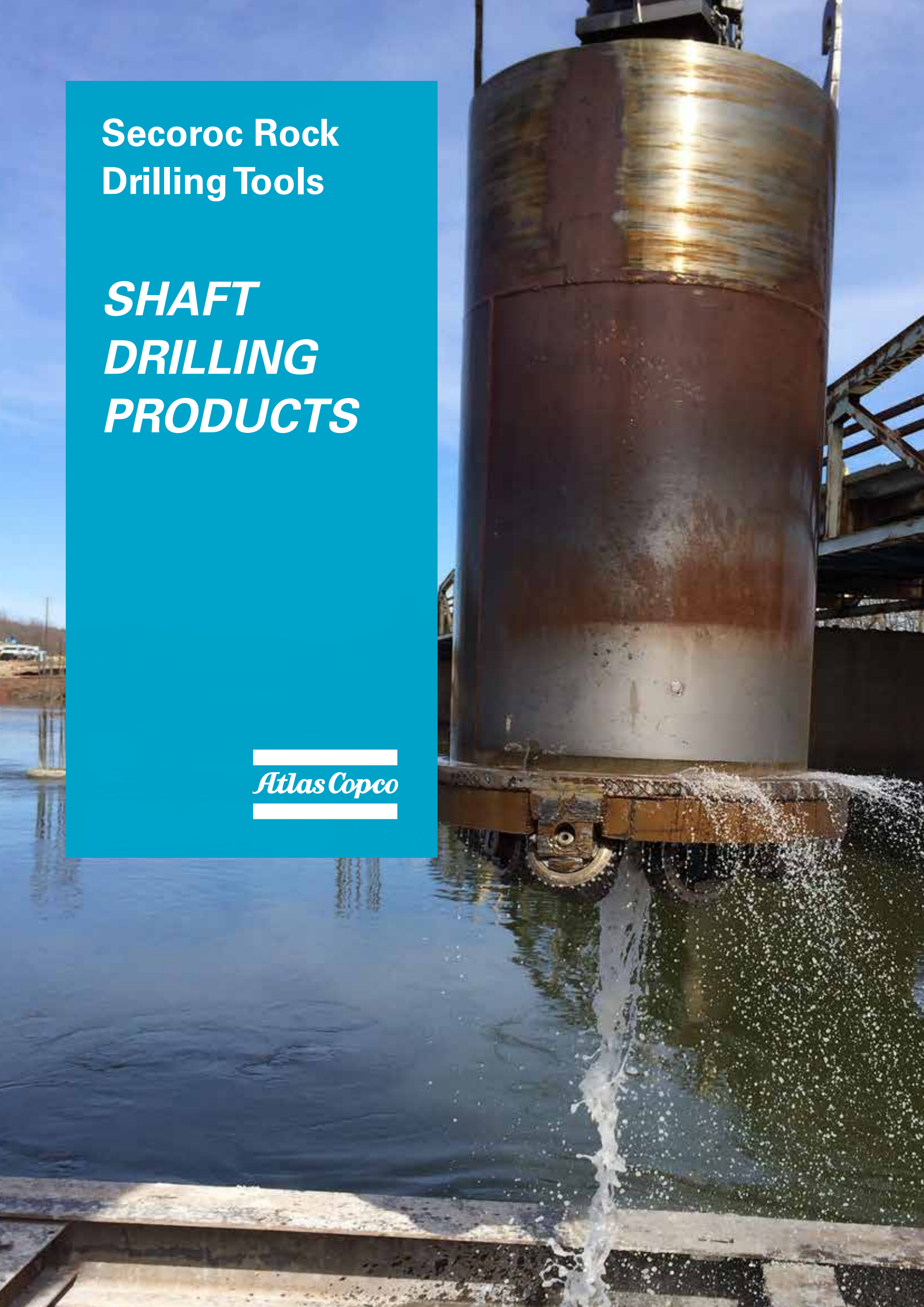


Secoroc Rock Drilling Tools

SHAFT DRILLING PRODUCTS

Atlas Copco

Shaft drilling – preferred in almost all situations

Shaft drilling is defined as the application of rotary drilling techniques for excavating large diameter vertical or near vertical openings or shafts.

Shafts are vertical openings which are driven downward. Decisions about the size, shape and positioning of shafts are taken based on the purpose they are intended to serve. Usually circular shafts are preferred in almost all situations because they are very stable.

Major advantages of shaft drilling over conventional drill and blast methods are the safety, speed, less fragmentation on the ground providing fewer losses in air flow for ventilation, utilization of capital and inherent ability to cope with adverse geological conditions.

Advantages

- A single drilled shaft replaces a group of piles and their pile cap.
- Shafts can be constructed in denser soils and are easier than driving piles.
- There is little noise or ground vibration compared to pile driving.
- Piles driven into soils may produce ground heaving which can cause previously driven piles to move laterally.
- The base of a drilled shaft can be enlarged to provide a greater resistance to uplift (under-reaming or "bell").
- The surface over which the base of the drilled shaft is constructed can be visually inspected.
- Drilled shafts have very high resistance to lateral loads.

