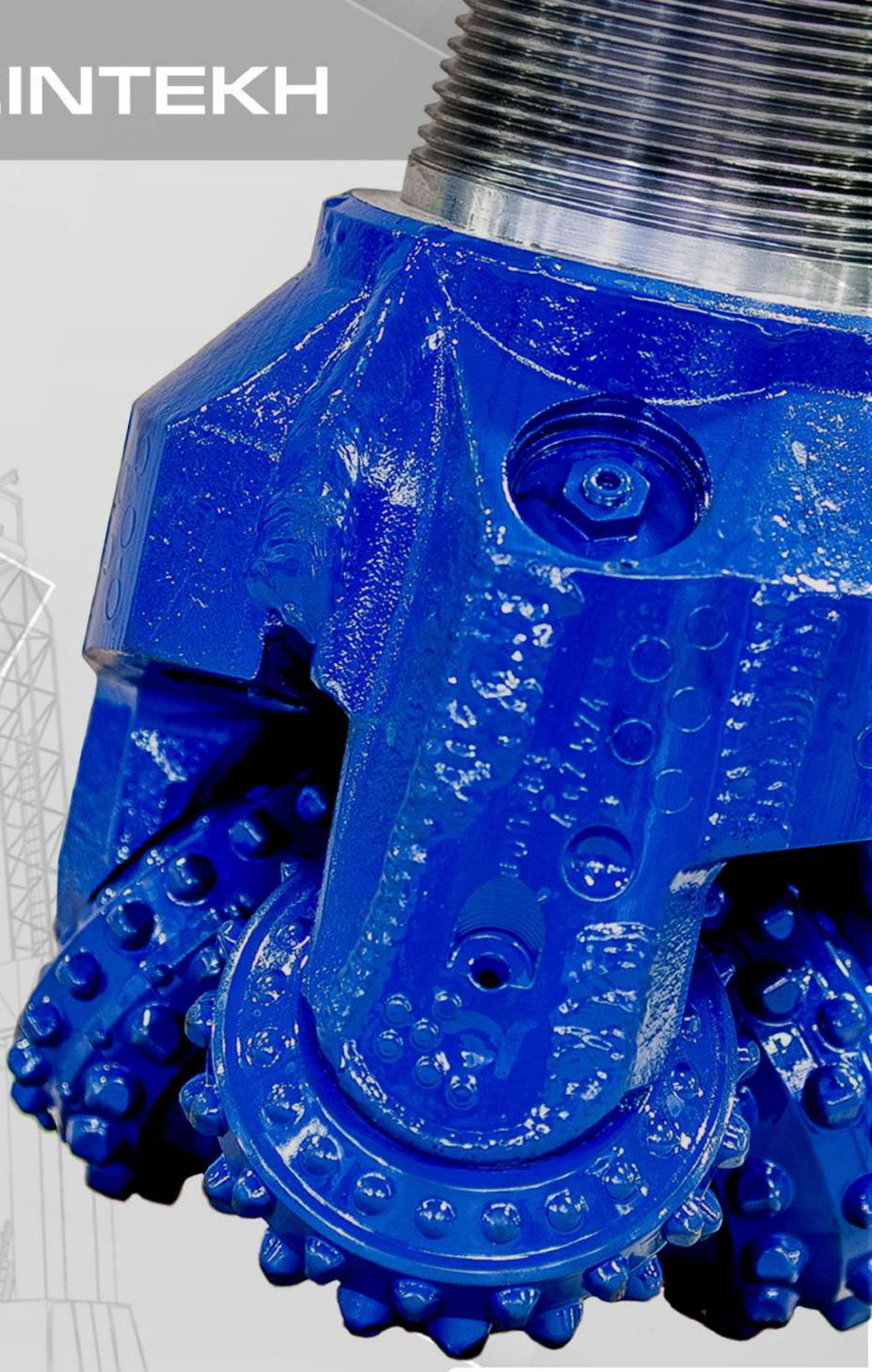
BURINTEKH



CATALOGUE

ROLLER-CONE BITS

CONTENTS

Профиль резьбы типа I V-0040
согласно табл.1
SURFACE
PROFILE

ABOUT PRODUCTS

- "BURINTEKH", Ltd roller-cone bits provide the highest level of reliability and performance. Each design embodies many years of design and manufacturing experience, the most stringent acceptance testing criteria and multiple tests in field conditions.

- Process of developing all designs is based on our own cutting structure and bearings design algorithms. Computer-aided design, mathematical and statistical analysis are used. Huge drilling experience in the most severe geological conditions is taken into account.

- Team of engineers is involved not only in the process of designing and manufacturing roller-cone bits, but also in analyzing all the incoming information regarding the operation of the tool.

- Up-to-date simulating, visualizing, analysis and data verification tools are at design-and-engineering team disposal. All this ensure task success.

- Equipment and unique technical solutions used in the production of bits act as a guarantor of the quality of manufacturing products.

- We can offer full range of designs for solving tasks of any complexity. Set of options provides an individual approach in the selection and use of bits.

