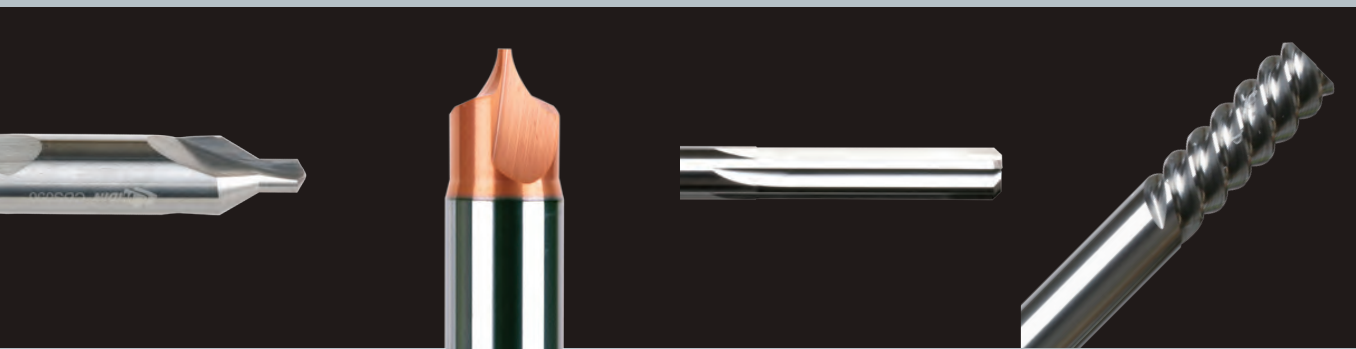







SOLID STANDARD








}	Centering Tools	368
	General Purpose	
	Reamers	375
	General Purpose	
	Technical Data	378

CENTERING TOOLS SERIES METRIC SIZE

Class	Feature	Type	Appearance	No. of Teeth	Item	App.	EDP. No.	Page
CENTERING TOOLS	Multi-Purpose				Center Drill Solid		CDS	370
				2FLUTE	NC Spotting Drill - 90°, 120°		LDS	371
				2FLUTE	Centering End Mill Solid - 90°		CES302	372
				2FLUTE	Centering End Mill Brazed Type - 90°		CEM	373
					CORNER ROUNDING CUTTER		CRC	374

CENTERING TOOLS SERIES METRIC SIZE

Class	Feature	Type	Appearance	No. of Teeth	Item	App.	EDP. No.	Page
REAMERS	Multi-Purpose	Straight		4&6FLUTE	Straight Flute Reamers		SSR	375
		7° Left Helix		4&6FLUTE	Helical Flute Reamers		SHR	376
		60° Left Helix		4&6FLUTE	Broach Reamers		SBR	377



	Carbon Steels (S45C,S55C...) ~ HB225	Alloy Steels (SCM,SK...) HB225~325	Prehardened Steels(NAK...) HRC30~50	Hardened Steels		Copper	Graphite	Cast Iron FCD400.500~	Aluminum	Stainless Steels
				~HRc55 SKD61	HRc55~ SKD11					
	○	○							○	
	○	○	○					○		
	○	○							○	



	Carbon Steels (S45C,S55C...) ~ HB225	Alloy Steels (SCM,SK...) HB225~325	Prehardened Steels(NAK...) HRC30~50	Hardened Steels		Copper	Graphite	Cast Iron FCD400.500~	Aluminum	Stainless Steels
				~HRc55 SKD61	HRc55~ SKD11					
	○	○								






Solid Standard Series

CENTERING TOOLS






Centering Tools



EDP. No.	APPEARANCE	FEATURE	STOCK	PAGE
CDS ...series		SOLID CENTER DRILL	•	370
LDS ...series		NC SPOTTING DRILL	•	371
CES302 ...series		CENTERING END MILL - SOLID	•	372
CEM ...series		CENTERING END MILL - BRAZED TYPE	•	373
CRC ...series		CORNER ROUNDING CUTTER	•	374

Reamers



EDP. No.	APPEARANCE	FEATURE	STOCK	PAGE
SSR ...series		STRAIGHT FLUTE REAMERS	•	375
SHR ...series		HELICAL FLUTE REAMERS	•	376
SBR ...series		BROACH REAMERS	•	377