Shaft applications:

Hydro-electric projects
- Surge chamber
- Ventilation shaft
- Elevator shaft
- Pressure shaft
- Cable shaft

Municipal water supply
- Access or service shaft
- Ventilation
- Supply riser
- Uptake or down-take shaft

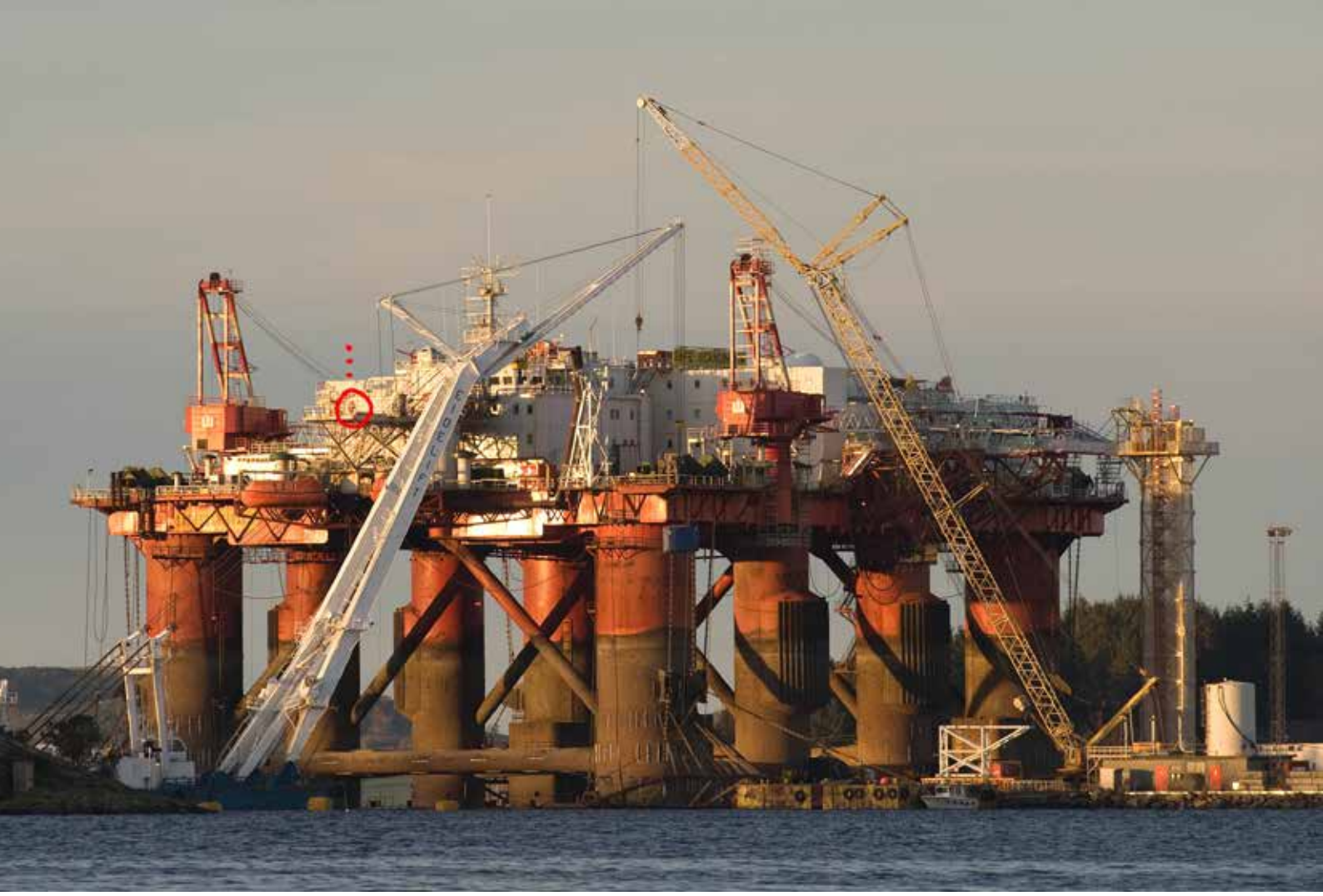
Waste water shafts
- Wells
- CO_2 sequestration, injection or hazardous waste wells

Bridges, Piers
- Onshore
- Offshore

Windmill Farms
- Onshore
- Offshore

Harbor, Dry Docks

Tunnel projects
- Ventilation
- Accelerators housing
- Access



Why Secoroc shaft drilling products?

Atlas Copco has been in the mining and construction market for many years and is committed to innovative, productive, market leading solutions.

