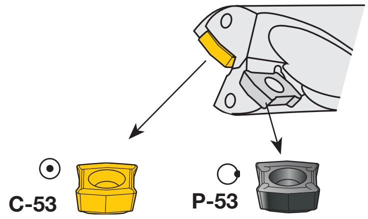
Insert geometries for Coromant U and T-MAX U drills

⦿ Central insert   ◔ Peripheral insert

D_c 12.7 — 17 mm

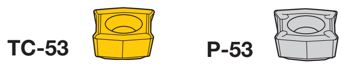
General choice



P M K N S H

- Good chip control in most materials including: steel, stainless, cast iron, titanium, heat resistant alloys and aluminium
- Low to high cutting speeds
- Central and peripheral insert

Complementary choice



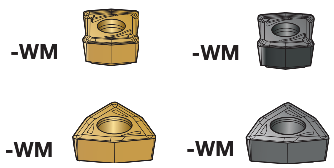
P K H

- TC -53, optimized geometry for increased edge security

D_c 17.5 — 41 mm

Wiper

Productivity choice

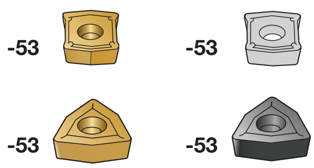


P K M

- Wiper geometry for up to 50% higher feed
- For steel and cast iron with hardness above 200HB and easy to machine stainless steels
- For stable conditions and open tolerance holes
- Central and peripheral insert

D_c 17.5 — 58 mm

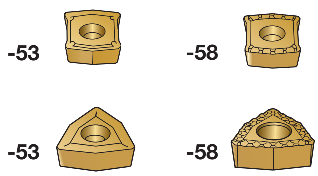
General choice



P M K N S H

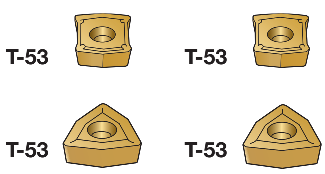
- Good chip control in most materials including: steel, stainless, cast iron, titanium, heat resistant alloys and aluminium
- Low to high cutting speeds
- Central and peripheral insert

Complementary choice



P M

- Geometry -58, optimized as peripheral insertfor low carbon steel and stainless steel
- High cutting speeds



P K H

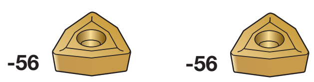
- Optimized geometries with increased edge security

D_c 26 — 58 mm

Complementary choice

P M K

- Geometry -51, optimized as peripheral for good chip control in steel, stainless, cast iron
- High cutting speeds

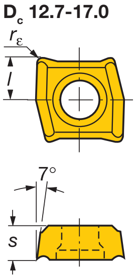


P M

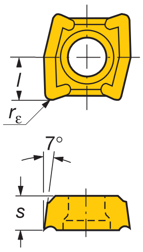
- Good chip control in steel and stainless

Inserts for Coromant U drills R416.2, R416.21, R416.22 and T-Max U drills R416.9, L416.1

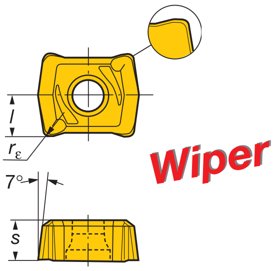
Central
LCMX 02
C-53
D_c 12.7-17.0



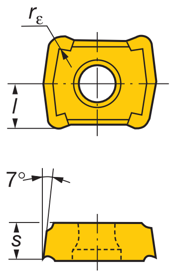
Peripheral
LCMX 02
P-53
D_c 12.7-17.0



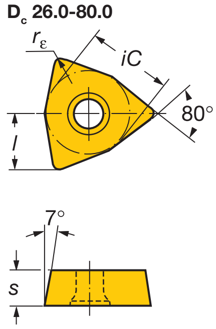
LCMX 03/04
R-WM
D_c 12.7-17.0



LCMX 03/04
D_c 17.5-25.0



WCMX 05/06/08
D_c 26.0-80.0



Insert code

◔ = Peripheral insert
⊙ = Central insert
⊙› = Central and peripheral insert

Dimensions, mm

				l	iC	d_1	s	$r_ε$
All-round geometry								
02	LCMX	02 02 04 P-53	◔	2.68	–	2.5	2.38	0.4
		02 02 04 C-53	⊙	2.68	–	2.5	2.38	0.4
		02 02 04 TC-53	⊙	2.68	–	2.5	2.38	0.4
03	LCMX	03 03 08-53	◔	3.25	–	2.5	3.18	0.8
		03 03 08-53	⊙	3.25	–	2.5	3.18	0.8
		03 03 04-58	◔	3.25	–	2.5	3.18	0.4
		03 03 08 T-53	⊙›	3.25	–	2.5	3.18	0.8
		03 03 04R-WM	◔	3.25	–	2.5	3.18	0.4
		03 03 04R-WM	⊙	3.25	–	2.5	3.18	0.4
04	LCMX	04 03 08-53	◔	4.0	–	2.8	3.18	0.8
		04 03 08-53	⊙	4.0	–	2.8	3.18	0.8
		04 03 04-58	◔	4.0	–	2.8	3.18	0.4
		04 03 08 T-53	⊙›	4.0	–	2.8	3.18	0.8
		04 03 04R-WM	◔	4.0	–	2.8	3.18	0.4
		04 03 04R-WM	⊙	4.0	–	2.8	3.18	0.4
05	WCMX	05 03 04 R-WM	◔	5.07	7.938	3.2	3.18	0.4
		05 03 04 R-WM	⊙	5.07	7.938	3.2	3.18	0.4
		05 03 08 R-51	◔	5.07	7.938	3.2	3.18	0.8
		05 03 08 R-53	◔	5.07	7.938	3.2	3.18	0.8
		05 03 08 R-53	⊙	5.07	7.938	3.2	3.18	0.8
		05 03 08-58	◔	5.07	7.938	3.2	3.18	0.8
		05 03 08 T-53	⊙›	5.07	7.938	3.2	3.18	0.8
		05 03 08-56	◔	5.07	7.938	3.2	3.18	0.8
06	WCMX	06 T3 04 R-WM	◔	6.14	9.525	3.7	3.97	0.4
		06 T3 04 R-WM	⊙	6.14	9.525	3.7	3.97	0.4
		06 T3 08 R-51	◔	6.14	9.525	3.7	3.97	0.8
		06 T3 08 R-53	◔	6.14	9.525	3.7	3.97	0.8
		06 T3 08 R-53	⊙	6.14	9.525	3.7	3.97	0.8
		06 T3 08-58	◔	6.14	9.525	3.7	3.97	0.8
		06 T3 08 T-53	⊙›	6.14	9.525	3.7	3.97	0.8
		06 T3 08-56	◔	6.14	9.525	3.7	3.97	0.8
08	WCMX	08 04 12 R-51	◔	8.14	12.7	4.3	4.76	1.2
		08 04 12 R-53	◔	8.14	12.7	4.3	4.76	1.2
		08 04 12 R-53	⊙	8.14	12.7	4.3	4.76	1.2
		08 04 12-58	◔	8.14	12.7	4.3	4.76	1.2
		08 04 12 T-53	⊙›	8.14	12.7	4.3	4.76	1.2
		08 04 12-56	◔					

Cutting data

– Coromant U and T-Max U drills — R/L416.1, R416.2, R416.21, R416.22 and R416.9

ISO	CMC No.	Material	HB	Drill dia D_c mm	Feed f_n mm/r	Speed v_c m/min	Geometry / Grade: FIRST CHOICE Highest productivity ◔	FIRST CHOICE ⊙	Complementary ◔	Complementary ⊙
P	01.0	**Unalloyed steel** Non hardened 0.05–0.10% C	80–170	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.08 0.04–0.08 0.05–0.08 0.07–0.10 0.08–0.12	290 (230–380)	-53/3040 -53/3040 -53/3040 -53/3040 -53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	01.1	Non hardened 0.05–0.25% C	90–200	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.08 0.04–0.08 0.05–0.10 0.07–0.12 0.08–0.14	270 (225–345)	-53/3040 -53/3040 -53/3040 -53/3040 -53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	01.2	Non hardened 0.25–0.55% C	125–225	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.04–0.14 0.08–0.18 0.10–0.20 0.12–0.24	230 (190–290)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	01.3	Non hardened 0.55–0.80% C	150–225	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.06–0.14 0.08–0.18 0.10–0.20 0.12–0.24	210 (170–275)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	01.4	High carbon & carbon tool steel	180–275	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.06–0.14 0.08–0.18 0.10–0.20 0.12–0.24	210 (200–275)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	02.1	**Low-alloy steel** Non hardened	150–260	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.06–0.12 0.10–0.16 0.11–0.18 0.12–0.22	220 (180–290)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	02.2	Hardened	220–450	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.06–0.14 0.10–0.18 0.10–0.20 0.12–0.24	170 (90–230)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	03.11	**High-alloy steel** Annealed	50–250	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.08 0.04–0.14 0.08–0.18 0.10–0.20 0.12–0.24	180 (160–275)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	03.21	Hardened steel	250–450	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.06–0.12 0.10–0.16 0.11–0.18 0.12–0.22	130 (80–200)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	06.1	**Steel castings** Unalloyed	90–225	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.08 0.04–0.08 0.05–0.10 0.06–0.12 0.07–0.14	200 (140–310)	-53/3040 -53/3040 -53/3040 -53/3040 -53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	06.2	Low alloyed (alloying elements ≤ 5%)	150–250	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.06–0.12 0.10–0.16 0.11–0.18 0.12–0.22	160 (110–250)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
M	05.11	**Stainless steel** Ferritic, Martensitic 13–25% Cr	150–270	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.04–0.14 0.08–0.18 0.10–0.20 0.12–0.24	170 (120–265)	-53/3040 -53/3040 -53/3040 -53/3040 -53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020
	05.21	Austenitic Ni > 8% 13–25% Cr	150–275	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.04–0.12 0.08–0.14 0.10–0.16 0.11–0.18	150 (120–250)	-53/3040 -53/3040 -53/3040 -53/3040 -53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020
	05.51 05.52	Austenitic Ferritic (duplex)-	180–320	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.04–0.12 0.08–0.14 0.10–0.16 0.11–0.18	110 (90–145)	-53/3040 -53/3040 -53/3040 -53/3040 -53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020

Insert positioning: ⊙ = Central
◔ = Peripheral

Wiper -WM geometry for machining steel and cast iron with hardness < 200 HB in stable conditions, increase feed (f_n) with 50%. For easy to machine stainless steels in stable conditions, increase feed (f_n) with 25%.

SANDVIK Coromant

ISO	CMC No.	Material	HB	Drill dia D_c mm	Feed f_n mm/r	Speed v_c m/min	Geometry / Grade: FIRST CHOICE Highest productivity ◔	FIRST CHOICE Highest productivity ⊙	Complementary ◔	Complementary ⊙
M	15.21	**Stainless steel** Austenitic castings	150–250	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.08 0.04–0.12 0.05–0.12 0.06–0.14 0.06–0.14	110 (80–155)	-53/1120 -53/1020	-53/1020 -53/1020 -53/1020 -53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020
S	20.21 20.22 20.24	**Heat resistant alloys** Ni based	140–425	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.03–0.08 0.04–0.08 0.06–0.10 0.08–0.12 0.09–0.14	50 (20– 88)	-53/1120 -53/1020	-53/1020 -53/1020 -53/1020 -53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020
	23.21 23.22	**Titanium alloys** α, near α and α + β alloys in annealed or aged conditions	R_m (MPa) 600–1500	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.08–0.14 0.12–0.16 0.14–0.18 0.16–0.20	60 (40–132)	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A
K	07.1	**Malleable cast iron** Ferritic (short chipping)	110–145	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.14 0.10–0.18 0.14–0.20 0.16–0.26 0.18–0.28	170 (140–230)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	07.2	Pearlitic (long chipping)	150–270	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.08–0.14 0.12–0.18 0.14–0.20 0.15–0.22	140 (105–170)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	08.1	**Grey cast iron** Low tensile strength	150–220	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.14 0.10–0.18 0.14–0.20 0.16–0.26 0.18–0.28	250 (210–310)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	08.2	High tensile strength	200–330	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.08–0.14 0.12–0.18 0.14–0.20 0.15–0.22	170 (125–230)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	09.1	**Nodular cast iron** Ferritic	125–230	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.08–0.14 0.12–0.18 0.14–0.20 0.15–0.22	170 (125–215)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020 T-53/1020
	09.2	Pearlitic	200–300	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.10 0.08–0.14 0.12–0.18 0.14–0.20 0.15–0.22	150 (110–200)	-53/3040	-53/1020	-53/1120 -53/1020 -53/1020 -53/1020 -53/1020	-53/1020
H	04.1	**Extra hard steel** Hardened and tempered	450–	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.05–0.08 0.07–0.15 0.07–0.15 0.10–0.15 0.10–0.15	40 (30–80)	-53/3040	-53/1020	-53/1020 -53/1120	-53/1020
N	30.12	**Aluminium alloys** Wrought or wrought and aged	30–150	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.12 0.06–0.16 0.10–0.18 0.12–0.22 0.14–0.26	350 (300–440)	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A
	30.21	Cast, non aging	40–100	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.12 0.06–0.16 0.10–0.18 0.12–0.22 0.14–0.26	150 (30–440)	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A
	30.22	Cast or cast and aged	70–140	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.12 0.06–0.16 0.10–0.18 0.12–0.22 0.14–0.26	300 (250–385)	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A
	33.1	**Copper and copper alloys** Free cutting alloys (Pb ≥ 1%)	50–160	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.12 0.06–0.16 0.10–0.18 0.12–0.22 0.14–0.26	300 (250–385)	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A
	33.2	Brass and leaded alloys (Pb ≤ 1%)	50–160	12.7–17.0 17.5–25.4 26.0–30.0 31.0–41.3 42.0–80.0	0.04–0.12 0.06–0.16 0.10–0.18 0.12–0.22 0.14–0.26	230 (180–265)	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1120 -53/H13A -53/H13A -53/H13A -53/H13A	-53/1020 -53/H13A -53/H13A -53/H13A -53/H13A