SOLID CENTER DRILL

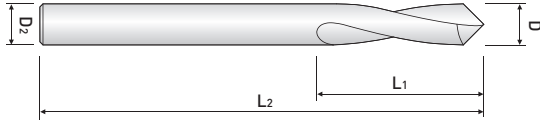
CDS ...series



EDP. No.	Dia.	F.L	OAL	SH.Dia.	STOCK
CDS010	1	1	40	3	•
CDS015	1.5	1.5	40	4	•
CDS020	2	2	45	5	•
CDS025	2.5	2.5	45	6	•
CDS030	3	3	55	8	•
CDS040	4	4.5	60	10	•
CDS050	5	5.5	65	12	•



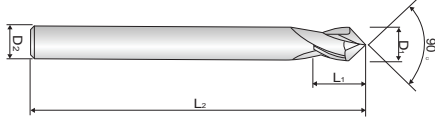
NC SPOTTING DRILL



LDS ...series



EDP. No.	Dia.	L ₁	L ₂	D ₂	Point Angle	STOCK
LDS030	3	9	50	3	90°	•
LDS030A					120°	•
LDS040	4	10	50	4	90°	•
LDS040A					120°	•
LDS050	5	12	50	5	90°	•
LDS050A					120°	•
LDS060	6	13	60	6	90°	•
LDS060A					120°	•
LDS080	8	23	70	8	90°	•
LDS080A					120°	•
LDS100	10	24	80	10	90°	•
LDS100A					120°	•
LDS120	12	28	80	12	90°	•
LDS120A					120°	•
LDS160	16	32	90	16	90°	•
LDS160A					120°	•
LDS200	20	35	100	20	90°	•
LDS200A					120°	•

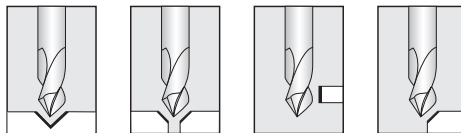


CENTERING END MILL - SOLID

CES302 ...series



EDP. No.	D ₁	L ₁	L ₂	D ₂	STOCK
CES302030	3	6	50	6	•
CES302040	4	8	50	6	•
CES302050	5	10	50	6	•
CES302060	6	12	60	6	•
CES302080	8	16	70	8	•
CES302100	10	18	70	10	•
CES302120	12	20	75	12	•
CES302140	14	24	80	14	•
CES302160	16	26	80	16	•
CES302200	20	32	100	20	•



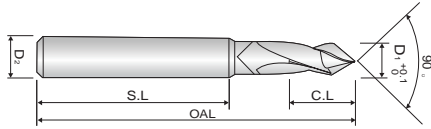
■ Tolerance

Mill Dia. (mm)	Shank Dia.
0 ~ -0,05	h6

※Items can be changed for quality improvement without notice.



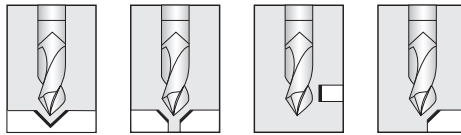
**CENTERING END MILL
- BRAZED TYPE**



CEM ...series



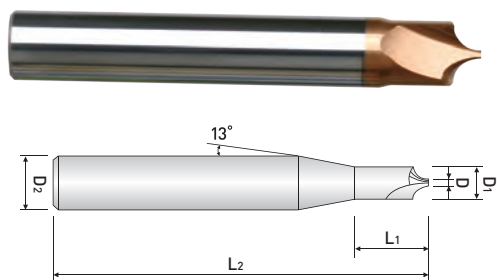
EDP. No.	D ₁	C.L	S.L	OAL	D ₂	STOCK
CEM1016	10	15	80	115	16	•
CEM1216	12	20	100	145	16	•
CEM1620	16	23	100	150	20	•
CEM2025	20	25	100	155	25	•



■ Tolerance

Mill Dia. (mm)	Shank Dia.
0 ~ +0,1	h7

※ Items can be changed for quality improvement without notice.



CORNER ROUNDING CUTTER

- Designed for prehardened, hardened and stainless steels and cast iron up to HRc 52.
- By using the newly developed raw-material(0.2 um), it provides excellent performance during high speed cutting.