Benefits and values:

- Faster rate of penetration for greater production.
- Most complete formation and hole coverage.
- Uses less weight of bit requiring less energy.
- Fail-safe load pin mechanism, so cutters aren't lost in hole.
- Hydrostatically sealed and can be submerged under water without affecting bearing performance.
- Random Cutting Structure on cutters allow a single cutter type to dress all positions and minimize inventory.
- Random Cutting structure is design to optimize the drilling parameters whenever machine load capacity is limited.
- Cutters are designed with replaceable load carrying elements.
- Agressive cutting structure on center cutters to maximize the performance on medium to harder rocks.
- Random TCI and paired milled tooth cutting structures are designed for optimum face coverage and drilling efficiency.
- Dual seals keep the lubricating grease inside the bearings, and the cutting and contamination out of the bearings.
- Bearings are designed with pressure compensation to equalize internal and external pressures to prevent seal damage.

Cutters for a large variety of applications

All shaft cutters are hydrostatically sealed and can be used in submerged applications without affecting the bearings.

The center of all shaft bits are typically dressed with a center cutter, specifically designed for small turning radius. Atlas Copco Secoroc offers center cutters with either milled tooth cutting structures for soft to medium ground formations, or with randomly placed tungsten carbide inserts for medium hard to hard ground formations.

The rest of the shaft bit is dressed with one of the three available cutter models depending on the drilling diameter. The 3 available models are the Series 8, the Series 12, and Series 13.

Series 8 cutters are the smallest of the cutters and are used to dress shaft bits smaller than 48 inches.

Features:
- Load Pin Cutters and Saddles
- Sealed Bearing Cutters
- Bores up to 1.2 meters (48")
- Pressure compensated
- Hard or Soft rock

Series 12 cutters are mid-size cutters commonly used in diameters larger than 42 inches and less than 12 feet.

Features:
- Load Pin Cutters and Saddles
- Sealed Bearing Cutters
- Bores 1.2 meters – 6 meters (47" – 236")
- Pressure-Compensated
- Hard or Soft rock

Series 13. cutters were designed for bolt on saddles; used for diameters up to 20 feet.

Features:
- Bolt-on Cutters
- Mag 99 Bolt-on Cutters
- Typical Cutter Layout
- Bores up to 6 meters (236")

All cutters are available with different cutting structures.

Details are provided on the product specification pages of this catalog.

18 3/8" Center Cutters

Center cutters are used to cover the center of the shaft bit. Their greater cone angle allows them to cut the rock at the center of the shaft, with maximum rolling efficiency.

Atlas Copco Secoroc offers both milled tooth (MT) center cutters and random TCI center cutters. The bearing design for both cutters, utilize three rows of roller bearings, and one row of ball bearing.

Milled tooth cutters are designed for soft to medium formations. Their teeth are long and sharp to create a gouging action on soft formations.

The random TCI (tungsten carbide inserts) cutter uses an aggressive cutting structure to maximize performance in medium to hard rock.

Center cutters are not commonly repaired after use and are commonly offered with mounting pads that allow them to be bolted on the bit.

18-3/8" IADC 6-1-5 random TCI (tungsten carbide insert) cutting structure

18-3/8" IADC 1-2-5 milled tooth

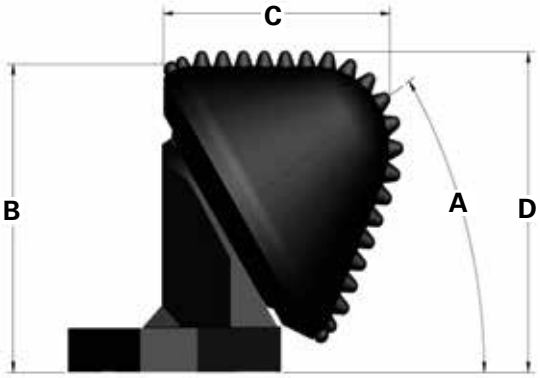
18 3/8" Center Cutters available

Cutter Size		Product No.	Product Code	IADC	Special Features	Kerf Length		Mount Pad	Weight estimate		Maximum Cutter Operating Parameters		
											WOB		RPM
inch	mm					inch	mm		lbs	kgs	lbs	tons	
18 3/8	467	91001191	CNT-04-RJS12	1-2-5	Milled Tooth, High Durability Hardfacing	9.13	232	MT	190	86	20,000	9.1	100
18 3/8	467	91000703	CNN-00-RJS61	6-1-5	Random Cutting Structure	9.29	236	TCI	190	86	20,000	9.1	100

18 3/8" Center Cutters Fastener Kit

Item	Product No.	Product Code	Qty Required per Cutter	Special Features	Weight estimate	
					lbs	kgs
MT Fastener Kit	91002799	FAS-NS-P	1	Includes (1) MT Mount Pad (2) Dowels (3) Bolts (3) Lock Washers	110	50
TCI Fastener Kit	91002800	FAS-NT-P	1	Includes (1) TCI Mount Pad (2) Dowels (3) Bolts (3) Lock Washers	92	41.82
ST Mount Pad	91002120	N/A	1	3.375" Height	97	44
TCI Mount Pad	91000260	N/A	1	2.75" Height	79	36
Dowel Pin	91001186	N/A	2	1.00" Dia x 1.44" (25.4 mm Dia x 36.6 mm)	0.07	0.03
Bolt	91002123	N/A	3	Socket head cap screw 1.75" UN-5 x 4.00"	4	2
Lock Washer	91002124	N/A	3	Nord lock washer 2.76" OD x 1.82" ID x .37" thick	0.35	0.16

