapidly in the future. Under such situation, there can be many cases where JIS symbols are not used, and the use of larger classification and their symbols is getting popular.

8. Surface Treatment

The best surface treatment is applied to each tap depending on the tapping purpose.
Characteristics and effectiveness of surface treatment are introduced at next section.

Oxidizing

❍ This treatment was processed by using HOMO furnace being made by LEED AND NORTHUP company USA in 1938, and it is called HOMO treatment. This treatment is also called vapor treatment and steam treatment. Through this treatment, Fe3O4 layer of blue black color is produced over the tool surface.

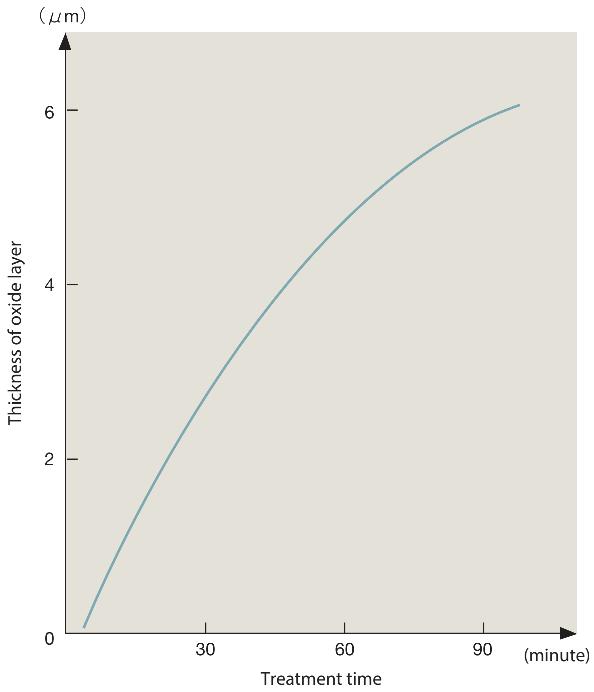
❍ Oxidization treatment produces porous layer on tool's surface. This porous layer works as oil pocket to reduce friction, to avoid welding and to improve the surface roughness of internal screw. Moreover, longer tool life is expected because the treatment reduces the remaining stress of HSS tools.

❍ This treatment does not increase the hardness on tool surface. Using the furnace of YAMAWA original design and choosing the proper treatment time, we have marked good result of oxidizing for YAMAWA HSS tools.

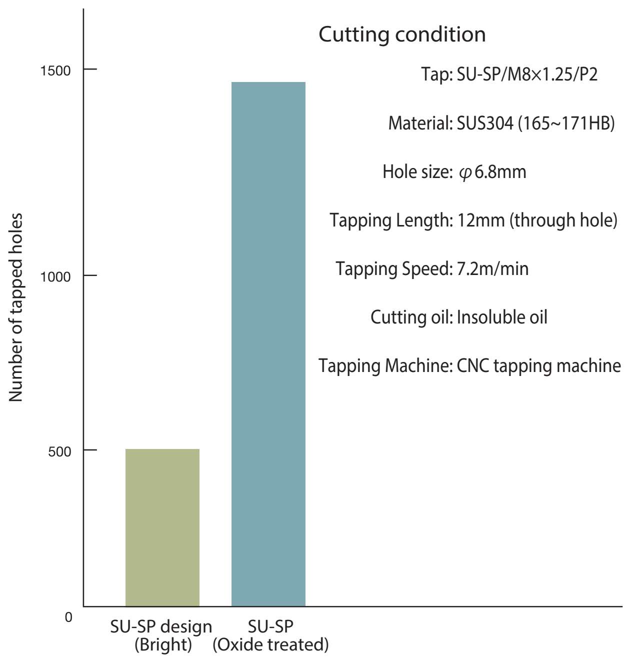
❍ Stainless steel and low carbon steel are the materials that are easy to get welding. We are applying this treatment to the special purpose taps for these materials to get good result. Further due to the reduction of friction force, this treatment has good result for wide range of steel type material.

❍ We combine oxidizing with nitriding for the taps designed for thermal refined steels of high carbon steels and alloy steels. This double treatment wins good reputation of the market.

Thickness of oxide layer and the time of treatment



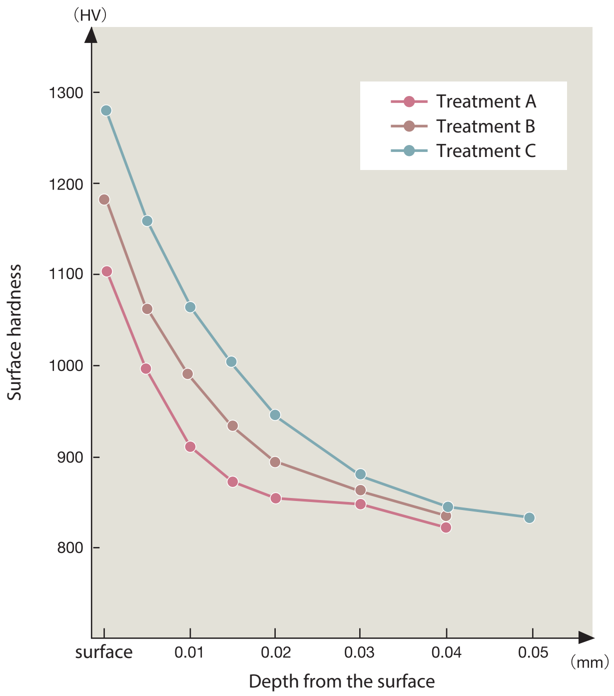
Comparison between bright and oxide treated