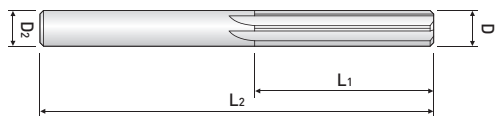
CRC ...series



EDP. No.	D	R	D ₁	L ₁	L ₂	D ₂	STOCK
CRC 209 050	0.9	0.5	2	3	45	4	•
CRC 209 075	0.9	0.75	2.5	4	45	4	•
CRC 209 100	0.9	1.0	3	5	50	6	•
CRC 259 100	5.9	1.0	8	-	60	8	•
CRC 214 150	1.4	1.5	4.5	8	50	6	•
CRC 249 150	4.9	1.5	8	-	60	8	•
CRC 214 200	1.4	2	5.5	10	50	6	•
CRC 239 200	3.9	2	8	-	60	8	•
CRC 219 250	1.9	2.5	7	13	60	8	•
CRC 219 300	1.9	3	8	-	60	8	•
CRC 219 350	1.9	3.5	9	13	70	10	•
CRC 219 400	1.9	4	10	-	70	10	•
CRC 219 450	1.9	4.5	11	13	80	12	•
CRC 219 500	1.9	5	12	-	80	12	•
CRC 239 600	3.9	6	16	-	85	16	•
CRC 259 700	5.9	7	20	-	85	20	•
CRC 239 800	3.9	8	20	-	85	20	•



STRAIGHT FLUTE REAMERS



SSR ...series



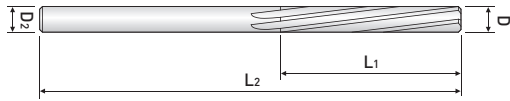
EDP. No.	Dia.	C.L	OAL	SH.Dia.	Z	STOCK
SSR020	2	25	60	4	4	•
SSR025	2.5	25	60	4	4	•
SSR030	3	28	70	4	6	•
SSR035	3.5	30	75	4	6	•
SSR040	4	30	75	4	6	•
SSR045	4.5	35	80	6	6	•
SSR050	5	35	80	6	6	•
SSR055	5.5	35	80	6	6	•
SSR060	6	35	80	6	6	•
SSR065	6.5	45	100	8	6	•
SSR070	7	45	100	8	6	•
SSR080	8	45	100	8	6	•
SSR090	9	50	110	10	6	•
SSR100	10	50	110	10	6	•
SSR110	11	50	120	12	6	•
SSR120	12	50	120	12	6	•

■ Tolerance mm = 1/1000mm

Tolerance \ Dia.	from 1 to 3	over 3 to 6	over 6 to 10	over 10 to 18	over 18 to 30
Cutting Edge(m5)	+6 +2	+9 +4	+12 +6	+15 +7	+17 +8
Shank(h6)	0 -6	0 -8	0 -9	0 -11	0 -13



HELICAL FLUTE REAMERS



SHR ...series



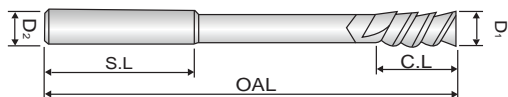
EDP. No.	Dia.	C.L	OAL	SH.Dia.	Z	STOCK
SHR020	2	25	60	4	4	•
SHR025	2.5	25	60	4	4	•
SHR030	3	28	70	4	6	•
SHR035	3.5	30	75	4	6	•
SHR040	4	30	75	4	6	•
SHR045	4.5	35	80	6	6	•
SHR050	5	35	80	6	6	•
SHR055	5.5	35	80	6	6	•
SHR060	6	35	80	6	6	•
SHR065	6.5	45	100	8	6	•
SHR070	7	45	100	8	6	•
SHR080	8	45	100	8	6	•
SHR090	9	50	110	10	6	•
SHR100	10	50	110	10	6	•
SHR110	11	50	120	12	6	•
SHR120	12	50	120	12	6	•

■ Tolerance $\mu\text{m}=1/1000\text{mm}$

Tolerance \ Dia.	from 1 to 3	over 3 to 6	over 6 to 10	over 10 to 18	over 18 to 30
Cutting Edge(m5)	+6 +2	+9 +4	+12 +6	+15 +7	+17 +8
Shank(h6)	0 -6	0 -8	0 -9	0 -11	0 -13



BROACH REAMERS



SBR ...series



EDP. No.	D ₁	C.L	S.L	OAL	D ₂	Z	STOCK
SBR030	3	12	30	70	4	4	•
SBR040	4	12	30	75	4	4	•
SBR050	5	16	35	80	6	4	•
SBR060	6	16	35	80	6	4	•
SBR080	8	20	40	100	8	4	•
SBR100	10	25	45	110	10	4	•
SBR120	12	28	50	120	12	4	•
SBR140	14	30	55	145	14	4	
SBR160	16	35	55	155	16	6	
SBR180	18	38	60	170	18	6	
SBR200	20	40	60	180	20	6	

* Above $\phi 14$ will be manufactured with brazed type.