Insert positioning: ⊙ = Central ◔ = Peripheral

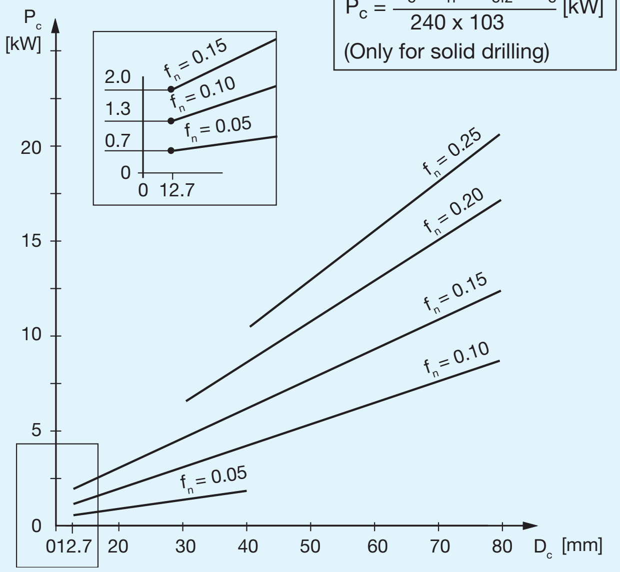
Graphs for Coromant U and T-Max U drills

Net power

k_c = 2500N/mm² v_c =100 m/min

$$P_c = \frac{D_c \times f_n \times k_{cfz} \times v_c}{240 \times 10^3} \text{ [kW]}$$

(Only for solid drilling)

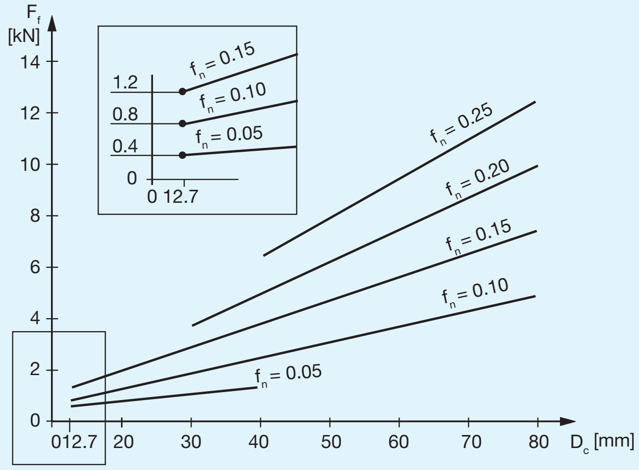


Feed force

k_c = 2500 N/mm²

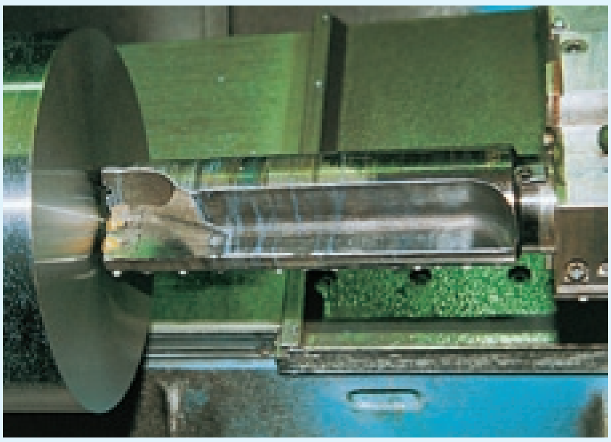
$$F_f = 0.5 \times \frac{D_c}{2} \times f_n \times k_{cfz} \times \sin\kappa_r \text{ [N]}$$

(Only for solid drilling)



Compensation factors for different cutting speeds

v_c m/min	78	93	100	123	153	200	250	300
Factor	0.78	0.93	1.00	1.23	1.53	2.00	2.50	3.00



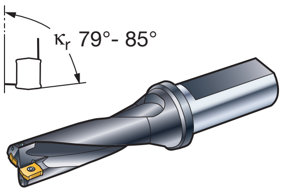
The graphs show nominal values which should not be regarded as strict recommendations. The values may need adjusting depending on the machining conditions e.g., the type of material.

Note that only net power ratings are given. Allowance must be made for the efficiency of the machine and the cutting edge wear.

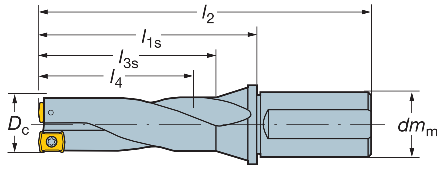
Specifications for Coromant U

2 × D_c R 416.2

Cylindrical shank
Flat according to ISO 9766



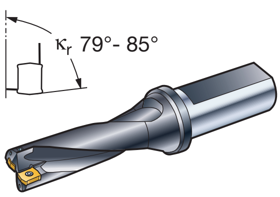
Drill diameter, D_c	12.7–58 mm
Hole tolerance	+0.3 mm -0.1 mm
Tolerance, D_c	± 0.15 mm (D_c 12.7 – 25.0 mm) ± 0.20 mm (D_c 26.0 – 58.0 mm)
Max hole depth, l_4	2 x D_c



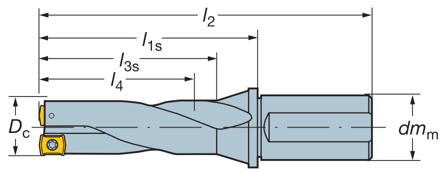
l_{1s} = programming length

3 × D_c R 416.2

Cylindrical shank
Flat according to ISO 9766



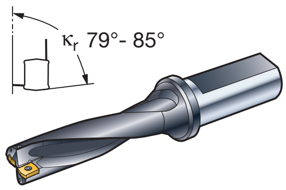
Drill diameter, D_c	12.7–58 mm
Hole tolerance	+0.3 mm -0.1 mm
Tolerance, D_c	± 0.15 mm (D_c 12.7 – 30.0 mm) ± 0.20 mm (D_c 31.0 – 58.0 mm)
Max hole depth, l_4	3 x D_c



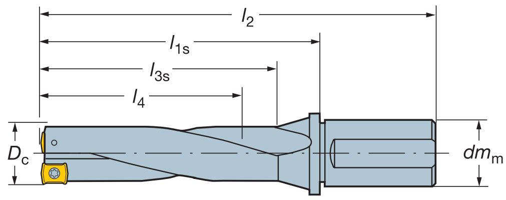
l_{1s} = programming length

4 × D_c R 416.2

Cylindrical shank
Flat according to ISO 9766



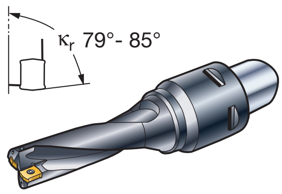
Drill diameter, D_c	12.7–58 mm
Hole tolerance	+0.4 mm -0.1 mm
Tolerance, D_c	± 0.20 mm
Max hole depth, l_4	4 x D_c



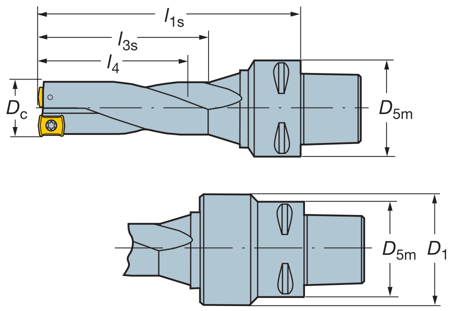
l_{1s} = programming length

3 × D_c R 416.2

Coromant Capto



Drill diameter, D_c	12.7–30 mm
Hole tolerance	+0.3 mm -0.1 mm
Tolerance, D_c	± 0.15 mm (D_c 12.7 – 25.0 mm) ± 0.20 mm (D_c 26.0 – 30.0 mm)
Max hole depth, l_4	3 x D_c



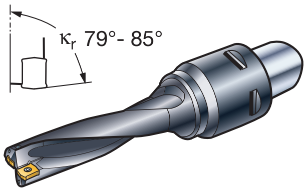
l_{1s} = programming length

SANDVIK Coromant

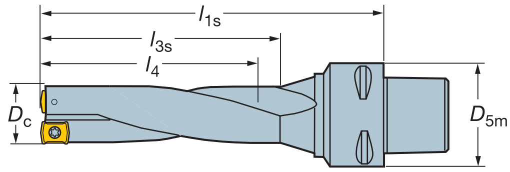
Specifications for Coromant U

4 × D_c R 416.2

Coromant Capto



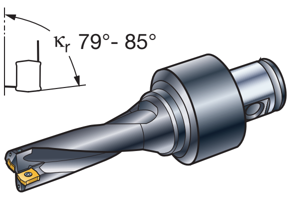
Drill diameter, D_c	12.7–41 mm
Hole tolerance	+0.4 mm -0.1 mm
Tolerance, D_c	± 0.20 mm
Max hole depth, l_4	4 x D_c



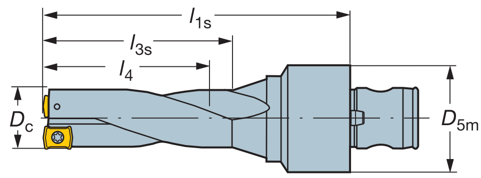
l_{1s} = programming length

3 × D_c R 416.2

Compatible with ABS holders



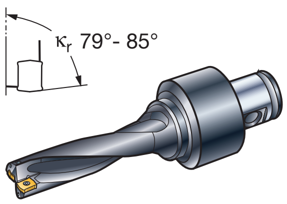
Drill diameter, D_c	12.7–41 mm
Hole tolerance	+0.3 mm -0.1 mm
Tolerance, D_c	± 0.15 mm (D_c 12.7 – 25.0 mm) ± 0.20 mm (D_c 26.0 – 41.0 mm)
Max hole depth, l_4	3 x D_c



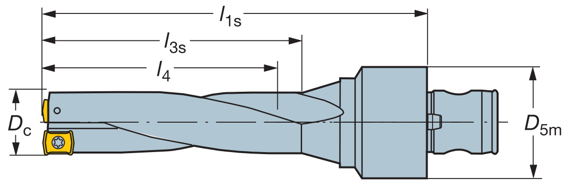
l_{1s} = programming length

4 × D_c R 416.2

Compatible with ABS holders



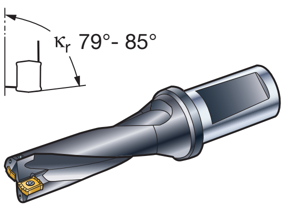
Drill diameter, D_c	12.7–41 mm
Hole tolerance	+0.4 mm -0.1 mm
Tolerance, D_c	± 0.20 mm
Max hole depth, l_4	4 x D_c



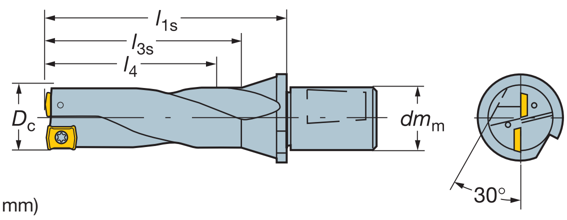
l_{1s} = programming length

3 × D_c R 416.2

Coromant Whistle Notch shank



Drill diameter, D_c	17.5–41.3 mm
Hole tolerance	+0.3 mm -0.1 mm
Tolerance, D_c	± 0.15 mm (D_c 12.7 – 25.0 mm) ± 0.20 mm (D_c 26.0 – 41.3 mm)
Max hole depth, l_4	3 x D_c



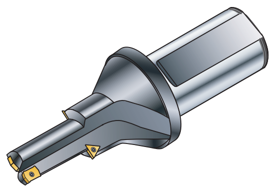
l_{1s} = programming length

Specifications for Coromant U

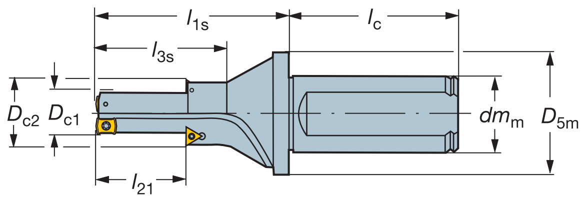
Socket head cap screw R 416.21

Cylindrical shank

Flat according to ISO 9766



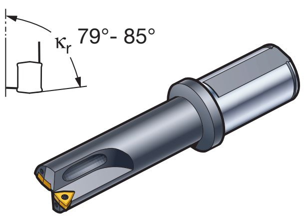
Drill diameter,	13–21 mm
Hole depth	1-3 x D_c
Hole tolerance	+0.3 mm
	-0.1 mm
Cutting fluid:	Emulsion



