

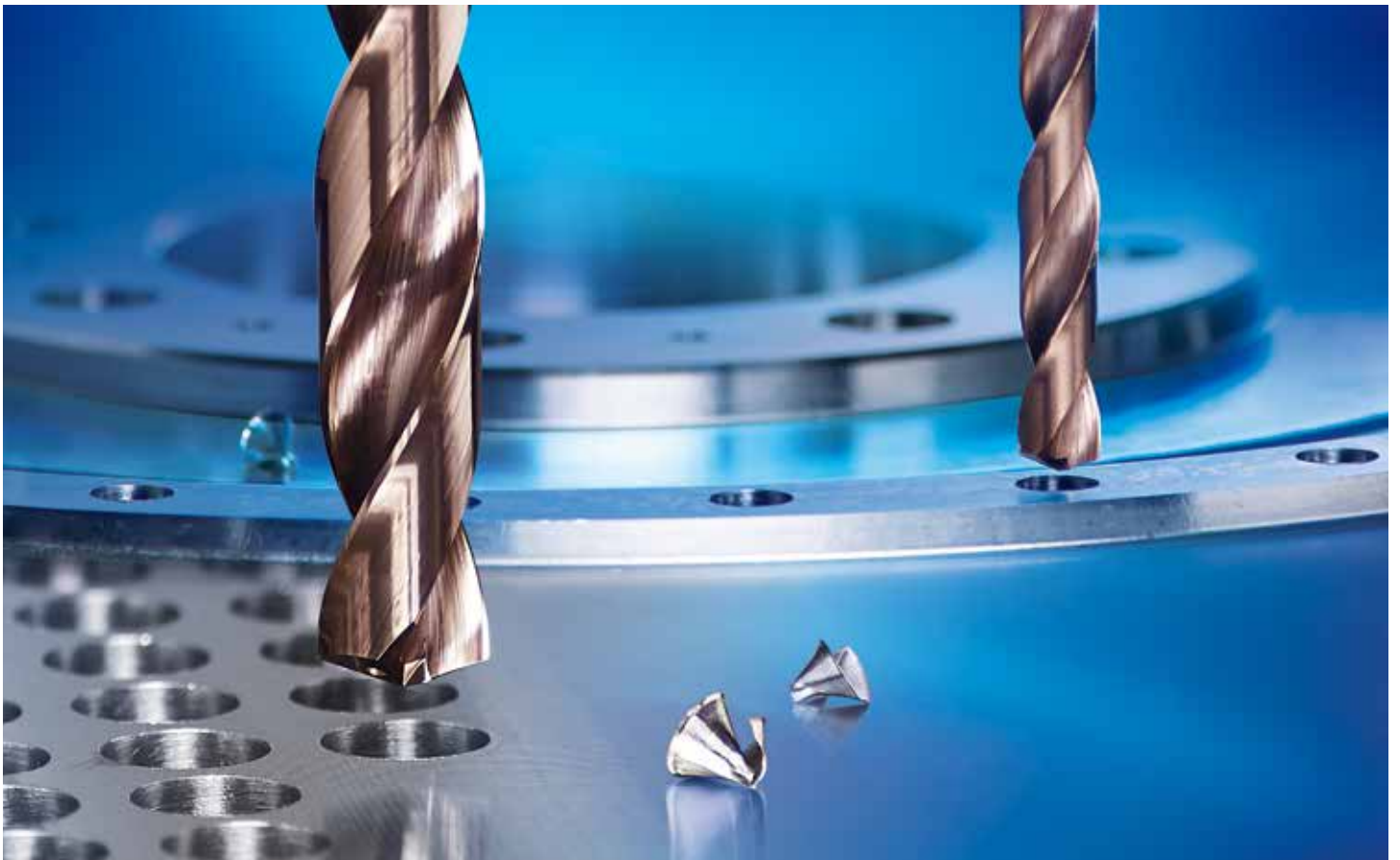
# MSD Plus-S



## **Mach Solid Drill Plus-S for Hole Making of Inconel and Titanium**

Specialized for heat-resistant alloys used in the aerospace, energy, power generation and automotive industries

- ▣ **Improved Productivity and Excellent Machinability**  
Ensuring machinability with optimized blade design and chip pockets
- ▣ **Stronger Resistance to Wear**  
Extended tool life due to excellent high temp resistance to chipping



# Drills Specialized for Machining Inconel & Titanium

Components Used in Aerospace, Power Generation and Energy Industries



## MSD Plus-S

For inconel and titanium

In recent years, the weight and efficiency of key components in the aerospace, power generation and energy industries have been improved, and the use of heat-resistant alloys, with light weight and high strength properties, has greatly increased.

