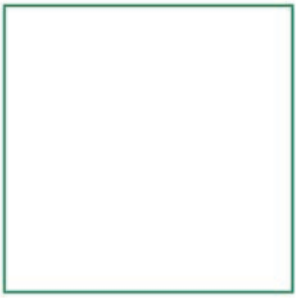
TECSO, S.A.

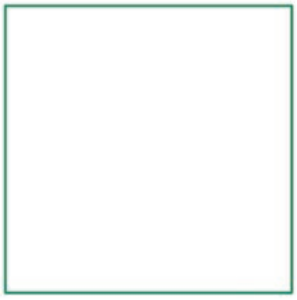
7. DIAMOND AND TUNGSTEN CARBIDE DRILLING TOOLS

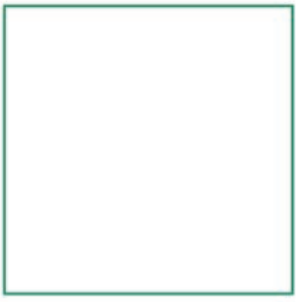












Surface set core drilling bits

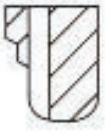
DIAMONDS SIZES	
S.P.C	TYPE OF FORMATION
8 - 10	Very soft
10 - 15	Soft to medium
20 - 25	Soft, medium-hard to hard
30 - 40	Hard
40 - 60	Very hard
60 - 80	Very hard, fine grain

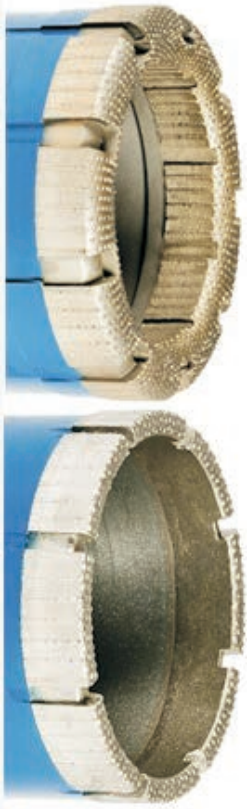
TECSO, S.A., Manufactures different types of surface set diamond bits adapted to each application, in order to obtain optimum performance and high drilling rates.

Diamonds for these bits are set on special profiles, designed and developed during many years to offer the best results to the user.

Diamonds on surface set diamond drill bits are embodied in a matrix powder for very resistant wear.

Surface set diamond bits are recommended for use in drilling soft, abrasive, unconsolidated formations that are not effectively drilled by impregnated diamonds bits.

BIT PROFILE		
BIT PROFIL		**TYPE OF FORMATION**
Half round		Standard, high drilling rate. All formations, hard and broken.
Redondo		For thick wall bits. Hard and abrasives formations.
Full round		Good drilling rate, standard for wire line bits. Fragile on broken formations.
Pilot		High stability, drilling rate and core recovery. Soft to medium hard formations
Front flushing		Thick wall bits. Very stable. Soft formations. Maximum core recovery
Note: This design is subject to alteration without notice		



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Impregnated diamond bits

Impregnated diamond bits are specially designed to work as if they were grinding tools and must work at high speed.

This type of bit is developed in such a way that are the matrix wears down new grains of diamond are exposed, resulting in an efficient and stable cutting action.

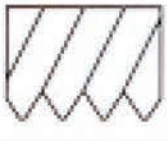
It is very important that matrix and diamond wear at the same rate to achieve the best drilling rates and the longer working life of the bit. You can understand what is the importance of the choice of the matrix.

Impregnated diamond bits may be manufactured with various diamond depths and different matrix compositions, as well as different diamond concentrations. Waterways on these bits are reinforced with natural diamonds and tungsten carbide inserts.

As on surface set diamond drill bits, there are different profiles for impregnated diamond bits.

Impregnated diamond core bits are primarily recommended in hard to medium hard formations.