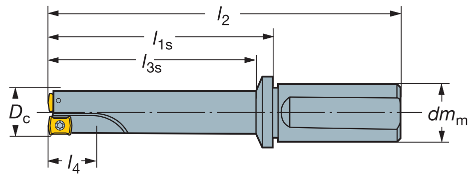
l_{1s} = programming length

l_{21} = Recommended max drilling depth

Plunge drills 4 × D_c R 416.22



Drill diameter, D_c	12.7–35 mm
Tolerance, D_c	± 0.20 mm
Max hole depth, l_4	4 x D_c



l_{1s} = programming length

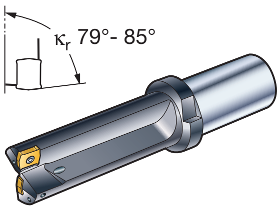
A
B
C
D
E
F
G
H

Specifications for T-Max U

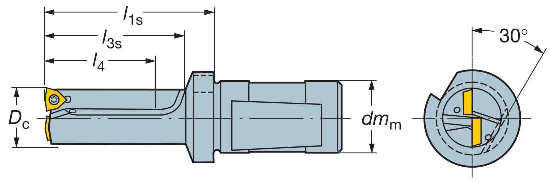
Left hand drills

Coromant Whistle Notch shank

2.5 × D_c R 416.1



Drill diameter, D_c	17.5–58 mm
Tolerance, D_c	± 0.20 mm
Max hole depth, l_4	2.5 x D_c

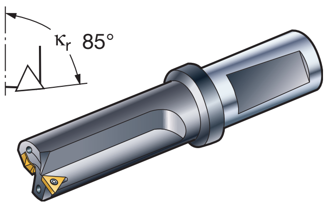


l_{1s} = programming length

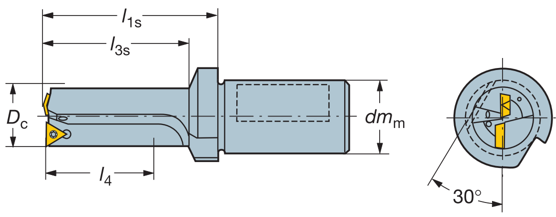
Stack drills

Coromant Whistle Notch shank

2.5 × D_c



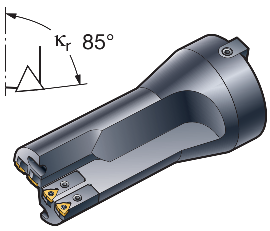
Drill diameter, D_c	27–59 mm
Tolerance, D_c	± 0.20 mm
Max hole depth, l_4	2.5 x D_c



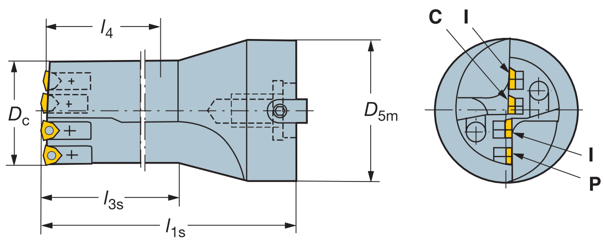
l_{1s} = programming length

Indexable drills - D_c 60-80 mm

Varilock coupling



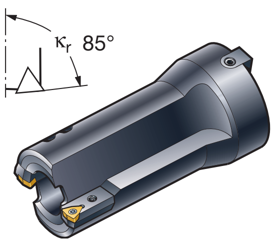
Drill diameter, D_c	60–80 mm
Tolerance, D_c	± 0.20 mm
Max hole depth, l_4	2.5 x D_c



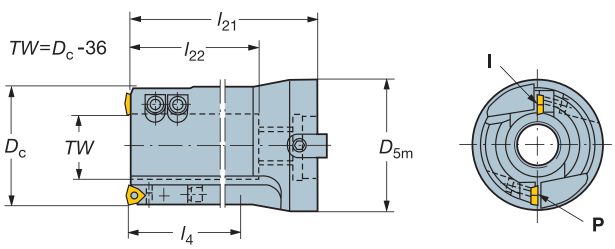
l_{1s} = programming length

Trepanning drills - D_c 60-110 mm

Varilock coupling



Drill diameter, D_c	60–110 mm
Tolerance, D_c	± 0.20 mm
Max hole depth, l_4	2.5 x D_c



l_{1s} = programming length

A
B
C
D
E
F
G
H

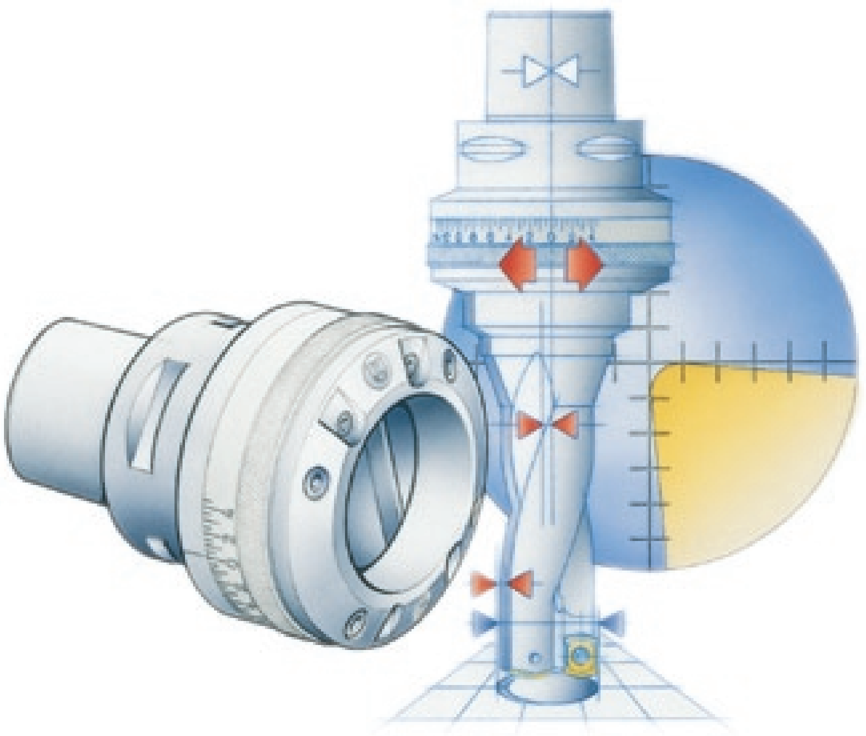
Varying the hole diameter with a rotating drill

The ability to adjust the diameter of an indexable insert drill is an important feature which extends the working area of one drill and reduces the need to have several close diameter versions in stock. Moreover, the ability to accurately set the cutting edges of indexable insert drills means that they take on a wider role as a high-productivity tool that makes close-tolerance holes. Tolerances within +/- 0.05 mm can be held.

An adjustable, specially designed tool holder for drills simplifies precision setting. This is a precision toolholder ensuring high accuracy and stability for drilling. It makes it easier to compensate for diameter deviations or to off-set the drill to make additional hole diameters. Sleeves are used to adapt various ISO shank sizes for one holder and make it possible to widen the application area for indexable insert drills and rotating tools, such as on machining centres.

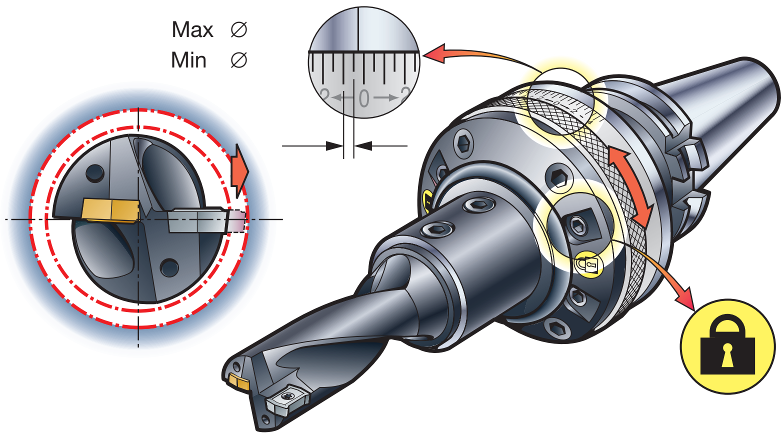
Two adjustable toolholder sizes are available, taper 40 and 50 with each series including Coromant Capto adaptor as well as two different types of solid holders. Taper 40 size holders will take drill diameters of 12.7 to 25.99 mm while taper 50 size takes 12.7 to 30.99 mm. The adjustment of the drill is always performed with the peripheral insert edge on a level with the centre-line of the holder. Setting is easily done by turning the scale ring surrounding the holder, marked in increments of 0.05 mm, indicating a diametrical movement of the tool. The scale has a zero mark as a nominal setting for the holder only.

The adjustable toolholder will always set the peripheral insert of the drill on a level with the centre-line of the holder to ensure correct radial adjustment. Adjustment/setting is made by turning a scale ring surrounding the holder marked in increments of 0.05 mm, indicating the diametrical movement of the drill. The scale also has a zero mark, as a nominal setting for the holder only. The adjustment range for the the drill should not be exceeded and it may be necessary to machine with a smaller feed rate.



Adjustable toolholder for rotating drills.

Setting of the holder can be made in a presetting unit, preferably one equipped with projector and electronic scanning facility. Initially the true nominal diameter for each drill has to be measured. The adjustment of the drill position can then be carried out to the hole diameter required. The setting range of the holder (+1.4/-0.4 mm on the diameter) does not correspond with the setting range for Coromant U-drills in diameters 16.5, 17 and 25 mm, this value has to be carefully checked in the ordering information before setting, and should never be exceeded. A diameter below the nominal value of the drill should never be considered. Further adjustments after the basic setting can normally be performed outside the presetting unit by refering to the scale only. Four locking screws keep the set value in position. Before the setting procedure commences these screws must be slackened off. The sleeve should be removed and cleaned when it is not in use for long periods.



Radial adjustment of rotating drills, in increments of 0.05 mm.
- Radial adjustment – 0.2 /+ 0.7 mm
- Hole tolerances: down to ± 0.05 mm

Radial adjustment for Coromant U

Coromant U drills $2 \times D_c$

Drill diameter D_c mm	Radial adjustment (max)	Max D_c
12.7	+ 1.2 →	15.1
13	+ 1.15	15.3
13.5	+ 1.1	15.7
14	+ 1.0	16.0
14.5	+ 0.9	16.3
15	+ 0.85	16.7
15.5	+ 0.75	17.0
16	+ 0.7	17.4
16.5	+ 0.6	17.7
17	+ 0.5	18.0
17.5	+ 1.0 →	19.5
18	+ 0.9	19.8
18.5	+ 0.85	20.2
19	+ 0.8	20.6
20	+ 0.75	21.5
21	+ 1.5 →	24.0
22	+ 1.25	24.5
23	+ 1.0	25.0
24	+ 0.75	25.5
25	+ 0.5	26.0
26	+ 2.5 →	31.0
27	+ 2.2	31.4
28	+ 2.1	32.2
29	+ 1.8	32.6
30	+ 1.8	33.0
31	+ 3.5 →	38.0
32	+ 3.2	38.4
33	+ 3.0	39.0
34	+ 2.8	39.6
35	+ 2.5	40.0
36	+ 2.3	40.6
37	+ 2.0	41.0
38	+ 1.8	41.6
39	+ 1.5	42.0
40	+ 1.2	42.4
41	+ 1.0	43.0
42	+ 4.2 →	50.4
43	+ 4.0	51.0
44	+ 3.7	51.4
45	+ 3.6	52.2
46	+ 3.3	52.6
47	+ 3.0	53.0
48	+ 2.7	53.4
49	+ 2.5	54.0
50	+ 2.2	54.4
51	+ 2.0	55.0
52	+ 1.8	55.6
53	+ 1.5	56.0
54	+ 1.2	56.4
55	+ 0.8	56.6
56	+ 0.6	57.2
57	+ 0.5	58.0
58	+ 0.4	58.8

Coromant U drills $3 \times D_c$

Drill diameter D_c mm	Radial adjustment (max) Stationary drill
17.5	+ 1.0
18	+ 0.9
18.5	+ 0.85
19	+ 0.8
20	+ 0.75
21	+ 1.5
22	+ 1.25
22.2	+ 1.2
23	+ 1.0
24	+ 0.75
25	+ 0.5
25.4	+ 0.4
26	+ 2.5
27	+ 2.2
28	+ 2.1
28.6	+ 1.9
29	+ 1.8
30	+ 1.5
31	+ 3.5
31.8	+ 3.3
32	+ 3.2
33	+ 3.0
34	+ 3.0
35	+ 2.5
36	+ 2.3
37	+ 2.0
38	+ 1.8
39	+ 1.5
40	+ 1.2
41	+ 1.0
41.3	+ 0.9

T-Max U drills Left hand drills $2.5 \times D_c$

Drill diameter D_c mm	Radial adjustment (max) Stationary drill
17.5	+ 1.5
18	+ 1.4
18.5	+ 1.3
19	+ 1.2
20	+ 1.0
21	+ 1.6
22	+ 1.5
23	+ 1.25
24	+ 1.0
25	+ 0.8
26	+ 2.5
27	+ 2.2
28	+ 2.1
29	+ 1.8
30	+ 1.5
31	+ 3.5
32	+ 3.2
33	+ 3.0
34	+ 2.8
35	+ 2.5
36	+ 2.3
37	+ 2.0
38	+ 1.8
39	+ 1.5
40	+ 1.2
41	+ 1.0
42	+ 4.2
43	+ 4.0
44	+ 3.7
45	+ 3.5
46	+ 3.3
47	+ 3.0
48	+ 2.7
49	+ 2.5
50	+ 2.2
51	+ 2.0
52	+ 1.8
53	+ 1.5
54	+ 1.2
55	+ 0.8
56	+ 0.6
58	+ 0.4

For CoroDrill radial adjustment values, see page E58.