- The quality management system controls all the production processes of the tool. Bit designs, equipment, production processes and quality control system fully complies with the requirements of API Q1 and ISO 9001 standards.

- "BURINTEKH", Ltd adheres to the philosophy of building partnerships with consumers of products. For us every review of product manufactured by our company is important.

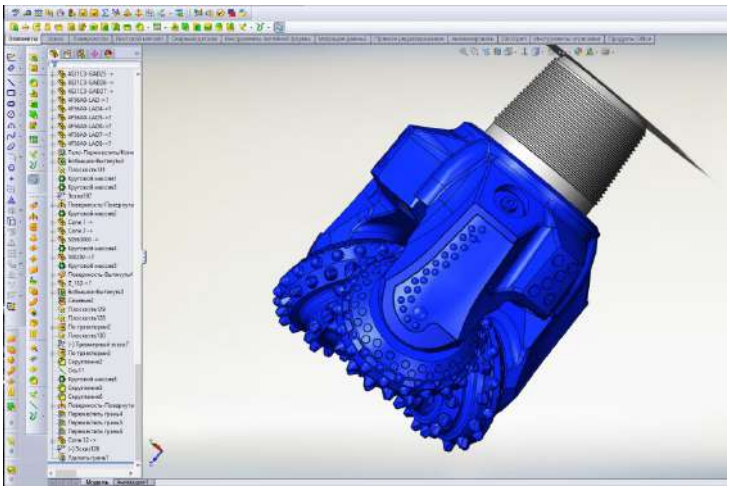
DESIGN AND MODELING

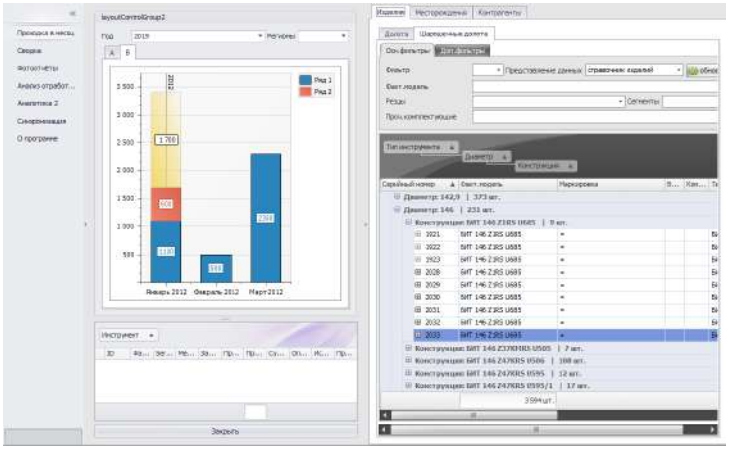
- The purpose of design process is the development of roller-cone bits corresponding to specific conditions and possessing high performance characteristics throughout the entire operation cycle.

- Drilling conditions comprehensive analysis. Design process takes into account the interaction of cutting structure performance, characteristics of rocks, drive system, effect of individual BHA components.

- Design development. Design development cycle is an ongoing process of design improvements aimed at improving bits performance reliability. Changes are based both on laboratory tests, field trials and on a continuous analysis of bits performance statistics.

- Own tool performance data analysis software allows conducting comprehensive analysis bits usage which in turn allows improving existing roller-cone bits designs and design new ones, taking into account all the features of its application.

