VAN CUTSEM tools
Quality tools for metalworking

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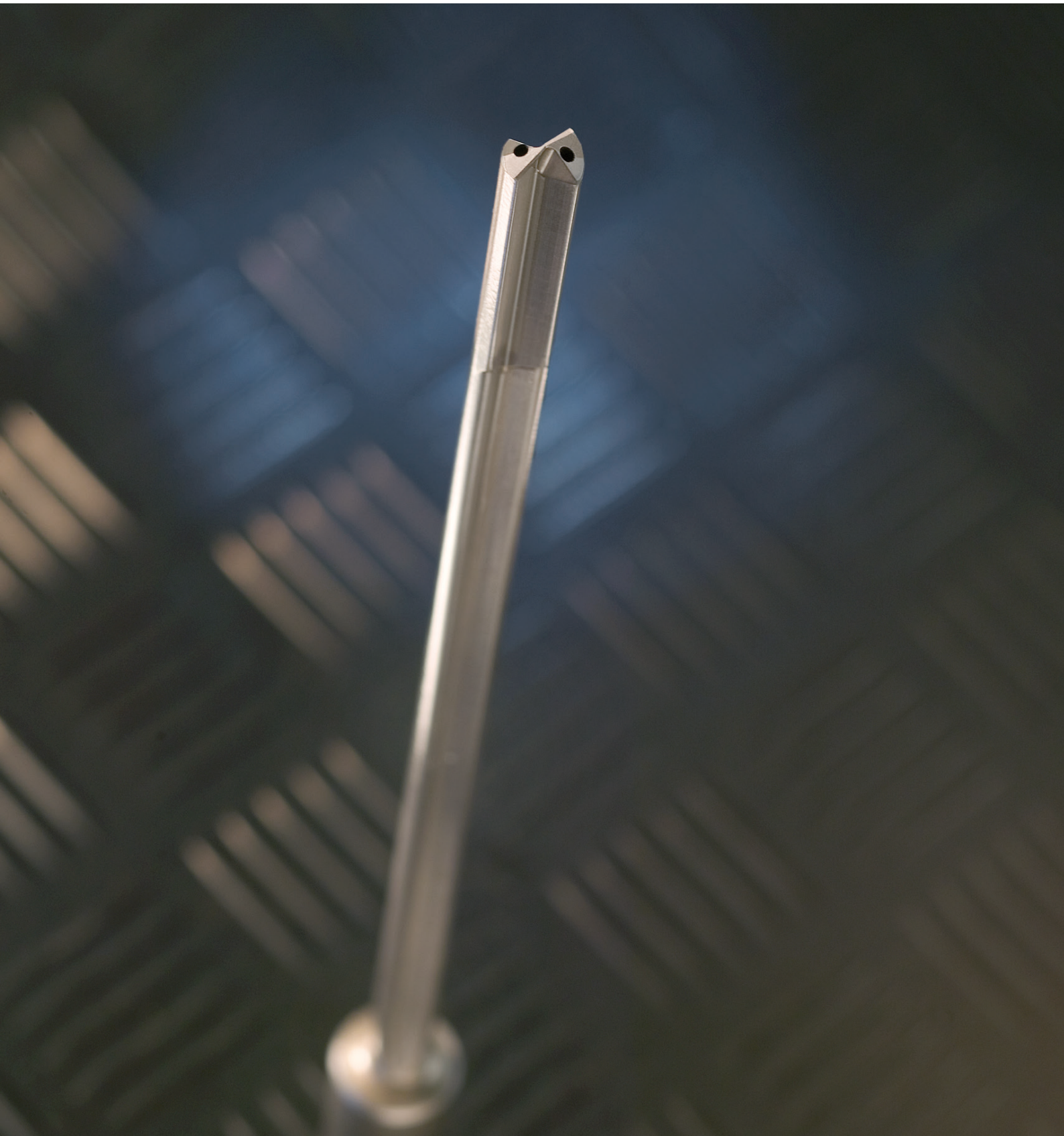
Gun Drilling



Gun drills

Wide range of application possibilities

Highly productive gun drills

Easy to use
- No pre-setting
- No need for tool room service

Solid carbide gun drills 428.5
- Diameter range: 0.8 - 12.00 mm (.031 - .472 inch)
- Hole depth: 300 mm (11.811 inch)
- Hole tolerance: IT8
- Surface finish: 0.1 - 3.0 µm
- Filter resolution: 5 - 10 µm
- Viscosity: Ø 0.8 - 2.0 mm = 7 - 10 mm² /S
  Ø 2.0 - 12 mm = 10 - 20 mm² /S
- Cooling lubricant (coolant) required

Single-lip 428.9
- Diameter range: 1.90 - 40.50 mm (.075 - 1.594 inch)
- Hole depth: ≤ 100 x diameter
- Hole tolerance: IT9
- Surface finish: 0.1-3.0 µm
- Filter resolution: 10 - 20 µm
- Viscosity: Ø 1.9 - 40.50 mm = 10 - 20 mm² /S
- Cooling lubricant (coolant) required

Twin-lip 428.2
- Diameter range: 6.00 - 26.50 mm (.236 - 1.043 inch)
- Hole depth:≤ 100 x diameter
- Hole tolerance: IT10
- Surface finish: 1.0 - 4.0 µm
- Filter resolution: 10 - 20 µm
- Viscosity: Ø 6.00 - 26.50 mm = 10 - 20 mm² /S
- Cooling lubricant (coolant) required
- Suitable for short chipping materials
- The feed rate can be increased compared to single-lip

High feed gun drills 428.7
- Diameter range: 3.00 - 12.00 mm (.118 - .472 inch)
- Hole depth: 300 mm
- Hole tolerance: IT8
- Surface finish: 0.1-3.0 µm
- Filter resolution: 10 - 20 µm
- Viscosity: Ø 3.00 - 12.00 mm = 10 - 20 mm² /S
- Cooling lubricant (coolant) required

Wide application area
- Optimized grade- and geometry combinations for most workpiece materials
- When ordering state workpiece material to be drilled

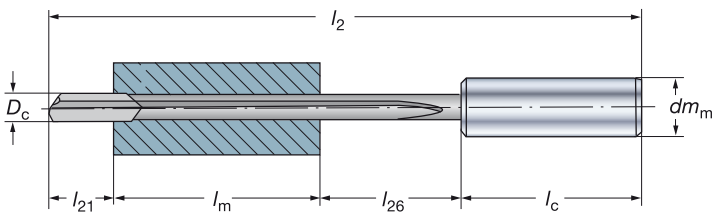
Customer specified diameter
- Finish ground within 0.01 mm (.0004 inch) increments

ISO application area:

P M K N S

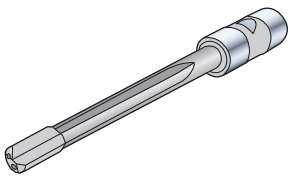
Gun Drills

Solid carbide heads code: **428.9 and 428.2**



l_2 = Overall length with or without driver
D_c = Drill diameter
l_{21} = Addition for regrinding
l_m = Depth of hole
l_{26} = Minimum chip evacuation distance
l_c = Length of drive
dm = Driver diameter

Single-lip
428.9



Drill diameter, mm (inch): 1.90-40.50 (.075-1.594)

Hole depth: ≤ 100 x diameter

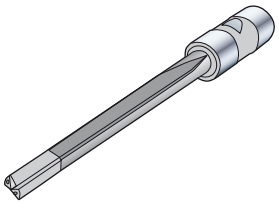
Hole tolerance: IT9

Surface finish R_a, µm: 0.1-3.0

Cutting fluid: Neat oil

Tolerance: D_c = h5
dm_m = d9

Twin-lip
428.2



Drill diameter, mm (inch): 6.00-26.50 (.236-1.043)

Hole depth: ≤ 100 x diameter (Note! $l_{2\,max}$ = 1250 mm)

Hole tolerance: IT10

Surface finish R_a, µm: 1.0-4.0

Cutting fluid: Neat oil

Tolerance: D_c = h5
dm_m = d9

Diameter range		Ordering code	Dimensions, millimeter, inch (mm, in.)			
		P M K N S	l_{21}	l_{21}	l_{26}	l_{26}
D_c mm	D_c inch		mm	in.	mm	in.
1.90-2.60	.075-.102	xxxxx-AAAA-BBB	10	.394	25	.984
2.61-3.35	.103-.132	xxxxx-AAAA-BBB	13	.512	25	.984
3.36-4.05	.133-.159	xxxxx-AAAA-BBB	13	.512	30	1.181
4.06-5.15	.160-.202	xxxxx-AAAA-BBB	19	.748	30	1.181
5.16-7.05	.203-.277	xxxxx-AAAA-BBB	23	.906	30	1.181
7.06-8.55	.278-.336	xxxxx-AAAA-BBB	25	.984	40	1.575
8.56-13.05	.337-.513	xxxxx-AAAA-BBB	25	.984	50	1.969
13.06-18.05	.514-.710	xxxxx-AAAA-BBB	25	.984	55	2.165
18.06-23.00	.711-.905	xxxxx-AAAA-BBB	30	1.181	65	2.559
23.01-26.50	.906-1.043	xxxxx-AAAA-BBB	35	1.378	65	2.559
26.51-32.00	1.044-1.259	xxxxx-AAAA-BBB	40	1.575	80	3.150
32.01-40.50	1.260-1.594	xxxxx-AAAA-BBB	45	1.772	90	3.543