※ These tools are manufactured based on order received.

■ Tolerance mm = 1/1000mm

Tolerance	Dia.	from 1 to 3	over 3 to 6	over 6 to 10	over 10 to 18	over 18 to 30
Cutting Edge(m5)		+6	+9	+12	+15	+17
		+2	+4	+6	+7	+8
Shank(h6)		0	0	0	0	0
		-6	-8	-9	-11	-13

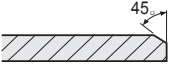
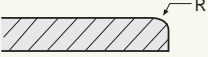
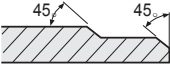
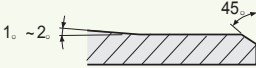
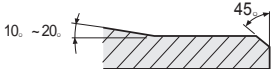
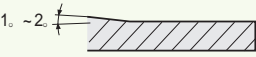
□ LDS series

MATERIAL	S15C-SS400 ~500N/mm ²		S45C		SCM440		SKD61 28HRC		SKD61 34HRC		FC250		AC4D	
V	63~80m/min		40~63m/min		32~50m/min		20~28m/min		16~22m/min		63~100m/min		80~160m/min	
DIAMETER (mm)	RPM (mm ⁻¹)	FEED (mm/rev)	RPM (mm ⁻¹)	FEED (mm/rev)	RPM (mm ⁻¹)	FEED (mm/rev)	RPM (mm ⁻¹)	FEED (mm/rev)	RPM (mm ⁻¹)	FEED (mm/rev)	RPM (mm ⁻¹)	FEED (mm/rev)	RPM (mm ⁻¹)	FEED (mm/rev)
3	7,500	0.04-0.08	5,500	0.04-0.08	4,500	0.04-0.08	2,500	0.04-0.08	1,500	0.04-0.08	8,000	0.05-0.09	12,000	0.10-0.22
4	5,700	0.05-0.10	4,100	0.05-0.10	3,300	0.05-0.10	1,900	0.05-0.10	1,100	0.05-0.1	6,500	0.07-0.12	9,500	0.12-0.25
6	3,800	0.06-0.12	2,700	0.06-0.12	2,300	0.06-0.12	1,250	0.06-0.12	750	0.06-0.12	4,300	0.12-0.18	6,400	0.14-0.28
8	2,800	0.08-0.15	2,000	0.08-0.15	1,700	0.08-0.15	950	0.08-0.15	550	0.08-0.15	3,200	0.13-0.20	4,800	0.18-0.32
10	2,300	0.10-0.18	1,700	0.10-0.18	1,400	0.10-0.18	750	0.10-0.18	450	0.1-0.18	2,600	0.17-0.25	3,800	0.22-0.36
12	1,900	0.12-0.21	1,400	0.12-0.21	1,200	0.12-0.21	650	0.12-0.21	370	0.12-0.21	2,200	0.21-0.30	3,200	0.25-0.40
16	1,400	0.16-0.28	1,000	0.16-0.28	900	0.16-0.28	500	0.16-0.28	280	0.16-0.28	1,600	0.24-0.32	2,400	0.32-0.48
20	1,150	0.20-0.34	820	0.20-0.34	700	0.20-0.34	400	0.20-0.34	220	0.2-0.34	1,300	0.26-0.40	1,900	0.40-0.60
25	900	0.25-0.45	650	0.25-0.45	560	0.25-0.45	300	0.25-0.45	180	0.25-0.45	1,000	0.30-0.50	1,500	0.50-0.75