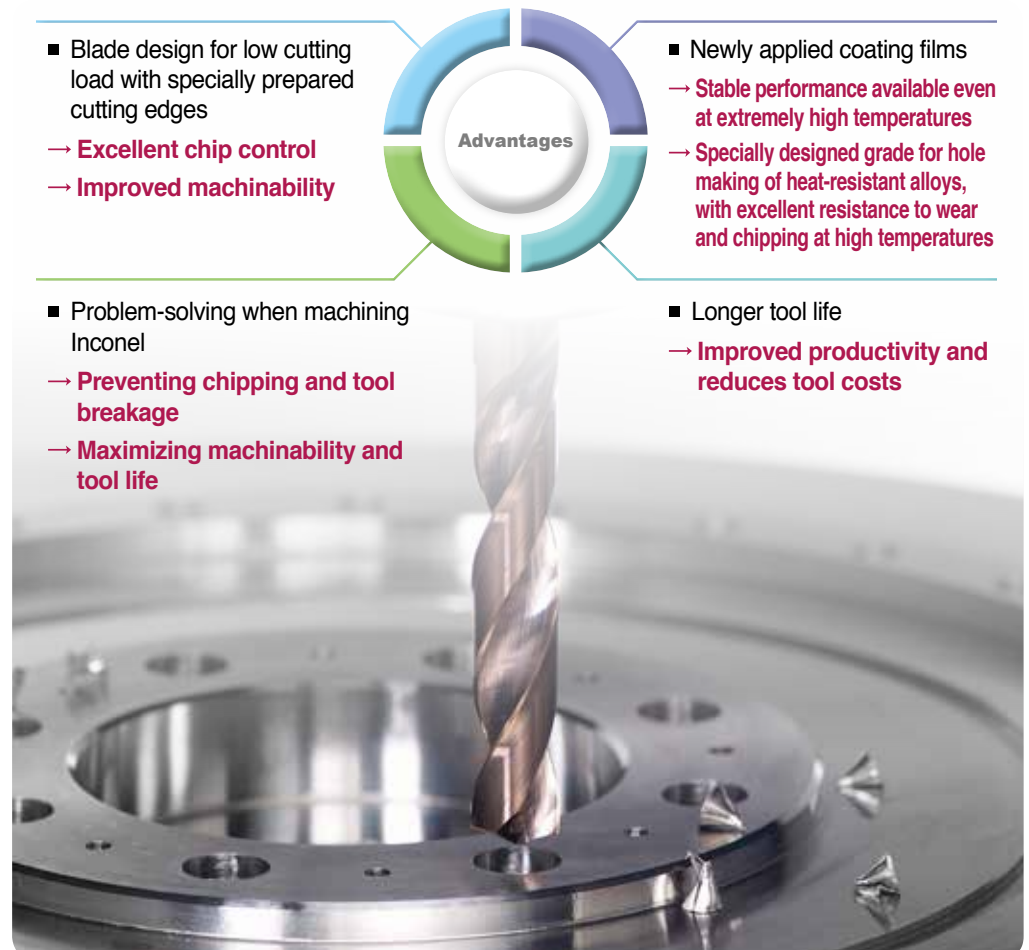
Among the heat-resistant alloys, inconel and titanium alloys have characteristics of high temp high strength and low heat conductivity, which causes problems such as thermal shock, work hardening and vibrations due to high concentration of cutting heat during machining; and shorter tool life and lower productivity due to chipping and breakage.

To meet these challenges, KORLOY has developed the MSD Plus-S, specialized for inconel and titanium machining, designed to greatly improve machinability and tool life.

**The MSD Plus-S** prevents chipping and sudden breakage with notch-controlled cutting edges and special edge preparation. Wide chip pockets and the optimized tip flank design significantly improve chip- and heat evacuation. This boosts productivity with stable machining even in high temp cutting conditions.

The new grade **PC325T** features stable tool life with excellent heat resistance and oxidation resistance, its exceptional surface finish minimizes built-up edges while smooth chip flow reduces the cutting load at high temperature.