Diameter range		Ordering code Suitable only for short chipping materials	Dimensions, millimeter, inch (mm, in.)			
		P K N	l_{21}	l_{21}	l_{26}	l_{26}
D_c mm	D_c inch		mm	in.	mm	in.
6.00-8.55	.236-.336	xxxxx-AAAA-BBB	25	.984	40	1.575
8.56-13.05	.337-.513	xxxxx-AAAA-BBB	25	.984	50	1.969
13.06-18.05	.514-.710	xxxxx-AAAA-BBB	25	.984	55	2.165
18.06-23.00	.711-.905	xxxxx-AAAA-BBB	30	1.181	65	2.559
23.01-26.50	.906-1.043	xxxxx-AAAA-BBB	35	1.378	65	2.559

When ordering gun drills the following must be stated:
- Drill diameter, xxxxx in the ordering code.
- Overall length l_2 , AAAA in the ordering code.
- If required, driver No., BBB in the ordering code.
- Material to be drilled.

Ordering example for gun drill head D_c 1,90 mm (.075 inch), length 250 mm (9.842 inch) with driver No 002 for drilling stainless steel:

2 pieces 428.9-01900-0250-002 solid carbide head for stainless steel.

For further information, please contact your local sales representative.

SAFETY INFORMATION
Precautions should always be taken when grinding and brazing cemented carbide, see page 19.

Cutting data for gun drills code: **428.9 and 428.2**

Metric version

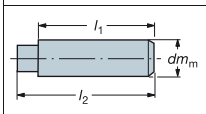
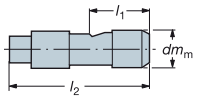
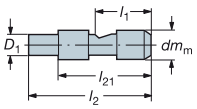
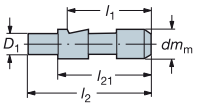
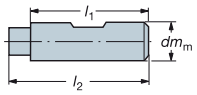
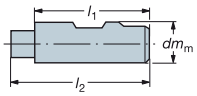
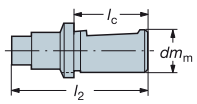
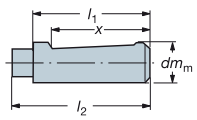
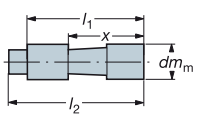
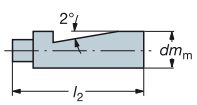
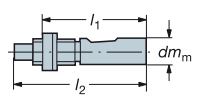
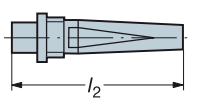
ISO	MC No. (CMC No.)	Material	Specific cutting force k_{c1} N/mm²	Hardness Brinell HB	Cutting speed Grade K15 v_c m/min	Drill diameter, mm 1.90-3.00 Feed f_n mm/r	3.00-6.30	6.00-12.50	12.50-40.50
P		**Unalloyed**							
	P1.1.Z.AN (01.1)	Non-hardened 0.10-0.25% C	1500	90-200	60-120	0.003-0.010	0.005-0.030	0.015-0.055	0.020-0.110
	P1.2.Z.AN (01.2)	Non-hardened 0.25-0.55% C	1600	125-225	50-120	0.003-0.010	0.005-0.030	0.015-0.055	0.020-0.110
	P1.3.Z.AN (01.3)	Non-hardened 0.55-0.80% C	1700	150-250	40-100	0.003-0.010	0.004-0.025	0.010-0.050	0.020-0.100
		Low alloy steel							
	P2.1.Z.AN (02.1)	Non-hardened	1700	150-260	40-120	0.003-0.010	0.004-0.030	0.010-0.055	0.020-0.110
	P2.5.Z.HT (02.2)	Hardened and tempered	1900	220-450	40-120	0.003-0.010	0.004-0.025	0.010-0.050	0.020-0.100
		High alloy steel							
	P3.0.Z.AN (03.11)	Annealed	1950	150-250	40-100	0.003-0.010	0.004-0.025	0.010-0.050	0.020-0.100
	P3.0.Z.HT (03.21)	Hardened tool steel	2900	250-350	50-100	0.003-0.010	0.005-0.025	0.015-0.050	0.030-0.100
		Castings							
	P1.5.C.UT (06.1)	Unalloyed	1400	90-225	50-120	0.003-0.010	0.005-0.030	0.015-0.055	0.020-0.110
	P2.6.C.UT (06.2)	Low alloyed (alloying elements < 5%)	1600	150-250	40-100	0.003-0.010	0.004-0.025	0.010-0.050	0.020-0.100
M		**Rolled/forged**							
	P5.0.Z.AN (5.11)	Ferritic/Martensitic, non hardened	1800	150-270	40-90	0.003-0.008	0.004-0.025	0.010-0.040	0.020-0.100
	M1.0.Z.AQ (05.21)	Austenitic	1950	150-275	40-90	0.003-0.008	0.004-0.025	0.010-0.040	0.020-0.100
K		**Malleable**							
	K1.1.C.NS (07.1)	Ferritic	790	110-145	70-90	0.005-0.010	0.008-0.030	0.020-0.070	0.050-0.190
	K1.1.C.NS (07.2)	Pearlitic	900	150-270	60-90	0.004-0.010	0.005-0.030	0.010-0.070	0.030-0.190
		Grey							
	K2.1.C.UT (08.1)	Low tensile strength	890	150-220	60-90	0.004-0.010	0.008-0.030	0.010-0.070	0.030-0.190
	K2.2.C.UT (08.2)	High tensile strength	1100	200-330	15-90	0.003-0.010	0.003-0.030	0.005-0.070	0.010-0.190
		Nodular							
	K3.1.C.UT (09.1)	Ferritic	900	125-230	70-90	0.005-0.010	0.008-0.030	0.020-0.070	0.050-0.190
	K3.3.C.UT (09.2)	Pearlitic	1350	200-300	60-90	0.004-0.010	0.005-0.030	0.010-0.070	0.030-0.190
N		**Aluminium alloys**							
	N1.3.C.UT (30.21)	Cast, non aging	600	40-100	65-300	0.005-0.015	0.005-0.040	0.020-0.070	0.030-0.150
		Copper and copper alloys							
	N3.3.U.UT (33.1)	Free cutting alloys (Pb > 1%)	550	70-160	65-300	0.005-0.015	0.005-0.040	0.020-0.070	0.030-0.150
	N3.2.C.UT (33.2)	Brass and leaded bronzes (Pb ≤ 1%)	550	50-200	65-300	0.005-0.015	0.005-0.040	0.020-0.070	0.030-0.150
S		**Iron base**							
	20.11	Annealed or solution treated	2400	180-230	10-40	0.003-0.008	0.004-0.025	0.010-0.040	0.020-0.100
		Nickel base							
	S2.0.Z.AN (20.21)	Annealed or solution treated	2650	140-300	10-40	0.003-0.008	0.004-0.025	0.010-0.040	0.020-0.100
		Cobalt base							
	20.31	Annealed or solution treated	2700	180-230	10-40	0.003-0.008	0.004-0.025	0.010-0.040	0.020-0.100
		Titanium							
	S4.2.Z.AN (23.21)	Alfa- , near Alfa- and Alfa + Beta alloys annealed	1400	600-1100	20-50	0.003-0.008	0.004-0.025	0.010-0.040	0.020-0.100

