



For more information

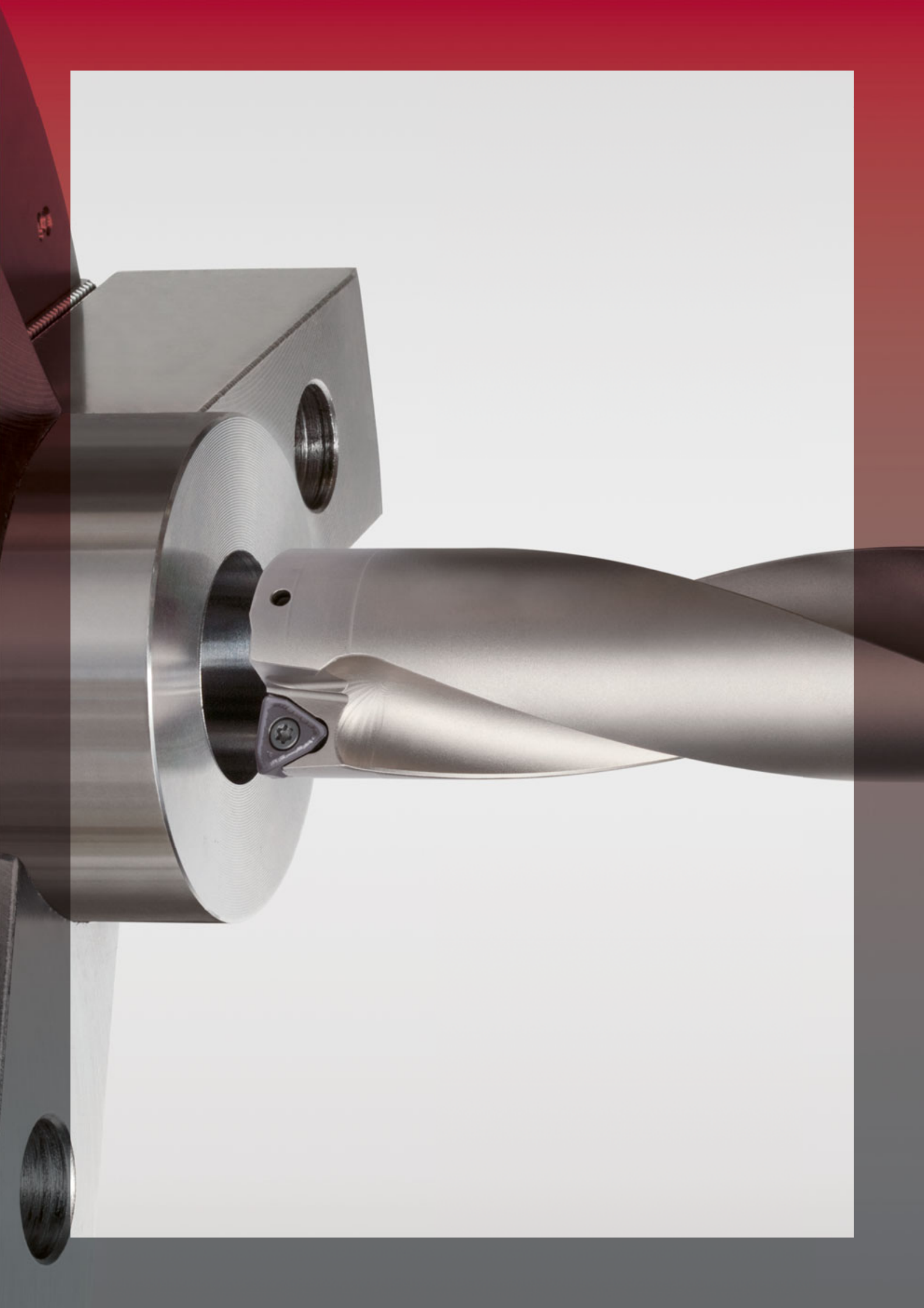
Indexable drill

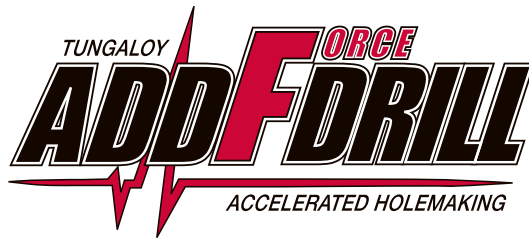
TUNGSIX-DRILL

Tungaloy Report No. 409-G

Introduction of the latest insert grades dedicated to drilling applications







TUNGSIX-DRILL



First-to-the-market*
Indexable drill series with 6-edge inserts

* As of June 2024.

Indexable drills for economical drilling solution

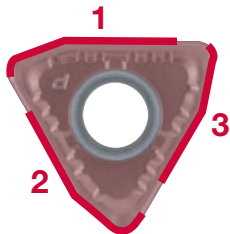
- Drilling diameters from 20 mm to 54.0 mm
- Drilling depths of 2xD, 3xD, and 4xD



Features

- 1** Economical, double-sided 6-edge inserts

Peripheral cutting edges



Center cutting edges

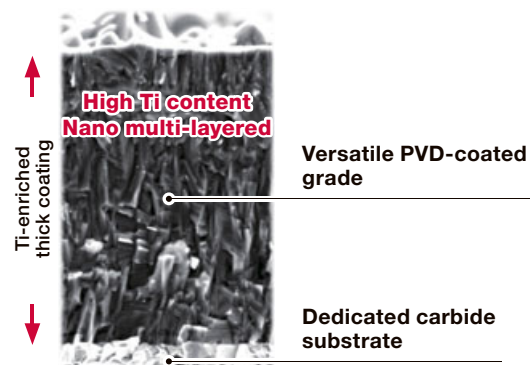


- 2** A single insert is interchangeable for the center cutting edge and peripheral cutting edge. This reduces tool inventory and investment.



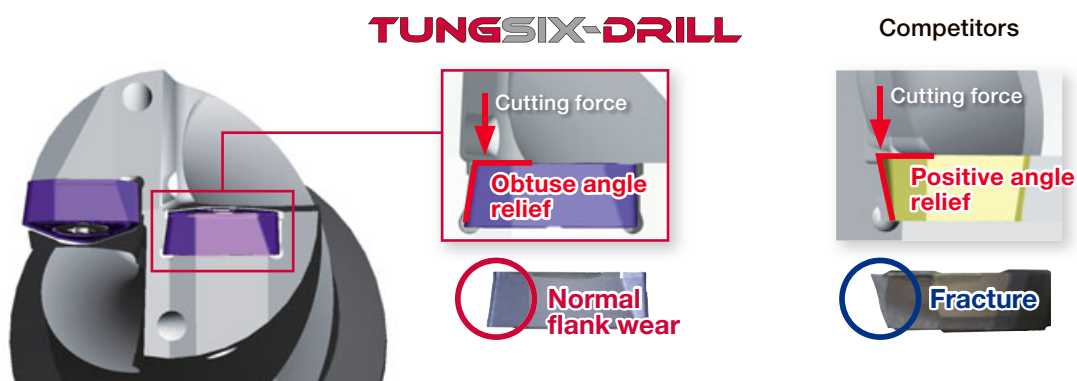
- 3** New insert grades developed specifically for drilling applications for prolonged insert tool life.

New AH7020, AH7030

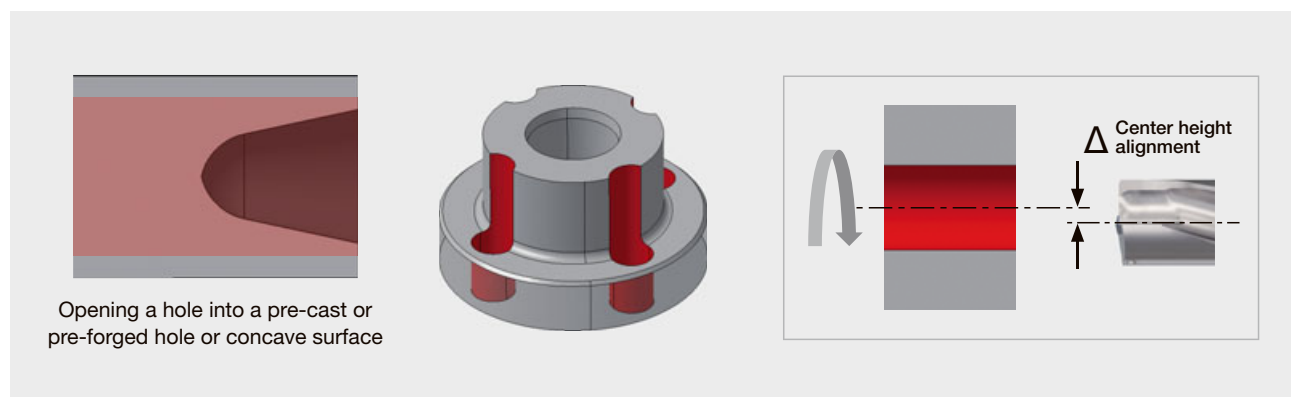


4 Strong center cutting edge

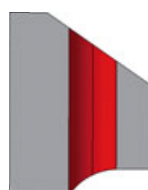
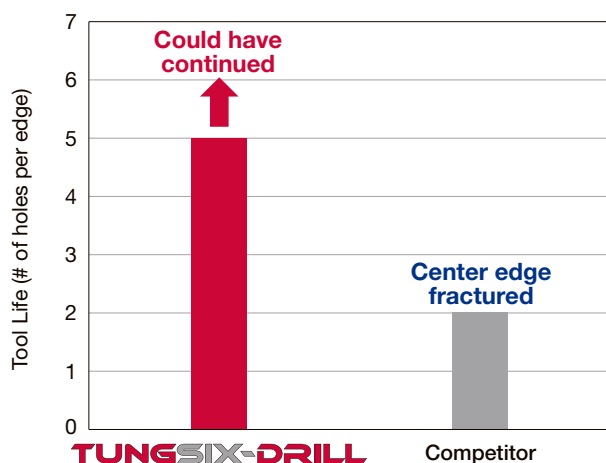
The insert incorporates an obtuse angle relief that provides the center edge with excellent edge line security.



Suited for applications that are taxing on the center cutting edge, such as drilling into a pre-cast or pre-forged hole, as well as non-rotating drilling on a lathe with a radial drill center offset.



■ Success case: Center edge integrity in aerospace part applications



Drilling inclined surface

S	Drill	: TDS450F40-3
	Insert	: WWMU11X512R-DS AH7030
	Workpiece material	: Ti-6Al-4V (40HRC)
	Cutting speed	: $V_c = 40$ m/min
	Feed	: $f = 0.05$ mm/rev
	Drilling depth	: 120 mm
	Coolant	: Wet (Internal supply)

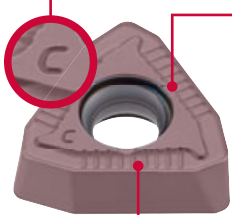
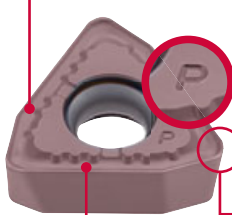
In the application of drilling an inclined surface of a titanium alloy part, the competitor's positive insert drill caused center edge fracture after opening only two holes. Meanwhile, the TUNGsix-DRILL demonstrated excellent center edge integrity, providing reliable tool life.