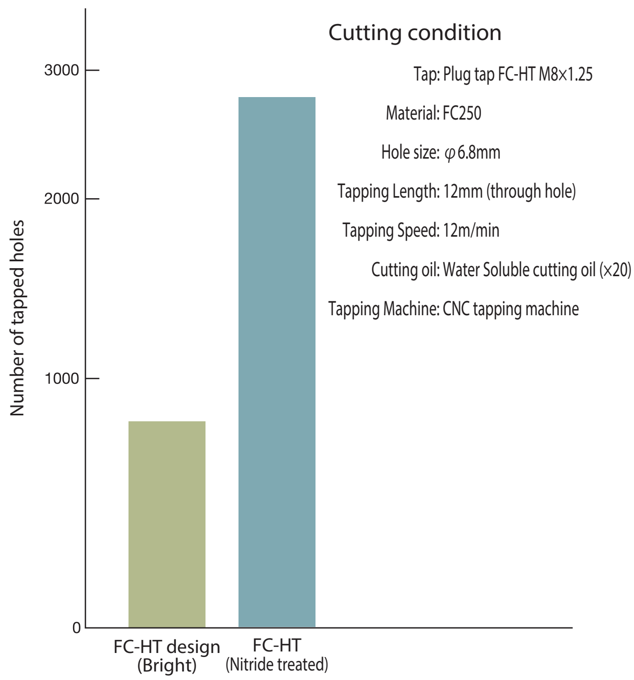
Nitriding

- In this treatment, we have Nitrogen and Carbon soak into the surface of HSS tools, and react with chemical of HSS material to produce hard nitride. There are 3 methods in the treatment, composition gas method, salt bath nitride method and ion nitride method.
- Salt bath nitride treatment is shifted into gas nitride treatment method because of cyanic environmental pollution.
- The temperature of treatment is 500 to 550 degree. Hardness and depth of the treatment can be controlled by active nitrogen concentration and reaction time.
- The high hardness of tool surface minimizes chemical attraction. Result is less welding and friction reduction. Great improvement is expected in tool's performance.
- We have found out the best combinations of hardness and toughness through our treatment technology
- The nitride treatment will be widely applicable to the taps for such workpiece materials as gray cast irons, special cast irons, aluminum diecastings with higher silicone content, copper alloys, and resinoids (plastics). These materials produce small segmental chips and are very abrasive.
- We combine nitrogen and oxidizing for comparatively sticky material such as thermal refined steels of high carbon steel and alloy steel. This double treatment improves the chipping resistance and have won good reputation.

Depth and hardness of Nitride Surface Treatment



Comparison between bright and nitride treated



Hard coating

High speed cutting and hard-to-machine material cutting are the recent technology. To meet this tendency, the hard layer coating by vapor deposition over tool's surface has become popular. There are two coating methods, CVD and PVD. PVD is mainly used for tap.

Physical Vapor Deposition

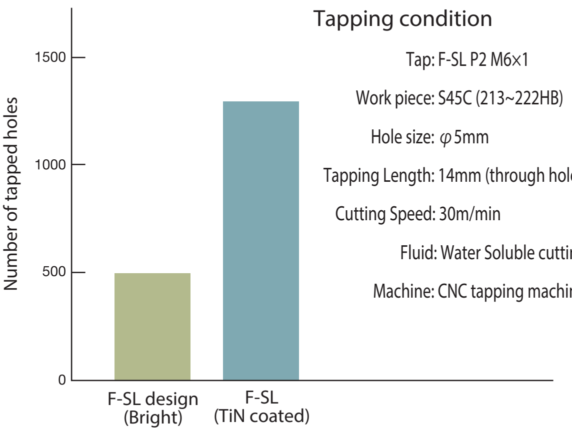
- Inside of the container of high vacuum, are vapor deposition materials heated. And we vapor-deposit particles ionized by electric discharge on tool's surface.
- Due to its low reaction temperature (lower than 500˚C), PVD makes little change in shape and hardness of HSS tools.