Item	A	B		C		D	
		in	mm	in	mm	in	mm
TCI Center Cutter	33°	11.14	283,1	9.29	236	11.52	292,7
ST Center Cutter	33°	10.751	273,06	9.13	232	11.65	295,8



Series 8 Cutters

Series 8 shaft cutters are commonly used for 24" to 47" diameter bores. They are the smallest saddle mounted cutters manufactured by Atlas Copco Secoroc. Series 8 cutters are available in either paired steel tooth cutter M1X and M2X or with random tungsten carbide cutting structure.

Series 8 cutters feature a sealed roller-ball-roller bearing design. These cutters are designed with a pressure compensator system to reduce the stress on the seals during operation. The paired M1X and M2X are used in medium to hard formations such as shale, chalk, limestone, etc.. The cutters have matched teeth patterns, which run in pairs for optimum face coverage and drilling efficiency.

Series 8 M1X cutter with saddle.

Series 8 M2X cutter with saddle.

Series 8 HH1X TCI random cutting structure cutter with saddle.

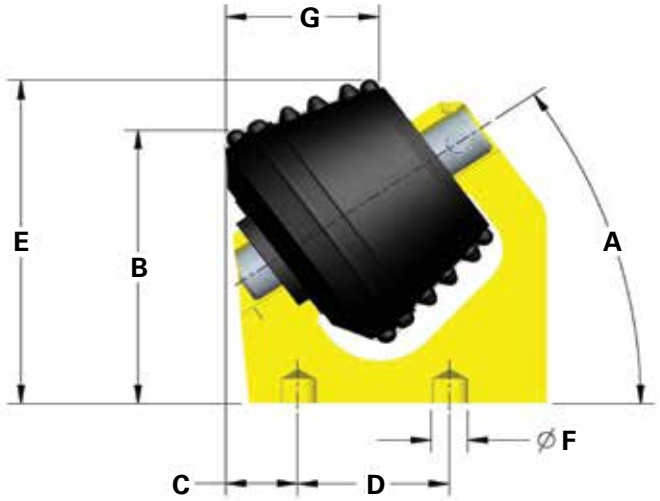
Series 8 Cutters

Product No.	Product Code	IADC	Product	Special Features	Kerf Length		Suggested Bore Diameters		Weight estimate		Maximum Operating Parameters		
											WOB		RPM
					inch	mm	inch	mm	lbs	kgs	lbs	tons	
91000636	CET-2-RJS12	1-2-4	S8 M1X	Milled tooth, high durability hardfacing	4.04	103	24-47	610-1194	42	19	6,000	2.7	250
91000637	CET-3-RJS12	1-2-4	S8 M2X	Milled tooth, high durability hardfacing	4.04	103	24-47	610-1194	40	18	6,000	2.7	250
91000638	CEN-00-RJS63	6-3-5	S8 HH1X	TCI random cutting structure	4.25	108	24-47	610-1194	53	26	10,000	4.5	250

Item	A		B		C		D		E		F		G	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Series 8 Gage TCI	35°	---	8.39	213.2	2.02	51.2	4.25	107.95	9.92	252	1.016	25.81	4.30	109.2
Series 8 Inner TCI	12.5°	---	9.80	248.9	.54	13.8	4.25	107.95	9.89	251.1	1.016	25.81	4.59	116.6
Series 8 Gage MT (MX1 & MX2 Combined)	35°	---	8.34	211.8	2.03	51.5	4.25	107.95	9.96	253.1	1.016	25.81	3.98	101.1
Series 8 Inner MT (MX1 & MX2 Combined)	12.5°	---	9.95	252.6	1.00	25.4	4.25	107.95	9.92	252.1	1.016	25.81	4.30	109.2
Series 8 Gage Riser Block Rec.	8.3	210.8	6.5	165.1	7.0	176.5	4.25	107.95	3.3	82.5	4.125	104.76	1.012	25.70
Series 8 Inner Riser Block Rec.	9.3	236.2	6.5	165.1	6.7	168.9	4.25	107.95	3.3	82.5	4.125	104.76	1.012	25.70

Series 8 fastner kit and individual piece parts

Product No.	Description	Required Per Cutter
91000614	Fastener Kit	1
91000185	1/2-13 UNC x 5" Grade 2 Bolt	2
91000186	1/2-13 UNC Self Locking Nut	2
91000257	Series 8 Load Pin	1
91000258	Outer Bushing	1
91000259	Inner Bushing	1