■ Chipbreakers

DJ

For general purpose

Suitable for cutting of a wide range of work material

Center cutting edge side	Peripheral cutting edge side
 ID marking: "C" for center edge Optimized for center cutting edge A wide and shallow curve profile on the rake face provides smooth chip flow during machining. Low cutting forces and long tool life The wavy feature on the rake surface provides minimum contact with chips during machining. This allows reduced cutting forces and eliminates edge fracture.	 Chipbreaker geometry designed specifically for peripheral cutting A high rake angle and steep wall enable smooth cutting and consistent chip forming. ID marking: "P" for peripheral edge Wiper For improved surface finish. Note: WWMU05... and WWMU06... inserts do not have a "P" mark on the peripheral side.

■ Chip control

P

SCM440 / 42CrMo4

Drill diameter: 20 mm
Machine : Vertical M/C

Cutting speed: Vc (m/min)	200			
	150			
	100			
		0.08	0.1	0.15
Feed: f (mm/rev)				

M

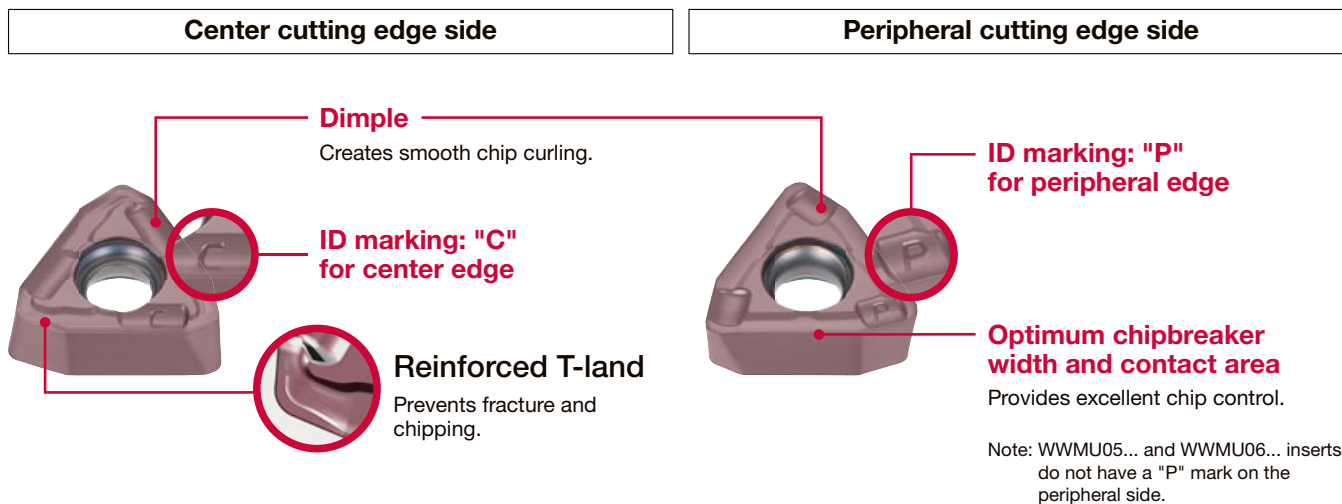
SUS304 / X5CrNi18-9

Drill diameter: 20 mm
Machine : Vertical M/C

Cutting speed: Vc (m/min)	200			
	150			
	100			
		0.04	0.08	0.13
Feed: f (mm/rev)				

DS For drilling stainless and gummy steels

Demonstrates exceptional chip control



■ Chip control

P SCM440 / 42CrMo4 Drill diameter: 20 mm
Machine : Vertical M/C

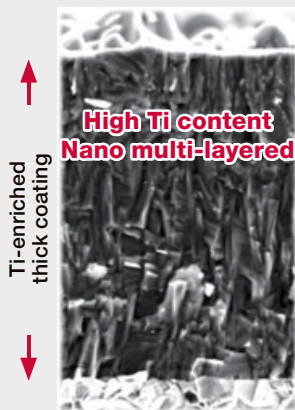
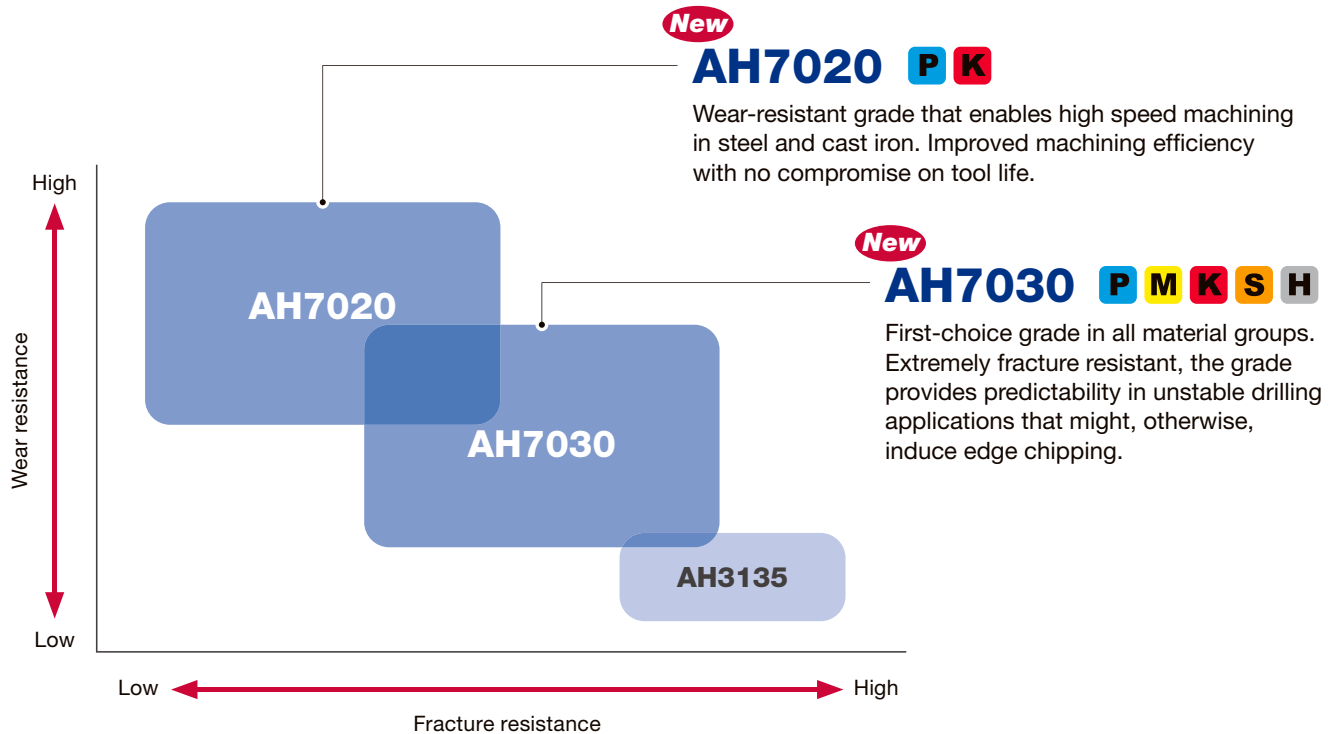
Cutting speed: Vc (m/min)	200			
	150			
	100			
		0.08	0.1	0.15
Feed: f (mm/rev)				

M SUS304 / X5CrNi18-9 Drill diameter: 20 mm
Machine : Vertical M/C

Cutting speed: Vc (m/min)	200			
	150			
	100			
		0.04	0.08	0.13
Feed: f (mm/rev)				

TUNGSIX-DRILL

New insert grades developed specifically for drilling applications bring increased tool life and reduced cost per part



Versatile PVD-coated grade

Ti-enriched coating

- Thick Ti-enriched PVD coating for enhanced thermal shock resistance.
- Reduced crater wear.

High Ti-content nano-structured multilayer coating

The outer layer consists of a high Ti-content nano-structured multilayer made possible by Tungaloy's latest coating technology. Its high hardness and nano structure provide the grade with a good balance of wear and fracture resistance, enhancing tool life and predictability.

Dedicated carbide substrate

AH7020

Thanks to high thermal conductivity of the substrate, heat generated during machining is dissipated, efficiently reducing temperature on the cutting edge. This provides edge toughness, while reducing plastic deformation of the cutting edge. Ideal for continuous cuts.

AH7030

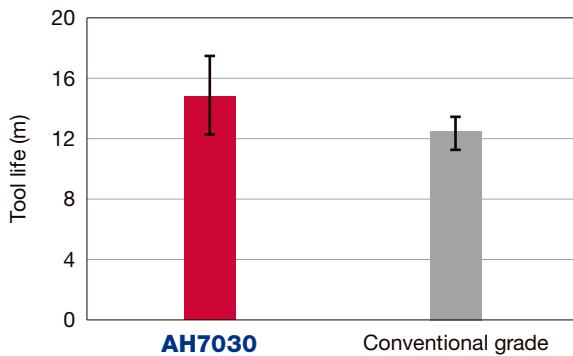
AH7030 incorporates a tough substrate that provides process security during interrupted machining. This tough substrate provides the grade with added reliability during interrupted cuts.

AH3135 P M PREMIUMTEC

- Multi-layered coating prevents crack expansion which causes chipping and fracture.
- Exclusive carbide substrate with remarkable impact resistance and toughness.

CUTTING PERFORMANCE

■ Tool life test results in peck drilling application



AH7030

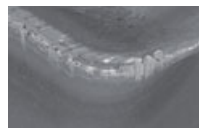
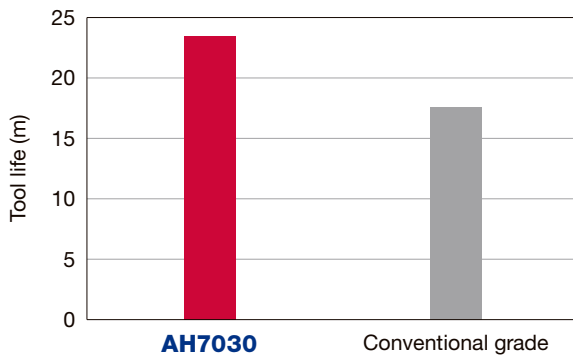


Conventional grade

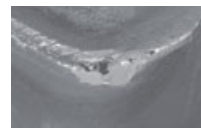
P	Drill	: TDS250F25-3
	Insert	: WWMU060306R-DJ AH7030
	Workpiece material	: Alloy steel (30HRC)
	Cutting speed	: $V_c = 100$ m/min
	Feed	: $f = 0.12$ mm/rev
	Drilling depth	: 60 mm
	Coolant	: Wet (Internal supply)
	Peck cycle	: 2 mm/peck

Increased wear and chipping resistance compared to conventional tools. Improved tool life stability.