Coromant U drill R416.2

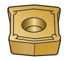
Tailor Made

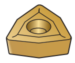
Drill diameter	Mounting type				
	Cylindrical with flat and Cylindrical	Coromant Whistle Notch	Coromant Capto	Varilock	Compatible with ABS holders
D_c mm	Mounting Size dm_m		Mounting Size D_{5m}		
12.70-17.43	16, 20 [1], 25, 32	16, 20, 25, 32	C3, C4, C5, C6	50, 63	50
17.44-20.99	20, 25, 32	20, 25, 32	C3, C4, C5, C6	50, 63	50
21.00-25.99	25, 32	25, 32	C4, C5, C6	50, 63	50
26.00-30.99	32, 40	25, 32, 40	C4, C5, C6	50, 63	50
31.00-41.99	40	32, 40	C5, C6	50, 63	50
42.00-58.99	40, 50	40	C6	63	-

[1] Also as short cylindrical with flat in drill diameter 12.70-17.43 mm

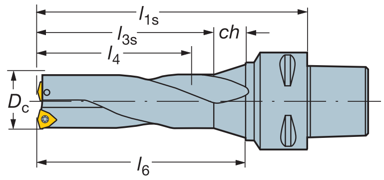
Standard inserts:

LCMX 02, D_c = 12.70-17.43
LCMX 03, D_c = 17.44-20.99
LCMX 04, D_c = 21.00-25.99
WCMX 05, D_c = 26.00-30.99
WCMX 06, D_c = 31.00-41.99
WCMX 08, D_c = 42.00-58.99


LCMX

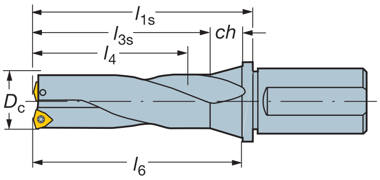

WCMX

Coromant Capto



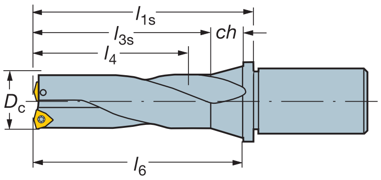
Cylindrical with flat

(acc. to ISO 9766)

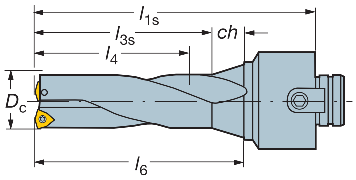


Cylindrical

(Same length as ISO 9766)

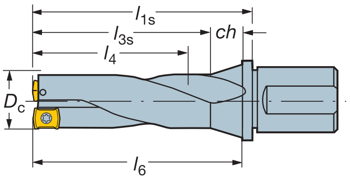


Varilock

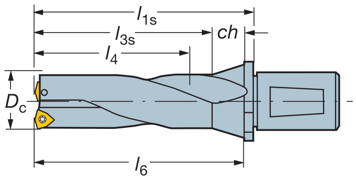


Short cylindrical with flat

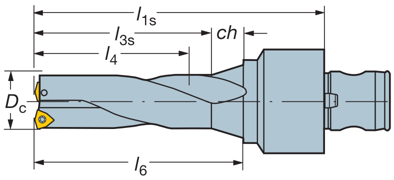
(Only shank size 20)



Coromant Whistle Notch



Compatible with ABS holders



Options

Diameter D_c — **12.70-58.99 mm**

Drill length l_{3s} — **28.0-239.7 mm** depending on other parameters

Drill depth l_4 — Dc—12.70-47.00—**2-x-D_c-5-x-D_c**
Dc—47.01-58.99—**Max 235 mm**

Mounting type — Cylindrical with flat, acc. to ISO 9766—**CYLPFF**,
Cylindrical same length as ISO 9766—**CYLFA**
Short cylindrical with flat—**CYLFB**
Coromant Whistle Notch—**CWN**
Coromant Capto—**Capto**
Varilock—**VL**
Compatible with ABS holders—**ABS**

Rotate Capto coupling 180° — **Yes** or **No**

dm_m-/D_{5m} — **Mounting size—see above**

Taper length ch — D_c—12.70-45.40—0.5-x-**D_c-1-x-D_c**
D_c—45.41-58.99—**Max 37.4-mm**
Recommened value 0.6-x-D_c

Programming length l_{1s} — **38.9-346.6 mm**—depending on other parameters

Flute length l_6 — **34.2-277.1 mm**,
Recommended value must be used to obtain required l_{3s} or l_4

SANDVIK Coromant

T-Max U stack drills — R416.01

ISO	CMC No.	Material	HB	Drill dia. D_c mm	Feed f_n mm/r	Speed v_c m/min	Geometry / Grade Insert positioning ⊙ = Central and peripheral
P	01.1	**Unalloyed steel** Non hardened 0.05–0.25% C	90–200	27-32.99 33-42.99 43-59	0.05–0.08 0.09–0.09 0.07–0.12	100-300	-54/235 -56/235 -56/235
	02.1	**Low-alloy steel** Non hardened	150–260	27-32.99 33-42.99 43-59	0.05–0.08 0.09–0.09 0.07–0.12	75-200	-54/235 -56/235 -56/235
M	05.11	**Stainless steel** Ferritic, Martensitic 13–25% Cr	150–270	27-32.99 33-42.99 43-59	0.05–0.08 0.09–0.09 0.07–0.12	75-200	-54/235 -56/235 -56/235
	05.21	Austenitic Ni > 8% 13–25% Cr	150–275	27-32.99 33-42.99 43-59	0.05–0.08 0.09–0.09 0.07–0.12	100-300	-54/235 -56/235 -56/235
	05.51 05.52	Austenitic Ferritic (duplex)	180–320	27-32.99 33-42.99 43-59	0.05–0.08 0.09–0.09 0.07–0.12	50-150	-54/235 -56/235 -56/235
	15.21	**Stainless steel** Austenitic castings	150–250	27-32.99 33-42.99 43-59	0.05–0.08 0.09–0.09 0.07–0.12	30-200	-54/235 -56/235 -56/235

Application area

The drill is specially designed for drilling holes in stacked components, with or without air gaps. The max recommended gap is 1 mm.

The combined features of geometry and position of the inserts produce a smaller end disc as different from conventional drills upon break through of the hole. This avoids the danger of inserts crushing.

The drill body is designed in the same way as other T-Max U drills with the exception of the inserts and insert seats.

Two types of inserts are used, a trigon insert with facets (WCMX xx xx SR) and a triangular insert (TCMT xx xx xx).

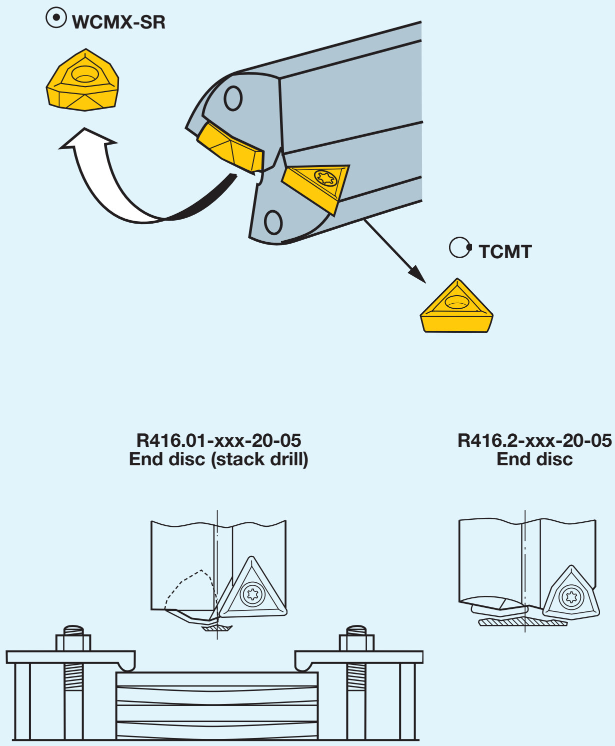
The centre insert (WCMX) is positioned so that its centre point begins cutting first and is placed somewhat in front of the periphery insert. Hence machining starts at the centre and continues outwards to the periphery.

The small end disc which is formed when drilling a through-hole can easily be flushed down any of the large chip channels.

T-MAX U stack drill — R416.01

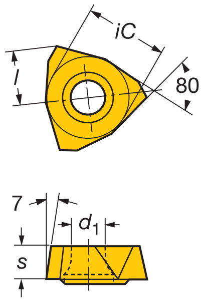
Note!

Only use WCMX-56 SR as central inserts

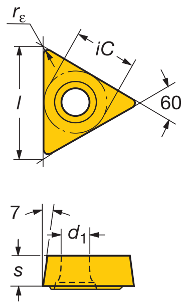


Inserts for T-Max U stack drills R416.01

Central
WCMX
D_c 27-59



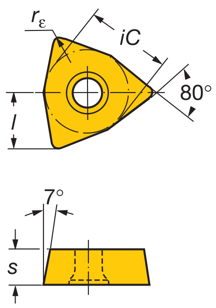
Peripheral
TCMT
D_c 27-59



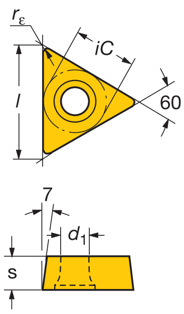
Insert code ◯ = Peripheral Insert, ⊙ = Central Insert			**Dimensions, mm** l	iC	d_1	s	r_ε
All round geometry							
05	**WCMX 05 03 SR-54**	⊙	5.07	7.938	3.2	3.18	-
06	**WCMX 06 T3 SR-56**	⊙	6.14	9.525	3.7	3.97	-
08	**WCMX 08 04 SR-56**	⊙	8.14	12.7	4.3	4.76	-
13	**TCMT 13 03 08-54**	◯	13.7	7.938	3.2	3.18	0.8
16	**TCMT 16 T3 08-56**	◯	16.5	9.525	3.7	3.97	0.8
22	**TCMT 22 04 12-56**	◯	22	12.7	4.3	4.76	1.2

Inserts for T-Max U trepanning drills R416.7

Central and Peripheral
WCMX
D_c 60-110



Central
TCMT
D_c 60-110



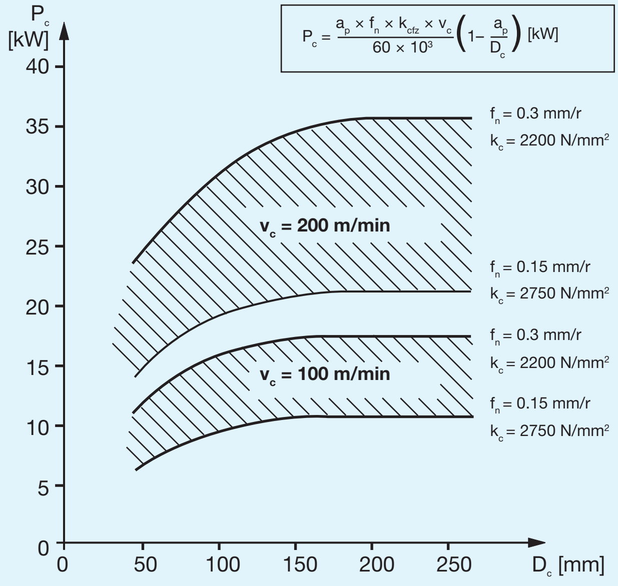
Insert code ◯ = Peripheral Insert, ⊙ = Central Insert			**Dimensions, mm** l	iC	d_1	s	r_ε
All round geometry							
06	**WCMX 06 T3 08 R-53**	⊙	6.14	9.525	3.7	3.97	0.8
	WCMX 06 T3 08 R-51	◯	6.14	9.525	3.7	3.97	0.8
Optimized geometry							
06	**WCMX 06 T3 08-58**	◯	6.14	9.525	3.7	3.97	0.8
	WCMX 06 T3 08-56	⊙	6.14	9.525	3.7	3.97	0.8
16	**TCMT 16 T3 08-UR**	⊙	16.5	9.525	4.4	3.97	0.8

SANDVIK Coromant

Graphs for T-Max U trepanning tools – R416.7

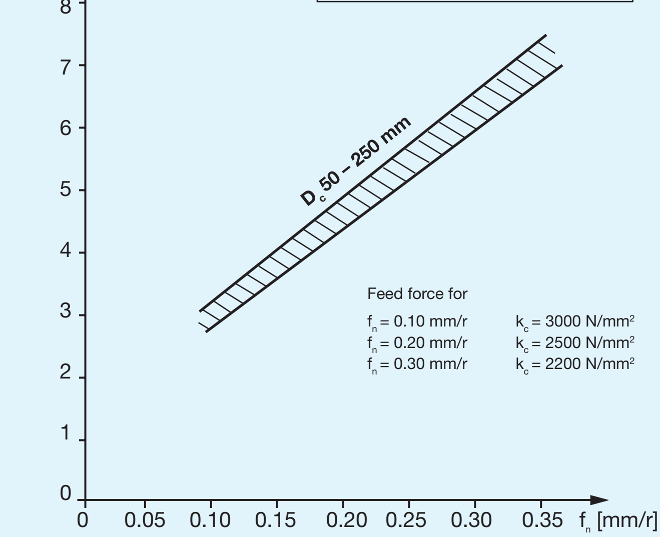
Net power

$$P_c = \frac{a_p \times f_n \times k_{cfz} \times v_c}{60 \times 10^3}\left(1 - \frac{a_p}{D_c}\right) \text{ [kW]}$$