Cutting data for gun drills code: **428.9 and 428.2**

Inch version

ISO	MC No. (CMC No.)	Material	Specific cutting force k_{c1} lbs/in²	Hardness Brinell HB	Cutting speed v_c ft/min	Drill diameter, inch .031-.118 Feed f_n inch/rev	.118-.248	.236-.492	.492-1.594
P		**Unalloyed**							
	P1.1.Z.AN (01.1)	Non-hardened 0.10-0.25% C	216,500	90-200	195-395	.0001-.0004	.0002-.0012	.0006-.0022	.0008-.0043
	P1.2.Z.AN (01.2)	Non-hardened 0.25-0.55% C	233,000	125-225	165-395	.0001-.0004	.0002-.0012	.0006-.0022	.0008-.0043
	P1.3.Z.AN (01.3)	Non-hardened 0.55-0.80% C	247,000	150-250	130-330	.0001-.0004	.0002-.0010	.0004-.0020	.0008-.0039
		Low alloy steel							
	P2.1.Z.AN (02.1)	Non-hardened	246,500	150-260	130-395	.0001-.0004	.0002-.0012	.0004-.0022	.0008-.0043
	P2.5.Z.HT (02.2)	Hardened and tempered	278,500	220-450	130-395	.0001-.0004	.0002-.0010	.0004-.0020	.0008-.0039
		High alloy steel							
	P3.0.Z.AN (03.11)	Annealed	282,000	150-250	130-330	.0001-.0004	.0002-.0010	.0004-.0020	.0008-.0039
	P3.0.Z.HT (03.21)	Hardened tool steel	420,000	250-350	165-330	.0001-.0004	.0002-.0010	.0006-.0020	.0012-.0039
		Castings							
	P1.5.C.UT (06.1)	Unalloyed	204,000	90-225	165-395	.0001-.0004	.0002-.0012	.0006-.0022	.0008-.0043
	P2.6.C.UT (06.2)	Low alloyed (alloying elements < 5%)	230,500	150-250	130-330	.0001-.0004	.0002-.0010	.0004-.0020	.0008-.0039
M		**Rolled/forged**							
	P5.0.Z.AN (05.11)	Ferritic/Martensitic, non hardened	262,000	150-270	130-295	.0001-.0003	.0002-.0010	.0004-.0016	.0008-.0039
	M1.0.Z.AQ (05.21)	Austenitic	285,000	150-275	130-295	.0001-.0003	.0002-.0010	.0004-.0016	.0008-.0039
K		**Malleable**							
	K1.1.C.NS (07.1)	Ferritic	115,000	110-145	230-295	.0002-.0004	.0003-.0012	.0008-.0028	.0020-.0075
	K1.1.C.NS (07.2)	Pearlitic	131,000	150-270	195-295	.0002-.0004	.0002-.0012	.0004-.0028	.0012-.0075
		Grey							
	K2.1.C.UT (08.1)	Low tensile strength	130,000	150-220	195-295	.0002-.0004	.0003-.0012	.0004-.0028	.0012-.0075
	K2.2.C.UT (08.2)	High tensile strength	159,500	200-330	50-295	.0001-.0004	.0001-.0012	.0002-.0028	.0004-.0075
		Nodular							
	K3.1.C.UT (09.1)	Ferritic	130,000	125-230	230-295	.0002-.0004	.0003-.0012	.0008-.0028	.0020-.0075
	K3.3.C.UT (09.2)	Pearlitic	194,500	200-300	195-295	.0002-.0004	.0002-.0012	.0004-.0028	.0012-.0075
N		**Aluminium alloys**							
	N1.3.C.UT (30.21)	Cast, non aging	87,000	40-100	65-300	.0002-.0006	.0002-.0016	.0008-.0028	.0012-.0059
		Copper and copper alloys							
	N3.3.U.UT (33.1)	Free cutting alloys (Pb > 1%)	79,500	70-160	65-300	.0002-.0006	.0002-.0016	.0008-.0028	.0012-.0059
	N3.2.C.UT (33.2)	Brass and leaded bronzes (Pb ≤ 1%)	80,000	50-200	65-300	.0002-.0006	.0002-.0016	.0008-.0028	.0012-.0059
S		**Iron base**							
	20.11	Annealed or solution treated	348,000	180-230	35-130	.0001-.0003	.0002-.0010	.0004-.0016	.0008-.0039
		Nickel base							
	S2.0.Z.AN (20.21)	Annealed or solution treated	383,000	140-300	35-130	.0001-.0003	.0002-.0010	.0004-.0016	.0008-.0039
		Cobalt base							
	20.31	Annealed or solution treated	391,500	180-230	35-130	.0001-.0003	.0002-.0010	.0004-.0016	.0008-.0039
		Titanium							
	S4.2.Z.AN (23.21)	Alfa- , near Alfa- and Alfa + Beta alloys annealed	203,000	600-1100	65-165	.0001-.0003	.0002-.0010	.0004-.0016	.0008-.0039

Drivers for gun drills CoroDrill® 428.9 and 428.2

	Diameter range		Driver[3]	Dimensions, millimeter, inch (mm, inch)												
	D_c mm	D_c inch	No.	dm_m mm	dm_m in.	D_1 mm	D_1 in.	l_1 mm	l_1 in.	l_2 mm	l_2 in.	l_{21} mm	l_{21} in.	l_c mm	l_c in.	Shank type
	1.90-4.50	.075-.177	**006**	6	.236	-		-		36	1.417	-		-		
	1.90-7.30	.075-.287	**010**	10	.394	-		-		40	1.575	-		-		
	1.90-12.40	.075-.488	**016**	16	.630	-		-		48	1.890	-		-		
	1.90-15.90	.075-.626	**020**	20	.787	-		-		50	1.969	-		-		
	6.00-19.50	.236-.768	**025**	25	.984	-		-		56	2.205	-		-		
	1.90-20.50	.075-.807	**002**	16	.630	-		31	1.220	45	1.772	-		-		-
	1.90-29.60	.075-1.165	**003**	20	.787	-		34	1.339	70	2.756	-		-		-
	10.00-48.99	.394-1.929	**005**	32	1.260	-		34	1.339	70	2.756	-		-		-
	4.00-20.50	.157-.807	**035**	19.05	.750	-		34	1.339	70	2.756	-		-		-
	6.00-49.00	.236-1.929	**036**	25.40	1.000	-		34	1.339	70	2.756	-		-		-
	1.90-7.30	.075-.287	**601**	10	.394	-		24	.945	40	1.575	-		-		-
	7.30-19.60	.236-.772	**801**	25	.984	-		33.30	1.311	70	2.756	-		-		-
	6.55-12.50	.258-.492	**602**	10	.394	8.20	.323	24	.945	-		40	1.575	-		-
	19.60-49.00	.772-1.929	**802**[1]	25	.984	20.30	.799	33.30	1.311	-		70	2.756	-		-
	1.95-12.60	.077-.496	**701**	16	.630	-		47	1.850	-		50	1.969	-		-
	12.60-20.50	.496-.807	**702**	16	.630	13.5		47	1.850	-		50	1.969	-		-
	1.95-12.59	.077-.495	**903**	10	.394	-		-		40	1.575	-		-		Weldon
	1.95-12.59	.077-.495	**904**	12	.472	-		-		45	1.772	-		-		
	1.95-16.59	.077-.667	**905**	16	.630	-		-		48	1.890	-		-		
	1.95-20.50	.077-.807	**906**	20	.787	-		-		50	1.969	-		-		
	6.00-49.00	.236-1.929	**907**	25	.984	-		-		56	2.205	-		-		Weldon
	9.70-49.00	.382-1.929	**908**	32	1.260	-		-		60	2.362	-		-		
	9.70-49.00	.382-1.929	**909**	40	1.575	-		-		70	2.756	-		-		
	1.95-16.59	.077-.667	**405**	16	.630	-		-		-		-		40	1.575	Coromant
	1.95-20.50	.077-.807	**406**	20	.787	-		-		-		-		40	1.575	Whistle Notch
	6.00-26.60	.236-1.047	**407**	25	.984	-		-		-		-		45	1.772	
	9.70-34.50	.382-1.358	**408**	32	1.260	-		-		-		-		45	1.772	
	9.70-42.70	.382-1.681	**409**	40	1.575	-		-		-		-		55	2.165	
	1.95-9.00	.077-.354	**603**	10	.394	-		-		40	1.575	-		-		Whistle Notch
	1.95-12.59	.077-.495	**604**	12	.472	-		-		45	1.772	-		-		
	1.95-16.59	.077-.667	**605**	16	.630	-		-		48	1.890	-		-		
	1.95-20.50	.077-.807	**606**	20	.787	-		-		50	1.969	-		-		
	6.00-49.00	.236-1.929	**607**	25	.984	-		-		56	2.205	-		-		
	9.70-49.00	.382-1.929	**608**	32	1.260	-		-		60	2.362	-		-		
	1.95-9.80	.077-.386	**101**	12.70	.500	-		-		38.10	1.500	-		-		-
	1.95-12.00	.077-.472	**102**	16	.630	-		-		70	2.756	-		-		-
	3.96-15.20	.156-.598	**103**	19.05	.750	-		-		70	2.756	-		-		-
	3.96-29.60	.156-1.165	**104**	20	.787	-		-		70	2.756	-		-		-
	3.96-20.50	.156-.807	**204**	19.05	.750	-		-		70	2.756	-		-		-
	6.00-49.00	.024-1.929	**205**	25.40	1.000	-		-		70	2.756	-		-		-
	6.00-49.00	.024-1.929	**206**	28	1.102	-		-		70	2.756	-		-		-
	9.70-49.00	.382-1.929	**207**	31.75	1.250	-		-		70	2.756	-		-		-
	9.70-49.00	.382-1.929	**208**	36	1.417	-		-		70	2.756	-		-		-
	9.70-49.00	.382-1.929	**209**	38.10	1.500	-		-		70	2.756	-		-		-
	1.90-12.00	.075-.472	**301**[2]	16	.630	-		112	4.409	-		-		-		-
	1.90-15.20	.075-.598	**302**[2]	20	.787	-		126	4.961	-		-		-		-
	6.00-26.00	.236-1.024	**303**[2]	28	1.102	-		126	4.961	-		-		-		-
	8.70-32.60	.343-1.283	**304**[2]	36	1.417	-		162	6.378	-		-		-		-
	11.90-49.00	.469-1.929	**305**[2]	48	1.890	-		166	6.535	-		-		-		-
	1.90-9.20	.075-.362	**501**[2]	-		-		-		84	3.307	-		-		Morse taper 1
	9.20-16.10	.362-.634	**503**[2]	-		-		-		84	3.307	-		-		Morse taper 3
	16.10-23.60	.634-.929	**504**[2]	-		-		-		131	5.157	-		-		Morse taper 4
	23.40-34.00	.921-1.339	**505**[2]	-		-		-		200	7.874	-		-		Morse taper 4