■ Tool life test results in stainless steel



AH7030

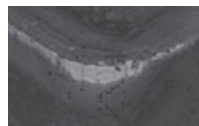
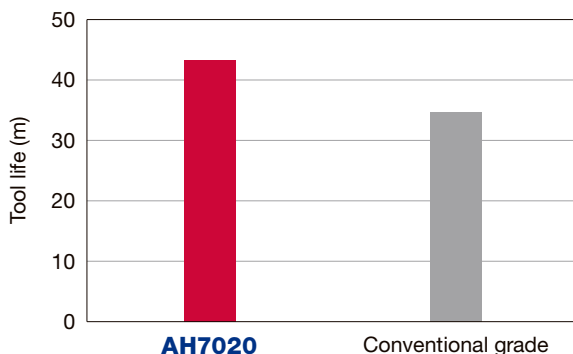


Conventional grade

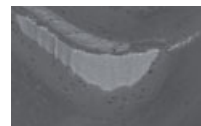
M	Drill	: TDS250F25-3
	Insert	: WWMU060306R-DS AH7030
	Workpiece material	: Austenitic stainless steel
	Cutting speed	: $V_c = 150$ m/min
	Feed	: $f = 0.08$ mm/rev
	Drilling depth	: 65 mm
	Coolant	: Wet (Internal supply)

Provided wear and fracture resistance in stainless steel and increased tool life.

■ Wear resistance



AH7020



Conventional grade

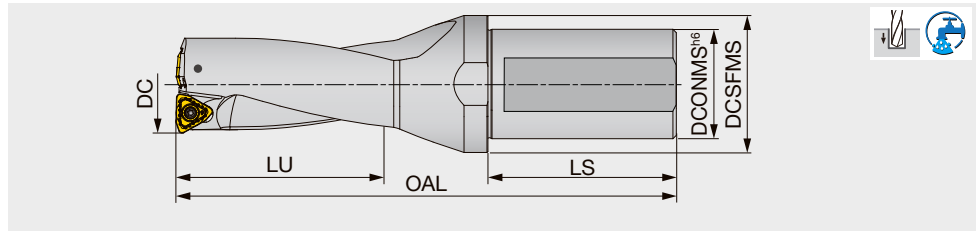
P	Drill	: TDS250F25-3
	Insert	: WWMU060306R-DS AH7020
	Workpiece material	: Carbon steel
	Cutting speed	: $V_c = 200$ m/min
	Feed	: $f = 0.1$ mm/rev
	Drilling depth	: 50 mm
	Coolant	: Wet (Internal supply)

New coated grade provided improved wear resistance and long tool life at an increased cutting speed.

TUNGSIX-DRILL

TDS-F L/D=2

Indexable drill, L/D = 2, flat cotter



Designation	DC	DCONMS	DCSFMS	LU	LS	OAL	Max. offset (radial)	WT(kg)	Insert
TDS200F25-2	20	25	32	40.8	54	115.8	1	0.3	WWMU05X205R-D*
TDS205F25-2	20.5	25	32	41.8	54	117.3	0.9	0.3	WWMU05X205R-D*
TDS210F25-2	21	25	32	42.8	54	118.8	0.8	0.3	WWMU05X205R-D*
TDS215F25-2	21.5	25	32	43.8	54	119.8	0.6	0.3	WWMU05X205R-D*
TDS220F25-2	22	25	32	44.8	54	120.8	0.5	0.3	WWMU05X205R-D*
TDS225F25-2	22.5	25	37	45.8	54	122.3	0.4	0.3	WWMU05X205R-D*
TDS230F25-2	23	25	37	46.8	54	123.8	0.3	0.4	WWMU05X205R-D*
TDS235F25-2	23.5	25	37	47.8	54	124.8	0.2	0.4	WWMU05X205R-D*
TDS240F25-2	24	25	37	48.9	54	125.9	1.2	0.4	WWMU060306R-D*
TDS245F25-2	24.5	25	37	49.9	54	127.4	1	0.4	WWMU060306R-D*
TDS250F25-2	25	25	37	50.9	54	128.9	0.8	0.4	WWMU060306R-D*
TDS255F25-2	25.5	25	37	51.9	54	130.4	0.6	0.4	WWMU060306R-D*
TDS260F25-2	26	25	37	52.9	54	131.9	0.5	0.4	WWMU060306R-D*
TDS270F32-2	27	32	40	54.9	59	138.9	0.3	0.6	WWMU060306R-D*
TDS280F32-2	28	32	40	57.1	59	142.1	1.3	0.6	WWMU08X408R-D*
TDS290F32-2	29	32	40	59.1	59	144.1	1.1	0.7	WWMU08X408R-D*
TDS300F32-2	30	32	40	61.1	59	147.1	0.8	0.7	WWMU08X408R-D*
TDS310F32-2	31	32	40	63.1	59	150.1	0.5	0.7	WWMU08X408R-D*
TDS320F32-2	32	32	40	65.1	59	152.1	0.2	0.8	WWMU08X408R-D*
TDS330F40-2	33	40	50	67.3	69	165.3	1.7	1.2	WWMU09X510R-D*
TDS340F40-2	34	40	50	69.3	69	168.3	1.4	1.2	WWMU09X510R-D*
TDS350F40-2	35	40	50	71.3	69	171.3	1.2	1.2	WWMU09X510R-D*
TDS360F40-2	36	40	50	73.3	69	174.3	0.9	1.3	WWMU09X510R-D*
TDS370F40-2	37	40	50	75.3	69	175.3	0.7	1.3	WWMU09X510R-D*
TDS380F40-2	38	40	50	77.3	69	178.3	0.4	1.3	WWMU09X510R-D*
TDS390F40-2	39	40	50	79.6	69	180.6	2.2	1.4	WWMU11X512R-D*
TDS400F40-2	40	40	50	81.6	69	183.6	1.9	1.4	WWMU11X512R-D*
TDS410F40-2	41	40	50	83.6	69	187.6	1.7	1.5	WWMU11X512R-D*
TDS420F40-2	42	40	55	85.6	69	189.6	1.5	1.6	WWMU11X512R-D*
TDS430F40-2	43	40	55	87.6	69	192.6	1.3	1.6	WWMU11X512R-D*
TDS440F40-2	44	40	55	89.6	69	194.6	1	1.7	WWMU11X512R-D*
TDS450F40-2	45	40	55	91.6	69	197.6	0.7	1.7	WWMU11X512R-D*
TDS460F40-2	46	40	55	93.6	69	200.6	0.4	1.8	WWMU11X512R-D*
TDS470F40-2	47	40	55	95.8	69	202.8	2.6	1.9	WWMU13X512R-D*
TDS480F40-2	48	40	55	97.8	69	205.8	2.4	1.9	WWMU13X512R-D*
TDS490F40-2	49	40	55	99.8	69	207.8	2.2	1.9	WWMU13X512R-D*
TDS500F40-2	50	40	55	101.8	69	210.8	2	2	WWMU13X512R-D*
TDS510F40-2	51	40	55	103.8	69	214.8	1.7	2.1	WWMU13X512R-D*
TDS520F40-2	52	40	55	105.8	69	216.8	1.5	2.2	WWMU13X512R-D*
TDS530F40-2	53	40	55	107.8	69	219.8	1.3	2.3	WWMU13X512R-D*
TDS540F40-2	54	40	55	109.8	69	221.8	1	2.4	WWMU13X512R-D*

SPARE PARTS

Designation	Clamping screw	Wrench
TDS200... - TDS235...	CSPB-2.2	IP-7D
TDS240... - TDS270...	CSPB-2.5	IP-8D
TDS280... - TDS320...	CSTB-3	T-9D
TDS330... - TDS380...	CSTB-4	T-15D
TDS390... - TDS540...	CSTB-5	T-20D

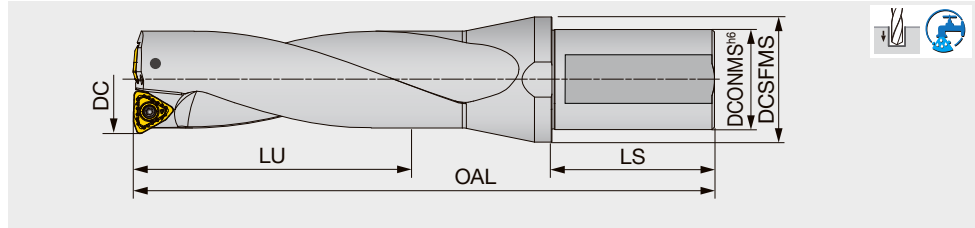
Tool diameter	Tool diameter tolerance	Hole diameter tolerance*
ø20 - ø27	+ 0.2 / 0	+ 0.25 / 0
ø28 - ø54	+ 0.2 / 0	+ 0.3 / 0

*Just for reference

Recommended clamping torque (N·m): CSPB-2.2 = 1, CSPB-2.5 = 1.3, CSTB-3 = 2.3, CSTB-4 = 3.5, CSTB-5 = 5