We assure our customers that the MSD Plus-S is the next-generation solution for hole making of components made of inconel & titanium in the aerospace, power generation and energy industries.



## Code System

[ Standard type ]

<b>MSDP(H)</b>	<b>060</b>	-	<b>5</b>	<b>S</b>
<b>Oil hole</b>	<b>Drill dia.</b>		<b>Aspect ratio (L/D)</b>	<b>Machining area</b>
None: MSDP With oil holes: MSDPH	060: Ø6		3D, 5D	S: HRSA

[ Special type ]

<b>MSDP(H)</b>	<b>060</b>	-	<b>50</b>	<b>S</b>	-	<b>100L</b>	-	<b>5S</b>
<b>Oil hole</b>	<b>Drill dia.</b>		<b>Flute length</b>	<b>Machining area</b>		<b>Overall length</b>		<b>Shank dia.</b>
None: MSDP With oil holes: MSDPH	060: Ø6		50: 50mm	S: HRSA		100L: 100mm		5S: Ø5

## Features

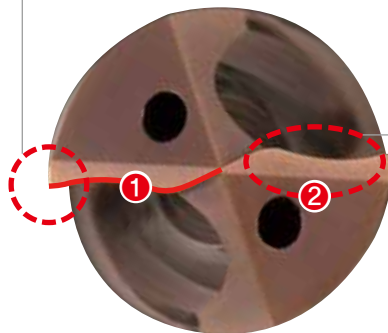
- Specially prepared cutting edges and optimized blade design prevent chipping and sudden tool breakage
- Optimized tip flank design improves heat evacuation

### Flute design

- Wider chip pockets improve chip evacuation

### Optimized margin and back-tapered design

- Reduced friction resistance and cutting temperature



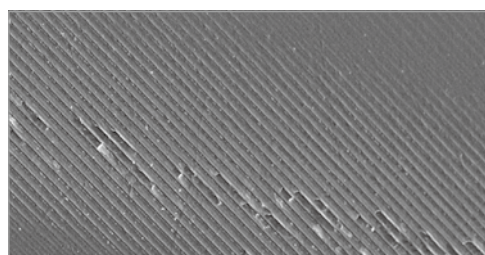
### Cutting-edge design

- Notch-controlled blade design and specially treated cutting edges prevent chipping and breakage
  - ① Cutting edges designed for low cutting resistance
  - ② Tip relief angle and shape optimized for heat evacuation

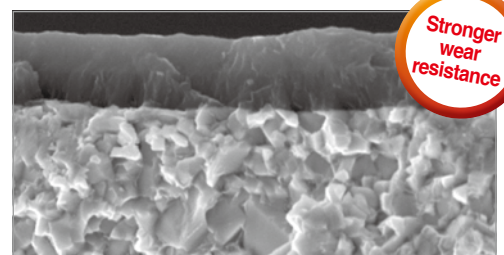
## The new grade PC325T

- Improved resistance to heat and oxidation thanks to the newly applied grade, PC325T
- Wear resistance stays excellent even at high temperatures

- Reduced friction resistance and improved chip evacuation due to excellent surface finish
- Exceptional wear resistance when machining heat-resistant alloys at high temperatures



[ Smooth coating surface ]



[ PC325T ]

**Stronger wear resistance**

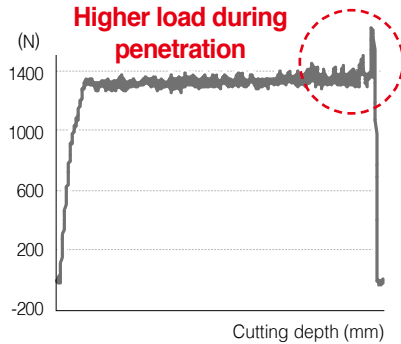
## ⇒ Performance Evaluation

- Improved chip flow reduces cutting load better than the competitor's
- Cutting load stays consistent during penetration, allowing stable hole making

### Cutting load

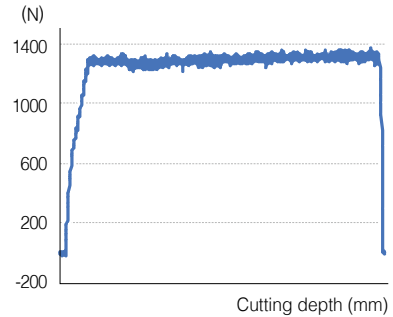
- Workpiece Inconel718 (HrC40~45)
- Cutting conditions Tool dia. (mm) = Ø6, vc (m/min) = 20, fn (mm/rev) = 0.09, ap (mm) = 25, wet
- Tool MSDPH060-5S (PC325T)