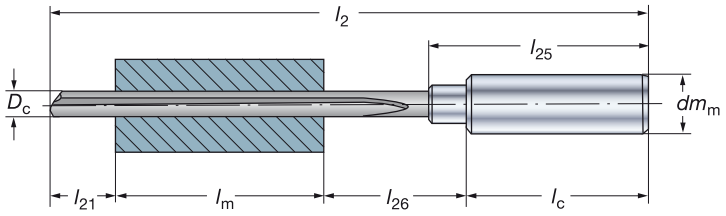
[1] Supplied with driving dog.

[2] Adjustable

[3] Available on request.

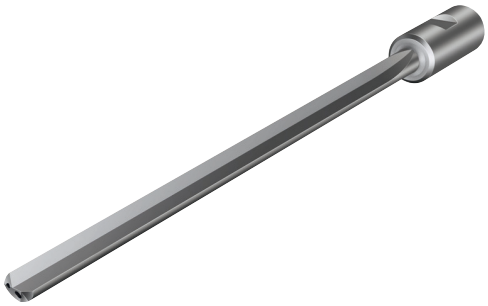
Gun drills

Solid carbide gun drills CoroDrill® 428.5
High feed gun drills CoroDrill® 428.7



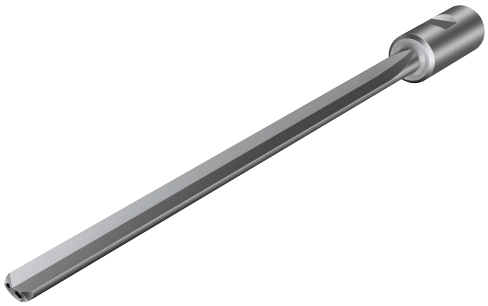
l_2 = Overall length with or without driver
D_c = Drill diameter
l_{21} = Addition for regrinding
l_m = Depth of hole
l_{26} = Minimum chip evacuation distance
l_c = Length of drive
dm_m = Driver diameter

Solid carbide gun drills 428.5



Drill diameter, mm (inch):	0.80-12.00 (.031-.472)
Max. drill length including driver, mm (inch):	300 (11.811)
Hole tolerance:	IT8
Surface finish R_a, µm:	0.1-3.0
Cutting fluid:	Neat oil
Tolerance:	D_c = h5 dm_m = g6

High feed gun drills 428.7



Drill diameter, mm (inch):	3.00-12.00 (.118-.472)
Max. drill length including driver, mm (inch):	300 (11.811)
Hole tolerance:	IT8
Surface finish R_a, µm:	0.1-3.0
Cutting fluid:	Neat oil
Tolerance:	D_c = h5 dm_m = g6

Diameter range mm inch	Ordering code	Dimensions, mm, inch		Diameter range mm inch	Ordering code	Dimensions, mm, inch	
D_c	P K N	l_{21}	l_{26}	D_c	P K N	l_{21}	l_{26}
0.80-12.00	428.5- xxxxx-AAAA-BBB	8-25	25-50	3.00-12.00	428.7- xxxxx-AAAA-BBB	8-25	25-50
.031-.472		*.315-.984*	*.984-1.969*	*.118-.472*		*.315-.984*	*.984-1.969*

When ordering gun drills the following must be stated:
- Drill diameter, xxxxx in the ordering code.
- Overall length l_2, AAAA in the ordering code.
- If required, driver No., BBB in the ordering code.
- Material to be drilled.

Ordering example for gun drill head Dc 3.00 mm (.118 inch), length 250 mm (9.842 inch) with driver No C01 for drilling stainless steel:

2 pieces 428.5-03000-0250-C01 solid carbide head for stainless steel.

For further information, please contact your local sales representative.

Cutting data for solid carbide gun drills CoroDrill® 428.5

Metric version

ISO	MC No. (CMC No.)	Material	Specific cutting force k_{c1} N/mm²	Hardness Brinell HB	Cutting speed v_c m/min	Drill diameter, mm 0.80-3.00 Feed f_n mm/r	3.00-6.30 Feed f_n mm/r	6.00-12.00 Feed f_n mm/r
P		**Unalloyed steel**						
	P1.1.Z.AN (01.1)	Non-hardened 0.10-0.25% C	1500	90-200	40-60	0.003-0.010	0.005-0.030	0.015-0.055
	P1.2.Z.AN (01.2)	Non-hardened 0.25-0.55% C	1600	125-225	35-60	0.003-0.010	0.005-0.030	0.015-0.055
	P1.3.Z.AN (01.3)	Non-hardened 0.55-0.80% C	1700	150-250	25-50	0.003-0.010	0.004-0.025	0.010-0.050
		Low alloy steel						
	P2.1.Z.AN (02.1)	Non-hardened	1700	150-260	25-60	0.003-0.010	0.004-0.030	0.010-0.055
	P2.5.Z.HT (02.2)	Hardened and tempered	1900	220-450	25-60	0.003-0.010	0.004-0.025	0.010-0.050
		High alloy steel						
	P3.0.Z.AN (03.11)	Annealed	1950	150-250	25-50	0.003-0.010	0.004-0.025	0.010-0.050
	P3.0.Z.HT (03.21)	Hardened tool steel	2900	250-350	35-50	0.003-0.010	0.005-0.025	0.015-0.050
		Steel castings						
	P1.5.C.UT (06.1)	Unalloyed	1400	90-225	35-60	0.003-0.010	0.005-0.030	0.015-0.055
	P2.6.C.UT (06.2)	Low alloyed (alloying elements < 5%)	1600	150-250	25-50	0.003-0.010	0.004-0.025	0.010-0.050
K		**Malleable cast iron**						
	K1.1.C.NS (07.1)	Ferritic	790	110-145	70-90	0.005-0.010	0.008-0.030	0.020-0.070
	K1.1.C.NS (07.2)	Pearlitic	900	150-270	60-90	0.004-0.010	0.005-0.030	0.010-0.070
		Grey cast iron						
	K2.1.C.UT (08.1)	Low tensile strength	890	150-220	70-100	0.004-0.010	0.008-0.030	0.010-0.070
	K2.2.C.UT (08.2)	High tensile strength	1100	200-330	60-90	0.003-0.010	0.003-0.030	0.005-0.070
		Nodular cast iron						
	K3.1.C.UT (09.1)	Ferritic	900	125-230	70-90	0.005-0.010	0.008-0.030	0.020-0.070
	K3.3.C.UT (09.2)	Pearlitic	1350	200-300	60-90	0.004-0.010	0.005-0.030	0.010-0.070
N		**Aluminium alloys**						
	N1.3.C.UT (30.21)	Cast, non aging	600	40-100	100-300	0.005-0.015	0.005-0.040	0.020-0.070
		Copper and copper alloys						
	N3.3.U.UT (33.1)	Free cutting alloys (Pb > 1%)	550	70-160	80-150	0.005-0.015	0.005-0.040	0.020-0.070
	N3.2.C.UT (33.2)	Brass and leaded bronzes (Pb ≤ 1%)	550	50-200	80-150	0.005-0.015	0.005-0.040	0.020-0.070