TDS-F L/D=3

Indexable drill, L/D = 3, flat cotter



Designation	DC	DCONMS	DCSFMS	LU	LS	OAL	Max. offset (radial)	WT(kg)	Insert
TDS200F25-3	20	25	32	60.8	54	135.8	1	0.3	WWMU05X205R-D*
TDS205F25-3	20.5	25	32	62.3	54	136.8	0.9	0.3	WWMU05X205R-D*
TDS209F25-3 (1)	20.9	25	32	63.5	54	138.8	0.8	0.3	WWMU05X205R-D*
TDS210F25-3	21	25	32	63.8	54	138.8	0.8	0.4	WWMU05X205R-D*
TDS215F25-3	21.5	25	32	65.3	54	140.8	0.6	0.4	WWMU05X205R-D*
TDS220F25-3	22	25	32	66.8	54	141.8	0.5	0.4	WWMU05X205R-D*
TDSU0875F25-3 (2)	22.2	25	32	66.8	54	141.8	0.4	0.4	WWMU05X205R-D*
TDS225F25-3	22.5	25	37	68.3	54	144.8	0.4	0.4	WWMU05X205R-D*
TDS230F25-3	23	25	37	69.8	54	145.8	0.3	0.4	WWMU05X205R-D*
TDS235F25-3	23.5	25	37	71.3	54	147.8	0.2	0.4	WWMU05X205R-D*
TDS239F25-3 (1)	23.9	25	37	72.6	54	149.9	1.2	0.4	WWMU060306R-D*
TDS240F25-3	24	25	37	72.9	54	149.9	1.2	0.4	WWMU060306R-D*
TDS245F25-3	24.5	25	37	74.4	54	151.9	1	0.5	WWMU060306R-D*
TDS250F25-3	25	25	37	75.9	54	153.9	0.8	0.5	WWMU060306R-D*
TDS255F25-3	25.5	25	37	77.4	54	154.9	0.6	0.5	WWMU060306R-D*
TDS260F25-3 (1)	26	25	37	78.9	54	156.9	0.5	0.5	WWMU060306R-D*
TDS264F32-3	26.4	32	40	80.1	59	163.4	0.4	0.6	WWMU060306R-D*
TDS265F32-3	26.5	32	40	80.4	59	163.4	0.4	0.6	WWMU060306R-D*
TDS270F32-3	27	32	40	81.9	59	164.9	0.3	0.6	WWMU060306R-D*
TDS275F32-3	27.5	32	40	83.1	59	168.1	0	0.6	WWMU08X408R-D*
TDS280F32-3	28	32	40	85.1	59	169.1	1.3	0.7	WWMU08X408R-D*
TDS285F32-3	28.5	32	40	86.1	59	171.1	1.1	0.7	WWMU08X408R-D*
TDSU1125F32-3 (2)	28.6	32	40	87.1	59	172.1	1.1	0.7	WWMU08X408R-D*
TDS290F32-3	29	32	40	88.1	59	172.1	1.1	0.7	WWMU08X408R-D*
TDS295F32-3	29.5	32	40	89.1	59	176.1	0.8	0.7	WWMU08X408R-D*
TDS300F32-3	30	32	40	91.1	59	177.1	0.8	0.8	WWMU08X408R-D*
TDS305F32-3	30.5	32	40	92.1	59	181.1	0.5	0.8	WWMU08X408R-D*
TDS310F32-3	31	32	40	94.1	59	181.1	0.5	0.8	WWMU08X408R-D*
TDSU1250F32-3 (2)	31.8	32	40	96.1	59	184.1	0.2	0.8	WWMU08X408R-D*
TDS320F32-3	32	32	40	97.1	59	184.1	0.2	0.9	WWMU08X408R-D*
TDS330F40-3	33	40	50	100.3	69	198.3	1.7	1.3	WWMU09X510R-D*
TDS340F40-3	34	40	50	103.3	69	201.3	1.4	1.3	WWMU09X510R-D*
TDS350F40-3	35	40	50	106.3	69	205.3	1.2	1.3	WWMU09X510R-D*
TDS360F40-3	36	40	50	109.3	69	209.3	0.9	1.4	WWMU09X510R-D*
TDS370F40-3	37	40	50	112.3	69	212.3	0.7	1.4	WWMU09X510R-D*
TDS380F40-3	38	40	50	115.3	69	216.3	0.4	1.5	WWMU09X510R-D*
TDS390F40-3	39	40	50	118.6	69	219.6	2.2	1.6	WWMU11X512R-D*
TDS400F40-3	40	40	50	121.6	69	223.6	1.9	1.6	WWMU11X512R-D*
TDS410F40-3	41	40	50	124.6	69	227.6	1.7	1.7	WWMU11X512R-D*
TDS420F40-3	42	40	55	127.6	69	230.6	1.5	1.8	WWMU11X512R-D*
TDS430F40-3	43	40	55	130.6	69	234.6	1.3	1.8	WWMU11X512R-D*
TDS440F40-3	44	40	55	133.6	69	237.6	1	1.9	WWMU11X512R-D*
TDS450F40-3	45	40	55	136.6	69	242.6	0.7	2	WWMU11X512R-D*
TDS460F40-3	46	40	55	139.6	69	246.6	0.4	2.1	WWMU11X512R-D*
TDS470F40-3	47	40	55	142.8	69	249.8	2.6	2.2	WWMU13X512R-D*
TDS480F40-3	48	40	55	145.8	69	253.8	2.4	2.3	WWMU13X512R-D*
TDS490F40-3	49	40	55	148.8	69	256.8	2.2	2.3	WWMU13X512R-D*
TDS500F40-3	50	40	55	151.8	69	260.8	2	2.4	WWMU13X512R-D*
TDS510F40-3	51	40	55	154.8	69	264.8	1.7	2.5	WWMU13X512R-D*
TDS520F40-3	52	40	55	157.8	69	267.8	1.5	2.6	WWMU13X512R-D*
TDS530F40-3	53	40	55	160.8	69	271.8	1.3	2.7	WWMU13X512R-D*
TDS540F40-3	54	40	55	163.8	69	274.8	1	2.9	WWMU13X512R-D*

SPARE PARTS



Designation	Clamping screw	Wrench
TDS200... - TDS235...	CSPB-2.2	IP-7D
TDS240... - TDS270...	CSPB-2.5	IP-8D
TDS280... - TDS320...	CSTB-3	T-9D
TDS330... - TDS380...	CSTB-4	T-15D
TDS390... - TDS540...	CSTB-5	T-20D

(1) For pre thread hole: DC = 20.9 mm: M24x3, DC = 23.9 mm: M27x3, DC = 26.4 mm: M30x3.5
(2) For inch size: DC: 22.2 mm = 0.875", DC: 28.6 mm = 1.125", DC: 31.8 mm = 1.250"

Tool diameter	Tool diameter tolerance	Hole diameter tolerance*
ø20 - ø27	+ 0.2 / 0	+ 0.25 / 0
ø28 - ø54	+ 0.2 / 0	+ 0.3 / 0

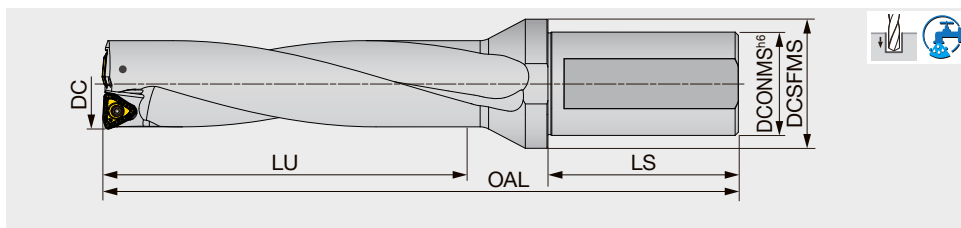
*Just for reference

Recommended clamping torque (N·m): CSPB-2.2 = 1, CSPB-2.5 = 1.3, CSTB-3 = 2.3, CSTB-4 = 3.5, CSTB-5 = 5

TUNGSIK-DRILL

TDS-F L/D=4

Indexable drill, L/D = 4, flat cotter



Designation	DC	DCONMS	DCSFMS	LU	LS	OAL	Max. offset (radial)	WT(kg)	Insert
TDS200F25-4	20	25	32	80.8	54	155.8	1	0.4	WWMU05X205R-D*
TDS205F25-4	20.5	25	32	82.8	54	157.8	0.9	0.4	WWMU05X205R-D*
TDS210F25-4	21	25	32	84.8	54	159.8	0.8	0.4	WWMU05X205R-D*
TDS215F25-4	21.5	25	32	86.8	54	161.8	0.6	0.4	WWMU05X205R-D*
TDS220F25-4	22	25	32	88.8	54	163.8	0.5	0.4	WWMU05X205R-D*
TDS225F25-4	22.5	25	37	90.8	54	166.3	0.4	0.4	WWMU05X205R-D*
TDS230F25-4	23	25	37	92.8	54	168.8	0.3	0.4	WWMU05X205R-D*
TDS235F25-4	23.5	25	37	94.8	54	171.3	0.2	0.5	WWMU05X205R-D*
TDS240F25-4	24	25	37	96.9	54	173.9	1.2	0.5	WWMU060306R-D*
TDS245F25-4	24.5	25	37	98.9	54	176.4	1	0.5	WWMU060306R-D*
TDS250F25-4	25	25	37	100.9	54	178.9	0.8	0.5	WWMU060306R-D*
TDS255F25-4	25.5	25	37	102.9	54	180.9	0.6	0.6	WWMU060306R-D*
TDS260F25-4	26	25	37	104.9	54	182.9	0.5	0.5	WWMU060306R-D*
TDS270F32-4	27	32	40	108.9	59	191.9	0.3	0.7	WWMU060306R-D*
TDS280F32-4	28	32	40	113.1	59	197.1	1.3	0.8	WWMU08X408R-D*
TDS290F32-4	29	32	40	117.1	59	201.1	1.1	0.8	WWMU08X408R-D*
TDS300F32-4	30	32	40	121.1	59	207.1	0.8	0.9	WWMU08X408R-D*
TDS310F32-4	31	32	40	125.1	59	212.1	0.5	0.9	WWMU08X408R-D*
TDS320F32-4	32	32	40	129.1	59	216.1	0.2	1	WWMU08X408R-D*
TDS330F40-4	33	40	50	133.3	69	231.3	1.7	1.4	WWMU09X510R-D*
TDS340F40-4	34	40	50	137.3	69	235.3	1.4	1.4	WWMU09X510R-D*
TDS350F40-4	35	40	50	141.3	69	240.3	1.2	1.4	WWMU09X510R-D*
TDS360F40-4	36	40	50	145.3	69	245.3	0.9	1.5	WWMU09X510R-D*
TDS370F40-4	37	40	50	149.3	69	249.3	0.7	1.5	WWMU09X510R-D*
TDS380F40-4	38	40	50	153.3	69	254.3	0.4	1.7	WWMU09X510R-D*
TDS390F40-4	39	40	50	157.5	69	259	2.2	1.8	WWMU11X512R-D*
TDS400F40-4	40	40	50	161.5	69	264	1.9	1.8	WWMU11X512R-D*
TDS410F40-4	41	40	50	165.5	69	269	1.7	1.9	WWMU11X512R-D*
TDS420F40-4	42	40	55	169.5	69	273	1.5	2	WWMU11X512R-D*
TDS430F40-4	43	40	55	173.5	69	278	1.3	2	WWMU11X512R-D*
TDS440F40-4	44	40	55	177.5	69	282	1	2.1	WWMU11X512R-D*
TDS450F40-4	45	40	55	181.5	69	288	0.7	2.3	WWMU11X512R-D*
TDS460F40-4	46	40	55	185.5	69	293	0.4	2.4	WWMU11X512R-D*
TDS470F40-4	47	40	55	189.8	69	297.3	2.6	2.5	WWMU13X512R-D*
TDS480F40-4	48	40	55	193.8	69	302.3	2.4	2.7	WWMU13X512R-D*
TDS490F40-4	49	40	55	197.8	69	306.3	2.2	2.7	WWMU13X512R-D*
TDS500F40-4	50	40	55	201.8	69	311.3	2	2.8	WWMU13X512R-D*
TDS510F40-4	51	40	55	205.8	69	316.3	1.7	2.9	WWMU13X512R-D*
TDS520F40-4	52	40	55	209.8	69	320.3	1.5	3	WWMU13X512R-D*
TDS530F40-4	53	40	55	213.8	69	325.3	1.3	3.1	WWMU13X512R-D*
TDS540F40-4	54	40	55	217.8	69	329.3	1	3.4	WWMU13X512R-D*

SPARE PARTS

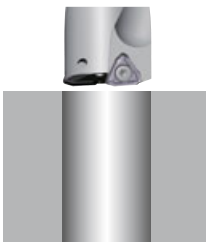
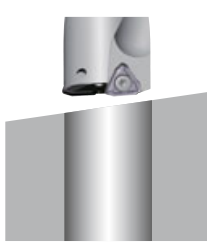
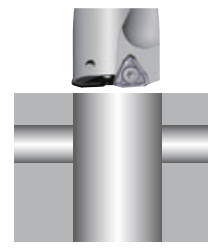
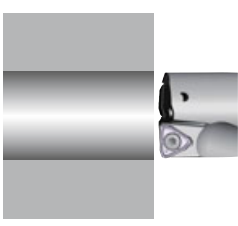
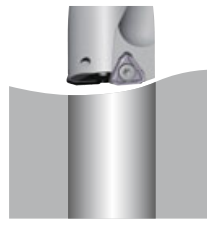
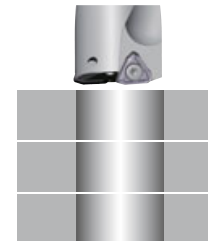
Designation	Clamping screw	Wrench
TDS200... - TDS235...	CSPB-2.2	IP-7D
TDS240... - TDS270...	CSPB-2.5	IP-8D
TDS280... - TDS320...	CSTB-3	T-9D
TDS330... - TDS380...	CSTB-4	T-15D
TDS390... - TDS540...	CSTB-5	T-20D

Tool diameter	Tool diameter tolerance	Hole diameter tolerance*
ø20 - ø27	+ 0.2 / 0	+ 0.3 / 0
ø28 - ø54	+ 0.2 / 0	+ 0.35 / 0

*Just for reference

Recommended clamping torque (N·m): CSPB-2.2 = 1, CSPB-2.5 = 1.3, CSTB-3 = 2.3, CSTB-4 = 3.5, CSTB-5 = 5

APPLICATION RANGE

Feed f (mm/rev)	See page 15	0.05	0.05	0.05
Application	OK Plane surface 	OK Slant surface 	OK Cross hole 	OK Plunging 
	0.1	0.05	Disapprove	Disapprove
Application	OK Boring 	OK Round surface 	× Stacked plate 	× Back boring 

In case of Interrupted cutting, feed should be decreased.

