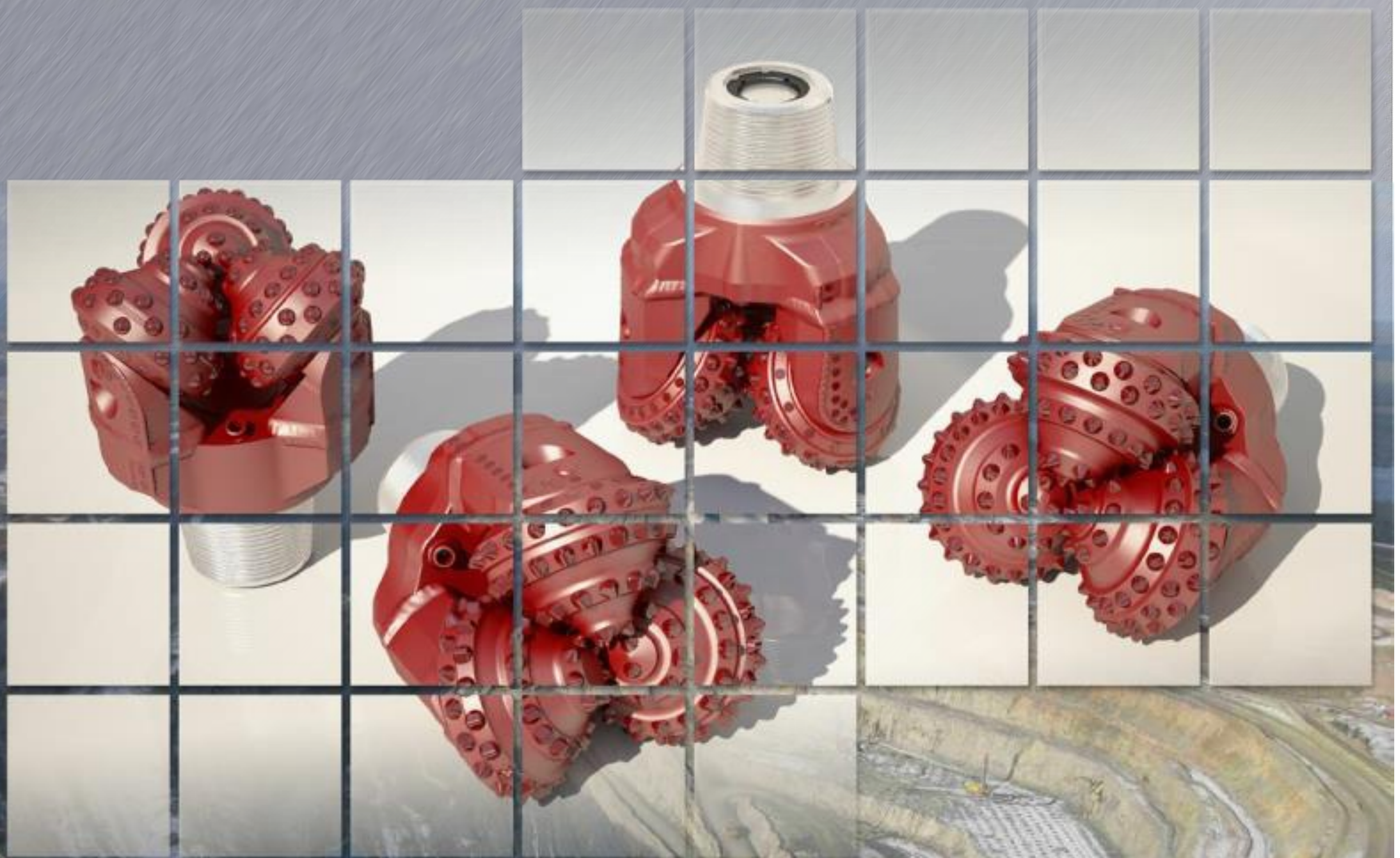
PIONEERS
For Mining Trading E.Z.C

Rock drilling tools



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About us

Pioneers for Mining Trading is a young and dynamic organization. The Company was established in 2016 based at Ajman freezone City and has been supplying a wide range of equipment to the industries of Mining, Foundation Drilling, Water Well Drilling, Exploration Drilling, Construction . and Geotechnical Drilling throughout UAE and Internationally

Pioneers for Mining Trading has made its mark as a reliable Supplier of high quality equipment's for construction, industrial, mining and quarrying industry with support from well-known brands and OEM partners. It is one .of the best suppliers of Quarry and mining equipment's in UAE

Conventional designation of rock drill bits

The following designation of roller cone drill bits is used as per GOST 20692–2003 "Roller cone bits. Specification":

III 250.8 ТКЗ-ПГВ (632Y)

- Number of cones
- Bit diameter, mm
- Drillable formation type
- IADC code
- ПГ – hole bottom cleaning scheme
- В – bearing structure

1. Types of drill bits by number of cones:
I – one-cone;
II – two-cone;
III – tri-cone.
Most of produced bits are of tricone type, so there is no necessity to indicate «III» in designation.

2. Types of drill bits by drillable rock formation features:
М – bit for soft formation drilling, with milled steel teeth;
МЗ – for soft abrasive formation drilling, with tungsten carbide inserts;
МС – for soft formation (with medium-soft formation layers) drilling, with milled steel teeth;
МСЗ – for soft abrasive formation (with medium-soft formation layers) drilling, with tungsten carbide inserts;
С – for medium-soft formation drilling, with milled steel teeth;
СЗ – for medium-soft abrasive formation drilling, with tungsten carbide inserts;
СТ – for medium-soft formation (with medium-hard formation layers) drilling, with milled steel teeth;
Т – for medium-hard formation drilling, with milled steel teeth;
ТЗ – for medium-hard abrasive formation drilling, with tungsten carbide inserts;
ТК – for medium-hard formation (with hard formation layers) drilling, with milled steel teeth;
ТКЗ – for medium-hard abrasive formation (with hard formation layers) drilling, with tungsten carbide inserts;
К – for hard formation drilling, with tungsten carbide inserts;
ОК – for extremely hard formation drilling, with tungsten carbide inserts.

3. Types of drill bits by structure and layout of blowing and flushing ducts:
Ц – bit with central hole bottom flushing;
Г – with lateral water jet flushing;
ЦГ – with combined flushing;
П – with central blowing;
ПГ – with lateral blowing;
ПЦГ – with combined blowing.

4. Types of drill bits by cone support structure:
В – support with radial rolling-element bearings (thrust plain bearings may be used);
ВУ – sealed support with radial rolling-element bearings and thrust plain bearings;
Н – support with one radial plain bearing and thrust plain bearings (the other bearings with rolling elements);
НУ – sealed support with one radial plain bearing and thrust plain bearings (the other bearings with rolling elements);
А – support with two or more radial and thrust plain bearings;
АУ – sealed support with two or more radial and thrust plain bearings.

5. IADC code.
Classification of roller cone bits by IADC (International Association of Drilling Contractors) code is based on four-digit code which represents the bit design and type of rock formation the drill bit is suited for. The first three digits are numerals and the fourth one is a letter.

The first digit represents the hardness of rock formation the drill bits are suited for. Every drill bit is designed for a certain type of rock formation, ranked according to hardness. The tool is assigned a numeral between 1 and 8 indicating the type of rock the teeth or buttons of a drilling tool are designed for:
1, 2 and 3: Drill bits with milled steel teeth. 1 is engineered for soft rock formations, 2 for medium formations, and 3 for hard formations.
4, 5, 6, 7, and 8: Drill bits with tungsten carbide inserts (TCI). Within this category 4 is designated for the softer formations, with 8 representing the hardest formations.
The second digit represents further properties of drillable formation. Regardless of tooth/insert type, the second digit takes into account all factors of the bit and ranks the rock formations the drilling tool is best suited for on a scale from 1 to 4. 1 represents soft formations going up to 4 representing the hardest formations.
The third digit represents the bearing type of the drilling tool.
The fourth digit is a letter indicating the special features of the drilling tool. In addition to the buttons, intended rock formations, and bearings used, tricone bits can have numerous other special properties (see the table below).

IADC code example:
214E – a drill bit with steel milled teeth for medium-soft rock formations (21), with sealed rolling-element bearings (4), with extended jets (E).
632Y – a drill bit with tungsten carbide inserts for medium-hard rock formations (63), with open air-cooled bearings (2), with conical inserts (Y).

Series		Drillable formation type		Support bearing type							
				1	2	3	4	5	6	7	8,9
				Standard open bearing roller bit	Standard open bearing roller bit, air-cooled	Standard open bearing roller bit with gauge protection which is defined as carbide inserts in the heel of the cone	Sealed roller bearing bit	Sealed roller bearing bit with gauge protection in the heel of the cone	Sealed plain bearing bit	Sealed plain bearing bit with gauge protection in the heel of the cone	Spare digits for possible future use
With milled steel teeth	1	Soft	1, 2, 3, 4								
	2	Medium-soft	1, 2, 3, 4								
	3	Medium-hard	1, 2, 3, 4								
With tungsten carbide inserts	4	Soft	1, 2, 3, 4								
	5	Medium-soft	1, 2, 3, 4								
	6	Medium-hard	1, 2, 3, 4								
	7	Hard	1, 2, 3, 4								
	8	Extremely hard									

A	Air Application
B	Special Bearing
C	Center Jetted
D	Deviation Control
E	Extended Jets
G	Extra Gauge or Body Protection
H	Horizontal/Steering
J	Jet Deflection
L	Lug Pads
M	Motor Application
S	Standard Steel Tooth
T	Two Cone
W	Enhanced Cutting Structure
X	Chisel Inserts
Y	Conical Inserts
Z	Other inserts shape

Tricone roller drill bit design

A tricone roller bit for cone drilling consists of several major parts:

- hull with connection thread and nozzles for hole bottom blow-through;
- three cones with cutting structure on the external surface and bearings inside;
- cutting structure (tungsten carbide inserts or milled steel teeth);
- three legs with journals aligned with cone bearing channels by means of bearings;
- radial rolling-element bearings or journal bearings;
- locker ball bearing;
- thrust plain bearings.