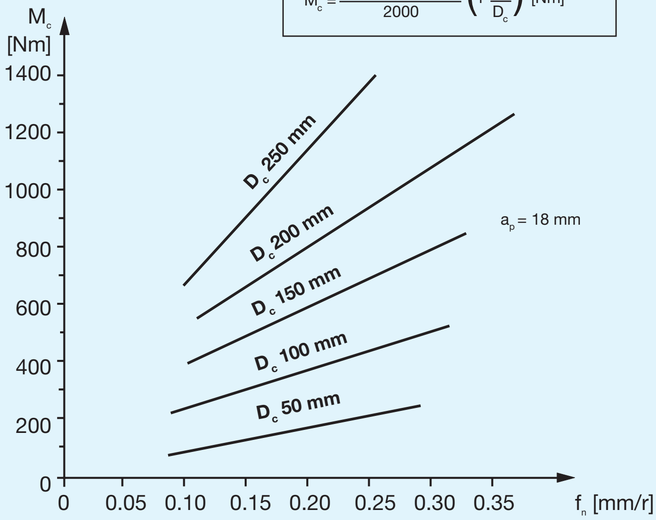
Feed force

$$F_f = 0.5 \times a_p \times f_n \times k_{cfz} \times \sin \kappa_r \text{ [N]}$$

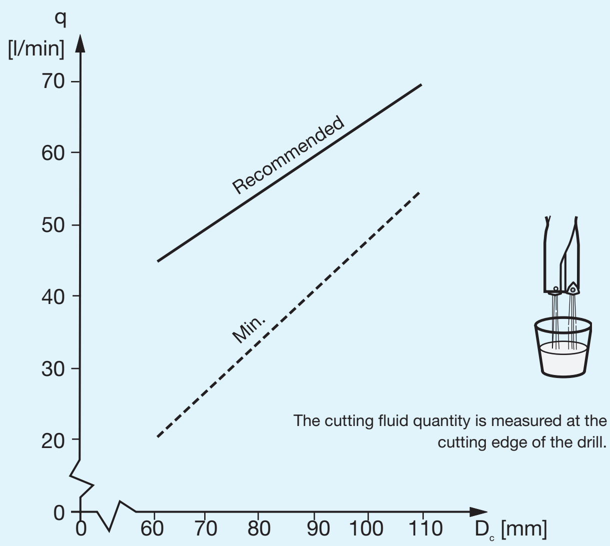


Trepanning torque

$$M_c = \frac{D_c \times f_n \times k_{cfz} \times a_p}{2000}\left(1 - \frac{a_p}{D_c}\right) \text{ [Nm]}$$



Cutting fluid flow



The graphs show nominal values which should not be regarded as strict recommendations. The values may need adjusting depending on the machining conditions e.g., the type of material.

Note that only net power ratings are given. Allowance must be made for the efficiency of the machine and the cutting edge wear.

A B C D E F G H

Cutting data for T-Max U trepanning tools — R416.7

ISO	CMC No.	Material	HB	Drill dia D_c mm	Feed f_n mm/r	Speed v_c m/min	Geometry / Grade FIRST CHOICE Highest productivity ⊙	Complementary ⊙
P		**Unalloyed steel**						
	01.0	Non hardened 0.05–0.10% C	80–170	60–110	0.07–0.10	250–345	-58/3040	-56/235
	01.1	Non hardened 0.05–0.25% C	90–200		0.07–0.12	225–315	-58/3040	-56/235
	01.2	Non hardened 0.25–0.55% C	125–225					
	01.3	Non hardened 0.55–0.80% C	150–250		0.10–0.20	130–210	-51/235	-56/235
	01.4	High carbon & carbon tool steel	180–275					
		Low-alloy steel						
	02.1	Non hardened	150–260	60–110	0.11–0.18	145–210	-51/235	-53/235
	02.2	Hardened	220–400		0.10–0.20	100–165		
		High-alloy steel						
	03.11	Annealed	50–250	60–110	0.10–0.20	125–200	-51/235	-53/235
	03.13	Annealed HSS						
	03.21	Hardened tool steel	250–450	60–110	0.11–0.18	90–145	-51/235	-53/235
	03.22	Hardened steel						
		Steel castings						
	06.1	Unalloyed	90–225	60–110	0.06–0.12	195–280	-58/3040	-56/235
	06.2	Low alloyed (alloying elements ≤ 5%)	150–250		0.11–0.18	120–175	-51/GC-A	-53/235
M		**Stainless steel**						
	05.11	Ferritic, Martensitic 13–25% Cr	150–270	60–110	0.10–0.20	170–240	-58/3040	-56/235
		Stainless steel						
	05.21	Austenitic Ni > 8% 18-25% Cr	150–270	60–110	0.10–0.16	100–140	-58/235	-56/235
K		**Malleable cast iron**						
	07.1	Ferritic (short chipping)	110–145	60–110	0.16–0.26	140–210	-53/3040	-53/H13A
	07.2	Pearlitic (long chipping)	150–270		0.14–0.20	105–155		
		Grey cast iron						
	08.1	Low tensile strength	150–220	60–110	0.16–0.26	210–280	-53/4025	-53/H13A
	08.2	High tensile strength	200–330		0.14–0.20	105–155		
		Modular cast iron						
	09.1	Ferritic	125–230	60–110	0.14–0.20	125–195	-53/3040	-53/H13A
	09.2	Pearlitic	200–300		0.14–0.20	110–180		
N		**Aluminium alloys**						
	30.12	Wrought solution treated & aged	75–150	60–110	0.12–0.22	250–400	-53/H13A	-53/H13A
	30.21	Cast	40–100					
	30.22	Cast, solution treated & aged	70–125					
		Copper and copper alloys						
	33.1	Free cutting alloys (Pb ≥ 1%)	50–160	60–110	0.12–0.22	180–350	-53/H13A	-53/H13A
	33.2	Brass and leaded bronzes (Pb ≤ 1%)						

Insert positioning:

⊙ = Central and peripheral inserts

A B C D E F G H

Application hints for T-Max U trepanning tool – R416.7

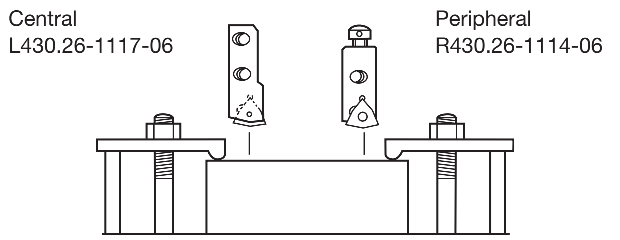
Application area

The drill is designed for drilling solid workpieces as well as stacked components with or without air gaps.

Solid workpiece

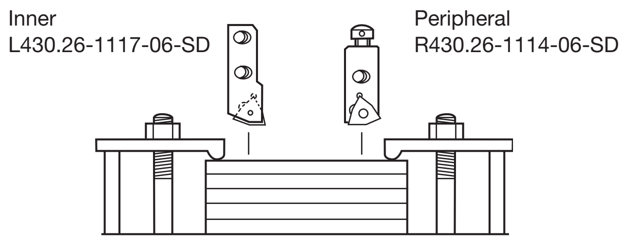
Normally the trepanning tool is used for drilling solid workpieces.

Standard cartridge is used together with WCMX insert size 06 in both peripheral and inner cartridges.



Workpiece without air gaps

When a stack component is drilled, an SD cartridge for stack drilling must be used to avoid end disc problem. WCMX insert size 06 should be used in both peripheral and inner cartridges.



Workpiece with air gaps

To avoid problems with the end disc between the plates an inner cartridge 3282 32 L4-1 together with TCMT size 16 must be used (see fig. 1).

When this inner cartridge is used, no end disc will be formed between the workpieces (see figs. 2 and 3).

As peripheral cartridge, use SD cartridge with WCMX insert size 06.

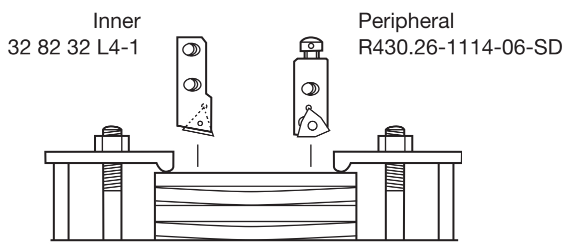


Fig. 1

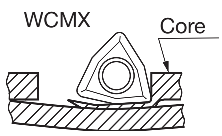


Fig. 2

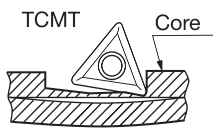


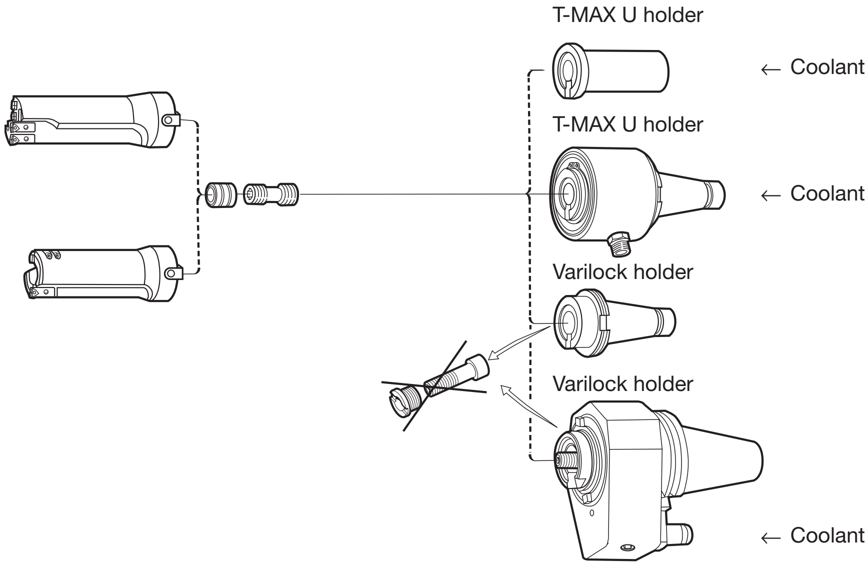
Fig. 3

Holding instructions for T-Max U trepanning drills – R416.7 and indexable drills – R416.9

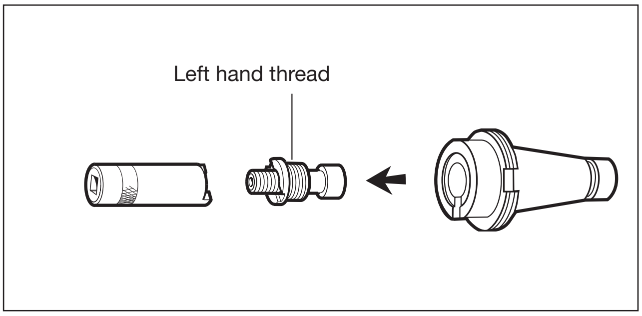
Assembly instructions

Note, when using Varilock basic holders:

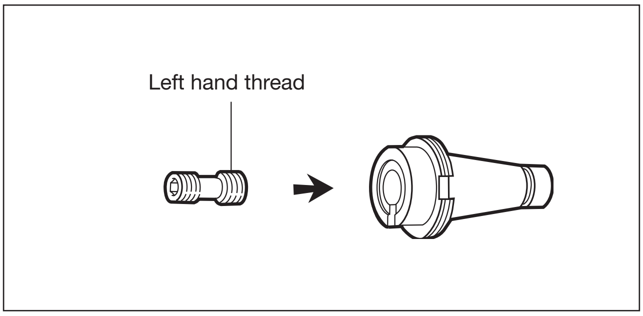
When machining with T-Max U drills R416.9 and R416.7, the original screw and lock nut in the Varilock basic holder must be replaced by a centering sleeve (5638 030-01) and screw (5516 030-01), which must be ordered separately.



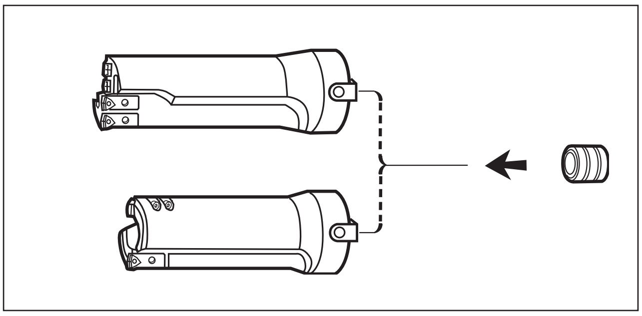
Mounting of drill into holder



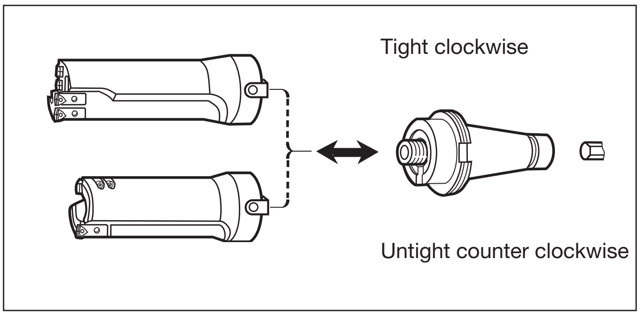
1. If the Varilock basic holder is used, remove the Varilock nut and screw from the basic holder, using Varilock key 5680 065-02.