Cutting data for solid carbide gun drills CoroDrill® 428.5

Inch version

ISO	MC No. (CMC No.)	Material	Specific cutting force k_{c1} lbs/in²	Hardness Brinell HB	Cutting speed v_c ft/min	Drill diameter, inch .031-.118 Feed f_n inch/rev	.118-.248 Feed f_n inch/rev	.236-.472 Feed f_n inch/rev
P		**Unalloyed steel**						
	P1.1.Z.AN (01.1)	Non-hardened 0.10-0.25% C	216,500	90-200	130-195	.0001-.0004	.0002-.0012	.0006-.0022
	P1.2.Z.AN (01.2)	Non-hardened 0.25-0.55% C	233,000	125-225	115-195	.0001-.0004	.0002-.0012	.0006-.0022
	P1.3.Z.AN (01.3)	Non-hardened 0.55-0.80% C	247,000	150-250	80-165	.0001-.0004	.0002-.0010	.0004-.0020
		Low alloy steel						
	P2.1.Z.AN (02.1)	Non-hardened	246,500	150-260	80-195	.0001-.0004	.0002-.0012	.0004-.0022
	P2.5.Z.HT (02.2)	Hardened and tempered	278,500	220-450	80-195	.0001-.0004	.0002-.0010	.0004-.0020
		High alloy steel						
	P3.0.Z.AN (03.11)	Annealed	282,000	150-250	80-165	.0001-.0004	.0002-.0010	.0004-.0020
	P3.0.Z.HT (03.21)	Hardened tool steel	420,000	250-350	115-165	.0001-.0004	.0002-.0010	.0006-.0020
		Steel castings						
	P1.5.C.UT (06.1)	Unalloyed	204,000	90-225	115-195	.0001-.0004	.0002-.0012	.0006-.0022
	P2.6.C.UT (06.2)	Low alloyed (alloying elements < 5%)	230,500	150-250	80-165	.0001-.0004	.0002-.0010	.0004-.0020
K		**Malleable cast iron**						
	K1.1.C.NS (07.1)	Ferritic	115,000	110-145	230-295	.0002-.0004	.0003-.0012	.0008-.0028
	K1.1.C.NS (07.2)	Pearlitic	131,000	150-270	195-295	.0002-.0004	.0002-.0012	.0004-.0028
		Grey cast iron						
	K2.1.C.UT (08.1)	Low tensile strength	130,000	150-220	230-330	.0002-.0004	.0003-.0012	.0004-.0028
	K2.2.C.UT (08.2)	High tensile strength	159,500	200-330	195-295	.0001-.0004	.0001-.0012	.0002-.0028
		Nodular cast iron						
	K3.1.C.UT (09.1)	Ferritic	130,000	125-230	230-295	.0002-.0004	.0003-.0012	.0008-.0028
	K3.3.C.UT (09.2)	Pearlitic	194,500	200-300	195-295	.0002-.0004	.0002-.0012	.0004-.0028
N		**Aluminium alloys**						
	N1.3.C.UT (30.21)	Cast, non aging	87,000	40-100	330-985	.0002-.0006	.0002-.0016	.0008-.0028
		Copper and copper alloys						
	N3.3.U.UT (33.1)	Free cutting alloys (Pb > 1%)	79,500	70-160	260-490	.0002-.0006	.0002-.0016	.0008-.0028
	N3.2.C.UT (33.2)	Brass and leaded bronzes (Pb ≤ 1%)	80,000	50-200	260-490	.0002-.0006	.0002-.0016	.0008-.0028

Cutting data for high feed gun drills CoroDrill® 428.7

Metric version

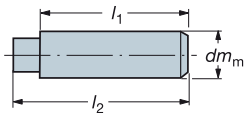
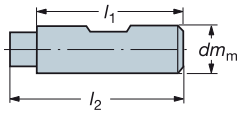
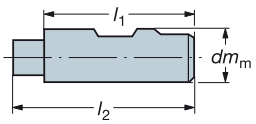
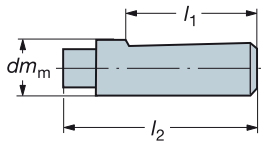
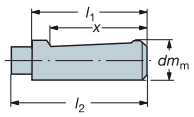
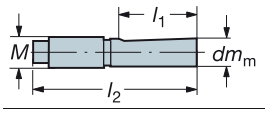
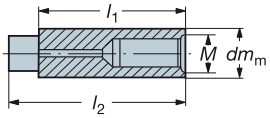
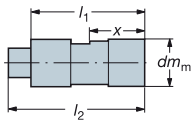
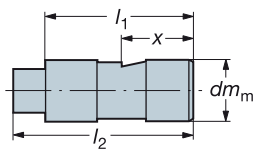
ISO	MC No. (CMC No.)	Material	Specific cutting force k_{c1} N/mm²	Hardness Brinell HB	Cutting speed v_c m/min	Drill diameter, mm 3.00-6.30 Feed f_n mm/r	Drill diameter, mm 6.00-12.00 Feed f_n mm/r
P		**Unalloyed steel**					
	P1.1.Z.AN (01.1)	Non-hardened 0.10-0.25% C	1500	90-200	40-60	0.025-0.150	0.075-0.275
	P1.2.Z.AN (01.2)	Non-hardened 0.25-0.55% C	1600	125-225	35-60	0.025-0.150	0.075-0.275
	P1.3.Z.AN (01.3)	Non-hardened 0.55-0.80% C	1700	150-250	25-50	0.020-0.125	0.050-0.250
		Low alloy steel					
	P2.1.Z.AN (02.1)	Non-hardened	1700	150-260	25-60	0.020-0.150	0.050-0.275
	P2.5.Z.HT (02.2)	Hardened and tempered	1900	220-450	25-60	0.020-0.125	0.050-0.250
		High alloy steel					
	P3.0.Z.AN (03.11)	Annealed	1950	150-250	25-50	0.020-0.125	0.050-0.250
	P3.0.Z.HT (03.21)	Hardened tool steel	2900	250-350	35-50	0.025-0.125	0.075-0.250
		Steel castings					
	P1.5.C.UT (06.1)	Unalloyed	1400	90-225	35-60	0.025-0.150	0.075-0.275
	P2.6.C.UT (06.2)	Low alloyed (alloying elements < 5%)	1600	150-250	25-50	0.020-0.125	0.050-0.250
K		**Malleable cast iron**					
	K1.1.C.NS (07.1)	Ferritic	790	110-145	70-90	0.040-0.150	0.100-0.350
	K1.1.C.NS (07.2)	Pearlitic	900	150-270	60-90	0.025-0.150	0.050-0.350
		Grey cast iron					
	K2.1.C.UT (08.1)	Low tensile strength	890	150-220	70-100	0.040-0.150	0.050-0.350
	K2.2.C.UT (08.2)	High tensile strength	1100	200-330	60-90	0.015-0.150	0.025-0.350
		Nodular cast iron					
	K3.1.C.UT (09.1)	Ferritic	900	125-230	70-90	0.040-0.150	0.100-0.350
	K3.3.C.UT (09.2)	Pearlitic	1350	200-300	60-90	0.025-0.150	0.050-0.350
N		**Aluminium alloys**					
	N1.3.C.UT (30.21)	Cast, non aging	600	40-100	100-300	0.025-0.200	0.100-0.350
		Copper and copper alloys					
	N3.3.U.UT (33.1)	Free cutting alloys (Pb > 1%)	550	70-160	80-150	0.025-0.200	0.100-0.350
	N3.2.C.UT (33.2)	Brass and leaded bronzes (Pb ≤ 1%)	550	50-200	80-150	0.025-0.200	0.100-0.350