After cone mounting the legs are assembled with the hull and welded to it. The assembly of a tricone roller bit and cutaway of one leg/cone joint displaying the location of internal parts is shown in the figure 1.

The figure 1 also displays air ducts, which lead from center of drill bit to cone bearings to ensure their cooling and prevent ingress of drill cuttings, which can result in premature wear of bearings and breakdown of the bit. So, this figure shows the bit with “air-cooled” bearings.

The bearing arrangement and blow-through schemes are displayed in the figures 2 and 3.

There are also other types of bearing configuration, such as “open” and “sealed” bearings.

The “open” (or fluidal) bearings have no internal air ducts, and back sides of the cones are open to the outside environment.

The “sealed” bearings also have no internal air ducts, they are fully insulated from the outside environment and filled with grease.

Fig. 1. Cutaway of a tricone bit

Fig. 3. Bearing blow-through scheme

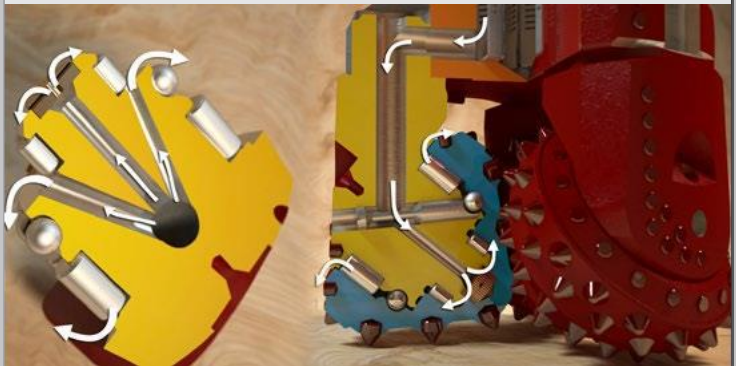
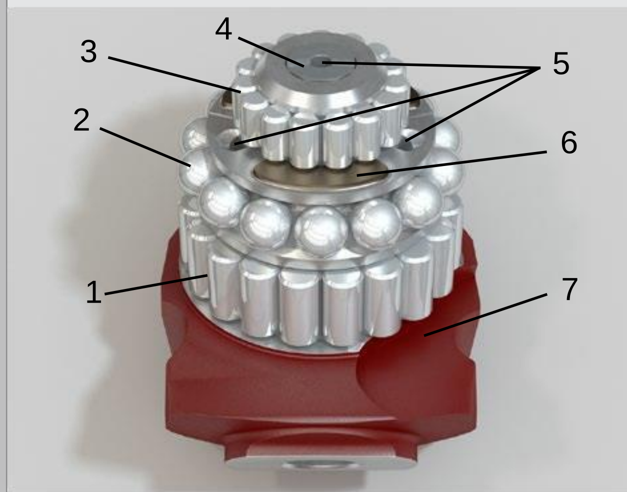


Fig. 2. Bearing arrangement



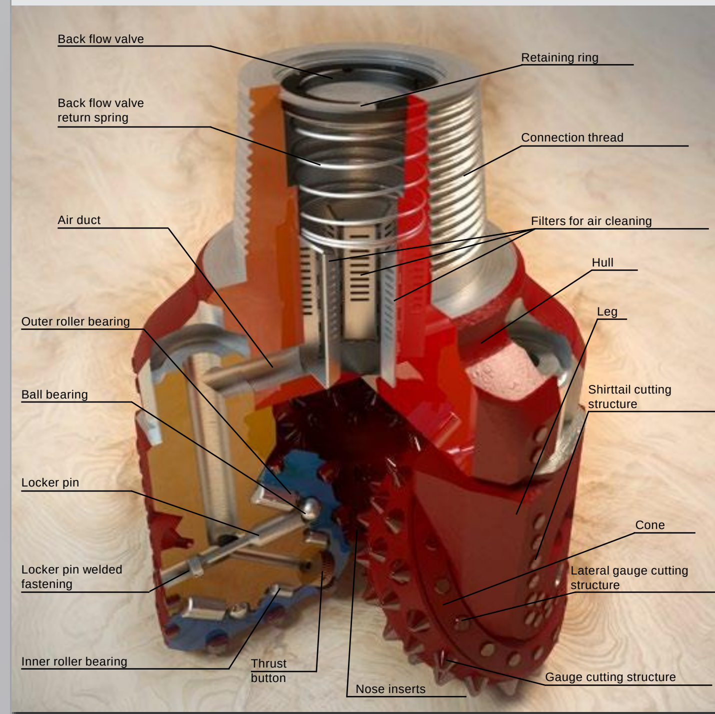
1. Outer roller bearing
2. Ball bearing
3. Inner roller bearing
4. Thrust button
5. Air ducts
6. Thrust plain bearing
7. Slotted air outlet

Tricone roller drill bit design

Drill bit elements

The elements of a tricone roller drill bit are displayed in the figure 4.

Fig. 4. Drill bit elements



Hull

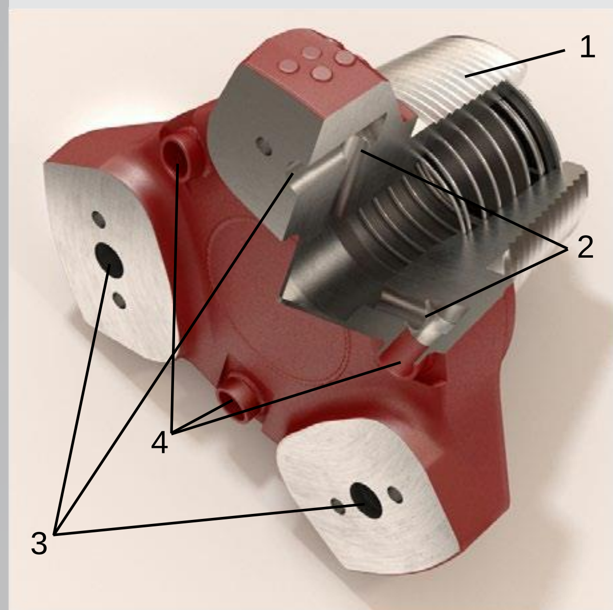
The hull (fig. 5) is the basic structural component of a tricone roller bit of hull-type design. It includes the following elements:

1. Connection thread for mounting on the rod of a drilling rig;
2. Air ducts for compressed air feed to nozzles for hole bottom cleaning and to bearings for their cooling and preventing ingress of drill cuttings;
3. Bores for mounting of legs with subsequent welding;
4. Nozzles for hole bottom blow-through.

After final assembly of the roller cone bit in the hull are also installed:

- Filter for air cleaning;
- Back flow valve for preventing ingress of drill cuttings into rod internal space.

Fig. 5. Cutaway of a tricone bit hull



Nozzles

The nozzles are intended for increasing of air flow during hole bottom cleaning from drill cuttings, as well as for providing counterpressure in a drill bit to ensure efficient cleaning and cooling of bearings.

Utilization of smaller nozzles allows to increase bearing lifetime, since when in use, proportionally more air passes through bearings, resulting in better cooling of bearings.

Efficiency of hole bottom cleaning from drill cuttings depends on power of air passing through nozzles. When smaller nozzles are in use, air flow rate also increases at the same air consumption level. Air flow power is determined as product of mass air flow by air flow rate. Therefore, use of smaller nozzles also provides greater effect on hole bottom for its cleaning.

But along with this, it should be taken into account that use of too small nozzles increases counterpressure over compressor set-point. If the set-point is reached, the compressor will decrease air supply, which can reduce drill bit efficiency.

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Legs

The legs (fig. 6) are mounted on the hull at an angle of 120° to each other and welded to it. Legs have the following elements:

1. Journal with grooves for ball and roller bearings;
2. Surfaced thrust plain bearing;
3. Slotted air outlet;
4. Air ducts for blow-through and cooling of bearings;
5. Thrust button.

The legs are also reinforced with tungsten carbide inserts (6) for increasing of their durability during operation in hard abrasive rocks. In addition, legs can be hardened with hardmetal shirttail surfacing.

Cones

The cones (fig. 7) are the cutting elements of drill bit and include the following elements:

1. Outer cone shell with holes for tungsten carbide inserts and with grooves;
2. Inner cone channel with grooves for ball and roller bearings;
3. Thrust button made of wear-resistant material for reacting axial load;
4. Tungsten carbide inserts press-fitted into the shell with interference.