MATRIX TYPE AND ROCKS CHARACTERISTICS	
DENOMINATION	**APLICATIONS**
S-3	Medium hard. Extremly abrasives and very broken formations.
S-4	Medium hard. Very abrasives and broken formations.
S-5	Medium hard. Abrasives and broken formations.
S-6	Hard. Medium abrasivitivy, lightly fractured formations. Medium grain.
S-7	Hard. Non abrasives, homogeneous and coarse formations. Medium grain.
S-9	Hard. Non abrasives, homogeneous and coarse formations. Fine grain.
S-10	Extremly hard. Non abrasives, homogeneous and coarse formations. Fine grain.

CHOICE OF BIT PROFILE		
BIT PROFILE		**FORMATION TO DRILL**
Flat		Hard. Broken formations, narrow profile. (B-T2)
W		Hard. Homogeneous formations, width profile. (T6-DCDMA- Wire-line)
Note: This design is subject to alteration without notice a		

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CASING SHOES

Casing shoes are fitted on a casing tube to assist in achieving the required hole depth.

The outer diameter of the casing shoe is according to the hole diameter, and the inner diameter of the casing shoe of an adequate diameter to enable a corebarrel to pass through it.

TECSO, S.A., makes surface set and impregnated diamond casing shoes.

SURFACE SET DIAMOND CASING SHOES
The profile for these casing shoes is of half round type. Size and quality of diamonds can be chosen.

IMPREGNATED DIAMOND CASING SHOES
The profile for these casing shoes is flat type, diamond depth is 4 mm and diamond concentration is 35%.

REAMING SHELLS

Diamond reaming shells ensure the constant size of the hole, so that when a new one replaces a worn bit, it is not necessary to redrill the hole.

They are usually larger than the bit. They reduce drill string vibrations and ensure props guidance of the bit.

Reaming shells can be made in all standards. Usually diamonds in reaming shells are Premium Normal Quality, with sizes from 20 to 40 s.c.p.

Waterways on reaming shells ensure the perfect coolant of the bit and the lifting of the cuttings.

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Tungsten carbide and “carbotec” bits

TUNGSTEN CARBIDE BITS (T.C. BITS)

On this type of bit, the cutting zone is formed by t.c. inserts welded to the steel core in a oven or by high frequency using a low fusion point alloy.

May be made using t.c. octagon prism or plaques. The quality of the t.c. used by TECSO in these bits is carefully selected and developed specially for rotary drilling, with excellent results against blocking and wear. The t.c prisms are shaped on a 10 to 15 degrees and can be reshaped to ensure the drilling rate of the bit giving longer life.

Once the t.c. prisms are welded onto the steel core, the outer and inner diameters are machined, the waterways are formed to enable the lifting of the cuttings to the surface.

Generally t.c. bits are used to drill soft to medium hard formations for soil investigation and Geotechnical works. Plaques t.c. drilling bits are specially in these formations as clays, limestones, and their drilling rates is very high.

“CARBOTEC” BITS

The cutting zone on a CARBOTEC T.C. bits is formed by tungsten carbide crystals conglomerates in sizes between 2 to 6 mm mixed with copper nickel base matrix.

Carbotec bits have more cutting points than a normal t.c. bit and its way of working is very similar to a diamond bit. Its drilling speed is higher than the speed of a prism t.c. bit and they produce less vibrations on the drill string.

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T.C. Casing shoes and reaming shells

CASING SHOES

REAMING SHELLS

CASING SHOES

On this type of casings shoes, the cutting zone is formed by T.C. inserts welded to the steel core. The outer and inner diameters are machined. The inner diameter of the casing shoe is the adequate diameter to enable a corebarrel to pass through it, and has no cutting point in the inner that could damage the corebarrel.

Can be made with different types of prisms

REAMING SHELLS

The T.C. reaming shells function is exactly the same as the diamond reaming shells, but in this case, the diamonds are replaced by T.C. Inserts.