Cutting data for high feed gun drills CoroDrill® 428.7

Inch version

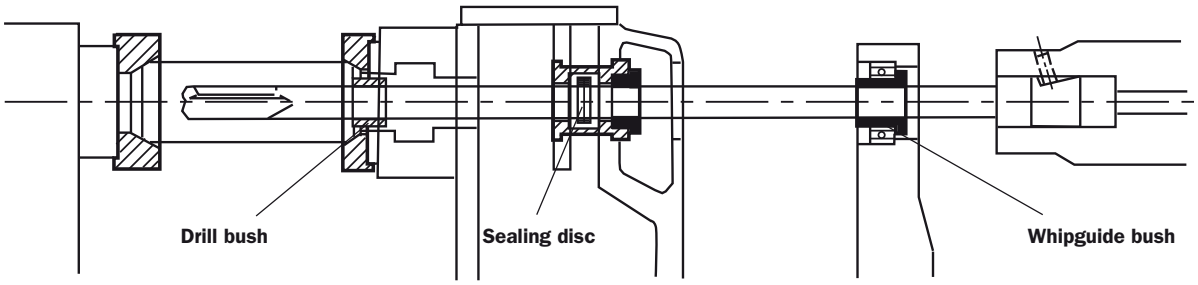
ISO	MC No. (CMC No.)	Material	Specific cutting force k_{c1} lbs/in²	Hardness Brinell HB	Cutting speed v_c ft/min	Drill diameter, inch .118-.248 Feed f_n inch/rev	Drill diameter, inch .236-.472 Feed f_n inch/rev
P		**Unalloyed steel**					
	P1.1.Z.AN (01.1)	Non-hardened 0.10-0.25% C	216,500	90-200	130-195	.0010-.0059	.0030-.0108
	P1.2.Z.AN (01.2)	Non-hardened 0.25-0.55% C	233,000	125-225	115-195	.0010-.0059	.0030-.0108
	P1.3.Z.AN (01.3)	Non-hardened 0.55-0.80% C	247,000	150-250	80-165	.0010-.0049	.0020-.0098
		Low alloy steel					
	P2.1.Z.AN (02.1)	Non-hardened	246,500	150-260	80-195	.0010-.0059	.0020-.0108
	P2.5.Z.HT (02.2)	Hardened and tempered	278,500	220-450	80-195	.0010-.0049	.0020-.0098
		High alloy steel					
	P3.0.Z.AN (03.11)	Annealed	282,000	150-250	80-165	.0010-.0049	.0020-.0098
	P3.0.Z.HT (03.21)	Hardened tool steel	420,000	250-350	115-165	.0010-.0049	.0030-.0098
		Steel castings					
	P1.5.C.UT (06.1)	Unalloyed	204,000	90-225	115-195	.0010-.0059	.0030-.0108
	P2.6.C.UT (06.2)	Low alloyed (alloying elements < 5%)	230,500	150-250	80-165	.0010-.0049	.0020-.0098
K		**Malleable cast iron**					
	K1.1.C.NS (07.1)	Ferritic	115,000	110-145	230-295	.0016-.0059	.0039-.0138
	K1.1.C.NS (07.2)	Pearlitic	131,000	150-270	195-295	.0010-.0059	.0039-.0138
		Grey cast iron					
	K2.1.C.UT (08.1)	Low tensile strength	130,000	150-220	230-330	.0016-.0059	.0020-.0138
	K2.2.C.UT (08.2)	High tensile strength	159,500	200-330	195-295	.0006-.0059	.0010-.0138
		Nodular cast iron					
	K3.1.C.UT (09.1)	Ferritic	130,000	125-230	230-295	.0016-.0059	.0039-.0138
	K3.3.C.UT (09.2)	Pearlitic	194,500	200-300	195-295	.0010-.0059	.0020-.0138
N		**Aluminium alloys**					
	N1.3.C.UT (30.21)	Cast, non aging	87,000	40-100	330-985	.0010-.0079	.0039-.0138
		Copper and copper alloys					
	N3.3.U.UT (33.1)	Free cutting alloys (Pb > 1%)	79,500	70-160	260-490	.0010-.0079	.0039-.0138
	N3.2.C.UT (33.2)	Brass and leaded bronzes (Pb ≤ 1%)	80,000	50-200	260-490	.0010-.0079	.0039-.0138

Drivers for gun drills CoroDrill® 428.5 and 428.7

	Diameter range		Driver[3]	Dimensions, millimeter, inch (mm, in.)									
	D_c mm	D_c inch	No.	dm_m mm	dm_m in.	M	l_1 mm	l_1 in.	l_2 mm	l_2 in.	x mm	x in.
	0.80-6.50	.031-.256	**C00**	10	.394		40	1.575	55	2.165		
	0.80-8.00	.031-.315	**C01**	12	.472		45	1.772	60	2.362		
	0.80-11.40	.031-.449	**C02**	16	.630		48	1.890	63	2.480		
	0.80-12.00	.031-.472	**C03**	20	.787		50	1.968	65	2.559		
	0.80-12.00	.031-.472	**C04**	25	.984		56	2.205	71	2.795		
	0.80-12.00	.031-.472	**C05**	32	1.260		60	2.362	75	2.953		
	0.80-7.10	.031-.280	**C10**	10	.394		40	1.575	55	2.165		
	0.80-8.00	.031-.315	**C11**	12	.472		45	1.772	60	2.362		
	0.80-12.00	.031-.472	**C12**	16	.630		48	1.890	63	2.480		
	0.80-12.00	.031-.472	**C13**	20	.787		50	1.968	65	2.559		
	0.80-12.00	.031-.472	**C20**	25	.984		56	2.205	71	2.795		
	0.80-12.00	.031-.472	**C21**	32	1.260		60	2.362	75	2.953		
	0.80-12.00	.031-.472	**C22**	40	1.575		70	2.756	85	3.346		
	0.80-7.10	.031-.280	**C30**	10	.394		40	1.575	55	2.165		
	0.80-8.00	.031-.315	**C31**	12	.472		45	1.772	60	2.362		
	0.80-11.40	.031-.449	**C32**	16	.630		48	1.890	63	2.480		
	0.80-12.00	.031-.472	**C33**	20	.787		50	1.968	65	2.559		
	0.80-12.00	.031-.472	**C34**	25	.984		56	2.205	71	2.795		
	0.80-12.00	.031-.472	**C35**	32	1.260		60	2.362	75	2.953		
	0.80-6.50	.031-.256	**C40**	10	.394		40	1.575	55	2.165		
	0.80-8.00	.031-.315	**C41**	12	.472		45	1.772	60	2.362		
	0.80-11.40	.031-.449	**C42**	16	.630		48	1.890	63	2.480		
	0.80-12.00	.031-.472	**C43**	20	.787		50	1.968	65	2.559		
	0.80-12.00	.031-.472	**C44**	25	.984		56	2.205	71	2.795		
	0.80-11.40	.031-.449	**C50**	16	.630	TR16x1.5	112	4.409	127	5.000		
	0.80-12.00	.031-.472	**C51**	20	.787	TR20x2	126	4.961	141	5.551		
	0.80-12.00	.031-.472	**C52**	28	1.102	TR28x2	126	4.961	141	5.551		
	0.80-12.00	.031-.472	**C53**	36	1.417	TR36x2	162	6.378	177	6.969		
	0.80-6.50	.031-.256	**C60**	10	.394	M6x0.5	60	2.362	75	2.953		
	0.80-12.00	.031-.472	**C61**	16	.630	M10x1	80	3.150	95	3.740		
	0.80-12.00	.031-.472	**C62**	25	.984	M16x1.5	100	3.937	115	4.528		
	0.80-11.40	.031-.449	**C70**	16	.630		40	1.575	55	2.165	15.5	.610
	0.80-12.00	.031-.472	**C71**	25	.984		50	1.968	65	2.559	25.5	1.004
	0.80-12.00	.031-.472	**C72**	35	1.378		60	2.362	75	2.953	29.5	1.161
	0.80-7.10	.031-.280	**C80**	10	.394		40	1.575	55	2.165	24.3	.957
	0.80-12.00	.031-.472	**C81**	16	.630		45	1.772	60	2.362	31.0	1.220
	0.80-12.00	.031-.472	**C82**	16	.630		50	1.968	65	2.559	47.5	1.870
	0.80-12.00	.031-.472	**C83**	25	.984		70	2.756	85	3.346	34.0	1.339

[3] Available on request.

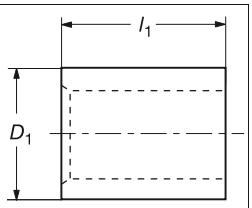
Accessories



Drill bush

According to DIN 179 extended model made of tool steel, hardened throughout.

Give measurement D_c when placing an order.



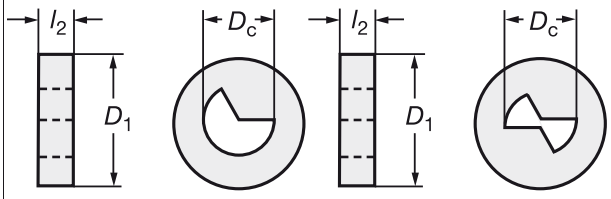
D_c mm	D_c inch	D_1 mm	D_1 inch	l_1 mm	l_1 inch
0.8-1.099	.0314-.0432	3	.118	9	.354
1.1-1.899	.0433-.0747	4	.157	9	.354
1.9-2.699	.0748-.1062	5	.197	9	.354
2.7-3.399	.1063-.1338	6	.236	12	.472
3.4-4.099	.1339-.1613	7	.276	12	.472
4.1-5.099	.1614-.2007	8	.315	12	.472
5.1-6.099	.2008-.2401	10	.394	16	.630
6.1-8.099	.2402-.3188	12	.472	16	.630
8.1-10.099	.3189-.3975	15	.591	20	.787
10.1-12.099	.3976-.4763	18	.709	20	.787
12.1-15.099	.4764-.5944	22	.866	28	1.102
15.1-18.099	.5945-.7125	26	1.024	28	1.102
18.1-22.099	.7126-.8699	30	1.181	36	1.417
22.1-26.099	.8700-1.0275	35	1.378	36	1.417
26.1-30.099	1.0276-1.1849	42	1.654	45	1.772
30.1-35.099	1.1850-1.3818	48	1.890	45	1.772
35.1-42.099	1.3819-1.6574	55	2.165	56	2.205

Sealing disc[1)]

Made of special plastic

Give drill diameter D_c when placing an order.