Fig. 6. Leg (without bearings)

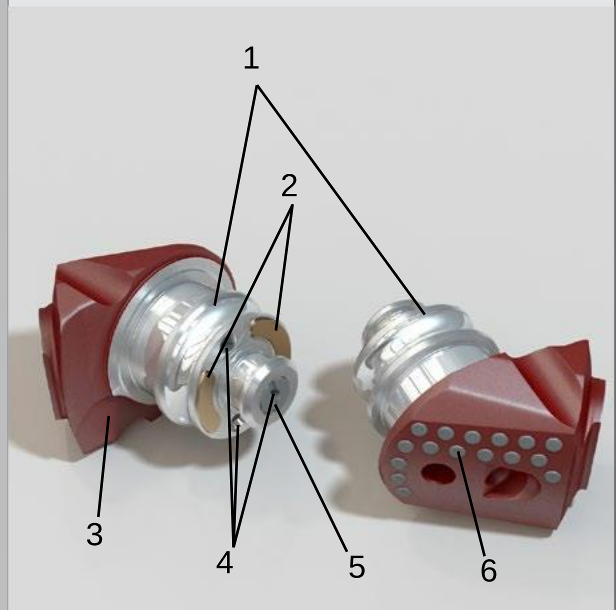
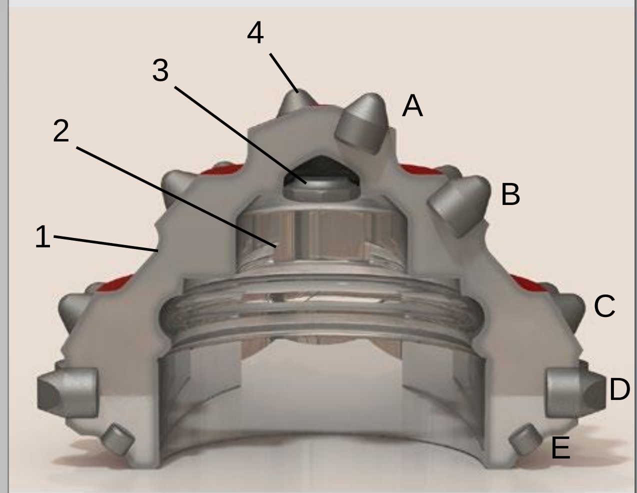


Fig. 7. Cutaway of a cone



Rows of tungsten carbide inserts:
A. Nose
B. Inner
C. Pre-gauge
D. Gauge
E. Lateral gauge

Fig. 8. Rock formation chipping scheme

Cone 1 Cone 2 Cone 3

Each of three cones has different arrangement of tungsten carbide insert rows and grooves, so the inserts of one cone get into grooves of two other cones, thereby providing bit self-cleaning capability during drilling. Also this way of tungsten carbide inserts arrangement provides uniform rock formation chipping over the whole area of hole bottom (see fig. 8).

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Tricone roller drill bit design

Tricone roller drill bit inserts

The inserts are the elements of a drill bit, which get into direct contact with rock formation and provide its breakage. They are made of tungsten carbide powder and cobalt binder. Tungsten carbide inserts differ in shape and physical characteristics depending on rock formation type the drill bit of one or another model is suited for.

The following types of tungsten carbide inserts are used in "Glubur®" tricone roller drill bits:

Spherical – are used in bits for extremely hard formation drilling (IADC code – 8XX), can also be used in gauge rows of cones of bits for hard formation drilling (IADC code – 7XX). They are characterized by high crack resistance at the cost of lower sinkage rate.

Conical – are used in bits for medium-hard formation drilling (IADC code – 6XX). They have more aggressive shape, hereupon are characterized by higher sinkage than spherical inserts, but have less durability and cannot be used in hardest formations.

Spherocon inserts are the intermediate type of inserts and are mainly used in bits for hard formation drilling (IADC code – 7XX). They have bigger curve radius than conical inserts and are balanced between sinkage rate and crack resistance, which allows them to be used for harder rock formations.

Chisel – are mainly used in bits for soft and medium-soft formation drilling (IADC code – 4XX and 5XX). They provide more efficient and quicker formation chipping, but are less durable than conical and spherical inserts.

Cylindrical – are used for wear protection of lateral cone surface and shirttail during operation in abrasive rock formations.

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Bits for medium-soft formation drilling

Tricone roller bits for drilling of medium-soft formations (4 to 8 as per M.M. Protodiakonov scale) are distinguished by most high performance cutting structure of chisel tungsten carbide inserts with relatively big offset from cone shell, which allows to get high drilling rate in soft and medium-soft rock formations, such as aleurolite, soft limestone, dense clay, medium-hard shale etc. Bits of this series have protection of shirttail with tungsten carbide inserts, which increases wear resistance while drilling highly abrasive rocks.

Chisel tungsten carbide insert cutting structure


Central or lateral hole bottom cleaning scheme

Shirttail protection with tungsten carbide inserts

Sizes from 92.1 mm ($3\frac{5}{8}$") to 490.0 mm ($19\frac{19}{64}$")

Bits for medium-hard formation drilling

Tricone roller bits for medium-hard (6 to 12 as per M.M. Protodiakonov scale) rock formation drilling are distinguished by cutting structure consisting of chisel tungsten carbide inserts on gauge rows of cones and conical inserts with relatively small curve radius on inner rows. It allows these bits to be used for drilling of rock formations such as apatite, gabbro, coal, silicified magnesite etc., with quite high drilling rate. Bits of this series also have protection of shirttail with tungsten carbide inserts, which increases wear resistance while drilling highly abrasive rocks.

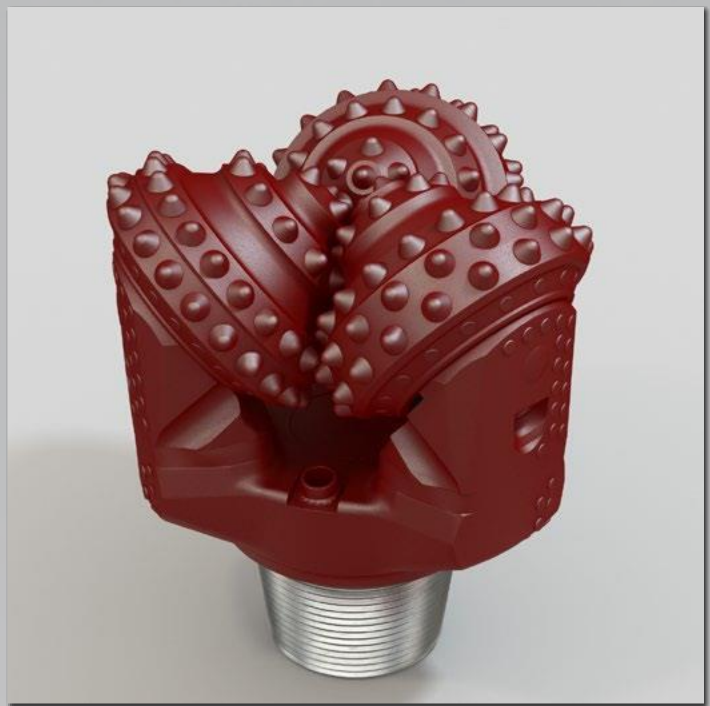

Chisel and conical tungsten carbide insert cutting structure


Central or lateral hole bottom cleaning scheme

Shirttail protection with tungsten carbide inserts

Sizes from 74.6 mm ($2\frac{15}{16}$") to 444.5 mm ($17\frac{1}{2}$")

Bits for medium-hard/hard formation drilling



Tricone roller bits for medium-hard/hard (8 to 16 as per M.M. Protodiakonov scale) rock formation drilling are distinguished by cutting structure fully consisting of conical tungsten carbide inser ts with relatively small curve radius. Such cutting structure layout allows these bits to be used for drilling of rock formations such as medium- and fine-grained basalt, fine-grained granite, siliceous limestone, porphyry etc. Bits of this series also have protection of shirttail with tungsten carbide inserts, which increases wear resistance while drilling highly abrasive rocks.

Conical tungsten carbide insert cutting structure

Central or lateral hole bottom cleaning scheme

Shirttail protection with tungsten carbide inserts

Sizes from 76.0 mm (3") to 311.1 mm (12 /4")

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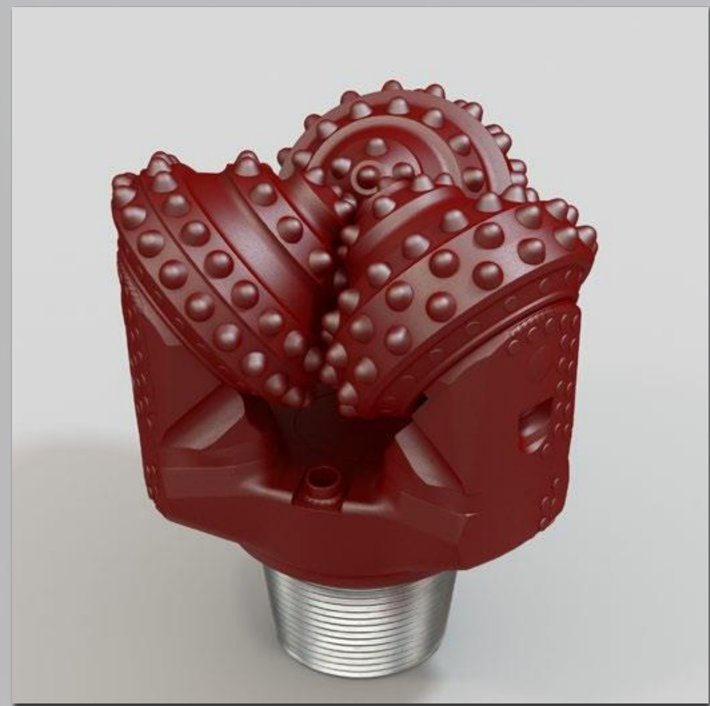
Bits for hard formation drilling



Tricone roller bits for hard (12 to 18 as per M.M. Protodiakonov scale) rock formation drilling are distinguished by more crack resistant cutting structure consisting of tungsten carbide inserts with bigger curve radius (spherocon-shaped inserts), and gauge rows of cones may have spherical tungsten carbide inserts. It provides efficient drilling of harder rocks such as coarse- and medium-grained granite, quartz sandstone, hard-grained greenstone and gabbro etc. Bits of this series also have additional protection of shirttail with tungsten carbide inserts and hardmetal surfacing, which increases their durability while drilling hard and highly abrasive rocks.