2. Twist the screw 5516 030-01 two full turns into the holder (Varilock or T-Max U holders).



3. Fit the centering sleeve 5638 030-01 into the rear of the drill.

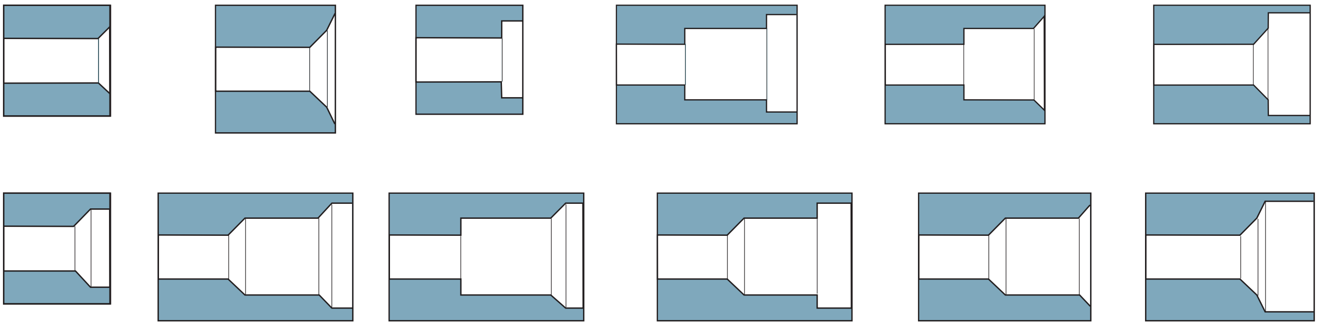


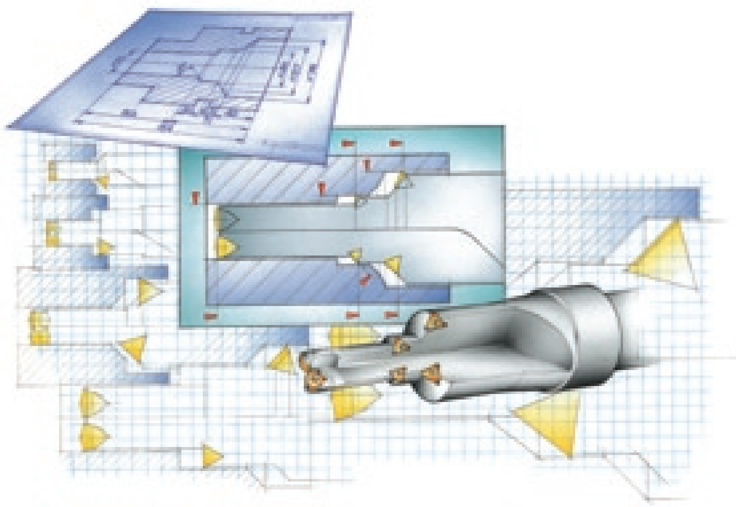
4. Screw drill and holder (Varilock or T-Max U holders) together using key 5680 005-01. Ensure that the driving dog is aligned with the driving slot. Then tighten with a torque wrench. Tightening torque 180-200 Nm.

Coromant U step and chamfer drill

High productivity – three tools in one

Operations

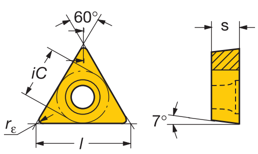




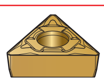
Cutting data recommendations

- Choose cutting data according to the drilling operation
- Reduce cutting data when step drilling
- Choose corner radius 0.4 mm for step/chamfer insert. If stronger insert is needed, choose radius 0.8 mm.
- For alternative step/chamfer inserts, see Turning tool catalogue.

Recommended step and chamfer inserts



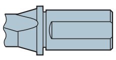
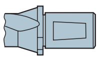
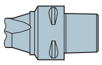
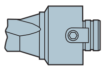
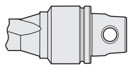
CoroTurn 107



ISO	l	
TCMT	06	T1 04-UF
TCMT	06	T1 04-MF
	06	T1 04-KF
TCMT	09	02 04-PF
	09	02 04-MF
	09	02 04-KF
TCMT	11	03 04-PF
	11	03 04-MF
	11	03 04-KF
TCMT	16	T3 04-PF
	16	T3 04-MF
	16	T3 04-KF
TCMT	09	02 04-UF
	09	02 04-UM
TCMT	16	T3 04-UF
	16	T3 04-UM

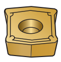
Coromant U drill, step and chamfer drill

Tailor Made

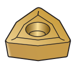
Drill diameter	Mounting type				
	 Cylindrical with flat and Cylindrical	 Coromant Whistle Notch	 Coromant Capto	 Varilock	 Compatible with ABS holders
D_{c1} mm	Mounting Size dm_m		Mounting Size D_{5m}		
12.70-17.43	16, 20, 25, 32	16, 20, 25, 32	C3, C4, C5, C6	50, 63	50
17.44-20.99	20, 25, 32	20, 25, 32	C3, C4, C, C6	50, 63	50
21.00-25.99	25, 32	25, 32	C4, C5, C6	50, 63	50
26.00-30.99	32, 40	25, 32, 40	C4, C5, C6	50, 63	50
31.00-41.99	40	32, 40	C5, C6	50, 63	50
42.00-58.99	40, 50	40	C6	63	-

Standard inserts:

LCMX 02, D_{c1} = 12.70-17.43
LCMX 03. D_{c1} = 17.44-20.99
LCMX 04, D_{c1} = 21.00-25.99
WCMX 05, D_{c1} = 26.00-30.99
WCMX 06, D_{c1} = 31.00-41.99
WCMX 08, D_{c1} = 42.00-58.99



LCMX



WCMX

Options

No of extra inserts	**1 or 2**
D_{c1}	1 extra insert; Drill diameter—**12.7-57.00** mm
	2 extra inserts; Drill diameter—**12.7-55.10** mm
Drill alternative	Step/boring = **B1**. Chamfer = **C1**
κ_{r1}	Chamfer angle 1 = **15º-90º**
ch_1	Chamfer width 1 = **0.03-11.23** mm
l_{ch1}	Length chamfer lch1 = **12.3-171.0** mm
D_{c2}	Step/boring diameter **18.43-58.90** mm
l_{21}	Length to step/boring **12-171.0** mm
Drill alternative	Step/boring = **B2**. Chamfer = **C2**
κ_{r2}	Chamfer angle 2 = **15º-90º**
ch_2	Chamfer width 2 = **0.03-11.23** mm
l_{ch2}	Length chamfer lch2 = **12.3-171.0** mm
D_{c3}	Step/boring diameter **21.4-58.90** mm
l_{22}	Length to step/boring **12.8-171.0** mm
l_{3s}	Reach length **17.5-176.7** mm
Coupling	**Type**
Rotate Capto coupling 180°	**Yes or No**
dm_m/D_{5m}	**Coupling size**
Coupling unit	**M**=metric or **U**=inch
l_{1s}	Programming length **35.3-307.4** mm

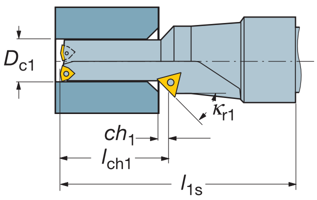
SANDVIK Coromant

Coromant U drill – step and chamfer drill

Tailor Made

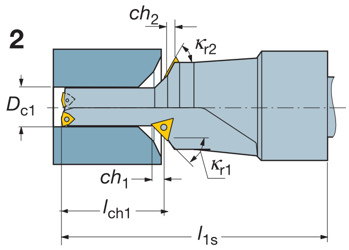
Type TM 416.20

1



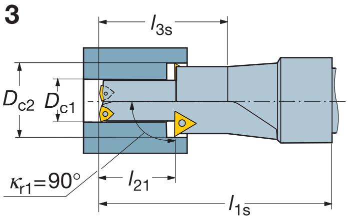
$l_{ch1} = 2.3 \times D_{c1}$

2



$l_{ch1} = 2.3 \times D_{c1}$

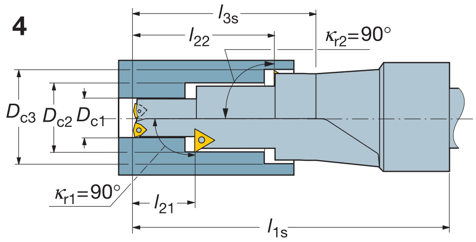
3



$l_{21} = 1.5 \times D_{c1}$

$l_{3s} = 1.5 \times D_{c2}$

4

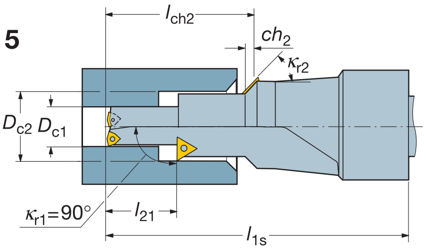


$l_{21} = 1.5 \times D_{c1}$

$l_{22} = 1.5 \times D_{c2}$

$l_{3s} = 1.5 \times D_{c3}$

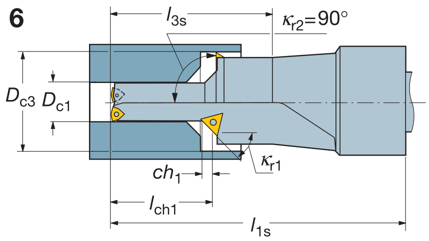
5



$l_{21} = 1.5 \times D_{c1}$

$l_{ch2} = 1.5 \times D_{c2}$

6

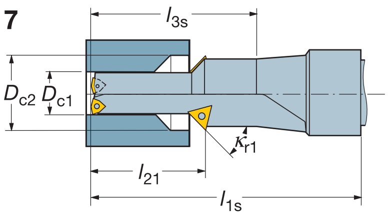


$l_{ch1} = 2.3 \times D_{c1}$

$l_{3s} = 1.5 \times D_{c3}$

Type S 416.20

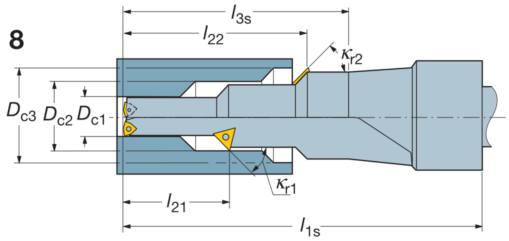
7



$l_{21} = 3.0 \times D_{c1}$

$l_{3s} = 3.0 \times D_{c2}$

8

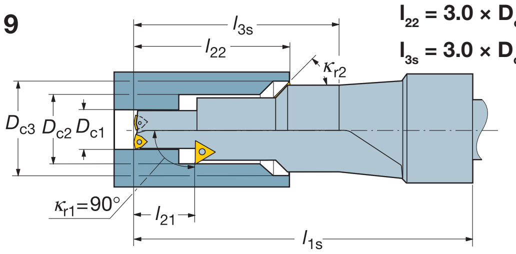


$l_{21} = 3.0 \times D_{c1}$

$l_{22} = 3.0 \times D_{c2}$

$l_{3s} = 3.0 \times D_{c3}$

9

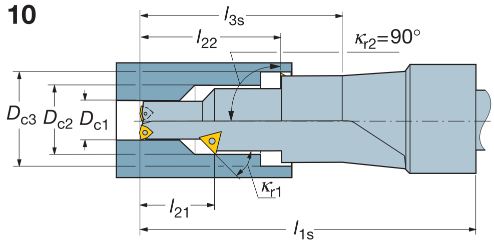


$l_{21} = 3.0 \times D_{c1}$

$l_{22} = 3.0 \times D_{c2}$

$l_{3s} = 3.0 \times D_{c3}$

10

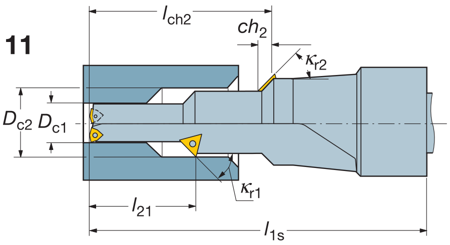


$l_{21} = 3.0 \times D_{c1}$

$l_{22} = 3.0 \times D_{c2}$

$l_{3s} = 3.0 \times D_{c3}$

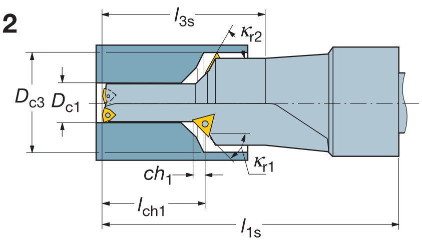
11



$l_{21} = 3.0 \times D_{c1}$

$l_{ch2} = 3.0 \times D_{c2}$

12



$l_{ch1} = 2.3 \times D_{c1}$

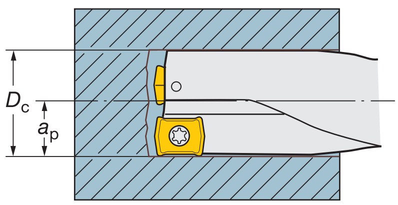
$l_{3s} = 3.0 \times D_{c3}$

Designations and formulas for drilling

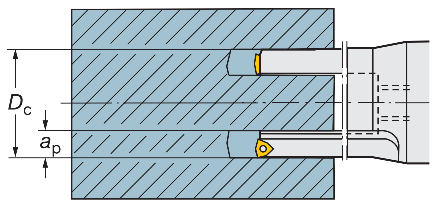
Designation acc. to ISO	Terminology	Unit
D_c	Drill diameter	mm
a_p	Cutting depth	mm
l_1	Programming length to outer corner	mm
l_{1s}	Programming length to chisel edge	mm
l_2	Total length	mm
l_3	Max. operating length to outer corner	mm
l_{3s}	Max. operating length to chisel edge	mm
l_4	Recommended max. operation length	mm
v_c	Cutting speed	m/min
n	Spindle speed	r/min
v_f	Feed speed	mm/min
f_n	Feed per rev.	mm/r
f_z	Feed per tooth	mm/z
k_c	Specific cutting force	N/mm^2
$k_{c\,0.4}$	Specific cutting force for fz = 0.4	N/mm^2
k_{cfz}	Specific cutting force for feed per edge	N/mm^2
F_f	Feed force	N
F_μ	Feed force caused by friction	N
M_c	Torque	Nm
M_μ	Torque caused by friction	Nm
P_c	Net power (cutting power)	kW
P_μ	Power caused by friction	kW
κ_r	Tool cutting edge angle	Degrees
λ_{sh}	Tool normal rake angle	Degrees
q	Cutting fluid quantity	l/min
p	Cutting fluid pressure	Mpa

Cutting depth, a_p

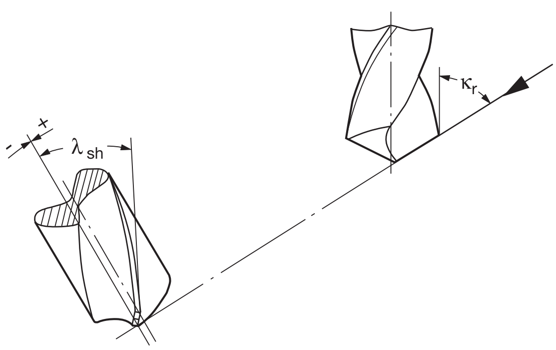
Solid drilling



Trepanning



Tool cutting edge angle, κ_r
Tool normal rake angle, λ_{sh}



Specific cutting force for feed per edge, k_{cfz}

$$k_{cfz} = k_{c\,0.4}\left(\frac{0.4}{f_z \times \sin\kappa_r}\right)^{0.29} (N/mm^2)$$

A
B
C
D
E
F
G
H

Formulas for Coromant 880, Coromant U, T-Max U, Coromant Delta and CoroDrill Delta-C

Cutting speed (m/min)	$v_c = \dfrac{\pi \times D_c \times n}{1000}$
Feed speed (mm/min)	$v_f = f_n \times n$
Feed force (N)[1]	$F_f = 0.5 \times \frac{D_c}{2} \times f_n \times k_{cfz} \times \sin\kappa_r$ (N)
Torque (Nm)[1]	$M_c = \dfrac{D_c \times f_n \times k_{cfz} \times a_p}{2000} \left(1 - \dfrac{a_p}{D_c}\right)$
Net power (kW)[1]	$P_c = \dfrac{D_c \times f_n \times k_{cfz} \times v_c}{240 \times 10^3}$

1) Feed force, torque and power at idling is not included in these formulas.