□ Recommendation of Cutting Conditions in Reamer

WORKPIECE			DIAMETER	CUTTING CONDITIONS	
Material	Tensile strength(Kg/mm ²)	Hardness(HB)		V (m/min)	f (mm/rev)
Carbon Steel Alloy Steel	~ 100		~10 10~25 25~40	8 ~ 12	0.15 ~ 0.25 0.20 ~ 0.40 0.30 ~ 0.50
	100 ~ 140		~10 10~25 25~40	6 ~ 10	0.12 ~ 0.20 0.15 ~ 0.30 0.20 ~ 0.40
Steel Castings	40 ~ 50		~10 10~25 25~40	8 ~ 12	0.15 ~ 0.25 0.20 ~ 0.40 0.30 ~ 0.50
	50 ~ 70		~10 10~25 25~40	6 ~ 10	0.12 ~ 0.20 0.15 ~ 0.30 0.20 ~ 0.40
Cast Irons		~ 200	~10 10~25 25~40	8 ~ 15	0.20 ~ 0.30 0.30 ~ 0.50 0.40 ~ 0.70
		200 ~	~10 10~25 25~40	6 ~ 12	0.15 ~ 0.25 0.20 ~ 0.40 0.30 ~ 0.50
Aluminum Alloys			~10	15 ~ 25	0.20 ~ 0.30 0.30 ~ 0.50 0.40 ~ 0.70
			10~25 25~40	20 ~30	

□ The Effect of Chamfer

TWIST DIRECTION	CHARACTERISTICS
	If the work piece is caught by sharp blade edge, dent occurs on the machined surface. It is applied to chucking reamer, etc.
	Guide edge was rounded. The ground surface is excellent but round machining is difficult and it may deteriorate the machined surface.
	It is 2 blade-type. Chip is produced in 2 stages and it provides good results. But regrinding is difficult.
	The guide part of second stage of cutting edge is 1~2°. Cutting edge blade is long and life is limited. It provides good results on finish machining
	The guide part of second stage is 10~20. It is very economical as the length of blade is short and utilized length is long
	It is used for finish machining. It is applied to hand reamer.

□ The Effect of Twist Angle

TWIST DIRECTION	CHARACTERISTICS
Straight blade (twist angle is 0°)	<ul style="list-style-type: none"> • Surface is generally poor except cast iron.
Right twist blade	<ul style="list-style-type: none"> • Excellent machinability and easy to discharge chip • Applicable work piece range is wide • Excellent for high hardness work piece
Left twist blade	<ul style="list-style-type: none"> • Excellent surface roughness for work piece of aluminium alloys, copper, and copper alloys • It is good for machining soft materials

▣ Trouble Shooting of Reaming

TROUBLE	PLAN	MEASURES
Enlarged Hole	Increase burnishing effects	<ul style="list-style-type: none"> • Decrease chamfer angle • Decrease back taper • Use S.Cl type cutting oil • Increase margin width • Grind 2 stages chamfer • Check reamer diameter
	Suppress the occurrence of built-up-edge	<ul style="list-style-type: none"> • Increase margin width • Change heat treatment conditions and microstructure of workpiece • Increase cutting oil supply • Increase cutting speed and reduce feed rate
	Reduce the unbalance of cutting force	<ul style="list-style-type: none"> • The cutting edge difference shall be less than 0.005mm • Increase cutting speed • Reduce the deviation of main axis and basic Diameter • Check wear conditions of bush and replace it • Change water soluble cutting oil to non-water soluble oil
Shrunked Hole	Reduce finish effects	<ul style="list-style-type: none"> • Increase the clearance angle of cutting edge • Decrease margin width • Increase cutting speed • Increase back taper
Poor roundness	Reduce Chattering	<ul style="list-style-type: none"> • Increase the strength of machine • Change to left helix reamer • Increase back taper • Increase feed rate • Reduce the tolerance of bush • Increase margin width • Decrease cutting speed
Poor surface roughness	Increase burnishing	<ul style="list-style-type: none"> • Use left helix • Grind with 2 stage chamfer • Decrease chamfer angle
	Remove deposit	<ul style="list-style-type: none"> • Increase rake angle • Reduce feed rate • Increase cutting speed
	Remove chattering	<ul style="list-style-type: none"> • The cutting edge difference shall be less than 0.005mm • Increase cutting speed • Align main axis center and basic diameter center • Change water soluble cutting oil to non-water soluble oil
	Remove chip interference	<ul style="list-style-type: none"> • Change shape of flute type • Increase the depth of flute