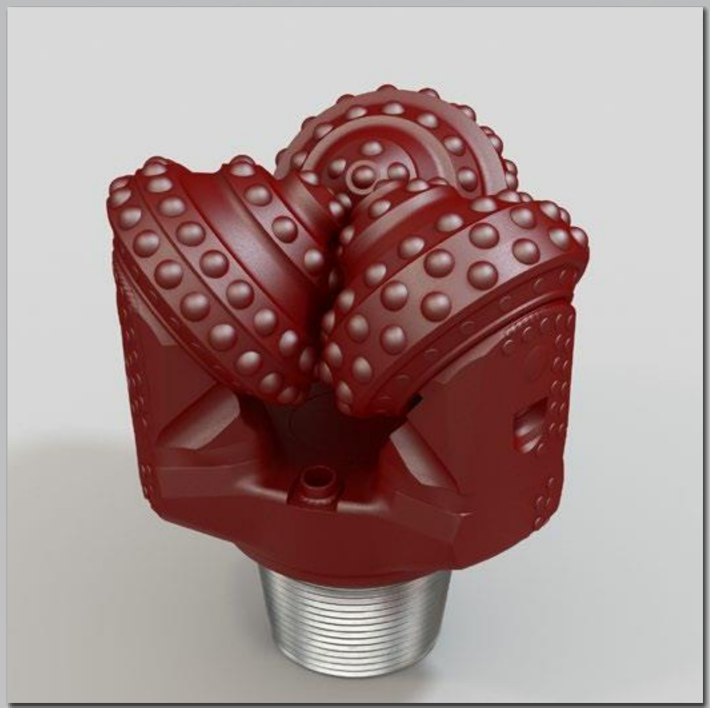
Spherocon tungsten carbide insert cutting structure

Central or lateral hole bottom cleaning scheme

Shirttail protection with tungsten carbide inserts and hardmetal surfacing

Sizes from 76.0 mm (3") to 311.1 mm (12 /4")

Bits for extremely hard formation drilling



Tricone roller bits for extremely hard (16 to 20 as per M.M. Protodiakonov scale) rock formation drilling are distinguished by least invasive, but most crack resistant cutting structure, which consists of spherical tungsten carbide inserts with small offset from cone shell. It provides efficient drilling of the hardest rocks such as quartzite, flint, hornstone, massive jasper etc. Bits of this series also have additional protection of shirttail with tungsten carbide inserts and hardmetal surfacing, which increases their durability while drilling the hardest highly abrasive rocks.

Spherical tungsten carbide insert cutting structure

Central or lateral hole bottom cleaning scheme

Shirttail protection with tungsten carbide inserts
and hardmetal surfacing

Sizes from 215.9 mm (8 1/2") to 320.0 mm (12 5/8")

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Technical specifications of bits

No.	Bit diameter		Bit designation		Connection thread		Rotation speed, RPM	Maximum applicable load, kN	Weight, kg
	mm	inches	ГОСТ 20692–2003	IADC	ГОСТ	API			
1	74.6	2 15/16	Т-ЦА	321C	cylindr.	N-ROD	100-40	50-80	1.8
2	76.0	3	К-ЦА	743CZ	3-42	–	100-40	60-110	4.3
3	76.0	3	Т-ПА	312C	3-42	–	115-60	30-60	1.5
4	76.0	3	Т3-ЦА	623CX	cylindr.	N-ROD	100-40		
5	92.1	3 5/8	С-ЦА	211C	3-66	2 7/8 REG	300-40	40-80	3.14
6	92.1	3 5/8	С-ГА	211	3-66	2 7/8 REG	300-40	40-100	4.5
7	93.0	3 2/3	К-ЦА	743CZ	3-50	–	100-40	60-110	4.7
8	93.0	3 2/3	Т-ЦА	311C	3-50	–	100-40	60-110	4.3
9	93.0	3 2/3	Т-ПН	312C	3-50	–	100-40	115-60	2.7
10	93.0	3 2/3	Т3-ЦА	623CX	3-50	–	100-40		
11	95.3	3 3/4	С-ЦН	211C	3-66	2 7/8 REG	100-40	30-70	3.3
12	98.4	3 7/8	С-ЦН	211C	3-66	2 7/8 REG	300-40	40-100	4.3
13	98.4	3 7/8	Т-ПН	312C	3-66	2 7/8 REG	115-60	40-80	3.7
14	98.4	3 7/8	М3-ЦН	521CY	3-66	2 7/8 REG	300-40	30-80	3.6
15	98.4	3 7/8	Т3-ЦН	621CX	3-66	2 7/8 REG	300-40		
16	101.6	4	С-ЦН	211C	3-66	2 7/8 REG	300-40	40-90	4.5
17	104.8	4 1/8	С-ГНУ	214	3-66	2 7/8 REG	300-40	40-90	5.06
18	104.8	4 1/8	С-ГНУ	215	3-66	2 7/8 REG	300-40	40-90	5.1
19	104.8	4 1/8	С-ЦА	211C	3-66	2 7/8 REG	100-40	40-90	4.4
20	108.0	4 1/4	С-ЦА	211C	3-66	2 7/8 REG	100-40	40-90	4.4
21	114.3	4 1/2	М3-ЦН	521CY	3-66 sh.	–	300-40	30-70	4.8
22	114.3	4 1/2	М3-ПН	522CY	3-66 sh.	–	115-60	20-80	4.6
23	114.3	4 1/2	С-ЦН	211C	3-66 sh.	–	300-40	40-90	5.2
24	117.5	4 5/8	С-ЦН	211C	3-76 sh.	–	300-40	40-90	4.5
25	118.0	4 41/64	СТ-ЦН	231C	3-76	2 7/8 REG	300-40		
26	120.6	4 3/4	СТ-ЦН	231C	3-76 sh.	–	300-40	60-110	6.1
27	120.6	4 3/4	К-ЦН	723CY	3-76 sh.	–	300-40	60-130	6.3
28	120.6	4 3/4	М3-ЦН	521CY	3-76 sh.	–	300-40	40-90	5.8
29	120.6	4 3/4	М3-ПН	522CY	3-76 sh.	–	115-60	20-80	5.5
30	120.6	4 3/4	С-ГН	211	3-76	2 7/8 REG	300-40	40-90	8.2
31	120.6	4 3/4	С-ЦН	211C	3-76 sh.	–	300-40	40-90	5.8
32	124.0	4 7/8	С-ЦН	211C	3-76 sh.	–	300-40	40-100	6.0
33	125.0	5	СТ-ЦН	231C	3-76 sh.	–	300-40	60-120	6.2
34	127.0	5	С-ЦН	211C	3-76 sh.	–	300-40	40-100	5.6
35	130.2	5 1/8	Т3-ПГН	612X	3-76 sh.	–	115-60	40-110	9.5
36	130.2	5 1/8	Т3-ЦН	613CX	3-76 sh.	–	115-60	40-110	6.1
37	130.2	5 1/8	Т3-ПН	612CX	3-76 sh.	–	115-60	40-110	6.4
38	130.2	5 1/8	С-ЦН	211C	3-76 sh.	–	300-40	40-100	5.7
39	130.2	5 1/8	М-ПН	122C	3-76 sh.	–	115-60	40-100	5.6
40	132.0	5 3/16	СТ-ЦН	512CY	3-63.5	–	300-40		
41	133.4	5 1/4	М3-ПН	513CY	3-76 sh.	–	115-60	20-90	6.6
42	133.4	5 1/4	С-ЦН	231C	3-76 sh.	–	300-40	50-110	5.9
43	133.4	5 1/4	М3-ЦН	513CY	3-76 sh.	–	115-60	20-90	6.8
44	136.5	5 3/8	М3-ПН	512CY	3-76 sh.	–	115-60	20-90	7.1

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No.	Bit diameter		Bit designation		Connection thread		Rotation speed, RPM	Maximum applicable load, kN	Weight, kg
	mm	inches	ГОСТ 20692–2003	IADC	ГОСТ	API			
45	136.5	5 3/8	МЗ-ЦН	513CY	З-76 sh.	–	115-60	20-90	7.1
46	139.7	5 1/2	СТ-ЦН	231C	З-88	3 1/2 REG	300-40	60-130	9.7
47	139.7	5 1/2	МЗ-ЦН	523CY	З-76 sh.	–	300-40	50-110	7.8
48	139.7	5 1/2	МЗ-ПН	522CY	З-76 sh.	–	115-60	20-90	7.8
49	142.9	5 5/8	ТКЗ-ПГН	632Y	З-88	3 1/2 REG	115-60	40-100	12.8
50	142.9	5 5/8	МЗ-ПН	522CY	З-88	3 1/2 REG	115-60	20-100	9.5
51	142.9	5 5/8	С-ЦН	211C	З-88	3 1/2 REG	300-40	50-110	9.6
52	142.9	5 5/8	С-ЦН	221C	З-88	3 1/2 REG	300-40	50-110	9.6
53	142.9	5 5/8	МЗ-ЦН	523CY	З-88	3 1/2 REG	300-40	50-110	9.8
54	142.9	5 5/8	С-ГН	211	З-88	3 1/2 REG	300-40	50-110	11.7
55	142.9	5 5/8	ТЗ-ПН	622CY	З-88	3 1/2 REG	115-60	40-100	9.5
56	149.2	5 7/8	М-ГН	121	З-88	3 1/2 REG	300-40	40-90	13.7
57	149.2	5 7/8	С-ГН	211	З-88	3 1/2 REG	300-40	50-120	13.7
58	149.2	5 7/8	С-ЦН	211C	З-88	3 1/2 REG	300-40	50-120	10.6
59	151.0	5 15/16	С-ЦН	211C	З-88	3 1/2 REG	300-40		
60	152.4	6	С-ГНУ	215	З-88	3 1/2 REG	300-40	50-120	13.8
61	152.4	6	Т-ГН	321	З-88	3 1/2 REG	300-40	70-140	14.2
62	152.4	6	С-ГН	211	З-88	3 1/2 REG	300-40	50-120	13.8
63	152.4	6	М-ГН	121	З-88	3 1/2 REG	300-40	50-120	13.8
64	152.4	6	С-ЦН	213C	З-88	3 1/2 REG	300-40	50-120	10.7
65	152.4	6	С-ЦН	211C	З-88	3 1/2 REG	300-40	50-120	10.0
66	155.6	6 1/8	С-ГНУ	215	З-88	3 1/2 REG	300-40	50-120	14.0
67	155.6	6 1/8	М-ГН	121	З-88	3 1/2 REG	300-40	40-100	13.8
68	155.6	6 1/8	С-ЦН	211C	З-88	3 1/2 REG	300-40	50-120	11.0
69	158.7	6 1/4	МЗ-ПГВ	512Y	З-88	3 1/2 REG	115-60	20-110	17.9
70	158.7	6 1/4	С-ПН	212C	З-88	3 1/2 REG	115-60	50-120	10.2
71	158.7	6 1/4	С-ЦН	221C	З-88	3 1/2 REG	300-40	50-120	13.5
72	158.7	6 1/4	С-ЦН	211C	З-88	3 1/2 REG	300-40	50-120	13.0
73	161.0	6 5/8	СТ-ЦН	231C	З-88	3 1/2 REG	300-40		
74	165.1	6 1/2	М-ЦН	121C	З-88	3 1/2 REG	300-40	40-110	13.0
75	165.1	6 1/2	С-ЦН	211C	З-88	3 1/2 REG	300-40	50-130	12.5
76	168.3	6 5/8	С-ЦН	211C	З-88	3 1/2 REG	300-40	50-120	13.0
77	171.4	6 3/4	МЗ-ПГВ	522	З-88	3 1/2 REG	115-60	30-120	
78	171.4	6 3/4	ТЗ-ПГВ	622Y	З-88	3 1/2 REG	115-60	50-140	
79	171.4	6 3/4	ТЗ-ПГВ	622X	З-88	3 1/2 REG	115-60	50-140	
80	171.4	6 3/4	ТКЗ-ПГВ	632Y	З-88	3 1/2 REG	115-60	50-140	19.0
81	171.4	6 3/4	ТЗ-ПГВ	622Y	З-88	3 1/2 REG	115-60	50-140	
82	171.4	6 3/4	С-ПВ	212C	З-88	3 1/2 REG	115-60	50-130	14.0
83	171.4	6 3/4	С-ЦВ	211C	З-88	3 1/2 REG	115-60	50-130	14.8
84	187.3	7 3/8	МЗ-ПГВ	522Y	З-88	3 1/2 REG	115-60	30-130	22.8
85	190.5	7 1/2	С-ГВ	211	З-117	4 1/2 REG	600-40	60-140	35.0
86	190.5	7 1/2	СТ-ГВ	231	З-117	4 1/2 REG	300-40		
87	190.5	7 1/2	СЗ-ГНУ	545X	З-117	4 1/2 REG	300-40	40-130	
88	190.5	7 1/2	ТЗ-ГНУ	625X	З-117	4 1/2 REG	300-40	60-160	