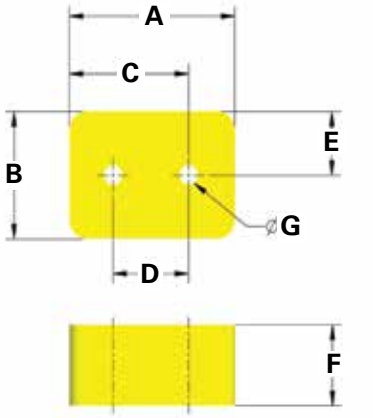


Series 8 Gage and Inner Saddles

Product No.	Postion	Angle
91000730	Gage	35
91000731	Inner	12.5

Series 8 Riser Block

Item	A		B		C		D		E		F		G	
	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Series 8 Gage Riser Block Recommended	8.3	210,9	6.5	165,1	7.0	176,5	4.25	107,95	3.3	82,5	4.125	104,76	1.012	25,7
Series 8 Inner Riser Block Recommended	9.3	236,2	6.5	165,1	6.7	168,9	4.25	107,95	3.3	82,5	4.125	104,76	1.012	25,7



Series 8 cutters are mounted with a riser block for height adjustment and cutting structure optimization.

Series 12 Cutters

Series 12 cutters are generally used for drilling holes 48" to 120" in diameter. Series 12 cutters feature a high capacity bearing package design using three rows of rollers and one row of balls (Roller- ball-roller-roller design). The bearing is protected by seals that keep the grease in and abrasive materials out. Several cutter designs are available including milled tooth and tungsten carbide inserts.

The random TCI cutters are used in medium-hard to hard formations. This cutter features tungsten carbide inserts placed in a random pattern providing full coverage on the formation. This requires only one type of cutter that will fit all the inner and gage positions on the shaft bit.

Kerf cutters are most efficient in medium to hard formation. A disk type cutting action is simulated for improved chip size and increased rate of penetration (ROP) assuming adequate circulation is available. Kerf cutters have cutting structures that allow them to be paired as required.

The milled tooth cutters are used in soft to medium formations such as siltstone, chalk, and shales. The milled tooth cutters have hardfaced cutting structures that enable them to be paired as required.

Series 12 TCI random cutting structure with saddle..

Series 12 MG1X Milled tooth cutter with saddle..

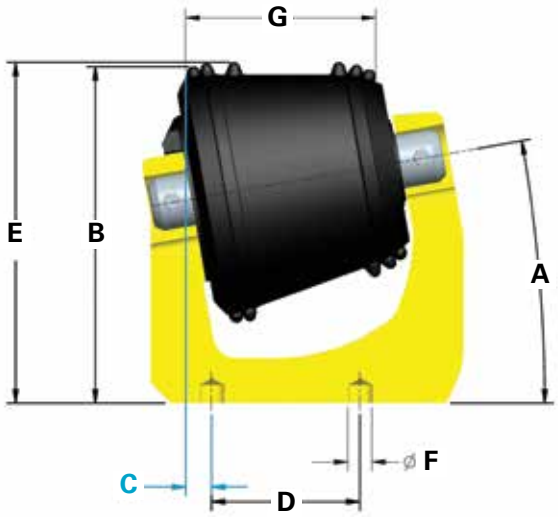
Series 12 MG2X Milled tooth cutter with saddle.

Series 12 Kerf Cutters.

Series 12 Cutters

Product No.	Product Code	IADC	Product	Special Features	Rebuild Kit Style	Kerf Length		Suggested Bore Diameters		Weight estimate		Maximum Operating Parameters		
						in	mm	in	mm	lbs	kgs	WOB		RPM
												lbs	t	
91000634	CLT-3N-RLS13	1-2-4	S12 MG1X	Milled tooth, high durability hardfacing	S	6.24	158	47-120	1194-3048	150	68	20,000	9.1	200
91000635	CLT-3G-RLS13	1-2-4	S12 MG2X	Milled tooth, high durability hardfacing	S	6.24	158	47-120	1194-3048	150	68	20,000	9.1	200
91000632	CLN-00-RMS61	6-2-5	S12 RDM	TCI random cutting structure	L	7.3	185	47-120	1194-3048	161	73	20,000	9.1	200
91002085	CLH-4-RMS		SC12 KC 4G	TCI 4 Kerf rows	S	7.3	185	47-20	1194-3048	141	64	20,000	9.1	200
91002086	CLH-4-RMS		S12 KC 4N	TCI 4 Kerf rows	S	7.3	185	47-120	1194-3048	134	61	20,000	9.1	200
91002087	CLH-3-RMS		S12 KC 3	TCI 3 Kerf rows	S	7.3	185	47-120	1194-3048	130	59	20,000	9.1	200