Maximum drilling diameter and maximum offset amount for each diameter

The drilling diameter can be adjusted by offsetting the drill using the X-axis of the machine or with the eccentric sleeve. Refer to the list below for the maximum drilling diameter and maximum offset amount available for the individual drill diameters.

DC	Max. drilling diameter	Max. offset amount	DC	Max. drilling diameter	Max. offset amount	DC	Max. drilling diameter	Max. offset amount
20	21.3	0.65	26.4	27.2	0.4	40	41.3	0.65
20.5	21.8	0.65	26.5	27.3	0.4	41	42.3	0.65
20.9	22.2	0.65	27	27.6	0.3	42	43.3	0.65
21	22.3	0.65	28	29.3	0.65	43	44.3	0.65
21.5	22.7	0.6	29	30.3	0.65	44	45.3	0.65
22	23	0.5	30	31.3	0.65	45	46.3	0.65
22.5	23.3	0.4	31	32	0.5	46	46.8	0.4
23	23.6	0.3	32	32.4	0.2	47	48.3	0.65
23.5	23.9	0.2	33	34.3	0.65	48	49.3	0.65
23.9	25.2	0.65	34	35.3	0.65	49	50.3	0.65
24	25.3	0.65	35	36.3	0.65	50	51.3	0.65
24.5	25.8	0.65	36	37.3	0.65	51	52.3	0.65
25	26.3	0.65	37	38.3	0.65	52	53.3	0.65
25.5	26.7	0.6	38	38.8	0.4	53	54.3	0.65
26	27	0.5	39	40.3	0.65	54	55.3	0.65

RECOMMENDED INSERT

ISO	Workpiece material	First choice	Wear resistance	Fracture resistance
P	Low carbon steel ($C \leq 0.3\%$)	DS AH7030	DS AH7020	DJ AH3135
	Carbon steel ($C > 0.3\%$)	DJ AH7030	DJ AH7020	DJ AH3135
	Low alloy steel	DS AH7030	DS AH7020	DJ AH3135
	Alloy steel	DJ AH7030	DJ AH7020	DJ AH3135
M	Stainless steel	DS AH7030	DS AH7020	DJ AH3135
K	Grey cast irons	DJ AH7030	DJ AH7020	-
	Ductile cast irons	DJ AH7020	-	DJ AH7030
N	Aluminium alloy	DS AH7030	-	-
S	Heat-resistant alloys	DS AH7020	-	DJ AH7020
	Titanium alloys	DS AH7030	DS AH7020	DJ AH3135
H	Hardened steel	DJ AH7020	-	DJ AH7030

STANDARD CUTTING CONDITIONS

ISO	Workpiece material	Hardness	Cutting speed V_c (m/min)	Series L/D	Feed: f (mm/rev)		
					$\phi 20 \sim \phi 27.5$	$\phi 28 \sim \phi 38$	$\phi 39 \sim \phi 54$
P	Low carbon steels ($C < 0.3$) SS400, SM490, S25C, etc. st42-1, St52-3, C25, etc.	- 200 HB	160 - 320	2D, 3D	0.04 - 0.1	0.04 - 0.1	0.04 - 0.1
				4D	0.04 - 0.1	0.04 - 0.1	0.04 - 0.1
	Carbon steels ($C > 0.3$) S45C, S55C, etc. C45, C55, etc.	- 300 HB	80 - 250	2D, 3D	0.06 - 0.15	0.06 - 0.16	0.06 - 0.18
				4D	0.06 - 0.15	0.06 - 0.15	0.06 - 0.17
	Low alloy steels SCM415, etc.	- 200 HB	160 - 250	2D, 3D	0.06 - 0.12	0.06 - 0.12	0.06 - 0.14
				4D	0.06 - 0.12	0.06 - 0.12	0.06 - 0.14
M	Alloy steels SCM440, SCr420, etc. 42CrMo4, 20Cr4, etc.	- 300 HB	80 - 200	2D, 3D	0.06 - 0.13	0.06 - 0.15	0.06 - 0.18
				4D	0.06 - 0.1	0.06 - 0.12	0.06 - 0.14
	Stainless steels (Austenitic) SUS304, SUS316, etc. X5CrNi18-9, X5CrNiMo17-12-2, etc.	- 200 HB	100 - 200	2D, 3D	0.04 - 0.1	0.04 - 0.12	0.04 - 0.12
				4D	0.04 - 0.1	0.04 - 0.12	0.04 - 0.12
	Stainless steels (Martensitic and ferritic) SUS430, SUS416, etc. X6Cr17, X20Cr13, etc.	- 200 HB	100 - 220	2D, 3D	0.04 - 0.1	0.04 - 0.12	0.04 - 0.12
				4D	0.04 - 0.1	0.04 - 0.12	0.04 - 0.12
K	Grey cast irons FC250, etc., 250, etc.	150 - 250 HB	80 - 250	2D, 3D	0.04 - 0.08	0.04 - 0.1	0.06 - 0.1
				4D	0.04 - 0.08	0.04 - 0.1	0.06 - 0.1
	Ductile cast irons FCD700, etc., 600-3, etc.	150 - 250 HB	80 - 200	2D, 3D	0.06 - 0.15	0.06 - 0.18	0.08 - 0.2
				4D	0.06 - 0.12	0.06 - 0.14	0.08 - 0.16
	Aluminium alloy A2017, ADC12, etc. AlCu4SiMg, AlSi11Cu3, etc.	-	200 - 400	2D, 3D	0.06 - 0.15	0.06 - 0.18	0.08 - 0.2
				4D	0.06 - 0.12	0.06 - 0.14	0.08 - 0.16
N	Heat-resistant alloys Inconel 718, etc.	- 40 HRC	20 - 60	2D, 3D	0.15 - 0.2	0.15 - 0.2	0.15 - 0.25
				4D	0.12 - 0.16	0.12 - 0.16	0.12 - 0.2
	Titanium alloys Ti-6Al-4V, etc.	- 40 HRC	40 - 120	2D, 3D	0.04 - 0.1	0.04 - 0.1	0.04 - 0.1
				4D	0.04 - 0.1	0.04 - 0.1	0.04 - 0.1
	Hardened steel	- 50 HRC	40 - 100	2D, 3D	0.06 - 0.12	0.06 - 0.12	0.06 - 0.12
				4D	0.06 - 0.1	0.06 - 0.1	0.06 - 0.1
S	Heat-resistant alloys Inconel 718, etc.	- 40 HRC	20 - 60	2D, 3D	0.04 - 0.1	0.04 - 0.1	0.04 - 0.1
				4D	0.04 - 0.1	0.04 - 0.1	0.04 - 0.1
H	Hardened steel	- 50 HRC	40 - 100	2D, 3D	0.04 - 0.1	0.04 - 0.1	0.04 - 0.1
				4D	0.04 - 0.08	0.04 - 0.08	0.04 - 0.08

TUNGDRILLBIG

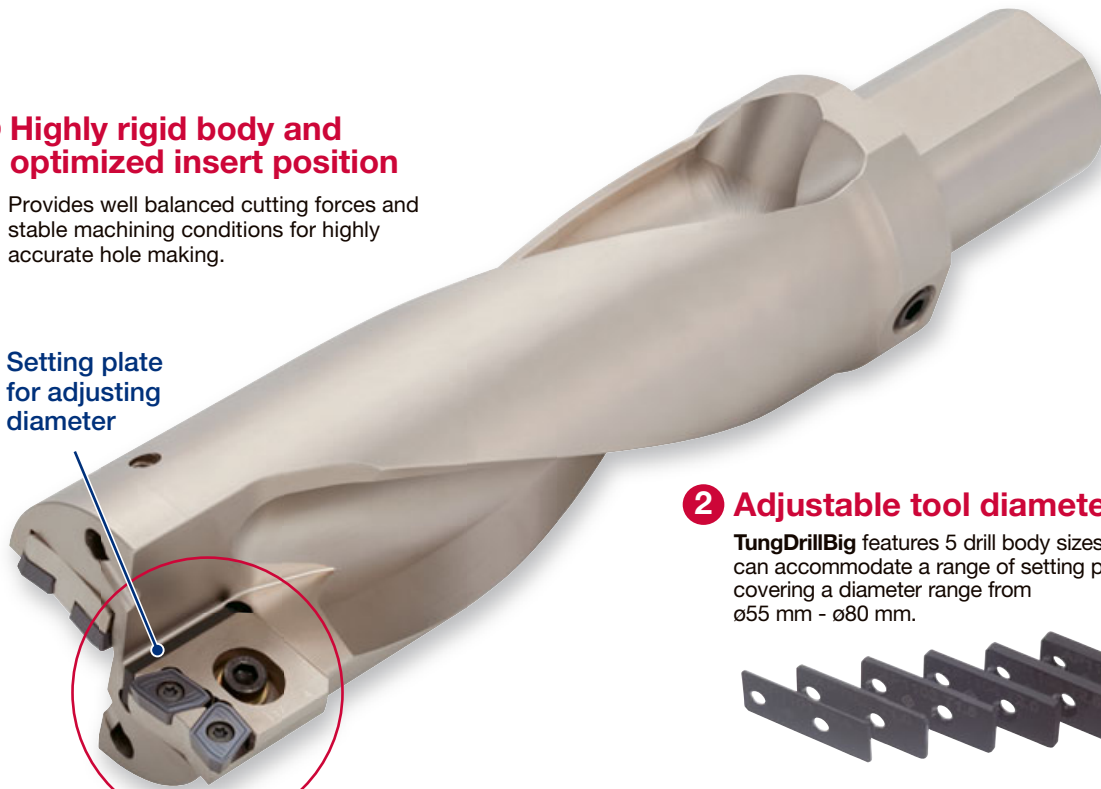
Drill body with adjustable cartridge covers
hole diameter ranges from:

DC: ø55 mm - ø80 mm, L/D = 2.5

1 Highly rigid body and optimized insert position

Provides well balanced cutting forces and stable machining conditions for highly accurate hole making.

Setting plate
for adjusting
diameter



Cartridge

2 Adjustable tool diameter

TungDrillBig features 5 drill body sizes that can accommodate a range of setting plates covering a diameter range from ø55 mm - ø80 mm.



3 Drill body protection

The cartridge design protects the drill body from damage during demanding machining applications.

4 Variety of design options

TDX and TDS type cartridges can be affixed to the same body.