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Technical specifications of bits (cont'd)

No.	Bit diameter		Bit designation		Connection thread		Rotation speed, RPM	Maximum applicable load, kN	Weight, kg
	mm	inches	ГОСТ 20692–2003	IADC	ГОСТ	API			
89	190.5	7 1/2	М-ГВ	111	З-117	4 1/2 REG	600-40	30-110	29.5
90	190.5	7 1/2	МЗ-ГВ	513X	З-117	4 1/2 REG	600-40	50-150	31.5
91	190.5	7 1/2	С-ГВ	211	З-117	4 1/2 REG	600-40	60-140	35.0
92	190.5	7 1/2	СЗ-ГВ	543X	З-117	4 1/2 REG	600-40	60-160	37.0
93	200.0	7 7/8	ТКЗ-ПГВ	632Y	З-117	4 1/2 REG	115-60	60-170	32.8
94	200.0	7 7/8	К-ПГВ	722Y	З-117	4 1/2 REG	115-60	90-180	32.8
95	200.0	7 7/8	МЗ-ПГВ	512Y	З-117	4 1/2 REG	115-60	30-140	32.7
96	200.0	7 7/8	ТЗ-ПГВ	622Y	З-117	4 1/2 REG	115-60	60-170	33.0
97	200.0	7 7/8	МСЗ-ГНУ	535X	З-117	4 1/2 REG	300-40	30-140	32.6
98	200.0	7 7/8	ТЗ-ГНУ	625X	З-117	4 1/2 REG	300-40	60-160	31.8
99	215.9	8 1/2	СЗ-ПГВ (ПВ)	542X	З-117	4 1/2 REG	115-60	60-160	33.9
100	215.9	8 1/2	ТЗ-ПГВ (ПВ)	622X	З-117	4 1/2 REG	115-60	60-170	33.9
101	215.9	8 1/2	ТКЗ-ПГВ (ПВ)	632Y	З-117	4 1/2 REG	115-60	70-180	33.8
102	215.9	8 1/2	К-ПГВ (ПВ)	732Y	З-117	4 1/2 REG	115-60	80-190	34.1
103	215.9	8 1/2	ОК-ПГВ (ПВ)	832Z	З-117	4 1/2 REG	115-60	90-200	34.6
104	215.9	8 1/2	МЗ-ЦГНУ	425	З-117	4 1/2 REG	300-40		
105	215.9	8 1/2	М-ЦГВУ	115	З-117	4 1/2 REG	300-40		
106	215.9	8 1/2	СТ-ГВ	231	З-117	4 1/2 REG	300-40		
107	215.9	8 1/2	СЗ-ЦГВУ	545X	З-117	4 1/2 REG	300-40	70-170	
108	215.9	8 1/2	ТЗ-ЦГВ	623X	З-117	4 1/2 REG	300-40		
109	215.9	8 1/2	СЗ-ЦГАУ	547X	З-117	4 1/2 REG	300-40		
110	215.9	8 1/2	С-ЦГАУ	217	З-117	4 1/2 REG	300-40		
111	215.9	8 1/2	М-ЦГАУ	117	З-117	4 1/2 REG	300-40		
112	215.9	8 1/2	МСЗ-ЦГАУ	537X	З-117	4 1/2 REG	300-40		
113	215.9	8 1/2	ТЗ-ГАУ	627Y	З-117	4 1/2 REG	300-40	100-210	
114	215.9	8 1/2	ТЗ-ЦГВУ	625X	З-117	4 1/2 REG	300-40	90-200	
115	215.9	8 1/2	МС-ЦГАУ	137	З-117	4 1/2 REG	180-40	70-180	
116	215.9	8 1/2	С-ЦГВУ	214	З-117	4 1/2 REG	300-40		
117	215.9	8 1/2	М-ПВ	122C	З-117 sh.	–	115-60	30-130	32.0
118	215.9	8 1/2	МЗ-ГВ	513X	З-117	4 1/2 REG	600-40	60-170	35.9
119	215.9	8 1/2	Т-ПВ	312C	З-117 sh.	–	115-60	100-180	34.0
120	215.9	8 1/2	М-ГВ	111	З-117	4 1/2 REG	600-40	40-130	33.0
121	215.9	8 1/2	С-ГН	211	З-117	4 1/2 REG	300-40	150-250	33.5
122	215.9	8 1/2	СЗ-ГВ	543X	З-117	4 1/2 REG	300-40		
123	228.6	9	МЗ-ПГВ	422Y	З-117	4 1/2 REG	115-60	70-190	40.7
124	228.6	9	СЗ-ПГВ (ПВ)	542X	З-117	4 1/2 REG	115-60	60-170	40.1
125	228.6	9	ТЗ-ПГВ (ПВ)	622X	З-117	4 1/2 REG	115-60	70-180	40.1
126	228.6	9	ТКЗ-ПГВ (ПВ)	632Y	З-117	4 1/2 REG	115-60	80-190	40.0
127	228.6	9	К-ПГВ (ПВ)	732Y	З-117	4 1/2 REG	115-60	90-200	40.3
128	228.6	9	ОК-ПГВ (ПВ)	832Z	З-117	4 1/2 REG	115-60	100-210	40.8
129	244.5	9 5/8	Т-ПВ	312C	З-121 sh.	4 1/2 FH	115-60	110-200	39.0
130	244.5	9 5/8	СЗ-ПГВ (ПВ)	542X	З-121 sh.	4 1/2 FH	115-60	80-190	45.5
131	244.5	9 5/8	ТЗ-ПГВ (ПВ)	622X	З-121 sh.	4 1/2 FH	115-60	90-200	45.5
132	244.5	9 5/8	ТКЗ-ПГВ (ПВ)	632Y	З-121 sh.	4 1/2 FH	115-60	100-210	45.5

Technical specifications of bits (cont'd)