The features and classification of coating

Classification / Features	Titanium nitride (TiN)	Titanium carbonitride (TiCN)	Titanium nitride aluminum (TiAlN)	Chromium nitride (CrN)
Vickers Hardness	2000～2400	3000～3500	2300～2700	1800～2200
Wear resistance	Good	Excellent	Excellent	Normal
Welding resistance	Good	Good	Good	Excellent
Heat resistance	Good	Normal	Excellent	Excellent
Acid resistance	Good	Normal	Excellent	Good
Slippery	Good	Excellent	Good	Excellent
Color	Gold	Blue Dray Violet	Violet	Silver
Workpiece materials	Carbon Steels Aluminum forging	Carbon Steels Hard Steels Stainless Steels Aluminum forging Cast Irons Brass・Bronze	Stainless Steels Cast Irons	Copper

Note: Evaluation (tri-level) of characteristic features is just comparative of these four coatings, TiN, TiCN, TiAlN, and CrN, in the table. These coatings have great advantages of wear resistance, welding resistance, and friction reduction. The values of vickers hardness are also higher than the heat treatment or nitriding of HSS cutting tools from the table.

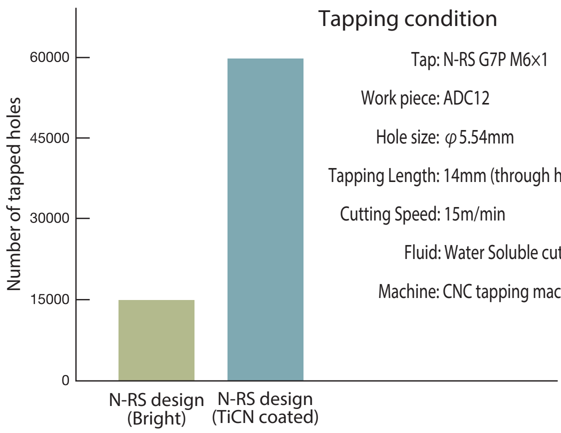
Comparison between bright and TiN coated



Tapping condition

Tap: F-SL P2 M6×1
Work piece: S45C (213~222HB)
Hole size: φ5mm
Tapping Length: 14mm (through hole)
Cutting Speed: 30m/min
Fluid: Water Soluble cutting oil
Machine: CNC tapping machine

Comparison between bright and TiCN coated



Tapping condition

Tap: N-RS G7P M6×1
Work piece: ADC12
Hole size: φ5.54mm
Tapping Length: 14mm (through hole)
Cutting Speed: 15m/min
Fluid: Water Soluble cutting oil
Machine: CNC tapping machine

9. Carbide Taps

Technological advances in CNC machines and machining centers, and machining automation have helped improve the overall tapping process.
YAMAWA was quick to respond to evolving customer needs resulting from technological innovations.
We can now recommend carbide taps, which provide tremendous improvements in mass-production and in reducing costs. It is estimated that carbide taps have 50 times more durability than HSS taps in tapping, when used properly. YAMAWA engineering believes the best carbide materials suitable for taps are ultramicro grain tungsten carbide, or ultrafine grain carbide made of high cobalt.

■ Features of Carbide Taps

(1). Excellent durability with high toughness is obtainable.
(2). High anti-friction features are provided by the material's high hardness and comparatively high toughness, which ultimately results in a longer tool life.
(3). Specially designed cutting angle and other dimensional features produce the internal threads with high tolerance accuracy and consistency.
(4). Under certain tapping condition, YAMAWA carbide taps can be used even for tapping hard-to-machine materials.

■ Points to note during tapping with Carbide taps:

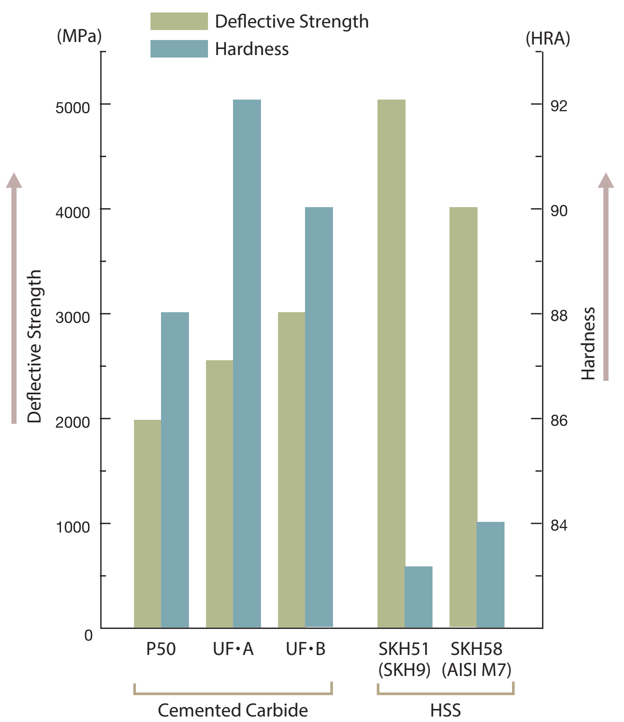
(1). Machine vibration, or run-out, can lead to Carbide tap chipping and premature failure. Tapping vibrations need to be kept to a minimum.
(2). Tap holder should be a rigid type for a Carbide tap. A holder attachment with axial float, or radial float tends to promote Carbide tap breakage and chipping.
(3). The hole to be tapped must be located correctly and on center; any centering off or non-straight drilled hole tends to cause Carbide tap breakage due to deflection. Select correct hole depth with respect to tapping length (for blind hole only). It is especially important to prevent tap damage from chip packing and bottom thrusting in blind hole tapping.
(4). Cutting lubricants - select grade of lubricant. Improper flow of coolant, or lack of sufficient amount of lubricant, or cooling can increase the likelihood of Carbide tap chipping due to work material welding. Caution must be taken during dry machining to prevent chip welding to the tap.
(5). Work pieces - we provide Carbide taps with increased toughness, but Carbide taps are inferior to High Speed Steel (HSS) in the area of toughness. As a matter of fact Carbide taps have limited application due to this difference in toughness to HSS.