Item	A	B		C		D		E		F		G	
		in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
Series 12 Gage	35°	14.17	359.9	1.09	27.7	6.25	158.75	14.36	364.7	1.016	25.81	7.28	184.8
Series 12 Inner	10°	1.09	27.7	.85	21.7	6.25	158.75	14.31	363.4	1.016	25.81	7.74	196.6
Series 12 Gage MT (MX1 & MX2 Combined)	35°	11.84	300.8	4.38	158.4	6.25	158.75	14.73	374.2	1.016	25.81	6.24	158.4
Series 12 Inner MT (MX1 & MX2 Combined)	10°	14.84	376.9	.60	15.3	6.25	158.75	14.82	376.5	1.016	25.81	6.88	174.6
Series 12 Gage Kerf (Combined)	35°	11.09	281.6	4.40	111.7	6.25	158.75	14.16	359.78	1.016	25.81	6.46	164.1
Series 12 Inner Kerf (Combined)	10°	14.13	358.8	.87	22.1	6.25	158.75	14.22	361.2	1.016	25.81	7.09	180.1



Series 12 Saddles

Product No.	Postion	Angle
91000732	Gage	35
91000733	Inner	10

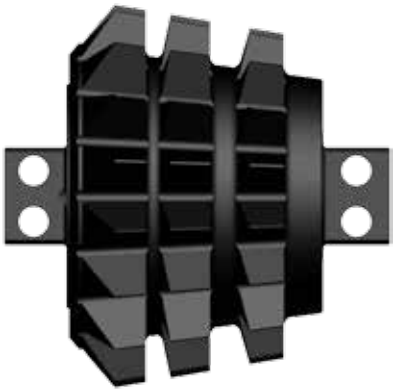
Series 12 fastener kit and individual piece parts

Product No.	Description	Required Per Cutter
91000616	Fastener Kit	1
91000174	3/4-10 UNC x 7" Grade 2 Bolt	1
45101162	3/4-10 UNC Self Locking Nut	2
91000184	3/4 10 UNIC x 5 1/2" Grade 2 Bolt	1
91000254	Bushing	2
91000255	Series 12 Load Pin	1

Series 13 Cutters

Product No.	Product Code	IADC	Product	Special Features	Kerf Length		Suggested Bore Diameters		Weight estimate		Max. Operating Parameters		
					inch	mm	inch	mm	lbs	kgs	WOB		RPM
											lbs	ton	
91002715	CBT-03G-RMD	1-2-5	S13 M1	Milled tooth 1	6.98	177	47-120	1200-3050	190	86	20,000	9.1	150
91002716	CBT-03N-RMD	1-2-5	S13 M2	Milled tooth 2	5.95	151	47-120	1200-3050	195	88	20,000	9.1	150
91001223	CBN-00-RMD	6-2-5	S13 RDM	TCI random cutting structure	7.68	195	47-120	1200-3050	165	175	20,000	9.1	150
Mag 99 Cutters													
91001753	CZN-00-RMS	6-2-5	MAG99	TCI random cutting structure	7.31	186	47-168	1200-4267	276	125	20,000	9.1	150

Series 13 M1 Milled tooth cutters - 91002715



Series 13 M2 Milled tooth cutters - 91002716

TCI shaft rings

Product No.	Product Code	UCS (ksi)	Product	Special Features	Weight estimate		Maximum Operating Parameters	
							WOB	
					lbs	kgs	lbs	tns
91001558	CKC-01SE	>20	13" Shark Ring	Carbide Inserts	24	11	45,000	17
91002104	CKC-01SF	>20	15" Shark Ring	Carbide Inserts	40	18	50,000	19
91002162	CKC-01SG	>20	17" Shark Ring	Carbide Inserts	71	32	60,000	22