The power requirement is calculated on the basis of an unused tool, i.e. tool without wear. For a tool with normal wear, the power requirement is 10-30% higher, depending upon the size of the drill.

Specific cutting force k_c for f_z = 0.4 for different materials

CMC No.	**Material**		**HB**	**Specific cutting force, $k_{c\,0.4}$** [1] **N/mm²**
01.1 01.2 01.3	**Unalloyed steel**	C = 0.15% C = 0.35% C = 0.60%	125 150 200	1900 2100 2250
02.1 02.2 02.2 02.2	**Low alloy steel**	Non-hardened Hardened and tempered Hardened and tempered Hardened and tempered	180 275 300 350	2100 2600 2700 2850
03.1 03.2	**High alloy steel**	Annealed Hardened	200 325	2600 3900
05.11 05.21	**Stainless steel**	Martensitic/ferritic Austenitic	200 175	2300 2450
06.1 06.2 06.3	**Steel castings**	Unalloyed Low alloyed high alloyed	180 200 225	2000 2500 2700
04 06.33	**Hard steel**	Hardened steel Manganese steel 12%	55 HRC 250	4500 3600
07.1 07.2	**Malleable cast iron**	Ferritic Pearlitic	130 230	1100 1100
08.1 08.2	**Grey cast iron**	Low tensile strength High tensile strength	180 260	1100 1500
09.1 09.2	**Nodular cast iron**	Ferritic Pearlitic	160 250	1100 1800
10	**Chilled cast iron**		400	3000
20.11 20.12 20.21. 20.31 20.22. 20.32 20.24. 20.33	**Heat resistant alloys**	Fe-base, annealed Fe-base, aged Ni- or Co-base, annealed Ni- or Co-base, aged Ni- or Co-base, cast	200 280 250 350 320	3000 3050 3500 4150 4150
30.11 30.12	**Aluminium alloys**	Non heat treatable Heat treatable	60 100	500 800
30.21 30.22	**Aluminium alloys, cast**	Non heat treatable Heat treatable	75 90	750 900
33.1 33.2 33.3	**Copper and copper alloys**	Lead alloys, Pb > 1% Brass, red brass Bronze and leadfree copper including electrolytic copper	110 90 100	700 750 1750

1) The k_c 0.4-values are valid for: f_z = 0.4 mm/z, $\kappa_r = 90°$, $\lambda_{sh} = +6°$

A B C D E F G H

If problems should occur

– Indexable insert drills

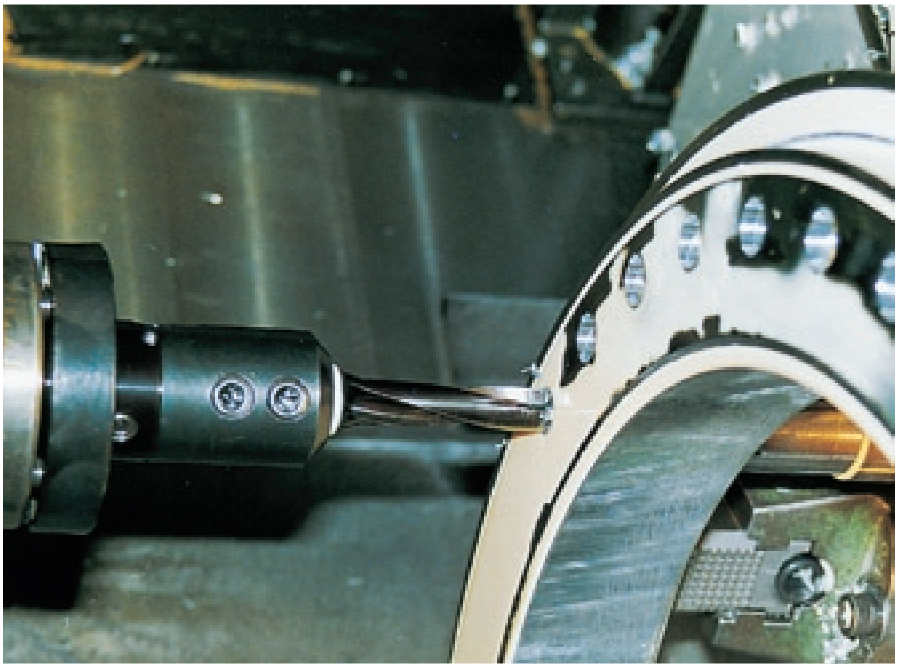
When cutting edges wear down prematurely giving **poor tool-life**, the cause is usually incorrect cutting data, wrong insert grades or even drill type or poor cutting fluid supply. Instability and poor cutting fluid supply also lead to poor tool-life. When cutting edges chip, the alignment of the drill should be checked for it should be within the recommended limits. Concentricity should be within +/-0.05 mm.

Lack of rigidity in the set-up, tool or machine often lead to chipping, necessitating a tougher cutting edge. If the insert is not seated or retained securely, chipping may occur. Insert seats and screws have to be well maintained in high performance drills with frequent changing of insert screws recommended. Another important factor is how securely the drill is held in the machine for stability during machining – **tool holding quality is important**.

If **over or under sized holes** are produced, the reason is often that the drill is off-centre. Other reasons can be that the machine spindle is out of true, the feed rate is too high or a lack of rigidity in the set-up. If the hole is not symmetrical, the source of the problem can often be traced back to a lack of stability through poor rigidity in set-up or machine. It is also possible that the cutting data is wrong for the material in question.

Unsatisfactory surface finish is usually the result of vibrations arising from poor rigidity in the machining set-up. The drill may be excessively long, held in a poor quality tool holder or tool position, the cutting data may be incorrect for the application or the initial penetration may be into poor surfaces. Cutting fluid supply may be insufficient or chip control not good enough, where chip evacuation is irregular.

The **limiting parameters of tool wear** in drilling are generally security or hole quality. Excessive wear and built up edge that distorts the cutting geometry excessively are hazards that affect how reliably a drill will make the required number of holes.

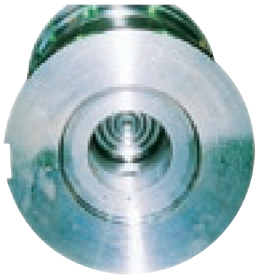


Good tool holding is vital.

Off-centre drill usually produces incorrect hole sizes.

SANDVIK Coromant

Practical tips for drilling – if problems occur



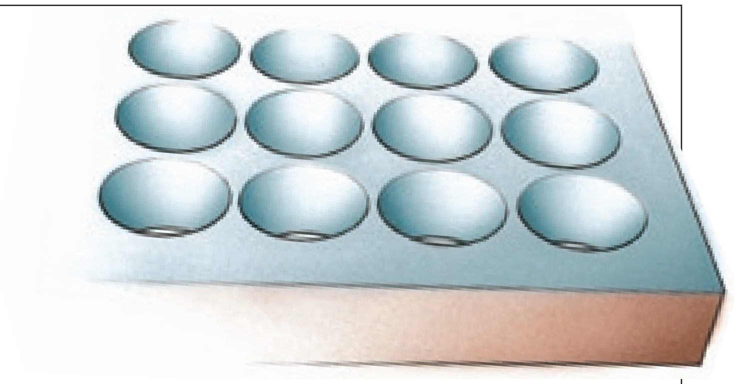
(1)
Problems
Front face of drill broken
Wear on outside diameter of drill
Oversized or undersized hole
Chip-jamming in drill flutes
Vibrations
Cutting edge frittering
Unsymmetrical hole
Poor tool-life

(2)
Possible remedies
Re-align the drill
Increase coolant flow, clean filter, clear drill coolant holes
Select a tougher grade
Improve stability, improve component fixuring, shorten drill overhang
Check bottom of hole or disk for possible centre stub (only Coromant U)
Check cutting speed and feed against recommendations
Check insert/drill grade against recommendations
Increase cutting speed

Remedies and solutions

Problems	Re-align the drill	Increase coolant flow, clean the filter, clear coolant holes in drill	Select a tougher grade	Reduce the feed	Improve the stability, reclamp component, shorten drill overhang	Check bottom of hole or disk for centre stub (only Coromant U-drill)	Check Speed/ feed guidelines	Check the carbide grade	Increase the speed
Front face of drill broken	●		●		●		●		
Wear on outside diameter of drill	●				●		●	●	
Oversize/undersize hole	●		●	●		●	●		
Chip jamming in the drill flutes		●		●	●		●		●
Vibrations				●	●		●		
Small cutting edge fracture (frittering)	●		●			●		●	●
Hole not symmetrical				●	●		●		
Poor tool life		●			●		●	●	

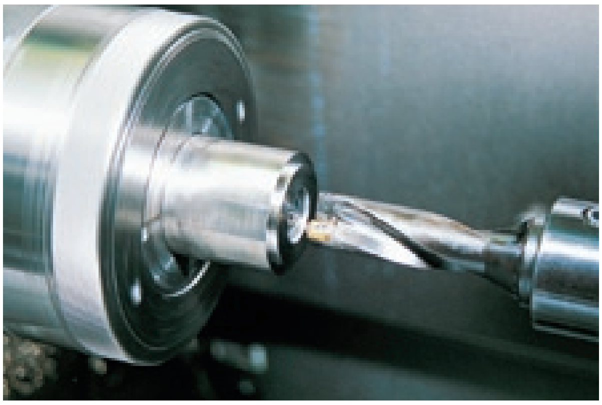
Basic hints for successful drilling

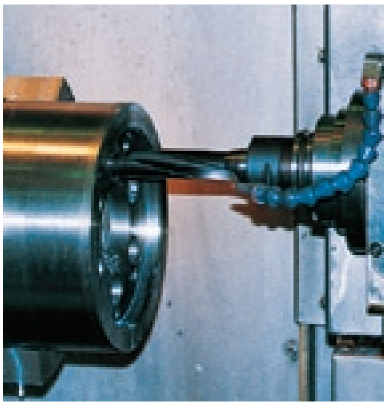


- check machine alignment, stability, quality of tool holding and fixturing
- check the power, feed force and torque available at machine spindle
- check coolant pressure and flow rates available
- select the right tool for the operation, apply correctly and optimize
- optimize as regards combination of high cutting speed and feed rate for good chip evacuation
- maintain tools regularly - change the insert-clamping screw on a regular basis

Additional measures for optimizing drilling

- check on the suitability of the drill for the operation - choose the best option available
- establish a reliable, predetermined tool-life program
- use minimum diameter drill and follow recommended insert overlapping
- establish correct feed rates for drilling irregular, rounded and angular surfaces and cross holes
- be aware of the versatility of indexable insert drills for a variety of operations from efficiently drilling a hole to precision hole machining





A
B
C
D
E
F
G
H

SANDVIK Coromant

Uncoated Cemented Carbide – HW

(H13A, P20, K20)

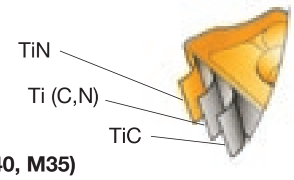
H13A - (N15, S20, K25)
H13A is a fairly fine grained grade with a very good balance between wear resistance and toughness making it a very versatile grade suitable for many materials and applications. Used for milling of heat resistant alloys at moderate cutting speed and feed, milling of aluminum alloys and finishing to medium machining of cast iron. Very suitable for nodular cast iron.

P20 - (P20)
A cemented carbide containing titanium based carbides adding wear resistance and hot hardness. The carbide is PVD coated, with a 3 micron TiN layer. Used for Coromant Delta drills in general steel applications.

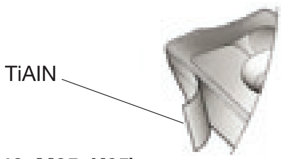
K20 - (M30, K20, N15, H20)
A carbide grade with a balanced combination of wear resistance and toughness making it a very versatile grade suitable for many materials and applications. The carbide is PVD coated, with a 3 micron TiN layer. Used for Coromant Delta drills in stainless steel, cast iron, aluminum and heat resistant materials.