Single-lip **Twin-lip**



Diameter range

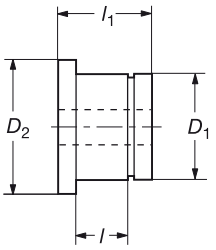
D_c mm	D_c inch	D_1 mm	D_1 inch	l_2 mm	l_2 inch
2.0-6.2	.079-.244	20	.787	3	.118
6.3-18.5	.248-.728	32	1.260	4	.157
18.6-24.6	.732-.969	40	1.575	4	.157
24.7-42.0	.972-1.654	90	3.543	4	.157

[1)] The sealing disc fits tightly onto the drill shank and must be held in position in the chip box with retaining device. This prevents the disc moving with the feed motion, which could cause chip obstruction.

Whipguide bush

Made of special plastic

Give drill diameter D_c when placing an order.



Diameter range

D_c mm	D_c inch	D_1 mm	D_1 inch	D_2 mm	D_2 inch	l mm	l inch	l_1 mm	l_1 inch
2.0-12.0	.079-.472	20	.787	26	1.024	12	.472	22	.866
2.0-25.0	.079-.984	30	1.181	38	1.496	16	.630	26	1.024
2.0-37.0	.079-1.457	45	1.772	52	2.047	14	.551	26	1.024

For further information, please contact your local sales representative.

Gun drill selection guide

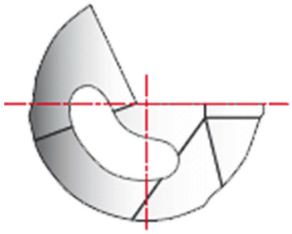
	428.9 Single-lip gun drill	428.2 Twin-lip gun drill	428.5 Solid carbide gun drill	428.7 High feed gun drill
ISO P Steel				
ISO M Stainless steel				
ISO K Cast iron				
ISO N Non-ferrous metals				
ISO S Heat resistant super alloys				
Main characteristics	Widest application	Improved productivity in short chipping materials	Stability	Highest productivity
Range *Dc* (mm/inch)	1.90 - 40.50 .075 - 1.594	5.00 - 25.50 .236 - 1.043	0.60 -12.00 .031 - .472	3.00 - 12.00 .118 - .472
Maximum drill depth (mm)	3050	900	353	353
Circumferential forms*	G60, A, D45, C	G60	G60, A, D45, C	G60, A, D45, C
Workpiece batch sizes	Small	Small Medium Large	Medium Large	Large
Coating options for improved tool life	TiN TiAlN	TiN TiAlN	TiN TiAlN	TiAlN
Machine Type	Deep Hole Drilling/ Conventional Machine	Deep Hole Drilling/ Conventional Machine	Deep Hole Drilling	Deep Hole Drilling
Coolant **	Neat oil/ Emulsion	Neat oil/ Emulsion	Neat oil/ Emulsion	Neat oil/ Emulsion

* Other circumferential forms are available, please refer to page 14.

COOLING LUBRICANTS
**An efficient and correctly dimensioned coolant system and filter are required in order to ensure the economic viability and process reliability of deep hole drilling. A further consideration is the requirement to adhere to a minimum level of fat content (depending on the material) when using emulsion. We recommend the use of deep hole drilling oil for small drill diameters and high alloy steels.

Circumferential forms

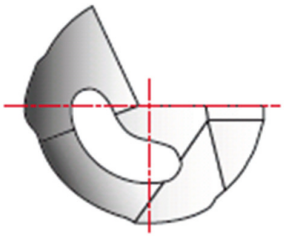
The circumferential shapes developed by Sandvik Coromant are specially tailored to the respective application.



First choise

Circumferential form G60

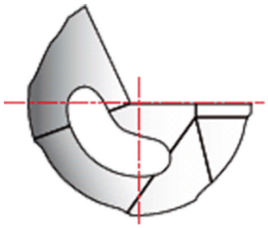
Standard form suitable for most materials and drilling jobs.



For narrow tollerences

Circumferential form C

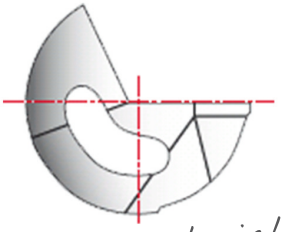
This form is the preferred choice for narrow tolerances in terms of the bore diameter and finish.



Troubleshooting

Circumferential form A

Form for awkward approaches to drilling work or cross drilling, machining of soft materials and poor performance of cooling lubricant. Also suitable for emulsion.

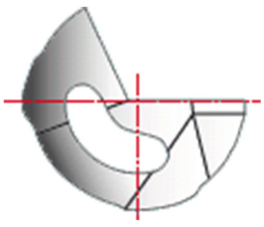


For soft materials

Circumferential form D45

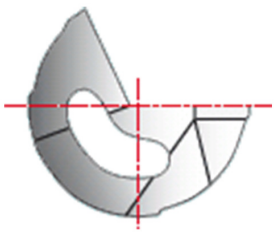
The form is almost exclusively used for soft materials, such as grey cast iron, graphite; especially in conjunction with narrow bore tolerances.

Special options



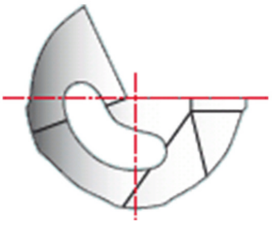
Circumferential form S

For tight tolerances, used in special cases; where there is a risk of tools jamming and soft materials.



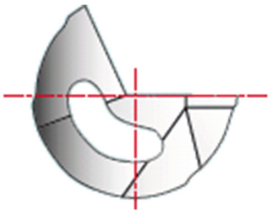
Circumferential form E185

For soft materials with small diameters.



Circumferential form F

For soft materials.

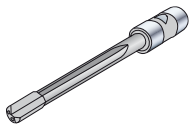
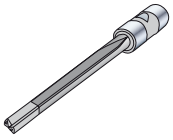


Circumferential form GA80

Form for moulds with cross holes and for counter boring.

Hole Quality

Obtainable hole tolerances with different tools

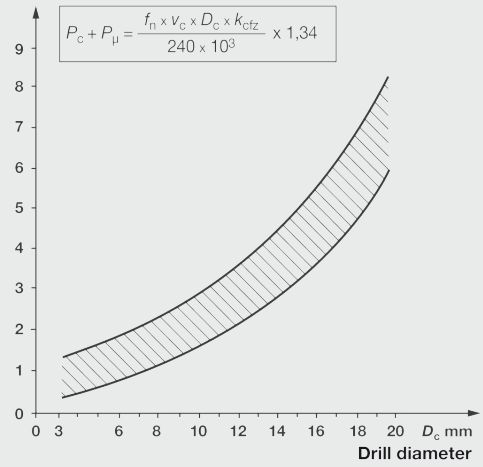
	428.9 Single-lip gun drill	428.2 Twin-lip gun drill	428.5 Solid carbide gun drill	428.7 High feed gun drill
				
IT6				
IT7				
IT8				
IT9				
IT10				
IT11				
IT12				
IT13				

Graphs for gun drills

Net power

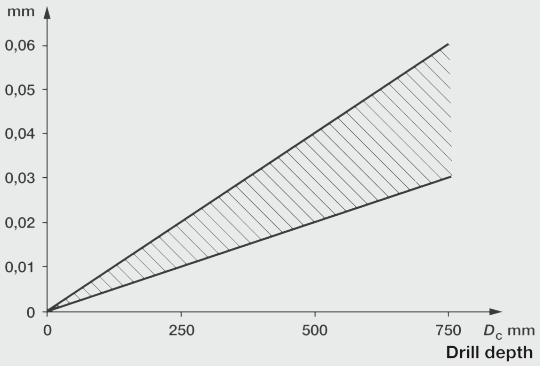
P_c kW

$$P_c + P_\mu = \frac{f_n \times v_c \times D_c \times k_{cfz}}{240 \times 10^3} \times 1{,}34$$



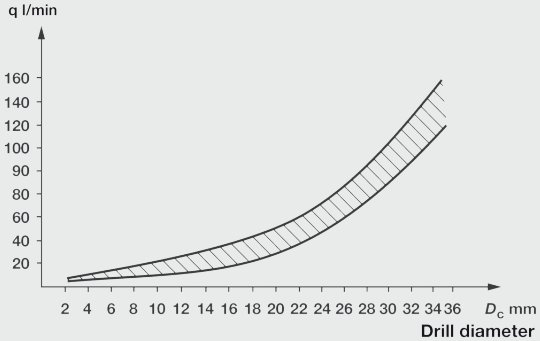
Straightness

Hole straightness depends on various factors e.g.
- Hole diameter and depth
- Machining method and cutting parameters
- Material quality and homogeneity
- Machine condition
- Drill bush