Average thrust: 1350N, Standard deviation: 45



[ Competitor ]

Average thrust: 1300N, Standard deviation: 25



[ MSD Plus-S ]

### Surface roughness

- Good surface finish due to stable hole making

- Workpiece Inconel718 (HrC40~45)
- Cutting conditions Tool dia. (mm) = Ø10, vc (m/min) = 20, fn (mm/rev) = 0.09, ap (mm) = 30, wet
- Tool MSDPH100-5S (PC325T)



[ Competitor ]



[ MSD Plus-S ]

Improved surface finish

- Workpiece Ti-6Al-4V (HrC42~47)
- Cutting conditions Tool dia. (mm) = Ø10, vc (m/min) = 40, fn (mm/rev) = 0.09, ap (mm) = 30, wet
- Tool MSDPH100-5S (PC325T)



[ Competitor ]



[ MSD Plus-S ]

Improved surface finish



## ⇒ Performance Evaluation

• Good chip shape due to specially prepared cutting edges and the optimized blade design

### Chip control

- Workpiece Inconel718 (H<sub>R</sub>C40~45)
- Cutting conditions Tool dia. (mm) = Ø10  
vc (m/min) = 20  
fn (mm/rev) = 0.09  
ap (mm) = 25  
wet
- Tool MSDPH100-5S (PC325T)



[ Competitor ]



[ MSD Plus-S ]

- Workpiece Ti-6Al-4V (H<sub>R</sub>C42~47)
- Cutting conditions Tool dia. (mm) = Ø10  
vc (m/min) = 40  
fn (mm/rev) = 0.09  
ap (mm) = 25  
wet
- Tool MSDPH100-5S (PC325T)



[ Competitor ]



[ MSD Plus-S ]

## ⇒ Application Examples

### Inconel718 (H<sub>R</sub>C40~45)

- Workpiece Aircraft parts (turbine disks, turbine shafts, etc.) and components used in the power generation industry
- Cutting conditions Tool dia. (mm) = Ø6.0, vc (m/min) = 20, fn (mm/rev) = 0.09, ap (mm) = 30, wet
- Tool MSDPH060-5S

MSD Plus-S

2m (66 holes)

Competitor

1m (33 holes)

100%  
longer

➔ Stable machining and 50% longer max. tool life compared to the competitor

### Ti-6Al-4V (H<sub>R</sub>C42~47)

- Workpiece Aircraft parts (engines, engine housings and turbine disks) and components used in the power generation industry
- Cutting conditions Tool dia. (mm) = Ø6.0, vc (m/min) = 40, fn (mm/rev) = 0.09, ap (mm) = 30, wet
- Tool MSDPH060-5S

MSD Plus-S

30m (1,000 holes)

Competitor

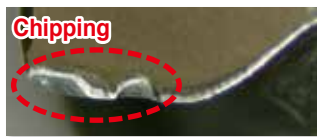
25m (833 holes)

20%  
longer

➔ 20% longer tool life compared to the competitor



[ MSD Plus-S ]



[ Competitor ]



[ MSD Plus-S ]

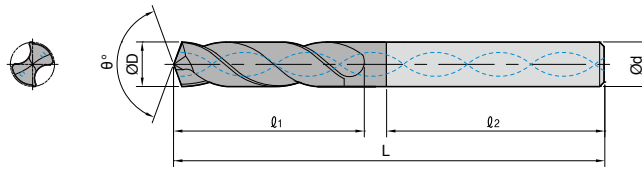


[ Competitor ]