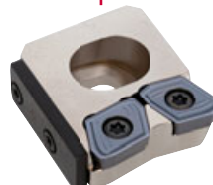
TDS type
Double sided insert
with 6 cutting edges



DJ



DS



TDX type
Single sided insert
with 4 cutting edges



DJ



DW



DS

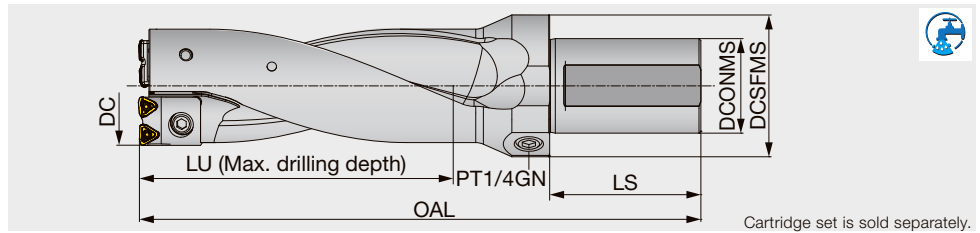


DG

TUNGDRILLBIG

TDB, TDS cartridge set

Indexable drill, L/D = 2.5, with tool diameter adjustability



Cartridge set is sold separately.

Body Designation	Cartridge set Designation	DC	DCONMS	DCSFMS	LU	LS	OAL	WT(kg)	Setting plate Designation	Thickness (mm)	Insert
TDB55-56F50-2.5	TDSCA55-56	55	50	75	140	80	262	3.2	-	-	WWMU08X408R-D*
TDB55-56F50-2.5	TDSCA55-56	56	50	75	140	80	262	3.2	AP0801	0.5	WWMU08X408R-D*
TDB57-62F50-2.5	TDSCA57-62	57	50	75	155	80	282	3.6	-	-	WWMU08X408R-D*
TDB57-62F50-2.5	TDSCA57-62	58	50	75	155	80	282	3.6	AP0801	0.5	WWMU08X408R-D*
TDB57-62F50-2.5	TDSCA57-62	59	50	75	155	80	282	3.6	AP0802	1	WWMU08X408R-D*
TDB57-62F50-2.5	TDSCA57-62	60	50	75	155	80	282	3.6	AP0803	1.5	WWMU08X408R-D*
TDB57-62F50-2.5	TDSCA57-62	61	50	75	155	80	282	3.6	AP0804	2	WWMU08X408R-D*
TDB57-62F50-2.5	TDSCA57-62	62	50	75	155	80	282	3.6	AP0805	2.5	WWMU08X408R-D*
TDB63-66F50-2.5	TDSCA63-66	63	50	75	165	80	297	4.2	-	-	WWMU08X408R-D*
TDB63-66F50-2.5	TDSCA63-66	64	50	75	165	80	297	4.2	AP0801	0.5	WWMU08X408R-D*
TDB63-66F50-2.5	TDSCA63-66	65	50	75	165	80	297	4.2	AP0802	1	WWMU08X408R-D*
TDB63-66F50-2.5	TDSCA63-66	66	50	75	165	80	297	4.2	AP0803	1.5	WWMU08X408R-D*
TDB67-73F50-2.5	TDSCA67-73	67	50	75	183	80	322	5	-	-	WWMU09X510R-D*
TDB67-73F50-2.5	TDSCA67-73	68	50	75	183	80	322	5	AP1101	0.5	WWMU09X510R-D*
TDB67-73F50-2.5	TDSCA67-73	69	50	75	183	80	322	5	AP1102	1	WWMU09X510R-D*
TDB67-73F50-2.5	TDSCA67-73	70	50	75	183	80	322	5	AP1103	1.5	WWMU09X510R-D*
TDB67-73F50-2.5	TDSCA67-73	71	50	75	183	80	322	5	AP1104	2	WWMU09X510R-D*
TDB67-73F50-2.5	TDSCA67-73	72	50	75	183	80	322	5	AP1105	2.5	WWMU09X510R-D*
TDB67-73F50-2.5	TDSCA67-73	73	50	75	183	80	322	5	AP1106	3	WWMU09X510R-D*
TDB74-80F50-2.5	TDSCA74-80	74	50	75	200	80	333	5.7	-	-	WWMU11X512R-D*
TDB74-80F50-2.5	TDSCA74-80	75	50	75	200	80	333	5.7	AP1101	0.5	WWMU11X512R-D*
TDB74-80F50-2.5	TDSCA74-80	76	50	75	200	80	333	5.7	AP1102	1	WWMU11X512R-D*
TDB74-80F50-2.5	TDSCA74-80	77	50	75	200	80	333	5.7	AP1103	1.5	WWMU11X512R-D*
TDB74-80F50-2.5	TDSCA74-80	78	50	75	200	80	333	5.7	AP1104	2	WWMU11X512R-D*
TDB74-80F50-2.5	TDSCA74-80	79	50	75	200	80	333	5.7	AP1105	2.5	WWMU11X512R-D*
TDB74-80F50-2.5	TDSCA74-80	80	50	75	200	80	333	5.7	AP1106	3	WWMU11X512R-D*

For more information on TungDrillBig.

e-catalog



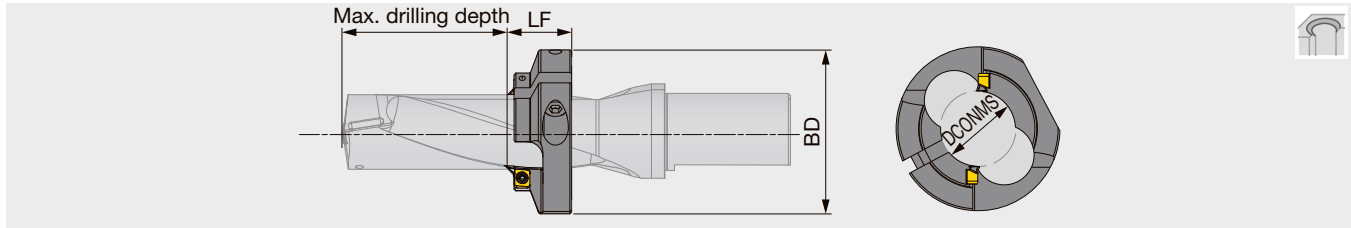
Tungaloy
Report



Chamfering tool

TDXCF chamfering tool

Chamfering tool for TungDrillTwisted and TungSix-Drill



Designation	DCONMS	BD	LF	Application drill	Max. drilling depth		
					L/D = 2	L/D = 3	L/D = 4
TDXCF200L25	19.1	49	25	TDS200*25-*	15.5	35.5	62.5
TDXCF210L25	20.1	49	25	TDS205*25-*	16.5	37	64.6
TDXCF210L25	20.1	49	25	TDS209F25-3	-	38.5	-
TDXCF210L25	20.1	49	25	TDS210*25-*	17.5	38.5	66.5
TDXCF220L25	21.1	49	25	TDS215*25-*	18.5	40	68.6
TDXCF220L25	21.1	49	25	TDS220*25-*	19.5	41.5	70.5
TDXCF230L25	22.1	49	25	TDS225*25-*	20.5	43	72.6
TDXCF230L25	22.1	49	25	TDS230*25-*	21.5	44.5	74.5
TDXCF240L25	23.1	49	25	TDS235*25-*	22.5	46	76.6
TDXCF240L25	23.1	49	25	TDS239F25-3	-	47.5	-
TDXCF240L25	23.1	49	25	TDS240*25-*	23.5	47.5	78.5
TDXCF250L25	23.95	49	25	TDS245*25-*	24.5	49	80.6
TDXCF250L25	23.95	49	25	TDS250*25-*	25.5	50.5	82.5
TDXCF260L30	24.95	64	30	TDS255*25-*	21.5	47	79.6
TDXCF260L30	24.95	64	30	TDS260*25-*	22.5	48.5	81.5
TDXCF270L30	25.9	64	30	TDS264F32-3	-	50	-
TDXCF270L30	25.9	64	30	TDS265F32-3	-	50	-
TDXCF270L30	25.9	64	30	TDS270*32-*	24.5	51.5	85.5
TDXCF280L30	26.9	64	30	TDS280*32-*	26.5	54.5	89.5
TDXCF290L30	27.9	64	30	TDS290*32-*	28.5	57.5	93.5
TDXCF300L30	28.9	64	30	TDS300*32-*	30.5	60.5	97.5
TDXCF310L30	29.9	64	30	TDS310*32-*	32.5	63.5	101.5
TDXCF320L30	30.9	64	30	TDS320*32-*	34.5	66.5	105.5

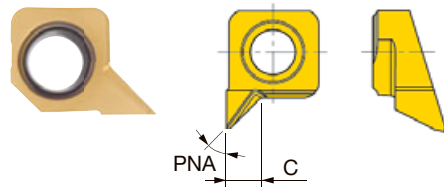
SPARE PARTS

Designation	Screw for insert	Screw for ring	Wrench for insert	Wrench for ring
TDXCF200... - TDXCF250...	CSPB-4S	CM6X16	IP-15D	P-5
TDXCF260... - TDXCF320...	CSPB-4S	CM8X1.25X20-A	IP-15D	P-6

Recommended clamping torque (N·m): CSPB-4S = 3.5

INSERT

XHGX-45A



Designation	PNA	C	Coated		Line up
			GH130		
XHGX090700R-45A	45°	2.5	●		

★ : First choice
☆ : Second choice

● : Line up

Caution in mounting the chamfering tool on the drill body

- ① Place the ring on the drill body and match the positions of flutes on drill and ring. Temporarily clamp the ring with the ring screw tightened lightly.
- ② Place the inserts, and tighten the insert screw lightly.
- ③ Adjust the ring position with a presetter, height gauge, or Vernier caliper, and securely tighten the ring screw, then the insert screw.



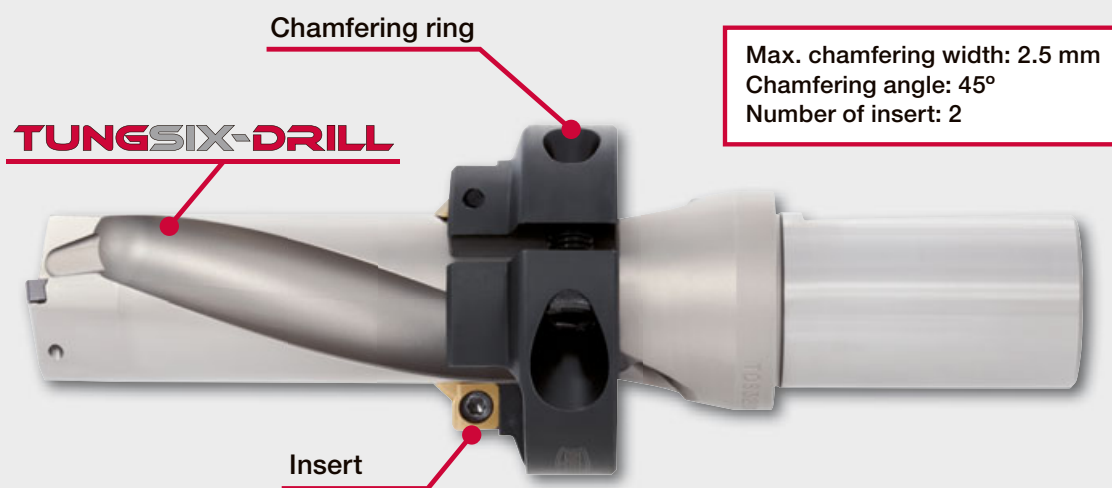
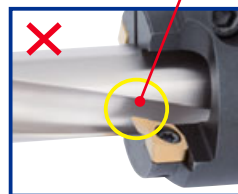
Match the positions of flutes on drill and ring.