■ Commonly used materials and cutting conditions

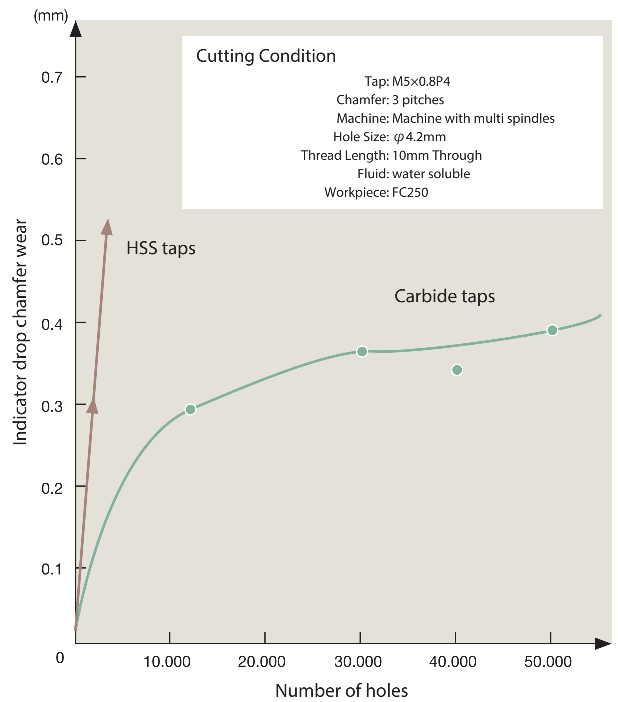
Work Materials		Cutting Speed (m/min)	Cutting Fluid (General recommendation)
Cast Iron	Ordinary	15~25	Dry, light oil, water soluble oil
	Nodular Graphite	10~20	Light oil, water soluble oil
	Malleable	10~20	Water soluble oil
Aluminum		20~40	Light oil, water soluble oil
Copper		15~30	Light oil, water soluble oil
Copper Alloy	Brass	20~30	Light oil, water soluble oil
	Phosphor Bronze	15~30	Light oil, water soluble oil
Die-Cast	Aluminum Alloy	15~25	Mixed oil of lard oil and kerosene
	Zinc Alloy	12~20	Mixed oil of lard oil and kerosene
Plastic	Thermosetting	15~25	Water soluble oil, air
	Thermo Plastic	15~25	Water soluble oil, air
Hard Rubber		15~30	Dry, air

Note: The table shows only general conditions. As for actual cutting operation, please consider the following points: (1) Machine Capacity, (2) Work piece(s), (3) Work Shape, (4) Setup (5) other factors.

Toughness and Hardness of Cemented Carbide and HSS



Chamfer wear and number of holes of Carbide taps and HSS taps



Carbide Tap examples and comparison of tool life

Classification	Size	M2×0.4	M8×1.25	M6×1	M8×1.25	M10×1.25
Workpiece	Material	Plastic with glass fibre	ADC12	FC250	FC250	FC250
	Part's name	Electric Parts	Car Parts	Electric Parts	Car Parts	Car Parts
Thread Condition	Tapping Hole. condition	φ1.6 Through	φ6.7 Blind	φ5.0 Blind	φ6.7 Blind	φ8.7 Blind
	Tapping Length	4mm	18mm	10mm	16mm	18mm
Condition of Use	Machine	Special Machine	Special Machine	4 spindle Machine	Multi Spindle Machine	Special Machine
	Cutting Speed	6.3m/min	8.5m/min	8m/min	6m/min	5.7m/min
	Fluid	Dry	Water soluble	Water soluble	Water soluble	Water soluble
Number of Holes	Carbide Tap	10.000	75.400	53.000	18.860	38.500
	HSS Tap	200	1.000	1.000	300	500
	Comparison of Life	50	75.4	53	62.9	77

Note: In all situations, HSS taps being used are standard ones.
Carbide taps, when used properly, bring out a long tool life.
These data have come from end users of carbide taps.