## ⇒ Recommended Cutting Conditions

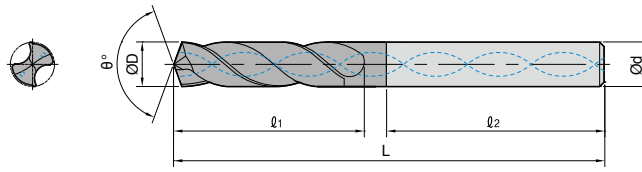
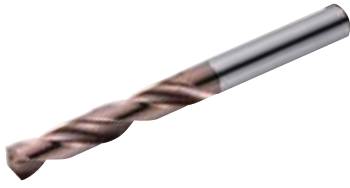
Workpiece		Hardness (H <sub>R</sub> C)	Grade	Cutting speed vc (m/min)	Feed (aspect ratio = 3D~5D)				
					Feed rate, fn (mm/rev) per drill dia. (mm)				
ISO	Workpiece materials				Ø2.5~Ø5.0	Ø5.1~Ø8.0	Ø8.1~Ø12.0	Ø12.1~Ø16.0	
S	HRSA (Inconel 718 and etc.)	Fe-base	25~35	PC325T	25~30	0.055~0.07	0.07~0.10	0.08~0.13	0.10~0.15
		Ni or Co base	35~45	PC325T	20~25	0.045~0.06	0.06~0.09	0.07~0.12	0.09~0.14
	Titanium alloy (Ti-6Al-4V and etc.)	Pure titanium	10~15	PC325T	40~50	0.07~0.11	0.09~0.14	0.12~0.18	0.16~0.23
		α and β alloys	35~45	PC325T	30~40	0.05~0.09	0.07~0.12	0.10~0.16	0.14~0.21

\* Cutting conditions above are for the case of less than 5D depth of cut and through coolant system applied.



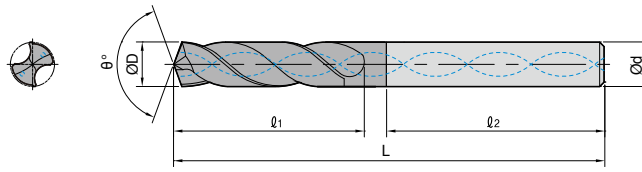
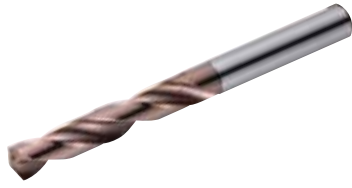
Specification	S
Grade	PC325T
Tolerance (Drill dia.)	h7
Tolerance (Shank dia.)	h6
Point angle ( $\theta^\circ$ )	140°
Twist angle	30°
Thinning	X Type
Coolant	Internal
International standard	DIN 6537
Shank type	DIN 6535 HA

Designation	$\varnothing D$		$\varnothing d$	3S		5S		$\ell_2$
	mm	inch		$\ell_1$	L	$\ell_1$	L	
<b>MSDPH</b> 030-□S	3.0		6	20	62	28	66	36
031-□S	3.1		6	20	62	28	66	36
0318-□S	3.18	1/8	6	20	62	28	66	36
032-□S	3.2		6	20	62	28	66	36
033-□S	3.3		6	20	62	28	66	36
034-□S	3.4		6	20	62	28	66	36
035-□S	3.5		6	20	62	28	66	36
0357-□S	3.57	9/64	6	20	62	28	66	36
036-□S	3.6		6	20	62	28	66	36
037-□S	3.7		6	20	62	28	66	36
038-□S	3.8		6	24	66	36	74	36
039-□S	3.9		6	24	66	36	74	36
0397-□S	3.97	5/32	6	24	66	36	74	36
040-□S	4.0		6	24	66	36	74	36
041-□S	4.1		6	24	66	36	74	36
042-□S	4.2		6	24	66	36	74	36
043-□S	4.3		6	24	66	36	74	36
0437-□S	4.37	11/64	6	24	66	36	74	36
044-□S	4.4		6	24	66	36	74	36
045-□S	4.5		6	24	66	36	74	36
046-□S	4.6		6	24	66	36	74	36
047-□S	4.7		6	24	66	36	74	36
0476-□S	4.76	3/16	6	28	66	44	82	36
048-□S	4.8		6	28	66	44	82	36
049-□S	4.9		6	28	66	44	82	36
050-□S	5.0		6	28	66	44	82	36
051-□S	5.1		6	28	66	44	82	36
0516-□S	5.16	13/64	6	28	66	44	82	36
052-□S	5.2		6	28	66	44	82	36
053-□S	5.3		6	28	66	44	82	36
054-□S	5.4		6	28	66	44	82	36
055-□S	5.5		6	28	66	44	82	36
0556-□S	5.56	7/32	6	28	66	44	82	36
056-□S	5.6		6	28	66	44	82	36
057-□S	5.7		6	28	66	44	82	36
058-□S	5.8		6	28	66	44	82	36
059-□S	5.9		6	28	66	44	82	36
0595-□S	5.95	15/64	6	28	66	44	82	36
060-□S	6.0		6	28	66	44	82	36