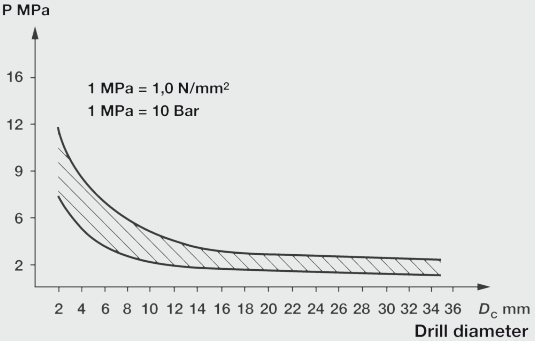
Cutting fluid flow

q l/min



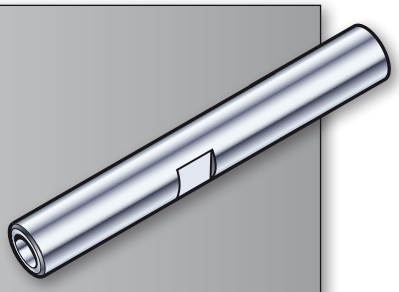
Cutting fluid pressure

P MPa



Customer Cases

Tool holder

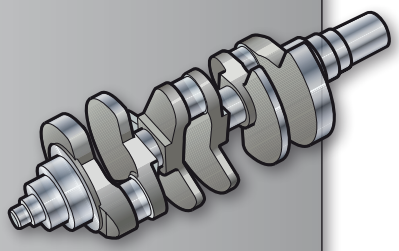


Material:	P2.2.Z.AN	Hole Dia.:	3 mm
Machine:	TBT	Hole Depth:	160 mm
Coolant:	Neat oil	Preassure:	150 bar

Cutting data	**Competitor**	**428.7-03000-305-C01**
v_c	42 m/min	45 m/min
fn start 10 mm	0.010 mm/r	0.010 mm/r
fn	0.010 mm/r	0.102 mm/r
Total drill length	300 mm	300 mm
Cycle time/hole	3.82 min	0.80 min
Tool condition	Even flank wear	Even flank wear

Productivity increase: + 477%

Crankshaft



Material:	GGG400	Hole Dia.:	6 mm
Machine:	Ingersol CM	Hole Depth:	80 mm
Coolant:	Emulsion 14%	Preassure:	100 bar
		Preassure rise:	70 bar

Cutting data	**Competitor**	**428.7-06000-0362-C02**
v_c	38-47 m/min	38-47 m/min
fn start 10 mm	0.06 mm/r	0.06 mm/r
fn	0.10 mm/r	0.10 mm/r
Total drill length	362 mm	362 mm
Cycle time/hole	10 s per hole (4 holes for component)	10 s per hole (4 holes for component)
Tool condition	Flank wear after 50 pcs. Breakage	Flank wear after 100 pcs. Breakage

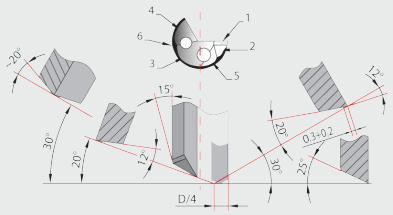
Tool life: + 100 %

Trouble shooting

Problem:	Cause:	Remedy:
Excessive guide pad wear	Too much heat in the contact zone between guide pad and drilled hole.	Firstly reduce the cutting speed (Vc), if this does not work then check coolant and increase concentration of emulsion. If running with neat oil, then top up EP additives.
Premature drill point wear	Excessive machine vibration and workpiece movement when the drill starts.	On deep hole drilling machines, use whip guide bushes. On conventional machine tools break up the depth of the bore into sections. If the workpiece moves, make fixturing more rigid.
Crater wear	Gun drill does not get proper guidance into the workpiece.	Check the diameter of the guide hole. Check fixturing and make more ridgid if necessary. Start with lower entry feed before ramping up.
Grooves and marks on the gun drill body	Insufficient chip evaluation. No contact between bushing and workpiece	Check coolant properties (volume and pressure). Look at chip formation and make adjustments to speed and feed. For deep hole drilling machines, modify set-up to ensure contact between bushing and workpiece.
Oversized hole entrance	Poor set-up.	Reduce size of bushing. Stabilize guide ways, check fixturing of workpiece and make more rigid if necessary.
Grooves on the surface finish	Abrasion between the drill and the workpiece.	Increase feed per minute. Use coated tools. Check coolant properties and remedy if necessary. Check the filter and replace if necessary. Stop spindle revolving before retracting the tool.
Oversized hole at the bottom of blind hole	Tool rotates after reaching the bottom of the hole.	Immediately stop drill rotation when required drill depth is reached.

Cutting edge geometry

Symbol	Axis A	Axis B	Axis C	Measure	Comment
1	-30°	+12°	+5°	>D/4	Set Axis C such that the chamfer during the second pass is parallel to the chip face. The width of the chamfer is the same as that of the circular grinding chamfer.
2	-30°	+20°	+6,5°	Chamfer 0,3...0,5	
3	+20°	+12°	-5°	D/4	
4	+30°	+12°	+55°		
5	0°	+25°	-5°		
6					Twist the single-lip drill lightly around the circum-ference without damaging the guide chamfer!
There may be slight deviation in measurement due to angle distortion					



Standard grind section for single-lip drills with Ø = 5 to 30 mm

Changes to the cutting edge geometry of the single-lip drill could affect the drilled surface, the chip shape, drilling tolerance, drill centring, chip removal, surface quality or useful life.

Virtually all drilling tasks can be executed successfully with standard grind facets. Generally speaking, special grind facets, sometimes with a chip separator/chip breaker are required when deep drilling particularly long-chipping materials or materials that are difficult to machine. We already manufacture and develop a wide range of grind sections or manufacture them to customer specifications. The standard grind facets for single-lip drills depend on the drill diameter and the material to be drilled.

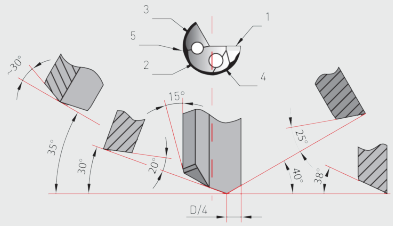
Changes to the cutting edge geometry will have a direct effect on bore quality and process reliability.

Our cutting edge geometry is the result of over 60 years of research and development work covering machine engineering, tool design and machining service.

With our cutting edge geometries, no job is too difficult!

Make use of our experience for your drilling jobs!

Symbol	Axis A	Axis B	Axis C	Measure	Comment
1	-40°	+25°	+12°	>D/4	
2	+30°	+20°	-7°	D/4	
3	+35°	+20°	+55°		
4	0°	+38°	0°		
5					
There may be slight deviation in measurement due to angle distortion					



Standard grind section for single-lip drills up to 5 mm

Safety information in connection with grinding of cemented carbide

Material composition
Most metal products contain tungsten carbide and cobalt. Other substances that may be constituents of hardmetal are titanium carbide, tantalum carbide, niobium carbide, chromium carbide, molybdenum carbide or vanadium carbide. Some grades contain titanium carbonitride and/or nickel.

Routes of exposure
Grinding or heating of hard metal blanks or hard metal products will produce dust or fumes with dangerous ingredients that can be inhaled, swallowed or come in contact with the skin or eyes.

Acute toxicity
The dust is toxic when inhaled. Inhalation may cause irritation and inflamation on the airways. Significantly higher acute inhalation toxicity has been reported during simultaneous inhalation of cobalt and tungsten carbide compared to inhalation of cobalt alone. Skin contact can cause irritation and rash. Sensitized persons may experience an allergic reaction.

Chronic toxicity
Repeated inhalation of aerosols containing cobalt may cause obstruction in the airways. Prolonged inhalation of increased concentrations may cause lung fibrosis or lung cancer. Epidemiological studies indicate that workers exposed in the past to high concentrations of tungsten carbide/cobalt carried an increased risk of developing lung cancer. Cobalt and nickel are potent skin sensitizers. Repeated or prolonged contact can cause irritation and sensitization.

Risk phrases
Toxic: danger of serious damage to health by prolonged exposure through inhalation
Toxic when inhaled
Limited evidence of a carcinogenic effect.
May cause sensitization by inhalation and skin contact.

Preventive measures
Avoid formation and inhalation of dust. Use adequate local exhaust ventilation to keep personal exposure well below the nationally authorized limits. If ventilation is not available or adequate, use respirators nationally approved for the purpose. Use safety goggles or glasses with side shields when necessary. Avoid repeated skin contact. Wear suitable gloves. Wash skin thoroughly after handling. Use suitable protective clothing. Launder clothing as needed. Do not eat, drink or smoke in the working area. Wash skin thoroughly before eating, drinking or smoking.

Notes

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