10. Selecting different tap holder combinations by machine feed system

The function of machine feed systems

Fully synchronous feed (Rigid) tapping system

Spindle revolution and machine feed are synchronized, a perfect thread lead and feed per revolution are realized.

Feed by lead screws

A better-feed condition is realized because the tap is fed by a master lead screw shaft that has the same thread lead as this tap.

Feed by gear

The tap is fed at the same thread lead by a combinations of gears. This creates a better-feed to thread lead condition.

Asynchronous feed system

Best used when the spindle rotation and the machine feed are set independently, especially, if the machine feed value cannot be accurately predicted to be that of the tap thread lead.

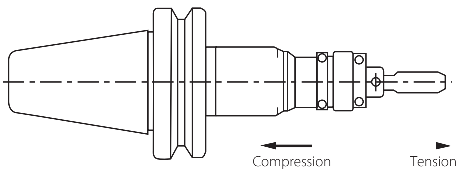
Hydraulic or Pneumatic pressure feed system

Feed is controlled by a pressure regulation system which normally results in an inaccurate feed per revolution compared to the tap thread lead.

Manual feed

Feed is controlled by operator which is difficult to keep a stable amount of feed per revolution.

Holders aspects



Spring direction

Completely rigid holder type

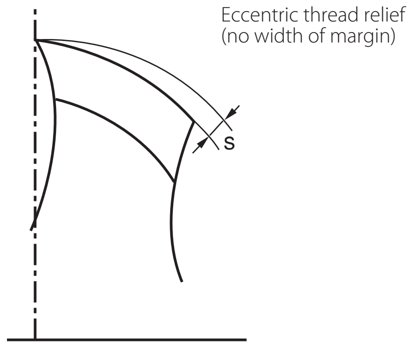
The tap is held with no axial or radial adjustment in the collet and holder.

Adjustable spring floating holder (Tension & Compression)

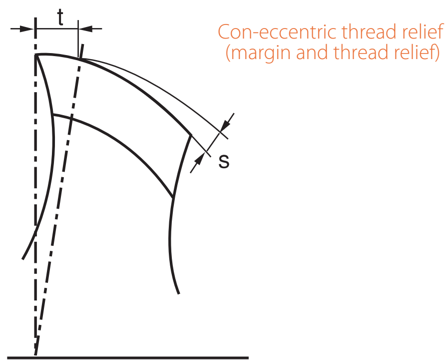
Machine feed and tap's thread lead errors are corrected by two types of spring system in the holder, the axial tension direction of the tap and the axial compression direction of the tap.

Characteristics of tap self-guiding behavior

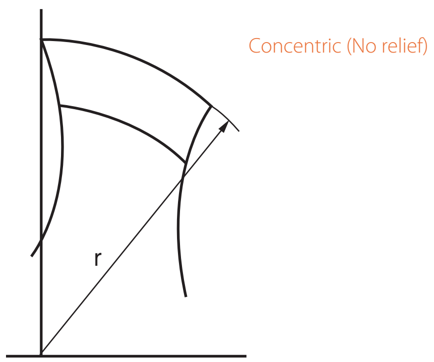
r=tap's radius, s=thread relief, t=margin width



Tap characteristics; high cutting performance and machining performance, with little to no self-guiding features. Operation; A fully synchronous machining system with fixed rigid holder is needed.
Example: "High speed tapping" and "fully synchronous tapping."



Tap; High level of self-guidance due to suitable tap diameter margin and thread relief. The combination of nice portion of margin and chamfer relief helps to make appropriate tap guidance.

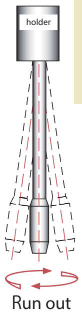


Tap; A full thread land stays in contact with the thread major diameter at all times. Tap has no thread relief on major diameter, creating a high level of self-guidance even with unbalanced feeding conditions.

11. The mechanism for a tap to cut oversize on an internal thread

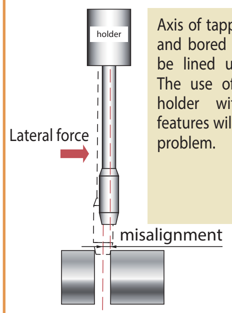
1. Run out, misalignment and tap cutting in non perpendicular to holes → Over-cutting at radial direction

Tool run out during tapping



Holder needs to be adjusted. Tapping with run out can be observed and checked when idle running.

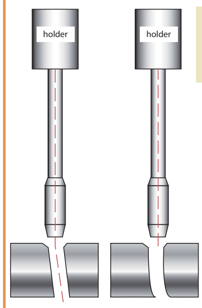
Misalignment during tapping



Axis of tapping process and bored hole should be lined up correctly. The use of adjustable holder with floating features will reduce this problem.