Specification	S
Grade	PC325T
Tolerance (Drill dia.)	h7
Tolerance (Shank dia.)	h6
Point angle (θ°)	140°
Twist angle	30°
Thinning	X Type
Coolant	Internal
International standard	DIN 6537
Shank type	DIN 6535 HA

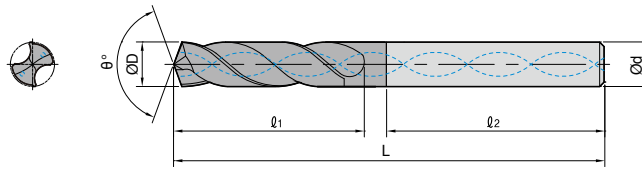
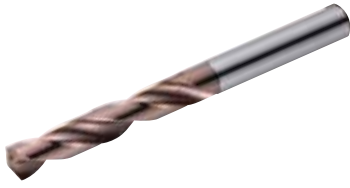
Designation	ØD		Ød	3S		5S		ℓ <sub>2</sub>
	mm	inch		ℓ <sub>1</sub>	L	ℓ <sub>1</sub>	L	
<b>MSDPH</b> 061-□S	6.1		8	34	79	53	91	36
062-□S	6.2		8	34	79	53	91	36
063-□S	6.3		8	34	79	53	91	36
0635-□S	6.35	1/4	8	34	79	53	91	36
064-□S	6.4		8	34	79	53	91	36
065-□S	6.5		8	34	79	53	91	36
066-□S	6.6		8	34	79	53	91	36
067-□S	6.7		8	34	79	53	91	36
0675-□S	6.75	17/64	8	34	79	53	91	36
068-□S	6.8		8	34	79	53	91	36
069-□S	6.9		8	34	79	53	91	36
070-□S	7.0		8	34	79	53	91	36
071-□S	7.1		8	41	79	53	91	36
0714-□S	7.14	9/32	8	41	79	53	91	36
072-□S	7.2		8	41	79	53	91	36
073-□S	7.3		8	41	79	53	91	36
074-□S	7.4		8	41	79	53	91	36
075-□S	7.5		8	41	79	53	91	36
0754-□S	7.54	19/64	8	41	79	53	91	36
076-□S	7.6		8	41	79	53	91	36
077-□S	7.7		8	41	79	53	91	36
078-□S	7.8		8	41	79	53	91	36
079-□S	7.9		8	41	79	53	91	36
0794-□S	7.94	5/16	8	41	79	53	91	36
080-□S	8.0		8	41	79	53	91	36
081-□S	8.1		10	47	89	61	103	40
082-□S	8.2		10	47	89	61	103	40
083-□S	8.3		10	47	89	61	103	40
0833-□S	8.33	21/64	10	47	89	61	103	40
084-□S	8.4		10	47	89	61	103	40
085-□S	8.5		10	47	89	61	103	40
086-□S	8.6		10	47	89	61	103	40
087-□S	8.7		10	47	89	61	103	40
0873-□S	8.73	11/32	10	47	89	61	103	40
088-□S	8.8		10	47	89	61	103	40
089-□S	8.9		10	47	89	61	103	40
090-□S	9.0		10	47	89	61	103	40
091-□S	9.1		10	47	89	61	103	40
0913-□S	9.13	23/64	10	47	89	61	103	40



Specification	S
Grade	PC325T
Tolerance (Drill dia.)	h7
Tolerance (Shank dia.)	h6
Point angle (θ°)	140°
Twist angle	30°
Thinning	X Type
Coolant	Internal
International standard	DIN 6537
Shank type	DIN 6535 HA