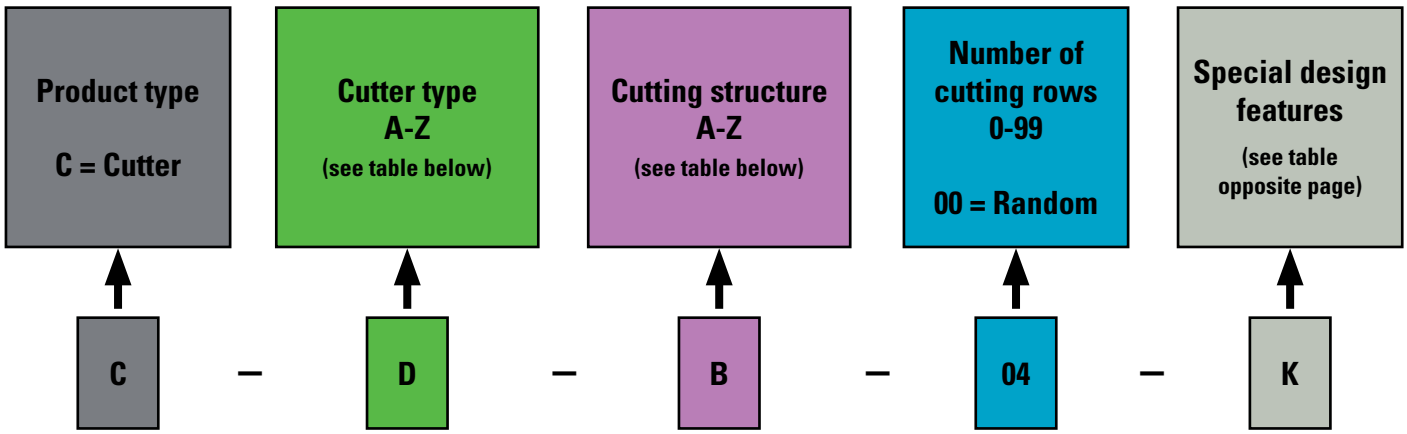
Cutter Selection Chart

Shaft Cutter Type vs. Rock Hardness		
Rock UCS (PSI)	**Cutter Types**	**Rock Type**
0	Milled Tooth	Claystone, Mudstone
		Chalky Limestone
4,000		Soft Shale
	TCI Random Cutting Structure	Loose Sandstones
8,000		Limestone, Siltstone
		Solid Sandstones
12,000		Medium Shales
		Tuff, Soft Schist
16,000		Andesite, Rhyolite
		Quartzite (Sand, Silt)
20,000		Limestone, Marble
		Monzonite, Granite
24,000	TCI Kerf Cutting Structure	Gneiss
		Diorite, Diabase
28,000		Hard Shale, Slate
		Limestone, Dolomite
32,000		Basalt
		Tactite, Skarn
36,000		Granodiorite
		Tacorite
40,000		Quartzite
		Syenite
44,000		Gabbro
48,000		Banded Iron Formation
		Taconite
52,000		Chert
56,000		Quartzite
60,000		Amphibolite
64,000		Hornfels
68,000		Hematite Ore
Higher		'Lava', Basalt, Biwabic, Quartzite

Rock UCS hardness (Unconfined Compressive Strength) is only one factor that contributes to the "drillability" of any rock. Other factors strongly influencing drillability are: fracture toughness, shear strength, Young's Modulus of Elasticity, Poisson's Ratio of Stress vs. Strain, internal angle of friction. Any particular bit may be used in harder or softer rock than this chart indicates.

Catalog code key

Shaft drilling products

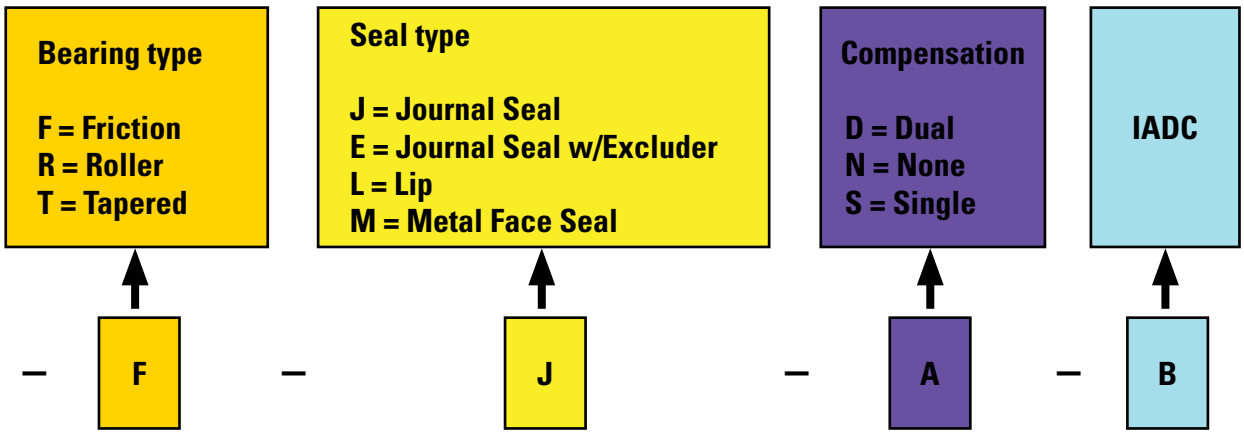


CUTTER TYPE TABLE

A = Magrok
B = BH99 cutter
C = C – cutter
D = Down reamer cutter
E = Series 8 cutter
F = HDD Trojan B cutter
G = Series 12 Wedgelok cutter
H = HDD Bit Third Weld on
J = HDD Square Lug Weld on
K = Disc cutter
L = Series 12 load pin
M = Magnum cutter
N = Shaft centre cutter
P = HDD Bolt on
Q = HDD Q - cutter
R = RCC cutter
S = SRCC cutter for Sandvik housing
T = HDD Trojan H cutter
U = Ultra Magnum cutter
V = Magnum cutter for Sandvik housing
W = W – cutter
Z = Mag99 (Magnum for Wirth Shaft Saddle)

CUTTING STRUCTURE TYPE TABLE

B = Ballistic insert
C = Round top chisel insert
D = Steel disc
H = Chisel insert
N = Conical insert
P = Scoop insert
S = Spherical insert
T = Steel tooth



SPECIAL DESIGN FEATURES TABLE

G = Cutter with 1" row spacing on gauge. Used for cutter types with the same amount of carbide rows in a pair.