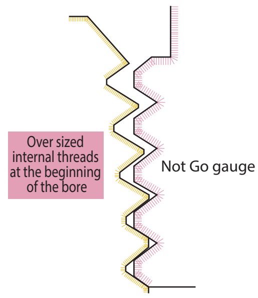
Solutions

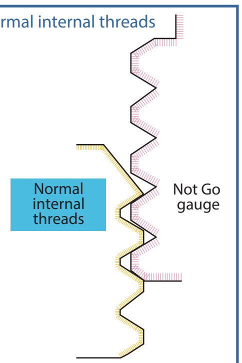
Tapping a non-parallel or non-perpendicular thread to the axis of the hole.

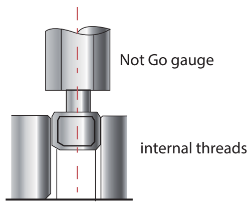


Verification of prepared hole condition.

Excessive cutting in radial direction causes oversized internal threads. Since tapping proceeds along bored hole, in the depth of hole, oversize cutting is minimized, that is, oversize cutting in the beginning of the hole and normal cutting in the depth of the hole.







2. Using a tap not suitable for the operation or a tap with dull cutting edge may cause galling and result in over-cutting. → Over-cutting caused by galling and excess cutting

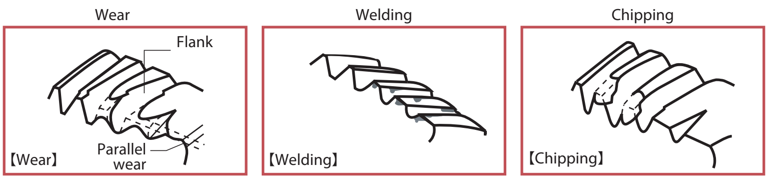
Using an incorrect tap for a specific workpiece material can cause problems

Select the correct Tap

- Straight fluted tap
- Spiral fluted tap
- Spiral pointed tap
- Roll tap

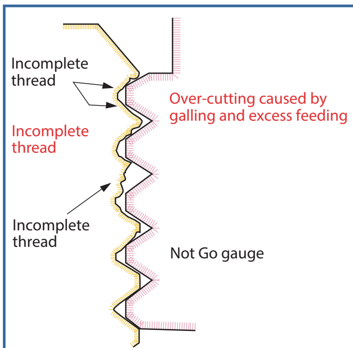
Selection of correct taps suitable for material being tapped is strongly recommended.

Tapping process with dull edge



Solution: Proper use of cutting oil, confirmation of a constant for tool life

Torn threads occur on the thread flanks. If this situation gets worse, there occur large thread collapses or incomplete threads finally bringing out oversized internal threads.
Depending on the condition of collapsed threads such trouble tends to occur discontinuously as NOT-GO gouge enters.
Special attention needs to be taken so that random inspection should not miss this kind of trouble.

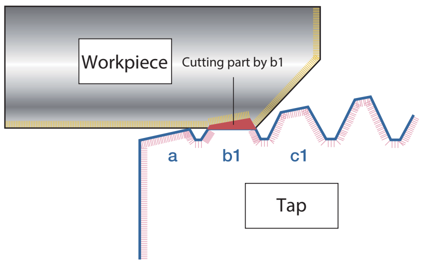


The mechanism for a tap to cut oversize on an internal thread

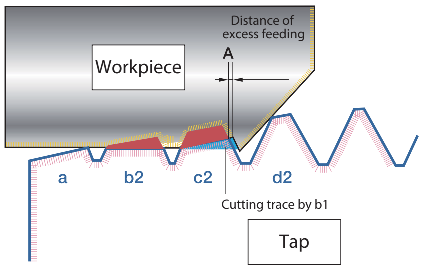
3. Tapping with an improper feed condition → over-cutting at axial direction

Process of over-cutting due to excessive feed

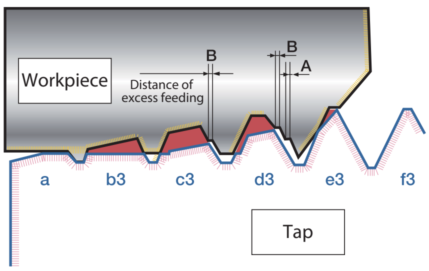
①With cutting edge b1, cutting starts.



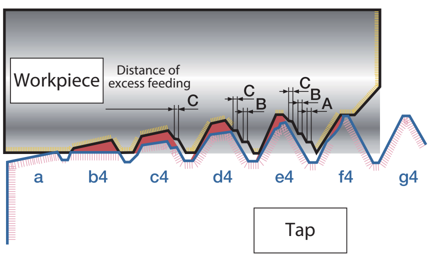
②Position between workpiece and tap after the tap rotates 1 turn.



③Position between workpiece and tap after the tap rotates 2 turns.



④The position between workpiece and tap after 3 rotations of tap.



Solutions

Feed adjustment is strongly recommanded.