Coated Cemented Carbide – HC

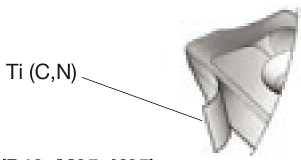
(GC235, GC1020, GC1025, GC1044, GC1120, GC1210, GC1220, GC3040, GC4014, GC4024, GC4044, N20D)



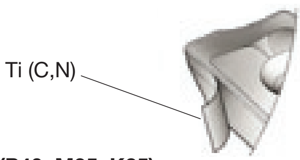
GC235 - (P40, M35)
GC235 has a very tough carbide substrate, which provides extremely good edge security in toughness demanding operations. The carbide is coated with a 2.5 micron CVD coating of TiC- TiCN-TiN for added wear resistance and lower friction.
GC235 is used as a complementary grade for unstable conditions and low to moderate cutting speeds.



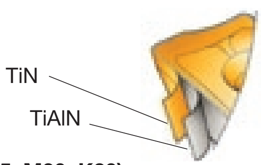
GC1044 - (P40, M35, K25)
Fine grained cemented carbide with an excellent combination of both hardness and toughness. The fine grains contribute to keeping the cutting edge sharp throughout the entire tool life. The carbide is PVD coated with a 3 micron bronze colored TiAlN layer giving excellent edge toughness and resistance against built-up edge. The basic choice for central drilling inserts in all materials.



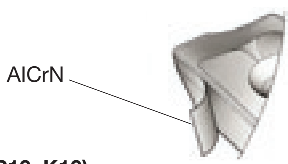
GC1020 - (P40, M35, K25)
Fine grained cemented carbide with an excellent combination of both hardness and toughness. The fine grains contribute to keeping the cutting edge sharp throughout the entire tool life. The carbide is PVD coated with 3 microns of TiCN for improved wear resistance. Versatile grade suitable both as central and peripheral insert in a variety of materials at low to moderate cutting speeds.



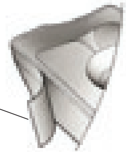
GC1120 - (P40, M35, K25)
Fine grained cemented carbide with a good balance between hardness and toughness. The carbide is PVD coated with a 3 micron layer of TiCN for added wear resistance. A basic grade for peripheral inserts at low to moderate cutting speeds in steel, austenitic stainless steel and cast iron.



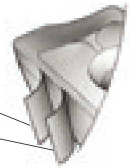
GC1025 - (P35, M30, K20)
Fine grained cemented carbide with an excellent combination of both hardness and toughness. The fine grains contribute to keeping the cutting edge sharp throughout the entire tool life. The carbide is PVD coated with 4 microns of TiAlN for improved wear resistance and resistant against built-up edge in smearing materials.
A universal grade with excellent resistance and toughness at low to moderate cutting speeds in most materials.



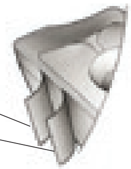
GC1210 - (P10, K10)
Hard and very wear resistant carbide substrate containing titanium based carbides, which adds a very good hot hardness. The carbide is coated with AlCrN giving excellent wear resistance and even better resistance against high cutting temperatures. Ideal grade in Coromant Delta C for drilling at medium to high speed in both cast iron and steel.



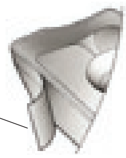
GC1220 - (P20, M20, K20, N20, H20)
Fine grained cemented carbide with an excellent combination of both hardness and toughness. The carbide is PVD coated with 3 microns of nano multilayers of TiAlN coating giving very good edge line security. First choice grade for steel, stainless steels and cast iron in Coromant Delta C.



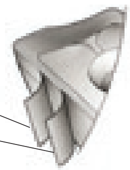
GC4024 - (P20, M20, K20)
GC4024 has a cemented carbide substrate with a good balance between hardness and toughness. The substrate is coated with a MT-CVD layer of TiCN giving excellent abrasive wear resistance, followed by a layer of Al_2O_3 giving very good high temperature protection. The total thickness is about 9 microns. A very universal grade for peripheral inserts in steel, stainless steel and cast iron at medium to high cutting speed.



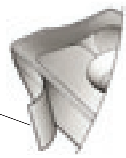
GC3040 - (P20, M20, K20, H15)
A cemented carbide with a high hardness and toughness. A MT-CVD layer of TiCN giving excellent abrasive wear resistance, followed by a layer of Al_2O_3 giving very good high temperature protection. The total thickness is about 9 microns. The grade is first choice for peripheral drilling inserts in most materials. Work very well at both medium and high cutting speed.



GC4044 - (P40, M35, K25)
Fine grained cemented carbide with an excellent toughness. The carbide is PVD coated with a 3 micron black colored TiAlN layer for improved wear resistance and resistance against built-up edge. The tough choice for peripheral drilling inserts in all materials.

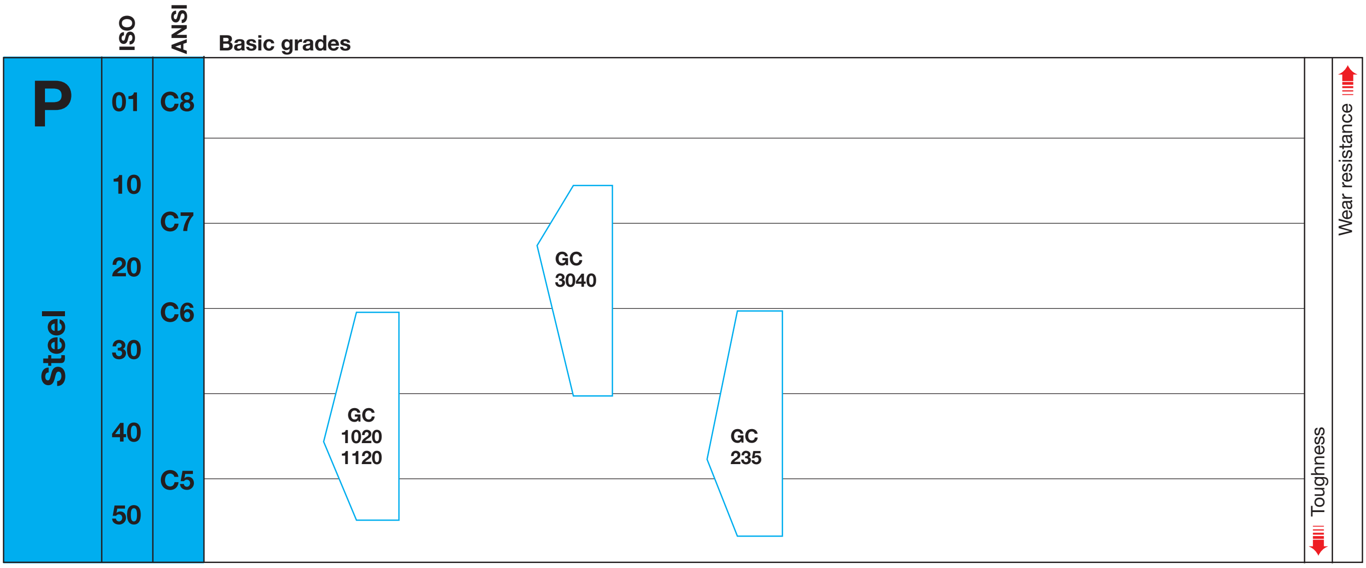


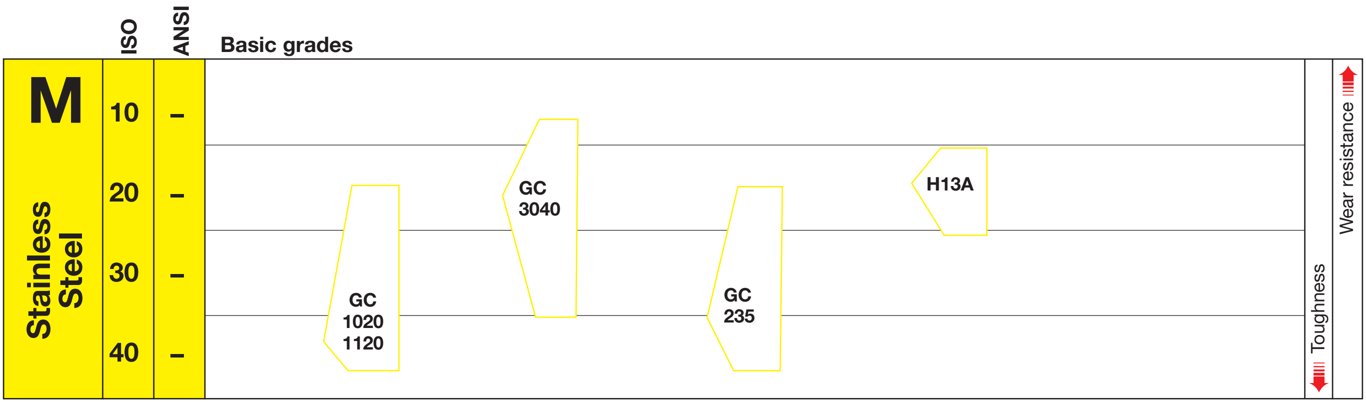
GC4014 - (P15, K15)
A hard carbide substrate with a thin cobalt enriched gradient zone just underneath the coating. This enables the grade to withstand high cutting temperatures with maintained edge line security. On top of this is a MT-CVD layer of TiCN giving excellent abrasive wear resistance, followed by a layer of Al_2O_3 giving very good high temperature protection permitting high metal removal rates. The ideal grade for peripheral insert in finishing to light roughing of steel, steel castings and cast iron at low to medium feed rates at high cutting speed.

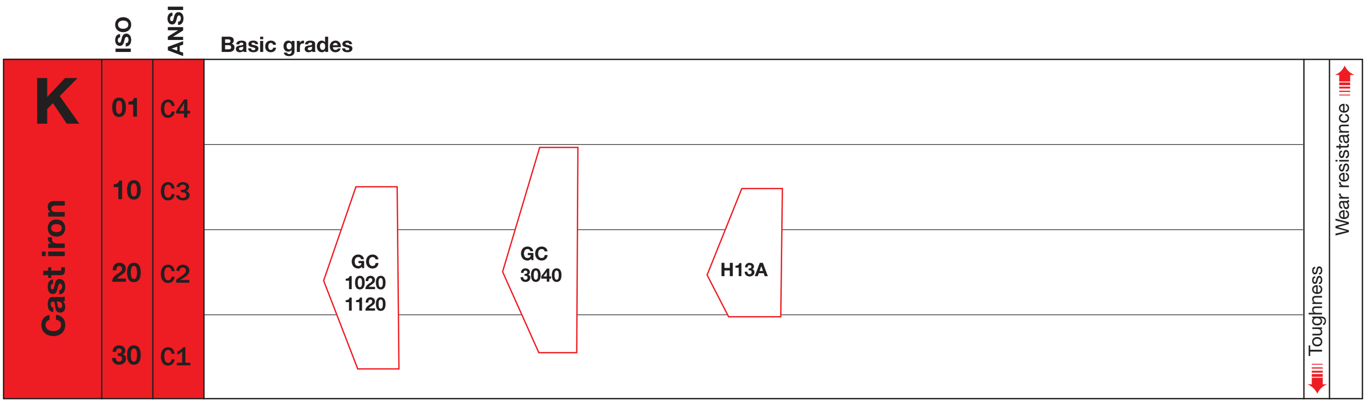


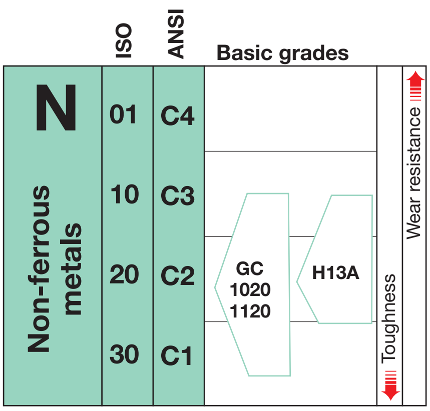
N20D - (N20)
A fine grained cemented carbide with an excellent combination of both hardness and toughness. The fine grains contribute to keeping the cutting edge sharp throughout the entire tool life. The carbide is PVD coated with smooth TiAlN adding wear resistance and lowering adherence to work material on the cutting edge.
First choice for Aluminum with a Silicon content up to 12%.

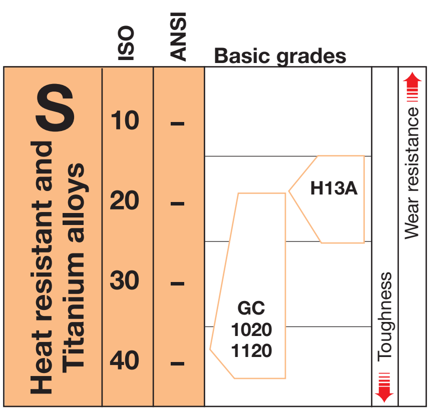
Grades for Coromant U drills

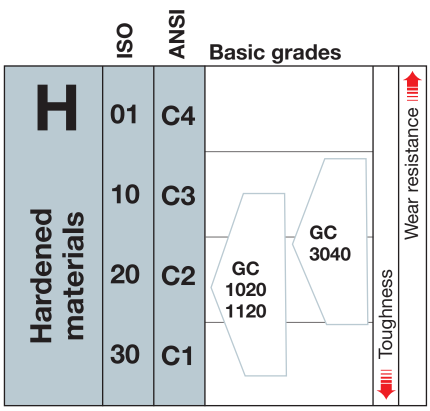












SANDVIK
Coromant