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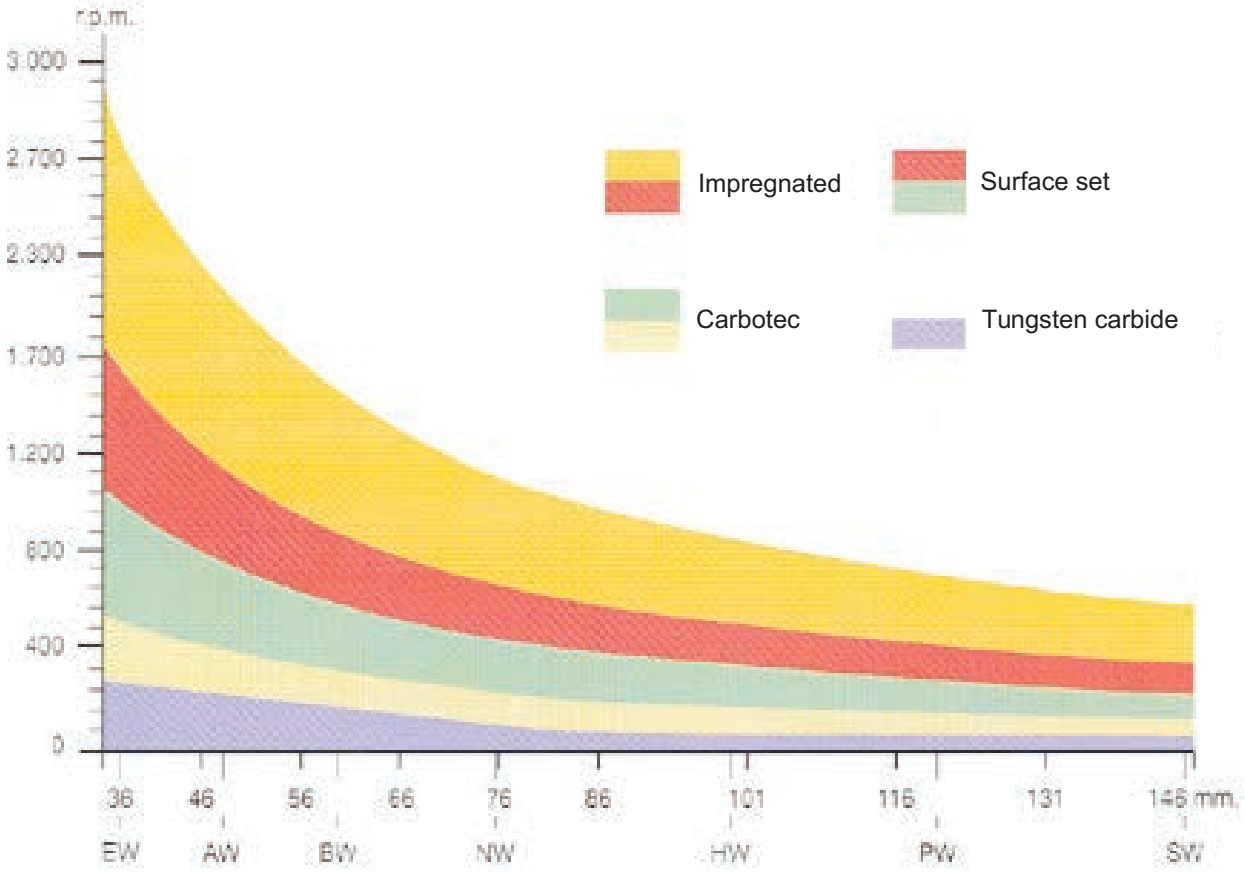
Recommendation chart for core drilling bits

ROCK DESCRIPTION	HARDNESS	TUNGSTEN CARBIDE BITS		DIAMOND BITS												
		T.C. BITS	CARBOTEC BITS	SURFACE SET DIAMOND BITS						IMPREGNATED DIAMOND BITS						
				S.C.P.						MATRIX						
				8-10	10-15	20-25	30-40	40-60	60-80	S10	S9	S7	S6	S5	S4	S3
CLAY CHALK GYPSUM	SOFT	X X X	X X X													
SAND SHALE SALT HARD SHALE ICE MED. HARD LEMESTONE	SOFT TO MEDIUM	X X X X X X	X X X X X X	X X X X X X	 X X X X											
SANDY SHALE SHALE CLAYSTONE SANDY LIMESTONE	MEDIUM HARD NON ABRASIVE		X X X X	X X X X	X X X X	 X X X							X X X X	 X X X		
SILTSTONE ALLUVIAL DEP. CALCITIC HARD SHALE	MEDIUM HARDABRASIVE		X X X	X X	X X X	X X X	X X X	X X X					X X X	X X X	X X X	
HARD LIMESTONE SCHIST SERPENTINE	HARD ABRASIVE				X X X	X X X	X X X	X X X	X X X				X X X	X X X	X X X	
HARD SCHIST HARD SILICEOUS DOLOMITE MARBLE SYENITE DIABASE PEGMATITE HEMATITE MAGNETITE	HARD NON ABRASIVE					X X X X X X	X X X X X X X X	X X X X X X X X X	X X X X X X X X X		X X	X X X X X X X X	X X X X X X X X			
GNEISS GRANITE BASALT DIORITE GABBRO RHYOLITE AMPHIBOLITE	VERY HARD							X X X X X X X	X X X X X X X	X X X X X X X	X X X X X X	X X X X X	X X X X X X			X X X
CONGLOMERATE TACONITE ABRASIVE QUARZITE ABRASIVE SAND STONE	VERY ABRASIVE								X X X X					X X X X		X X X X