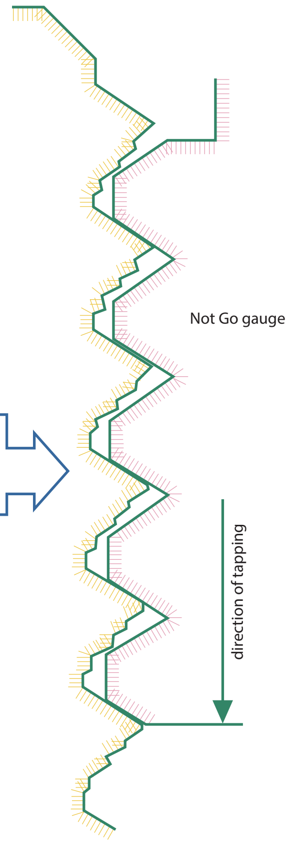
∗(Use fully synchronous feed system and fixing holder)

When using machines that do not have the synchronous feed system, such as drilling machine.

∗Adjust the correct weight balance of main spindle properly.

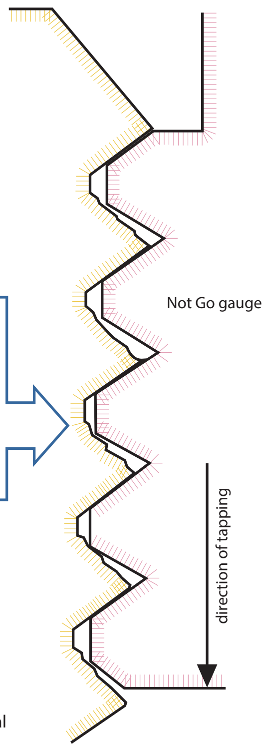
∗Use an axial/radial floating holder for adjustment.

Excessive-cutting of the thread with excessive feeding



Over-cutting of the thread by too slow feeding

Process Opposite of excessive feeding Factors in fluencing extra material is cut at back frank.



over-cutting during tapping

①The tap mounting condition in the holder.
②The condition of bored hole.
③The cutting oil selection.
④Incorrect adjustment of feed balance.
⑤Selection of the tap depending on material being cut.

12. Symbols for Standard Threads

Japan

Thread symbols	Kinds of threads	Related Standards
M	Metric screw threads	JIS B 0205-1～0205-4
S	Miniature screw threads	JIS B 0201
UNC	Unified threads, Coarse series	JIS B 0206
UNF	Unified threads, Fine series	JIS B 0208
Tr	Metric Trapezoidal screw threads	JIS B 0216
R	Taper external pipe threads	JIS B 0203 (JIS main book)
Rc	Taper internal pipe threads	JIS B 0203 (JIS main book)
Rp	Parallel internal pipe threads	JIS B 0203 (JIS main book)
G	Parallel pipe threads	JIS B 0202 (JIS main book)
PF	Parallel pipe threads	JIS B 0202 (JIS Appendix)
PT	Taper pipe threads	JIS B 0203 (JIS Appendix)
PS	Parallel internal pipe threads	JIS B 0203 (JIS Appendix)
CTC	Screw threads for rigid metal thin-walled conduit and fitting	JIS C 8305
CTG	Screw threads for rigid metal thick-walled conduit and fitting	JIS C 8305
BC	Cycle threads	JIS B 0225
SM	Screw threads for sewing machine	JIS B 0226 (2001.2.20repeal)
E	Electric socket and lamp-base threads	JIS C 7709
V	Tire valve threads of automobile	JIS D 4207
CTV	Tire valve threads of cycle	JIS D 9422

ISO

Thread symbols	Kinds of threads	Related Standards
M	ISO Metric threads	ISO 261
S	ISO Miniature screw threads	ISO 1501
Tr	ISO Metric trapezoidal screw threads	ISO 2902
UNC	ISO Unified threads, coarse series	ISO 263
UNF	ISO Unified threads, fine series	ISO 263
UNEF	ISO Unified threads, extra fine series	ISO 263
UN	ISO Unified threads, constant pitch series	ISO 263
UNJC	Aerospace - UNJ threads (coarse)	ISO 3161
UNJF	Aerospace - UNJ threads (fine)	ISO 3161
UNJEF	Aerospace - UNJ threads (extra fine)	ISO 3161
UNJ	Aerospace - UNJ threads (constant pitch series)	ISO 3161
MJ	Aerospace - MJ threads	ISO 5855
R	Taper external pipe threads	ISO 7/1
Rc	Taper internal pipe threads	ISO 7/1
Rp	Parallel internal pipe threads	ISO 7/1
G	Parallel pipe threads	ISO 228/1
GL	Glass container threads	ISO 1115
V	Tire valve threads	ISO 4570/1～3