Designation	ØD		Ød	3S		5S		ℓ <sub>2</sub>
	mm	inch		ℓ <sub>1</sub>	L	ℓ <sub>1</sub>	L	
<b>MSDPH</b> 092-□S	9.2		10	47	89	61	103	40
093-□S	9.3		10	47	89	61	103	40
094-□S	9.4		10	47	89	61	103	40
095-□S	9.5		10	47	89	61	103	40
0953-□S	9.53	3/8	10	47	89	61	103	40
096-□S	9.6		10	47	89	61	103	40
097-□S	9.7		10	47	89	61	103	40
098-□S	9.8		10	47	89	61	103	40
099-□S	9.9		10	47	89	61	103	40
0992-□S	9.92	25/64	10	47	89	61	103	40
100-□S	10.0		10	47	89	61	103	40
101-□S	10.1		12	55	102	71	118	45
102-□S	10.2		12	55	102	71	118	45
103-□S	10.3		12	55	102	71	118	45
1032-□S	10.32	13/32	12	55	102	71	118	45
104-□S	10.4		12	55	102	71	118	45
105-□S	10.5		12	55	102	71	118	45
106-□S	10.6		12	55	102	71	118	45
107-□S	10.7		12	55	102	71	118	45
1072-□S	10.72	27/64	12	55	102	71	118	45
108-□S	10.8		12	55	102	71	118	45
109-□S	10.9		12	55	102	71	118	45
110-□S	11.0		12	55	102	71	118	45
1111-□S	11.11	7/16	12	55	102	71	118	45
112-□S	11.2		12	55	102	71	118	45
113-□S	11.3		12	55	102	71	118	45
114-□S	11.4		12	55	102	71	118	45
115-□S	11.5		12	55	102	71	118	45
1151-□S	11.51	29/64	12	55	102	71	118	45
116-□S	11.6		12	55	102	71	118	45
117-□S	11.7		12	55	102	71	118	45
118-□S	11.8		12	55	102	71	118	45
119-□S	11.9		12	55	102	71	118	45
1191-□S	11.91	15/32	12	55	102	71	118	45
120-□S	12.0		12	55	102	71	118	45
121-□S	12.1		12.1	60	107	77	124	45
122-□S	12.2		12.2	60	107	77	124	45
123-□S	12.3	31/64	12.3	60	107	77	124	45
124-□S	12.4		12.4	60	107	77	124	45





Specification	S
Grade	PC325T
Tolerance (Drill dia.)	h7
Tolerance (Shank dia.)	h6
Point angle (θ°)	140°
Twist angle	30°
Thinning	X Type
Coolant	Internal
International standard	DIN 6537
Shank type	DIN 6535 HA

Designation	ØD		Ød	3S		5S		ℓ2
	mm	inch		ℓ1	L	ℓ1	L	
<b>MSDPH</b> 125-□S	12.5		12.5	60	107	77	124	45
126-□S	12.6		12.6	60	107	77	124	45
127-□S	12.7	1/2	12.7	60	107	77	124	45
128-□S	12.8		12.8	60	107	77	124	45
129-□S	12.9		12.9	60	107	77	124	45
130-□S	13.0		13	60	107	77	124	45
131-□S	13.1		13.1	60	107	77	124	45
132-□S	13.2		13.2	60	107	77	124	45
133-□S	13.3		13.3	60	107	77	124	45
134-□S	13.4		13.4	60	107	77	124	45
1349-□S	13.49	17/32	13.49	60	107	77	124	45
135-□S	13.5		13.5	60	107	77	124	45
136-□S	13.6		13.6	60	107	77	124	45
137-□S	13.7		13.7	60	107	77	124	45
138-□S	13.8		13.8	60	107	77	124	45
139-□S	13.9		13.9	60	107	77	124	45
140-□S	14.0		14	60	107	77	124	45
141-□S	14.1		14.1	65	115	83	133	48
142-□S	14.2		14.2	65	115	83	133	48
1429-□S	14.29	9/16	14.29	65	115	83	133	48
143-□S	14.3		14.3	65	115	83	133	48
144-□S	14.4		14.4	65	115	83	133	48
145-□S	14.5		14.5	65	115	83	133	48
146-□S	14.6		14.6	65	115	83	133	48
147-□S	14.7		14.7	65	115	83	133	48
148-□S	14.8		14.8	65	115	83	133	48
149-□S	14.9		14.9	65	115	83	133	48
150-□S	15.0		15	65	115	83	133	48
151-□S	15.1		15.1	65	115	83	133	48
152-□S	15.2		15.2	65	115	83	133	48
153-□S	15.3		15.3	65	115	83	133	48
154-□S	15.4		15.4	65	115	83	133	48
155-□S	15.5		15.5	65	115	83	133	48
156-□S	15.6		15.6	65	115	83	133	48
157-□S	15.7		15.7	65	115	83	133	48
158-□S	15.8		15.8	65	115	83	133	48
1587-□S	15.87	5/8	15.87	65	115	83	133	48
159-□S	15.9		15.9	65	115	83	133	48
160-□S	16.0		16	65	115	83	133	48

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