(Inserts will be automatically set to the right positions.)

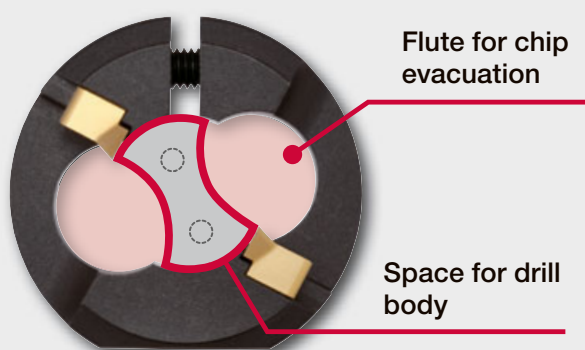
The cutting edge of the insert is in the ring flute.



The flutes on drill and ring do not match.



Max. chamfering width: 2.5 mm
Chamfering angle: 45°
Number of insert: 2



Flute for chip evacuation

Space for drill body



Clamping screw for chamfer ring

Special Indexable Tooling Competency —

Tungaloy's customized indexable combination drills for higher productivity

We at Tungaloy design and produce indexable combination drills tailored to meet your specific application needs. In addition to lower tooling cost thanks to indexable solution, one of the key benefits of these custom combination tools is the ability to perform several different operations such as drilling, chamfering, and counterboring in a single pass, thereby providing increased machine uptime and reduced cost per part.

Drilling + Chamfering



Drilling + Counter boring



L/D = 5 Deep drilling



■ EZ sleeve (Eccentric sleeve)

The function of EZ sleeves

Adjusting the hole diameter when drilling

Adjusting the hole diameter in tool-rotating applications.

By using EZ sleeve, the hole diameter can be adjusted in the range from **+0.6 mm to -0.2 mm**.



Scale for adjusting the hole diameter in milling machine (Periphery of sleeve)

Adjusting cutting edge height on lathe

Adjusting the cutting edge height in rotating work applications.

By using EZ sleeve, the cutting edge height can be adjusted in the range from **+0.3 mm to -0.2 mm**. That reduces problems caused by improper cutting-edge height.

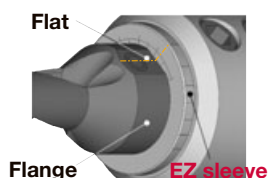


Scale for adjusting cutting edge height in turning (Front face of sleeve)

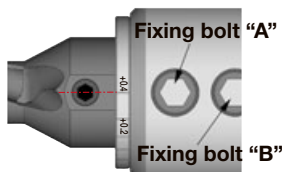
Setting of EZ sleeve

Adjusting the hole diameter on M/C

Set the EZ sleeve between the drill shank and the holder. Align the scale on the periphery of EZ sleeve with the center of the flat on drill flange.



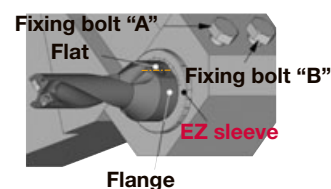
In the figure shown on right, the sleeve is set and the hole diameter will be increased by 0.4 mm.



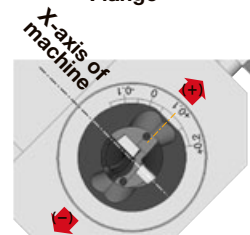
When rotating the EZ sleeve, fixing bolts "A" and "B" must be loosened. After setting the hole diameter, fix the drill body with bolt "A". Then lightly tighten bolt "B" to secure the EZ sleeve. If bolt "B" is over-tightened, the EZ sleeve may be damaged.

Adjusting cutting edge height on lathe

Set the EZ sleeve between the drill shank and the toolblock. Align the scale on the front face of the EZ sleeve with the center of the flat on drill flange.



In the figure shown on right, the sleeve is set and the center of the drill will shift by 0.1 mm to the plus (+) direction.

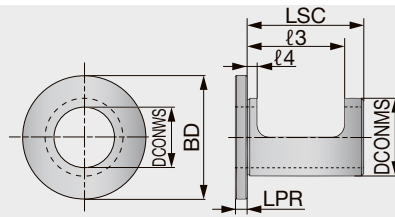


Cautious points

- Cannot be used for collet chuck holders.
- For adjustments over $L/D = 4$, please reduce feed rate.
- For smaller adjustment, the drill itself will interfere with the hole diameter. It is recommended that the hole diameter should be adjusted to a larger diameter than the drill diameter.

EZ sleeve

Eccentric sleeve for TungDrillTwisted and TungSix-Drill



Designation	DCONWS	DCONMS	BD	LSC	LPR	ℓ3	ℓ4	Hole diameter adjustment	Cutting edge height adjustment
EZ2025	20	25	46	49	5	32.5	4	+0.4 ~ - 0.2	+0.2 ~ - 0.15
EZ2532	25	32	51	52	5	38	4	+0.4 ~ - 0.2	+0.2 ~ - 0.15
EZ3240	32	40	54	62	5	43	4	+0.4 ~ - 0.2	+0.2 ~ - 0.15
EZ4050	40	50	69	63	5	55	4	+0.6 ~ - 0.2	+0.3 ~ - 0.2

SPARE PARTS



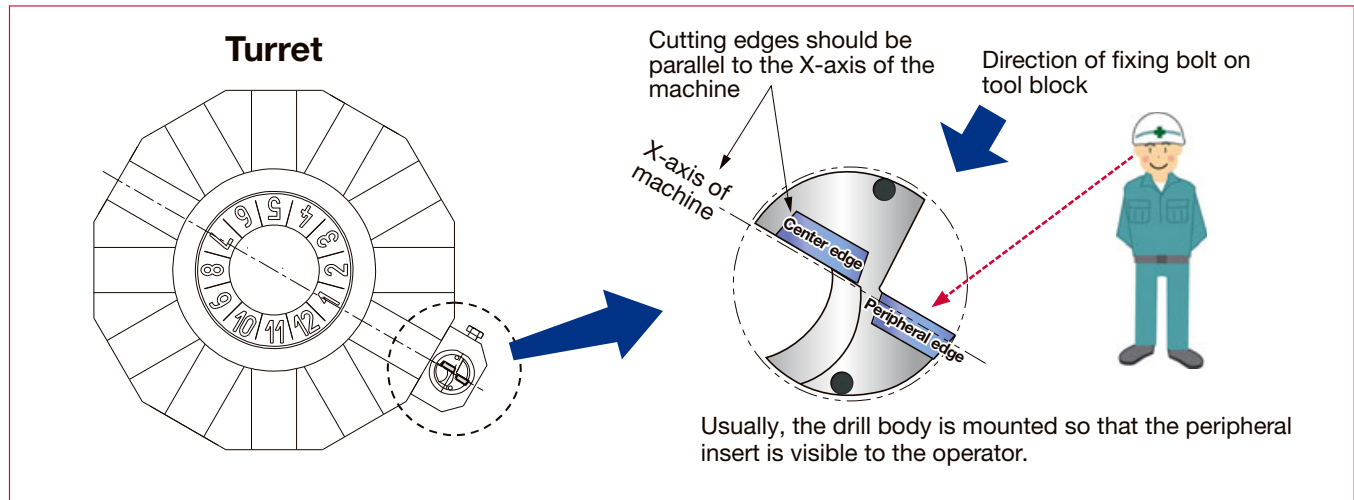
Designation	Wrench
EZ...	P-2.5

■ Use of TungSix-Drill on lathes

Setting of drill body is critical for successful machining

Mounting the drill on turret (tool post)

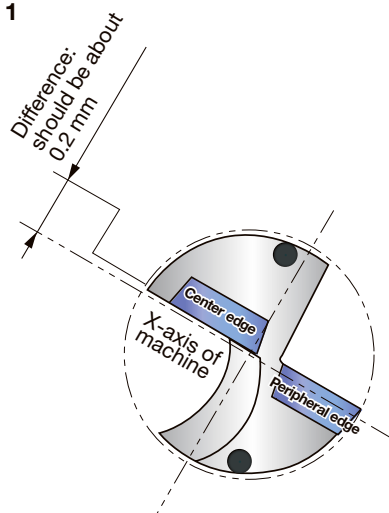
- When mounting drill body, the cutting edges should be parallel to the X-axis of the machine.
- Usually, the drill body is mounted in the direction that allows the peripheral insert to be seen by the operator.
- As the flat on the shank is parallel to the cutting edges, the clamping of the drill ensures that the cutting edges are parallel to the X-axis of the machine.



Checking of cutting edge height

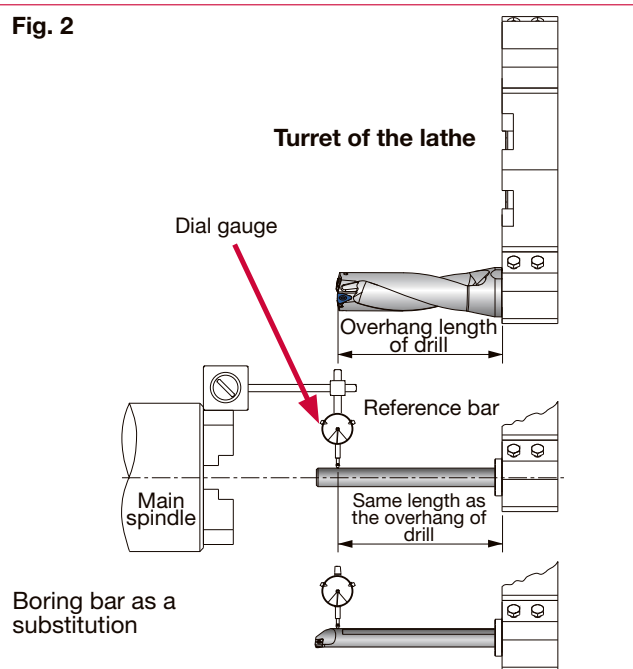
- The cutting edge height is an important factor for stable machining.
- The cutting edge of center insert should be 0.2 mm lower than the rotating axis of machine.
- For checking the difference between rotating center and the tool block, please use a reference bar from ground solid bar. (Fig. 2)
- In this case, the checking of the center height should be measured at the same position as the overhang length of the drill required.
- When there isn't a reference bar, the ground part of a boring bar can be used as a substitute.

Fig. 1



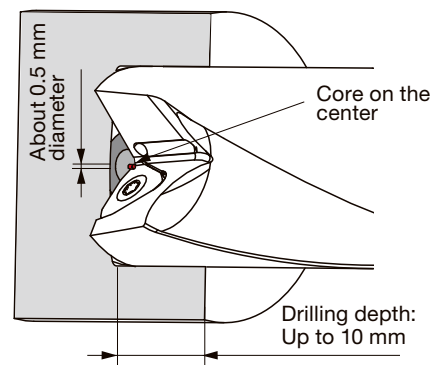
If the condition of the cutting edge height is not good, typically the height should be adjusted by adjusting the turret. However, a simpler method is shown on the next page.

Fig. 2



Checking setting conditions through trial cutting

- After mounting the drill body, the tool center should be checked by trial cutting before production.
- When the drill body is properly set, a core with about $\phi 0.5$ mm diameter is left on the bottom of hole.
- If there is no core, the drill is “above center”. If the core diameter is larger than $\phi 1$ mm, it is “excessively below center”. In these cases, the cutting edge height has to be checked again.
- When trial cutting, the feed should be 0.1 mm/rev or less, drilling depth should be up to 10 mm.