N = Cutter with 1" row spacing on nose. Used for cutter types with the same amount of carbide rows on each cutter in a pair.

M = Medium Formation (for HDD cutters)

H = Hard Formation (for HDD cutters)

K = Kerf Rows

GH = Gage cutter with harder carbide

NH = Nose cutter with harder carbide

RH = Right Hand Helix

LH = Left Hand Helix

SA = 5 ¼"

SB = 6 ¾"

SC = 9"

SD = 12 ¼"

SE = 13"

SF = 15"

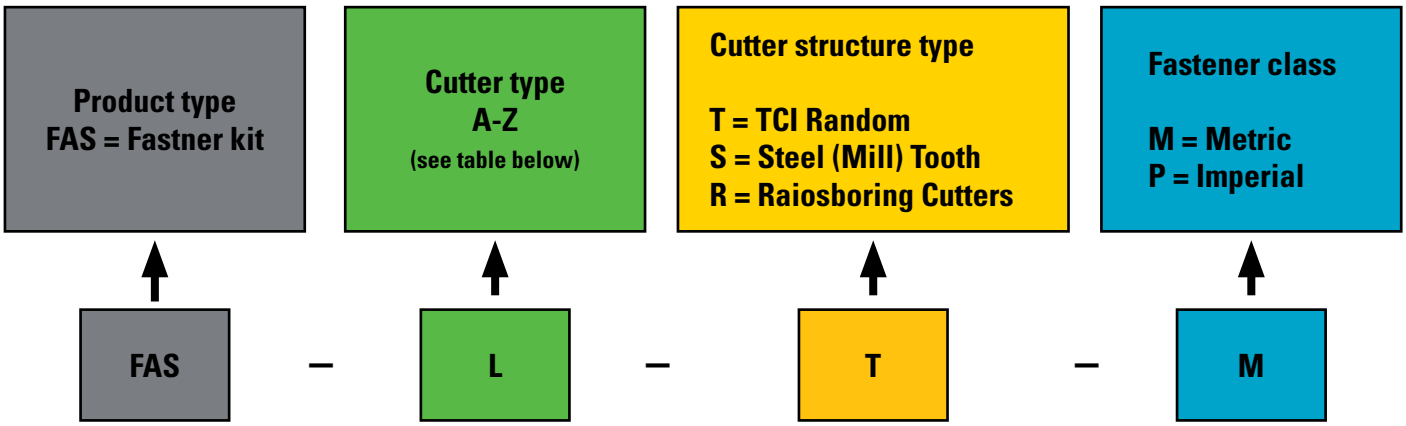
SG = 17"

SH = 17 ½"

SJ = 24"

Catalog code key

Rebuild/fastener kits



CUTTER TYPE TABLE	
A = Magrok	M = Magnum cutter
B = BH99 cutter	N = Shaft centre cutter
C = Cutter	P = HDD Bolt on
D = Down reamer cutter	Q = HDD Q cutter
E = Series 8 cutter	R = RCC cutter
F = HDD Trojan B cutter	S = SRCC cutter for Sandvik housing
G = Series 12 Wedgelok cutter	T = HDD Trojan H cutter
H = HDD Bit Third Weld on	U = Ultra Magnum cutter
J = HDD Square Lug Weld on	V = Magnum cutter for Sandvik housing
K = Disc cutter	W = W cutter
L = Series 12 load pin	Z = Mag99 (Magnum for Wirth Shaft Saddle)

Terminology/Definitions

Center cutter The center most cutter placement on a bit.

Cutting structure The area of the cutter that is designed to come in contact with the ground to break or cut the formation.

Fastener kit Kit specially design to assemble cutters to the saddles and to correctly place the saddles on the bit.

Hardfacing Special weld material used to improve wear propterties.

Gage cutter The cutters of the bit that drills the outermost diameter of the hole.

IADC code International Association of Drilling Contractors code assigned to cutters for determining appropriate cutting structure.

Inner cutter The cutter that is placed between the center cutter and the gage cutter.

Kerf length The length of the cutting structure that comes in contact with the formation during drilling.

Load pin Metal pin that attaches the cutter to the saddle.

Pressure comphensated The ability of the cutter to adjust internal pressure to external pressure to reduce stresses on internal components.

Product code Special code assigned to identify products and their special features.

Riser pad Metal plate used for adjusting height for a better cutting profile.

ROP Rate of penetration.

Shaft drilling Rotary drilling techniques for excavating large diameter vertical or near vertical openings.

UCS Unconfined Compressive Strength of the rock.

WOB Weight on Bit.

COMMITTED TO SUSTAINABLE PRODUCTIVITY

We stand by our responsibilties towards our customers, towards the environment and the people around us. We make performance stand the test of time. This is what we call – Sustainable Productivity

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