No.	Bit diameter		Bit designation		Connection thread		Rotation speed, RPM	Maximum applicable load, kN	Weight, kg
	mm	inches	ГОСТ 20692–2003	IADC	ГОСТ	API			
133	244.5	9 5/8	К-ПГВ (ПВ)	732Y	З-121 sh.	4 1/2 FH	115-60	110-220	45.5
134	244.5	9 5/8	ОК-ПГВ (ПВ)	832Z	З-121y	4 1/2 FH	115-60	120-230	45.5
135	250.8	9 7/8	Т-ПГВ	312	З-152	6 5/8 REG	115-60	80-210	
136	250.8	9 7/8	МЗ-ГНУ	425	З-152	6 5/8 REG	300-40		
137	250.8	9 7/8	ТЗ-ГВУ	625X	З-152	6 5/8 REG	300-40		
138	250.8	9 7/8	СЗ-ГВУ	545X	З-152	6 5/8 REG	300-40	70-170	61.0
139	250.8	9 7/8	СЗ-ПГВ (ПВ)	542X	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	90-200	48.3 / 65.1
140	250.8	9 7/8	ТЗ-ПГВ (ПВ)	622X	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	100-210	48.2 / 65.0
141	250.8	9 7/8	ТКЗ-ПГВ (ПВ)	632Y	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	110-220	48.2 / 65.0
142	250.8	9 7/8	К-ПГВ (ПВ)	732Y	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	120-230	48.4 / 65.2
143	250.8	9 7/8	ОК-ПГВ (ПВ)	832Z	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	130-240	48.0 / 64.8
144	258.0	10 1/8	СЗ-ПГВ (ПВ)	542X	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	100-210	48.3 / 65.1
145	258.0	10 1/8	ТЗ-ПГВ (ПВ)	622X	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	110-220	48.2 / 65.0
146	258.0	10 1/8	ТКЗ-ПГВ (ПВ)	632Y	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	120-230	48.2 / 65.0
147	258.0	10 1/8	К-ПГВ (ПВ)	732Y	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	120-230	48.4 / 65.2
148	258.0	10 1/8	ОК-ПГВ (ПВ)	832Z	З-121 sh. / З-152	4 1/2 FH / 6 5/8 REG	115-60	130-240	48.0 / 64.8
149	295.3	11 5/8	С-ЦГНУ	214	З-152	6 5/8 REG	300-40		
150	295.3	11 5/8	М-ЦГНУ	114	З-152	6 5/8 REG	300-40	80-210	
151	295.3	11 5/8	МСЗ-ЦГВУ	535X	З-152	6 5/8 REG	300-40		
152	295.3	11 5/8	МС-ЦГНУ	135	З-152	6 5/8 REG	300-40		
153	295.3	11 5/8	СЗ-ЦГАУ	547X	З-152	6 5/8 REG	300-40		
154	295.3	11 5/8	МСЗ-ЦГАУ	537X	З-152	6 5/8 REG	300-40		
155	295.3	11 5/8	С-ЦГАУ	217	З-152	6 5/8 REG	300-40		
156	295.3	11 5/8	М-ЦГАУ	117	З-152	6 5/8 REG	300-40		
157	295.3	11 5/8	МС-ЦГАУ	137	З-152	6 5/8 REG	300-40	100-240	
158	295.3	11 5/8	К-ЦГВ	74 3Y	З-152	6 5/8 REG	300-40		
159	295.3	11 5/8	М-ЦГВ	121	З-152	6 5/8 REG	600-40	50-180	69.0
160	295.3	11 5/8	С-ЦГВ	211	З-152	6 5/8 REG	600-40	40-200	71.0
161	295.3	11 5/8	СЗ-ЦГВ	543X	З-152	6 5/8 REG	600-40	50-200	79.0
162	295.3	11 5/8	СЗ-ГВ	543X	З-152	6 5/8 REG	600-40	50-200	81.5
163	295.3	11 5/8	С-ГВ	211	З-152	6 5/8 REG	600-40	100-240	77.0
164	295.3	11 5/8	МС-ГВ	131	З-152	6 5/8 REG	600-40	50-180	76.0
165	295.3	11 5/8	М-ГВ	111	З-152	6 5/8 REG	600-40	50-180	71.5
166	295.3	11 5/8	СЗ-ГВУ	545X	З-152	6 5/8 REG	300-40	60-210	83.7
167	295.3	11 5/8	ТЗ-ГВУ	625X	З-152	6 5/8 REG	300-40	60-210	
168	311.1	12 1/4	С-ЦГВ	211	З-152	6 5/8 REG	600-40	140-270	
169	311.1	12 1/4	СЗ-ПГВ (ПВ)	542X	З-152	6 5/8 REG	115-60	120-230	80.4
170	311.1	12 1/4	ТЗ-ПГВ (ПВ)	622X	З-152	6 5/8 REG	115-60	130-240	80.3
171	311.1	12 1/4	ТКЗ-ПГВ (ПВ)	632Y	З-152	6 5/8 REG	115-60	140-250	80.3
172	311.1	12 1/4	К-ПГВ (ПВ)	732Y	З-152	6 5/8 REG	115-60	140-250	80.5
173	311.1	12 1/4	ОК-ПГВ (ПВ)	832Z	З-152	6 5/8 REG	115-60	150-260	80.1
174	311.1	12 1/4	М-ЦГНУ	114	З-152	6 5/8 REG	300-40		
175	311.1	12 1/4	М-ЦГВУ	115	З-152	6 5/8 REG	300-40		80.0
176	311.1	12 1/4	МС-ЦГВУ	135	З-152	6 5/8 REG	300-40	110-240	81.0
177	311.1	12 1/4	С-ЦГВУ	215	З-152	6 5/8 REG	300-40	140-270	83.0

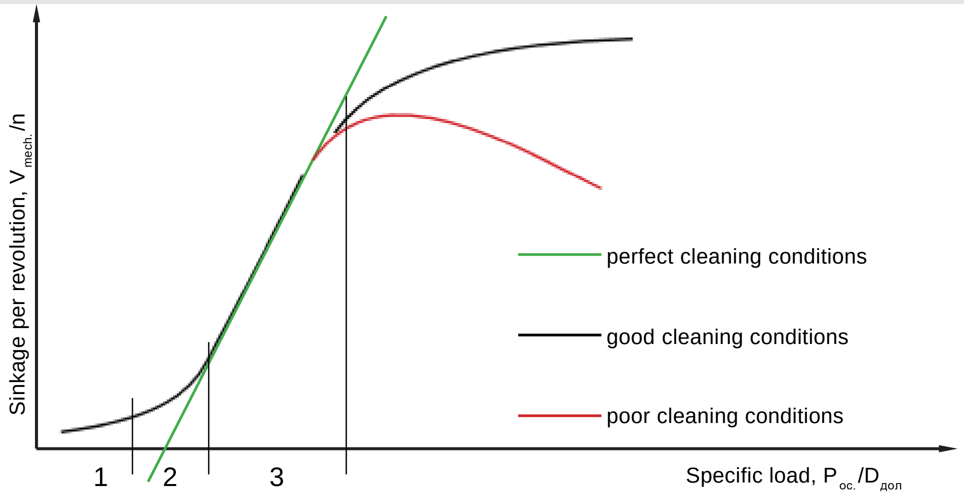
Technical specifications of bits (concl.)

No.	Bit diameter		Bit designation		Connection thread		Rotation speed, RPM	Maximum applicable load, kN	Weight, kg
	mm	inches	ГОСТ 20692–2003	IADC	ГОСТ	API			
178	311.1	12 1/4	СТ-ЦГВУ	235	З-152	6 5/8 REG	300-40	150-280	83.8
179	311.1	12 1/4	МЗ-ЦГВУ	425Z	З-152	6 5/8 REG	300-40		
180	311.1	12 1/4	МСЗ-ЦГВУ	535X	З-152	6 5/8 REG	300-40	110-220	98.4
181	311.1	12 1/4	СЗ-ЦГВУ	545X	З-152	6 5/8 REG	300-40	110-220	94.0
182	311.1	12 1/4	ТЗ-ЦГВУ	625Y	З-152	6 5/8 REG	300-40	110-260	91.5
183	320.0	12 5/8	МСЗ-ЦГВ	533X	З-152	6 5/8 REG	300-40		
184	320.0	12 5/8	ТЗ-ПГВ	622Y	З-152	6 5/8 REG	115-60	130-270	97.0
185	320.0	12 5/8	ОК-ПВ	832CZ	З-152	6 5/8 REG	115-60	130-270	98.0
186	320.0	12 5/8	Т-ПГВ	312	З-152	6 5/8 REG	115-60		89.0
187	339.7	13 3/8	МСЗ-ЦГВУ	535X	З-152	6 5/8 REG	300-40	150-230	124.8
188	349.2	13 3/4	С-ЦГВ	211	З-152	6 5/8 REG	600-40	150-260	122.0
189	349.2	13 3/4	СЗ-ГВ	543Y	З-152	6 5/8 REG	600-40	50-240	120.0
190	349.2	13 3/4	ТЗ-ЦГВУ	625X	З-152	6 5/8 REG	300-40	150-280	121.5
191	349.2	13 3/4	СЗ-ЦГВУ	545X	З-152	6 5/8 REG	300-40	150-240	128.0
192	374.6	14 3/4	МЗ-ЦГВУ	425Z	З-177	7 5/8 REG	300-40		
193	374.6	14 3/4	СЗ-ЦГВУ	545X	З-177	7 5/8 REG	300-40	160-260	144.5
194	374.6	14 3/4	МСЗ-ЦГВУ	535X	З-177	7 5/8 REG	300-40		145.0
195	374.6	14 3/4	ТЗ-ЦГВУ	625X	З-177	7 5/8 REG	300-40		
196	381.0	15	С-ЦГВУ	215	З-177	7 5/8 REG	300-40	120-300	138.5
197	393.7	15 1/2	М-ЦГВ	111	З-177	7 5/8 REG	600-40	70-240	152.0
198	393.7	15 1/2	Т-ЦГВ	311	З-171	6 5/8 FH	300-40	170-350	163.0
199	393.7	15 1/2	С-ЦГВ	211	З-171	6 5/8 FH	600-40	120-290	
200	393.7	15 1/2	М-ЦГВ	111	З-171	6 5/8 FH	300-40	70-240	161.0
201	393.7	15 1/2	Т-ЦГВУ	315	З-177	7 5/8 REG	300-40	170-350	160.0
202	393.7	15 1/2	С-ЦГВУ	215	З-177	7 5/8 REG	300-40		150.0
203	393.7	15 1/2	М-ЦГВУ	114	З-177	7 5/8 REG	300-40		160.0
204	393.7	15 1/2	МС-ЦГВУ	135	З-177	7 5/8 REG	300-40	70-290	150.0
205	393.7	15 1/2	М-ЦГВУ	115	З-177	7 5/8 REG	300-40		160.0
206	393.7	15 1/2	МЗ-ЦГВУ	425Z	З-177	7 5/8 REG	300-40		
207	393.7	15 1/2	СЗ-ЦГВУ	545X	З-177	7 5/8 REG	300-40	170-290	152.0
208	393.7	15 1/2	ТЗ-ЦГВУ	625X	З-177	7 5/8 REG	300-40	210-330	163.0
209	444.5	17 1/2	С-ЦГВ	213	З-177	7 5/8 REG	600-40	130-310	230.0
210	444.5	17 1/2	МС-ЦГВ	131	З-177	7 5/8 REG	600-40	80-310	230.0
211	444.5	17 1/2	М-ЦГВ	111	З-177	7 5/8 REG	600-40	80-270	213.0
212	444.5	17 1/2	МС-ЦГВУ	135	З-177	7 5/8 REG	300-40		
213	444.5	17 1/2	М-ЦГВУ	115	З-177	7 5/8 REG	300-40	80-270	210.0
214	444.5	17 1/2	Т-ЦГВУ	315	З-177	7 5/8 REG	300-40	200-400	210.0
215	444.5	17 1/2	С-ЦГВУ	215	З-177	7 5/8 REG	300-40	130-330	226.0
216	444.5	17 1/2	ТЗ-ЦГВУ	625X	З-177	7 5/8 REG	300-40	190-370	240.0
217	444.5	17 1/2	МЗ-ЦГВУ	515X	З-177	7 5/8 REG	300-40		229.0
218	444.5	17 1/2	МЗ-ЦГВУ	435Z	З-177	7 5/8 REG	300-40		
219	444.5	17 1/2	МСЗ-ЦГВУ	535X	З-177	7 5/8 REG	300-40	170-330	247.8
220	490.0	19 19/64	М-ЦВ	121C	З-171	6 5/8 FH	300-40	150-310	
221	490.0	19 19/64	С-ЦВ	213C	З-171	6 5/8 FH	600-40	170-340	300.0
222	490.0	19 19/64	М-ЦГВУ	115	З-177	7 5/8 REG	300-40	150-310	