America

Thread symbols	Kinds of threads	Related Standards
UN	Unified inch screw threads	ANSI B 1.1
UNC/UNRC	Unified coarse thread series	ANSI B 1.1
UNF/UNRF	Unified fine thread series	ANSI B 1.1
UNEF/UNREF	Unified extra-fine thread series	ANSI B 1.1
4UN/4UNR	Unified constant-pitch series with 4-threads	ANSI B 1.1
6UN/6UNR	Unified constant-pitch series with 6-threads	ANSI B 1.1
8UN/8UNR	Unified constant-pitch series with 8-threads	ANSI B 1.1
12UN/12UNR	Unified constant-pitch series with 12-threads	ANSI B 1.1
16UN/16UNR	Unified constant-pitch series with 16-threads	ANSI B 1.1
20UN/20UNR	Unified constant-pitch series with 20-threads	ANSI B 1.1
28UN/28UNR	Unified constant-pitch series with 28-threads	ANSI B 1.1
32UN/32UNR	Unified constant-pitch series with 32-threads	ANSI B 1.1
UNS/UNRS	Unified threads of special diameters, pitches and lengths of engagement	ANSI B 1.1
NR	American National thread with a 0.108p to 0.144p controlled root radius	MIL-B-7838
Acme	Acme screw threads	ANSI B 1.5
Stub-Acme	Stub Acme screw threads	ANSI B 1.8
Butt	Buttress inch screw threads	ANSI B 1.9
UNM	Unified miniature thread series	ANSI B 1.10
NC5	Class 5 interference-fit thread	ANSI B 1.12
NPT	American Standard taper pipe threads for general use	ANSI/ASME B 1.20.1
NPTR	American Standard taper pipe threads for railing joints	ANSI/ASME B 1.20.1
NPSC	American Standard straight pipe thread in pipe couplings	ANSI/ASME B 1.20.1
NPSL	American Standard straight pipe threads for loose-fitting mechanical joints with locknuts	ANSI/ASME B 1.20.1
NPSM	American Standard straight pipe threads for free-fitting mechanical joints for fixture	ANSI/ASME B 1.20.1
NPSH	American Standard straight pipe threads for loose-fitting mechanical joints for hose couplings	ANSI/ASME B 1.20.1
NPTF	Dryseal American Standard taper pipe threads	ANSI B 1.20.3, 1.20.4
F-PTF	Dryseal fine taper pipe threads series	ANSI B 1.20.3, 1.20.4
PTF-SAE SHORT	Dryseal SAE short taper pipe threads	ANSI B 1.20.3, 1.20.4
PTF-SPL SHORT	Dryseal special short taper pipe threads	ANSI B 1.20.3, 1.20.4
PTF-SPL EXTRA SHORT	Dryseal special extra short taper pipe threads	ANSI B 1.20.3, 1.20.4
SPL-PTF	Dryseal special taper pipe threads	ANSI B 1.20.3, 1.20.4
NPSI	Dryseal American Standard intermediate internal straight pipe threads	ANSI B 1.20.3, 1.20.4
NPSF	Dryseal American Standard fuel internal straight pipe threads	ANSI B 1.20.3, 1.20.4
ANPT	Aeronautical National Form taper pipe threads	MIL-P-7150
NGO	National gas outlet threads	ANSI B 57.1
NGS	National gas straight threads	ANSI B 57.1
NGT	National gas taper threads	ANSI B 57.1
SGT	Special gas taper threads	ANSI B 57.1
NH	Hose coupling and firehose coupling threads	USAS B 2.4
NHR	Hose coupling and firehose coupling threads	USAS B 2.4
NPSH	Hose coupling and firehose coupling threads	USAS B 2.4
AMO	American Standard microscope objective threads	ANSI B 1.11

British

Thread symbols	Kinds of threads	Related Standards
UNS	Unified special series	BS 1580
B.S.W.	British Standard Whitworth coarse threads	BS 84
B.S.F.	British Standard fine threads	BS 84
BSP	British Standard pipe thread (corresponding to R, Rc, Rp of ISO)	BS 21,2779
B.A.	B.A.-Screw threads	BS 93
Acme	General purpose, Acme screw threads	BS 1104
Buttress	Buttress threads	BS 1657
BSC	Cycle threads	BS 811
BSMO	Microspoce objective threads	BS 3569
E	Edison screw threads	BS 5042

German

Thread symbols	Kinds of threads	Related Standards
GL	Glass containers thread	DIN 168
S	Buttress thread	DIN 513,2781,20401
Rd	Knuckle thread	DIN 262,3182,7273,15403,20400
W	Whitworth-gewinde	DIN 168,477,6630,49301
KS,KT	Screw siles for packages made of Plastics	DIN 6063
E	Edison screw thread	DIN 40400
Pg	Steel condiut thread	DIN 40430
Vg	Automobil tire valve thread	DIN 7756
Gf	Thread for freezing pipes	DIN 4930
Gg	Threads for drill pipe	DIN 4941,20314
HA	Thread for bone screws and nuts	DIN 58810
FG	Bicycle threads	DIN 79012

Edit. 1/16

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