Recommendations rotation speed



SURFACE SET DIAMOND BITS

Most suitable rotational speed is between 1 and 2.5 m/s.

IMPREGNATED DIAMOND BITS

Generally, it can be said, that a rotational speed is good, in respect to the feed, when relation (r.p.m. / Feed (m/min)) is between 80 and 100.

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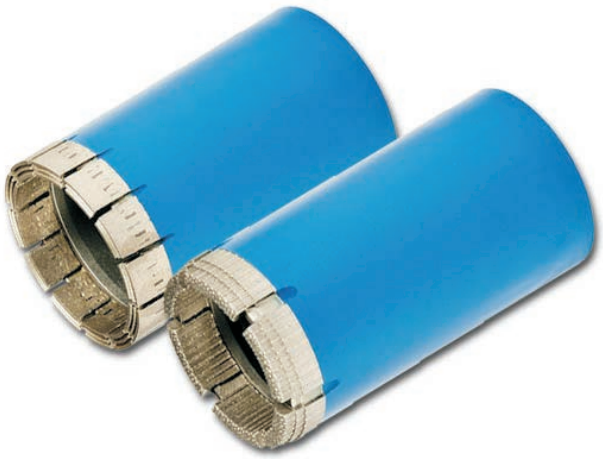
Recommendations - load on bit



SURFACE SET DIAMOND BITS

There are many different ways to choose the maximum load on bit for a surface set diamond bit, and all of them are approximated.
Most used ones are:

1. Max. load = weight on carats x size of diamond (s.p.c.) x 3.2

For the “woc” is considered just the drill bit front.
Size of diamonds on a 40/60 s.p.c. could be used for calculation 50 s.p.c.
Number of carats must be asked to the manufacturer.

Example. TECSO T2-86 40/60 s.p.c. diamond bit:

Max. load = 8.5 carats x 50 x 3.2 = 1360 kg

A T2-86 bit has a surface of 17.37 cm² , so max. pressure:
Pmax = 1360 Kg /17.37 cm² = 78.29 Kg / cm²

2. Max. load = nº diamonds x max. load per diamond

This method is more exact than the previous one but is needed to know the max. load per diamond that depends on the quality of diamonds used. So for the same type of bit using natural diamonds AA quality:

Max. load = (8.5 carats x 50 s.p.c.) x 38 N = 16150 ˜ 1631 Kg

Max. Pressure should be:

Pmax = 1631 /17.37 cm² = 93 Kg / cm²

3. On the drilling site is mostly used a very simple meted. It is not exact but it works.

P = Ø bit x 10 (minimum load)= 8.6 cm x 10 Kg / cm² = 86 Kg / cm²
P = Ø bit x 15 (minimum load)= 8.6 cm x 15 Kg / cm² = 129 Kg / cm²

It is recommended start with the minimum load, when penetration rate drops, load must be increased to maintain a constant penetration rate, and repeat this up to the maximum load. When penetration rate is below 2 cm/min with the max. load the drilling must be stopped.