Principle of tricone roller drill bit operation

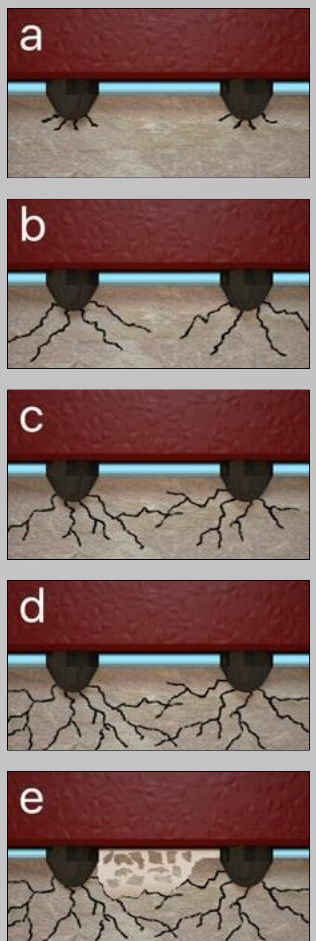
Tricone roller drill bits operate on chipping principle (contrary to popular opinion, they do not crush rock formation). Principle of chipping is the following: when the drilling rod rotates with application of heavy load (of about 500–2000 kg on 1 cm of diameter), in the contact area of bit teeth (inserts) with drilled out rock formation occurs the tension, leading to cracking and splitting of the formation as load is increased. Sinking rate depends on drilling rod rotation speed, as well as on applied load. But it doesn't mean that the higher either rotation speed or load is, the more efficient drilling process is. If one or another parameter exceeds particular value, it results in reduced sinking rate. The figure 9 shows the graph of bit sinkage per one revolution related to specific load applied to the bit.

Fig. 9. Graph of bit sinkage per revolution related to load



Rock formation breakage process can be conventionally divided into 3 stages:

1. Abrasion;
2. Fatigue breakage;
3. Bulk breakage.



The first stage of rock formation breakage – abrasion (a) – can be observed at low load on the drill bit. This stage is characterized by grinding of hole bottom and can be determined by ejection of dust-like drill cuttings. Drilling rate on this stage is low – only about 3 meters per hour.

As load is increased, the second breakage stage – fatigue breakage (b) – occurs. On this stage cracks get deeper than on abrasion stage, but they do not connect, hereupon on fatigue breakage stage a large number of impacts of teeth (inserts) with drilled formation can be needed for its breakage. Drilling rate is also not high – no more than 10 meters per hour.

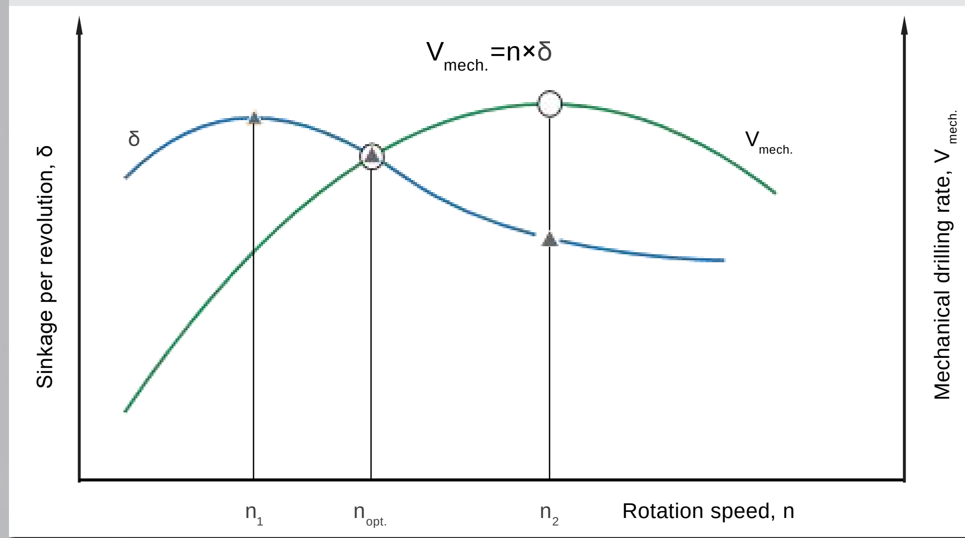
As we can see from the graph, rock formation drilling on above mentioned stages is not efficient, thus more load on the bit is needed, which will lead to deeper penetration of teeth (inserts) into the formation and its splitting in result of connection of cracks among themselves – in this case the bulk breakage (c) stage occurs. As load is increased, cracks connect deeper, which also increases drilling efficiency (d). On this stage drill cuttings consist of large amount of formation clusters and little amount of dust-like particles.

However, if too heavy load is applied to the drill bit, its cone shell nearly contacts with rock formation, and clusters of latter one get stuck between the bit and hole bottom surface, making their ejection by blow-through impossible (e). Thus excessive load on the drill bit only does harm to drilling efficiency.

Principle of tricone roller drill bit operation

Drilling rate can be stated as product of bit sinkage per revolution and drilling rod rotation speed. If rotation speed changes, frequency and duration of tungsten carbide inserts impact with hole bottom surface also change. Graph of bit sinkage per revolution and mechanical drilling rate related to rod rotation speed is shown on the figure 10.

Fig. 10. Graph of bit sinkage per revolution and mechanical drilling rate related to rod rotation speed



As drilling rod rotation speed is increased in range up to n_1, sinkage per revolution (δ) and mechanical drilling rate ($V_{mech.}$) increase. As rotation speed is increased in range from n_1 to n_2, δ starts decreasing, but $V_{mech.}$ keeps increasing. However, further increasing of rotation speed makes $V_{mech.}$ decrease. It can be explained by the following reasons:

– Reduction of insert with formation contact time;
– Reduction of impact energy per insert;
– At low bit sinkage rate per revolution, formation plastic features begin to come out, leading to increase of its dynamic breakage resistance;
– Increase of drilling rod wobble;
– Change of air flow movement nature on hole bottom;
– Increase of power consumption at drilling rod idle rotation.

Optimal drilling rod rotation speed value corresponds with nominal point of δ and $V_{mech.}$ intersection, because increase of $V_{mech.}$ above this point is insignificant, but wear of cutting structure of drill bit rises, which reduces its service period.

Roller cone bit optimum utilization guideline

1. Be careful when screwing the drill bit on and off to aviod its damage.

A. When screwing off the drill bit, keep away from pressure application to unscrewing device. Raise the drilling rod to height enough for bit fall out from clutch coupling into unscrewing device.
B. Ensure the proper installation of unscrewing device and absence of extraneous objects on the platform.
C. Clean the connection threads of the drilling rod and new drill bit, apply anti-seize compound.
D. When screwing on the drill bit, keep away from excess pressure application to lateral side of thread profile. If couplings of the drilling rod and the bit are not aligned, align the machine.
E. Perform the coupling on low rotation speed and low torque.

2. When drilling with a new bit, apply lowered load and rotation speed in accordance with "the rule of thirds": first third of the hole should be drilled at 1/3 of nominal load and speed, second third – at 2/3 of these parameters value, remaining range – with regular parameters.

After breaking-in check the cones for temperature equality. If one or more cones become hot, check the drill bit for obstacles in air ducts for bearing blow-through to prevent its breakdown.

Purge all cones to remove remains of fitting grease.

Roller cone bit optimum utilization guideline

3. Provide optimal air feed for decrease of wear of cones and legs and for failproof operation of bearings.

For ensuring maximum service period of bearings, pressure differential on the bit should be not less than 2.8 bar.

For efficient ejection of drill cuttings from the hole, air is needed to be fed in amount enough for providing ascending stream speed not less than 1525 m/min (for ejecting of light cuttings) or 2130 m/min (for ejecting of heavy cuttings). If ascending stream speed is insufficient, drill cuttings will fall back on hole bottom and get regrinded till it becomes small enough for ejection, also leading to reduction of drill bit service period.

Indications of bad hole cleaning:

- Increase of torque (by increased pressure in hydraulic system or ammeter reading);
- Increase of air feed pressure;
- Excessive amount of drill cuttings on hole bottom;
- Severe wear and/or damage of drill bit leg back.

4. Before lowering the drill bit, engage air feed and do not disengage it until completion of drilling and raising the bit from hole. The bit must be rotated while raising and lowering for better removal of drill cuttings and preventing of its ingress into bearings.