Adjusting of cutting edge height

When the condition of the cutting edge height is incorrect, the height should be adjusted with the following methods.

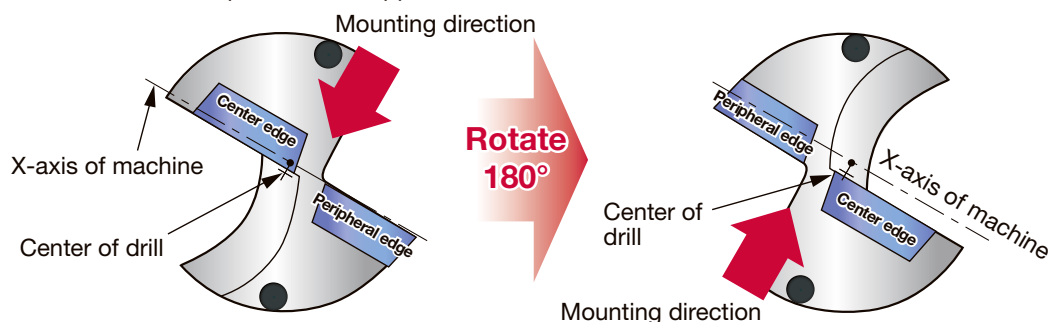
① In the case of “above-center”

When machining with such condition, the center cutting edge may be easily chipped. So this condition has to be rectified.

Solution #1: Change the mounting direction.

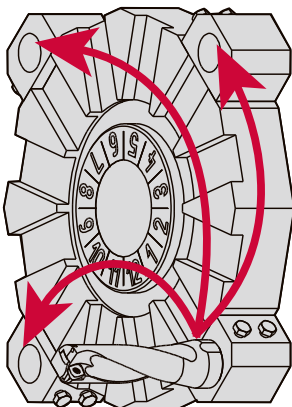
Solution #2: Rotate drill body 180°

In #2, additional cotter is required on the opposite side.



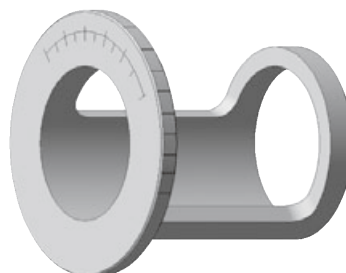
② In the case of “slightly above-center” (about 0.05 mm)

In this case, shifting the mounting position to another position may improve the condition.



③ In the case of “excessively below-center” (0.2 mm or more)

When this occurs, a large core diameter remains and heavy vibration may occur. To improve this situation, use the EZ sleeve (the eccentric sleeve) and adjust the cutting edge height to the correct value. Information on the EZ sleeve is on page 21.



Machining with offset on the lathe

A larger hole than the drill diameter can be machined!

Drilling with offset

- When drilling on the lathe, the hole diameter can be adjusted by offsetting the drill body along the X-axis of machine.
- When drilling with offset, the drill body must be correctly mounted with cutting edges parallel to the X-axis of the machine. "Mounting the drill on the turret" can be viewed on page 23.

Interferences

Offsetting direction to achieve smaller diameters

X-axis of machine

Direction to achieve larger diameters

Direction of decreased diameters

Hole diameter machined with offset are roughly calculated as following.

Drilled diameter
= Drill diameter + offset value x 2

Example:
 Drill diameter: ø20 mm
 Offset value: 0.2 mm
 Drilled hole diameter = 20 + 0.2 x 2 = ø20.4 mm

Offset value (+) depends on each drill body.

Offsetting direction to achieve larger diameters

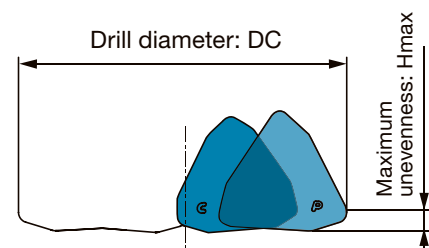
SHAPE OF THE HOLE BOTTOM

Un-evenness of the hole-bottom face when machined with **TungSix-Drill** is smaller than with HSS drills!

The shape of the hole bottom machined with **TungSix-Drill** is closer to flat compared with those machined with HSS drills.

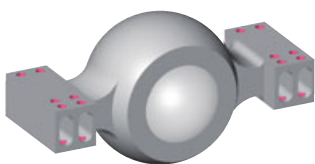
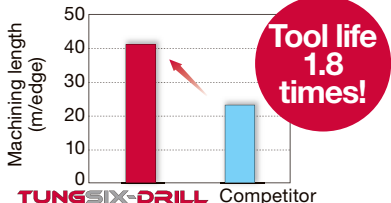
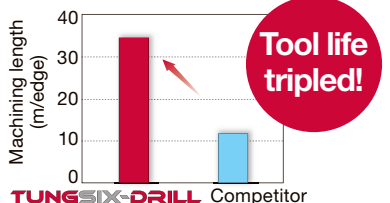
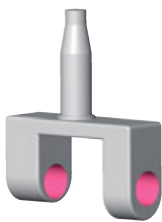
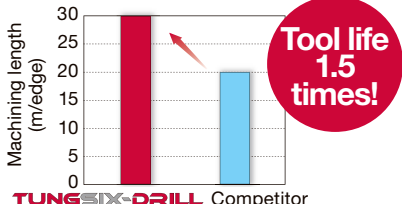
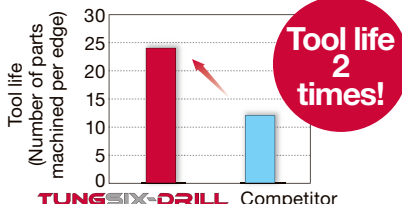
Drill diameter DC (mm)	ø20 - 23.5	ø23.6 - 27.4	ø27.5 - 32.9	ø33 - 33.9	ø39 - 46.9	ø47 - 54.5
Insert	WWMU 05...	WWMU 06...	WWMU 08...	WWMU 09...	WWMU 11...	WWMU 13...
Hmax (mm)	1.2	1.4	1.8	2.1	2.5	2.7

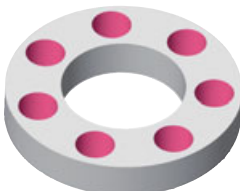
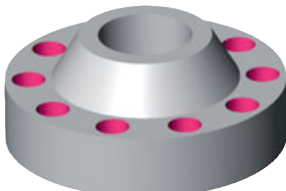
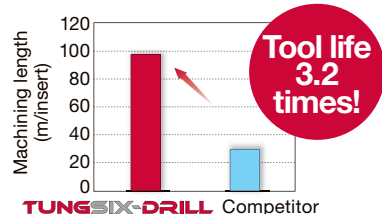
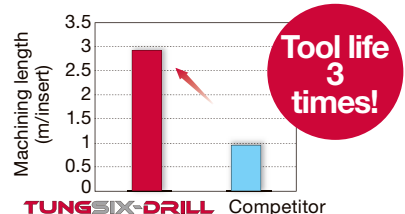
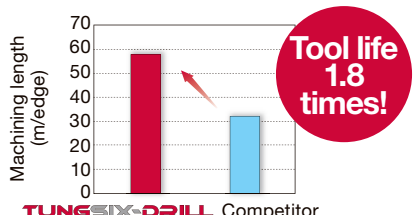
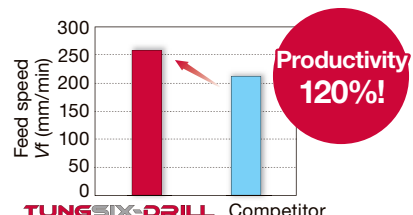
■ Hole bottom shape obtained with TungSix-Drill



TUNGSIK-DRILL

PRACTICAL EXAMPLES

Workpiece type		Connecting rod	Housing
Drill		TDS200F25-2, DC = 20 mm	TDS420F40-2, DC = 42 mm
Insert		WWMU05X205R-DJ	WWMU11X512R-DJ
Grade		AH7020	AH7020
Workpiece material		S55C / C55	FCD450 / GGG45
			
Cutting conditions	Cutting speed: V_c (m/min)	200	120
	Feed: f (mm/rev)	0.15	0.2
	Feed speed: V_f (mm/min)	477	180
	Drilling depth: H (mm)	30	80
	Machine	Vertical M/C, BT40	Vertical M/C, BT50
	Coolant	Wet	Wet
Results		 AH7020 achieves longer tool life even when machining with external coolant supply, due to the high oxidation resistance.	 Tough cutting edge prevents chipping and edge fracture, even when interrupted machining. Increase in tool life and higher number of insert corners drastically reduce machining cost.
Workpiece type		Knuckle	Bevel gear
Drill		TDS500F40-3, DC = 50 mm	TDS230F25-3, DC = 23 mm
Insert		WWMU13X512R-DJ	WWMU05X205R-DJ
Grade		AH7020	AH7020
Workpiece material		SCM440 / 42CrMo4	HSS (60HRC)
			
Cutting conditions	Cutting speed: V_c (m/min)	160	50
	Feed: f (mm/rev)	0.11	0.05
	Feed speed: V_f (mm/min)	112	35
	Drilling depth: H (mm)	80, 65	29
	Machine	Horizontal M/C, BT50	Horizontal M/C, BT40
	Coolant	Wet	Wet
Results		 The machining of TungSix-Drill is highly stable without chattering due to lower cutting forces. No sudden fracture and 6 corners of insert reduce the machining cost.	 TungSix-Drill provided double tool life without fracturing the center cutting edge during machining of hardened steel.

Workpiece type		Flange	Flange
Drill		TDS290F32-2, DC = 29 mm	TDS350F40-3, DC = 35 mm
Insert		WWMU08X408R-DS	WWMU09X510R-DS
Grade		AH7030	AH7030
Workpiece material		SUS304 / X5CrNi18-9	Inconel 625
		 M	 S
Cutting conditions	Cutting speed: V_c (m/min)	140	40
	Feed: f (mm/rev)	0.075	0.06
	Feed speed: V_f (mm/min)	120	22
	Drilling depth: H (mm)	29	60
	Machine	Vertical M/C, BT50	Vertical M/C, BT50
		Coolant	Wet
Results		 The DS chipbreaker creates well controlled chips and the AH7030 provides longer tool life with improved chipping resistance.	 AH7030 with high reliability allows longer tool life. When machining super alloys such as Inconel, inserts with higher number of corners are very effective for reducing tool cost.
Workpiece type		Link	Slewing ring
Drill		TDS240F25-3, DC = 24 mm	TDS330F40-4, DC = 33 mm
Insert		WWMU060306R-DJ	WWMU09X510R-DJ
Grade		AH7020	AH7020
Workpiece material		SCM440 / 42CrMo4	SCM440 / 42CrMo4
		 P	 P
Cutting conditions	Cutting speed: V_c (m/min)	130	180
	Feed: f (mm/rev)	0.1	0.15
	Feed speed: V_f (mm/min)	170	260
	Drilling depth: H (mm)	40	100
	Machine	Vertical M/C, BT40	Vertical M/C, BT50
		Coolant	Wet
Results		 Tough cutting edges prevents chipping even in interrupted drilling condition and provides longer tool life.	 Due to high rigidity, TungSix-Drill can machine without chattering even at higher cutting speed than competitor. Increased number of cutting edge and higher productivity drastically reduces the machining cost.

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