To check if the load is correct, having a look to the bit after some meters drilled, if:

· Diamond are broken: excessive load
· Diamond are polished: poor load
· Diamond are sharpened: good load

IMPREGNATED BITS

This bits can resist loads between 50 Kg / cm² up to 175 Kg / cm².
Max. load in respect to the matrix hardness is:
· Hard matrix: max. 175 Kg / cm²
· Medium matrix: max. 155 Kg / cm²
· Soft matrix: max. 140 Kg / cm²

Recommendations:

For hard formations medium grain it's recommended from 50 to 60 Kg / cm²
For hard formations fine grain it's recommended from 80 to 150 Kg / cm²

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Wear patterns (Causes - Solutions)

WEAR PATTERN			CAUSE	SOLUTION
	1	Outside diameter gauge loss	Vibrations	Lower the rotational speed
			Lack of fluid circulation	Increase the pump rate
			Reaming wear	Change reaming
	2	Inside diameter gauge loss	Overfeeding The bit	Reduce the penetration rate
			Damage from drilling into highly unconsolidated material	Cement the drill hole or change to a harder matrix type
			Lack of fluid circulation	Check the inner tube length adjustment. Check the in-hole circulation pump rate and the drill rod string for leaks
	3	Cracked waterways	Excesive bit load	Change bit and reduce bit pressure
	4	Concave face wear	Rotational speed is too high	Reduce rotational speed
			Very abrasive rocks	Change to a bit with more abrasion resistance
	5	Convex face wear	Insufficient fluid circulation	Check the circulation pump and drill rod string for leaks
			Repeated in hole “drystripping” in hard non abrasive formations	Cchange to a softer matrix type
	6	Excesive diamond exposure	The penetration rate is too high for the rotational speed in use (overfeeding)	Reduce the penetration rate or increase the rotational speed
			Matrix too soft	Cambiar
	7	Glazed bit face	Slower rotational speed	Lower in hole fluid circulation rate
			Matrix too hard	Change the bit. Change to a softer matrix type.
	8	Burnt bit crown	Loss of fluid	Check pumps, hoses and drill rod string
			Waterway canals are blocked	Clean waterway canals or change the bit

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Matrix selection card Impregnated diamond bits

Hardness (Mohs)	Simple compressive strength (Kg/cm²)	Formation characteristics	Typical rocks	Recommended Matrix	Matrix Hardness
4 (Fluorite)	< 30	Soft. Very abrasive. Highly fractured	Calcite, Limestone, Sandstone, Slate, Marl.	S3	HARD
5 (Apatite)	30 a 100	Medium – soft. Abrasive. Medium to coarse grained	Dolomitic Limestone Hard Limestone, "Soft" granite, Shale, Serpentine.	S4	
6 (Feldspar)	100 a 250	Medium – hard. Moderately abrasive. Fine to medium grained	Andesite, Dacite, Diabase, Greenstone, Dolomite, Marble, Hematite,Micaceous schist, Peridotite, Silicified schist, Syenite.	S5	
7 (Quartz)	250 a 700	Hard. Moderately abrasive. Fine grained.	Granite, Greenstone, Gabbro, Gneiss, Basalt, Pegmatite, Porphyry,Quarzite, Rhyolite, Trachyte, Silicified volcanic, Skarn (granate).	S6 S7	
8 (Topaz)	700 a 2000	Hard. Non-abrasive. Fine grained.	Siliceous conglomerates, Sulphides, Rhyolite,Quarzite, Taconite, Jasperita.	S9	
9 (Corundum)	> 2000	Very Hard. Non-abrasive. Very fine grained.	Silex (Chert), Armorican Quarzite Iron Ore, Rhyolite, Taconite.	S10	SOFT

Recommended Rotation Speed (r.p.m.)

CONVENTIONAL Ø BIT* (mm)	Impregnated		Surface Set	
	Max.	Min.	Max.	Min.
46	1650	950	950	350
56	1350	750	800	300
66	1155	650	700	250
76	1000	550	600	225
86	850	500	525	200
101	750	425	455	170
116	650	350	400	150
131	575	325	350	133
146	525	300	315	115

WIRE-LINE Ø BIT*	Impregnated		Surface Set	
	Max.	Min.	Max.	Min.
AWL (47.6 mm)	1600	920	950	360
BWL (59.6 mm)	1275	725	750	275
NWL (75.3 mm)	1000	575	600	225
HWL (95.3 mm)	800	450	480	180
PWL (122.0 mm)	625	350	375	140

* Nominal Diameter

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