5. While drilling in water-saturated formations or with water injection, keep pressure differential on bit as great as practicable to prevent ingress of water and drill cuttings into bearings.

6. Keep the bit away from falling to avoid damage of bearing grooves or disruption of weld seams.

7. Before mounting a new bit, check the back flow valve operation and smoothness of cone rotation.

8. In case of long (over a period of shift or longer) downtime of partially blunted bit, assure yourself of easy running of cones by turning them by hand.

9. Check air pressure at regular intervals when drill bit is removed to ensure that there are no obstacles in drilling rod or shackle.

Perform check of blunted bit for presence of extraneous materials, also put down pressure value in drilling log-book on each bit change to ensure possibility of obstacle or leak detection.

10. Check the bit components for possibility of cracks, breaking or jamming occurence at regular intervals.

11. Perform appropriate service of drilling rod, keep away from using bent components to avoid breakdown of drill bits due to load irregularity.

12. Apply load to bits enough for efficient rock formation chipping, keep away from insufficient or excessive load (see chapter "Principle of tricone roller drill bit operation", pages 20–21).

13. Select optimal drilling rod rotation speed in accordance with drilled rock formation features.

Lesser rotation speed assures bigger sinkage per bit, but sinking rate is lower. If rotation speed is greater, sinking rate increases, but excessive rotation speed reduces sinkage per bit.

14. Do not apply load on bit without rotation of drilling rod.

15. Keep away from drilling-in of a hole with new bit to avoid cone jamming or breaking of gauge rows of tungsten carbide inserts.

16. After changing of used bit clean it from cuttings, examine it to define wear nature and rate and put them down in drilling log-book.

17. If significant chips of tungsten carbide inserts occur, decrease drilling rod rotation speed or load on bit.

18. If erosive wear and loss of cone tops occur when using bit with central blowing, it is recommended to use bit with lateral blowing.

Annex 1

Measurement unit conversion tables

Length units		mm	m	in	ft
mm	1 mm	1	0,001	0,03937	0,003281
m	1 m	1000	1	39,3701	3,2808
inch (in)	1 in	25,4	0,0254	1	0,08333
foot (ft)	1 ft	304,8	0,3048	12	1

Weight units		kg	t	lb
kg	1 kg	1	0,001	2,2046
t	1 t	1000	1	2204,6
lb	1 lb	0,45359	$4,5359 \cdot 10^{-4}$	1

Pressure units		bar	atm	MPa	kg/cm^2	psi (lb/in^2)
bar	1 bar	1	0,98692	0,1	1,01972	14,504
atm	1 atm	1,01325	1	0,10132	1,03323	14,696
MPa	1 MPa (N/m^2)	10	9,8692	1	10,197	145,0377
kg/cm^2	1 kg/cm^2	0,98067	0,96784	0,09806	1	14,2233
psi (lb/in^2)	1 psi (lb/in^2)	0,06895	0,06805	0,00689	0,07031	1

Volume units		l	m^3	cf
l	1 l	1	0,001	0,03531
m^3	1 m^3	1000	1	35,3146
cf (ft^3)	1 cf (ft^3)	28,3168	0,02831	1

Performance units		l/min	m^3/min	cfm
l/min	1 l/min	1	0,001	0,03531
m^3/min	1 m^3/min	1000	1	35,3146
cfm (ft^3/min)	1 cfm (ft^3/min)	28,3168	0,02831	1

Speed units		m/s	km/h	m/h	ft/min
m/s	1 m/s	1	3,6	3600	196,85
km/h	1 km/h	0,2778	1	39,3701	54,68
m/h	1 m/h	$2,778 \cdot 10^{-4}$	0,001	1	0,05468
ft/min	1 ft/min	304,8	0,01828	18,2879	1

Application
for bit type picking

1. Organization name ______________________________
2. Address ______________________________
3. Required bit diameter, mm ______________________________
   - a) bit connection thread type ______________________________
   - б) required mechanical drilling rate, m/h ______________________________
4. Type of mineral mined ______________________________
5. Formations drilled ______________________________
   - a) hardness factor, f= ______________________________
   - б) breaking point for one-axis compression, σ_{comp} ______________________________
   - в) abrasiveness ______________________________
   - г) water encroachment ______________________________
   - д) fractures ______________________________
6. Model of drilling rig, number of rigs ______________________________
   - a) compressor performance, m^3/min ______________________________
   - б) drilling rod outer diameter, mm ______________________________
   - в) drilling rig operation cost per hour, $ ______________________________
   - г) cost of one linear meter drilling, $ ______________________________
7. Statistical data of bit work off for two latest years (according to Annex 4)
8. Prospective plan of drilling development on mine (according to Annex 5)

Post ______________________________

Full name ______________________________

Contact phone number ______________________________

Date, signature ______________________________

DRILLING REPORT

Mine ______________ Bit model ______________ Factory No. ______________ Weighted average category ______________

Drilling rig ______________ Side No. ______________ Mount date ______________ Removal date ______________

Litology

No.	Seam	Block No.	Hole No. as per preject	f =	Hole depth, m	Hole net drilling time								Drilling parameters			Operator's name Signature. Date/Shift
						Rod 1		Rod 2		Rod 3		Total		pressure on hole bottom, atm	rotator speed, RPM	air pressure, atm	
						min	m	min	m	min	m	min	m				

Drill site supervisor ______________

Annex 4

Statistical data of bit work off for ______ years

No.	Bit type	Bit factory No.	Drilling rig model / Side No.	Mine	Seam	Block	Formation hardness factor, f=	Bit mount date	Drilling parameters: Load on bit, kN	Drilling parameters: Rotation speed, RPM	Drilling parameters: Air pressure in bit, atm (MPa)	Bit sinkage, m	Drilling time, hours	Mechanical drilling rate, m/h	Bit removal date	Bit removal reasons

Post ______ Name ______ Signature ______

Annex 5

Prospective plan of drilling development for ______ year

Drilling amount, thousands of meters: Mine	Seam	Block	Total, linear meters	Drilling amount by hardness, thousands of meters: f=____	f=____	f=____	f=____

Post ______ Name ______ Signature ______

PIONEERS
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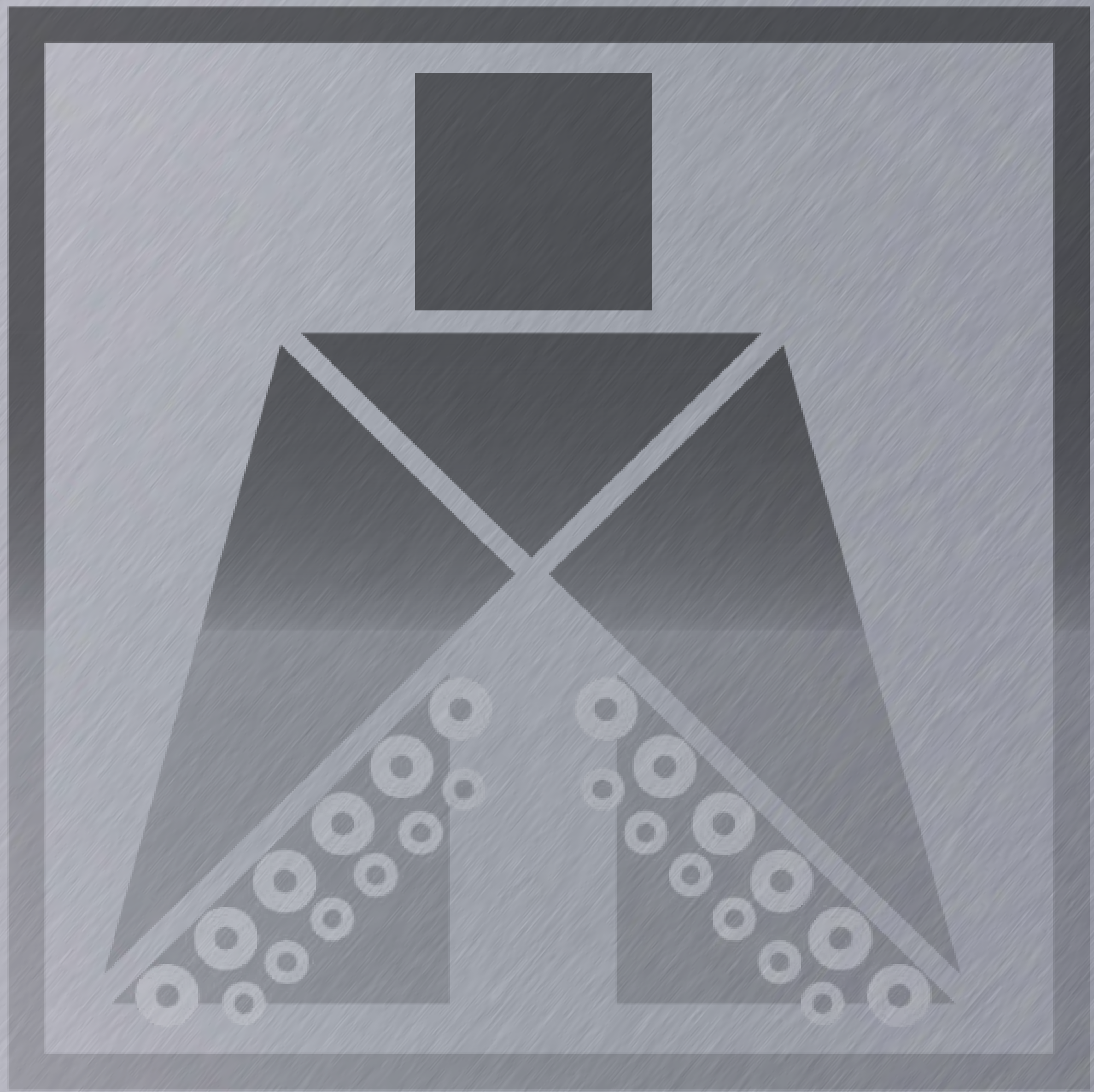

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