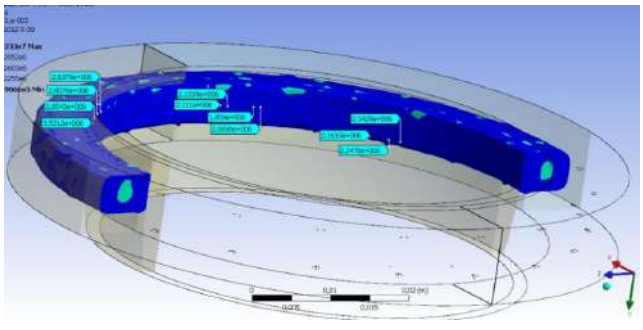


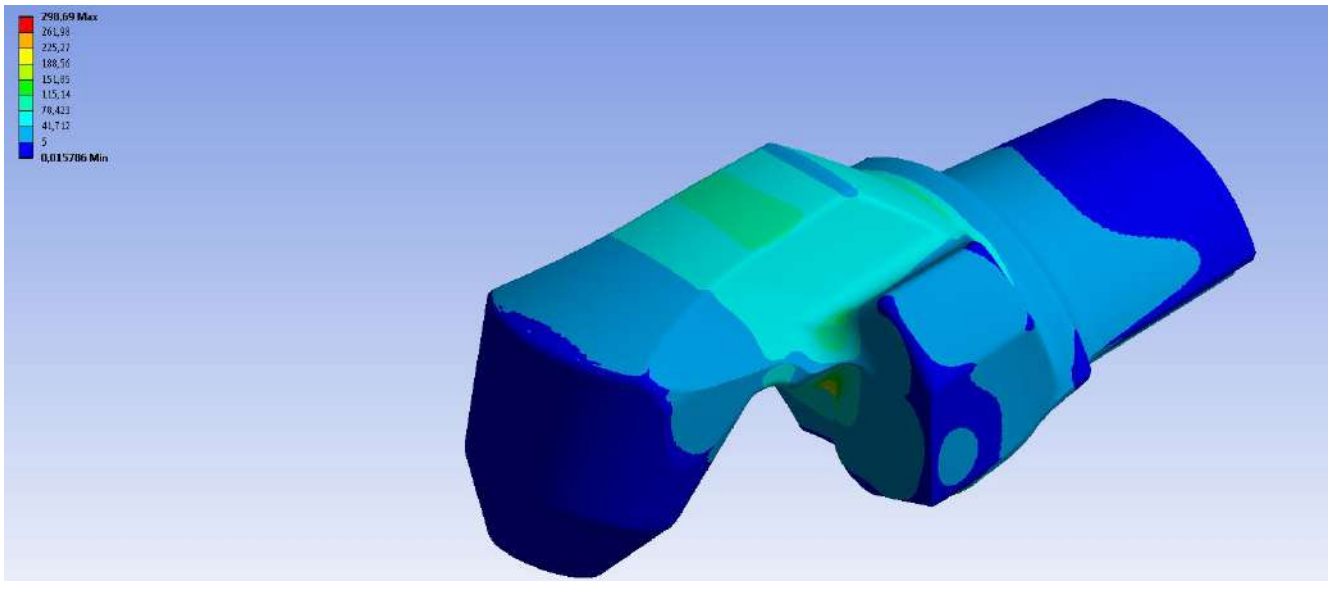


DESIGN AND MODELING

> FINITE ELEMENT ANALYSIS

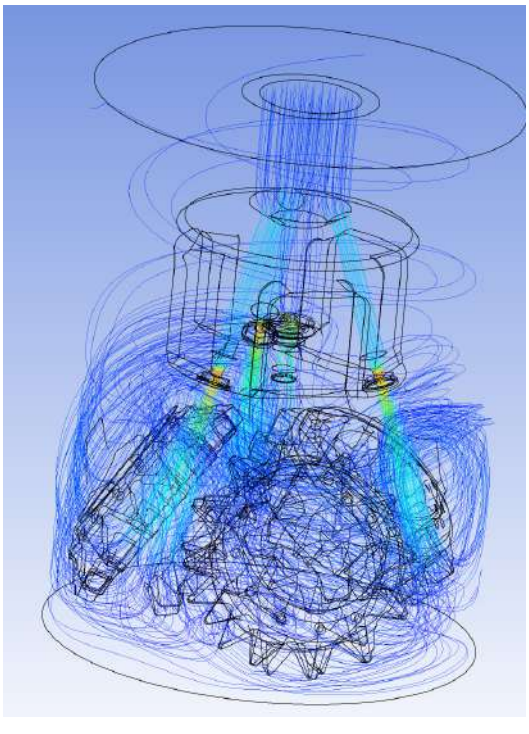
At the design stage it is important to assess the reliability of all structural elements affected by various factors that occur during drilling. Analysis carried out according to this method allows minimizing risks of premature wear during designing both individual components and the entire structure.





> EFFECTIVE BIT HYDRAULICS

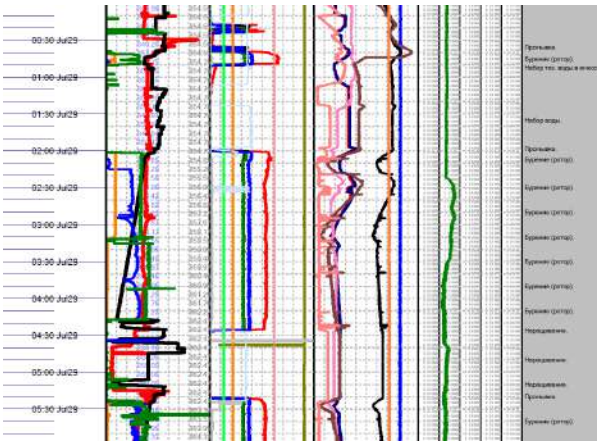
Properly selected and technically implemented model of hydraulic parameters of the bit is one of the most important reasons for the effective operation of cutting structure. That is why engineers pay special attention to solve problems of improving the performance of the hydraulic system when designing bits. BURINTEKH design engineers use CFD analysis to simulate the interaction of the bit with the drilling fluid in the bottomhole formation zone. CFD is a process of mathematical modeling of the fluid close to the bit. Computer flow dynamics analysis shows tangential stresses and turbulent processes; this method also makes possible to evaluate the efficiency of cuttings transportation, bottomhole and cutting structure cleaning.



> ANALYSIS OF TOOL PERFORMANCE

When designing in order to achieve high operational parameters of bits a comprehensive analysis of tool operation is important. That is why engineering departments of company pay special attention to the study of drilling processes and its impact on the wear of roller-cone bits.

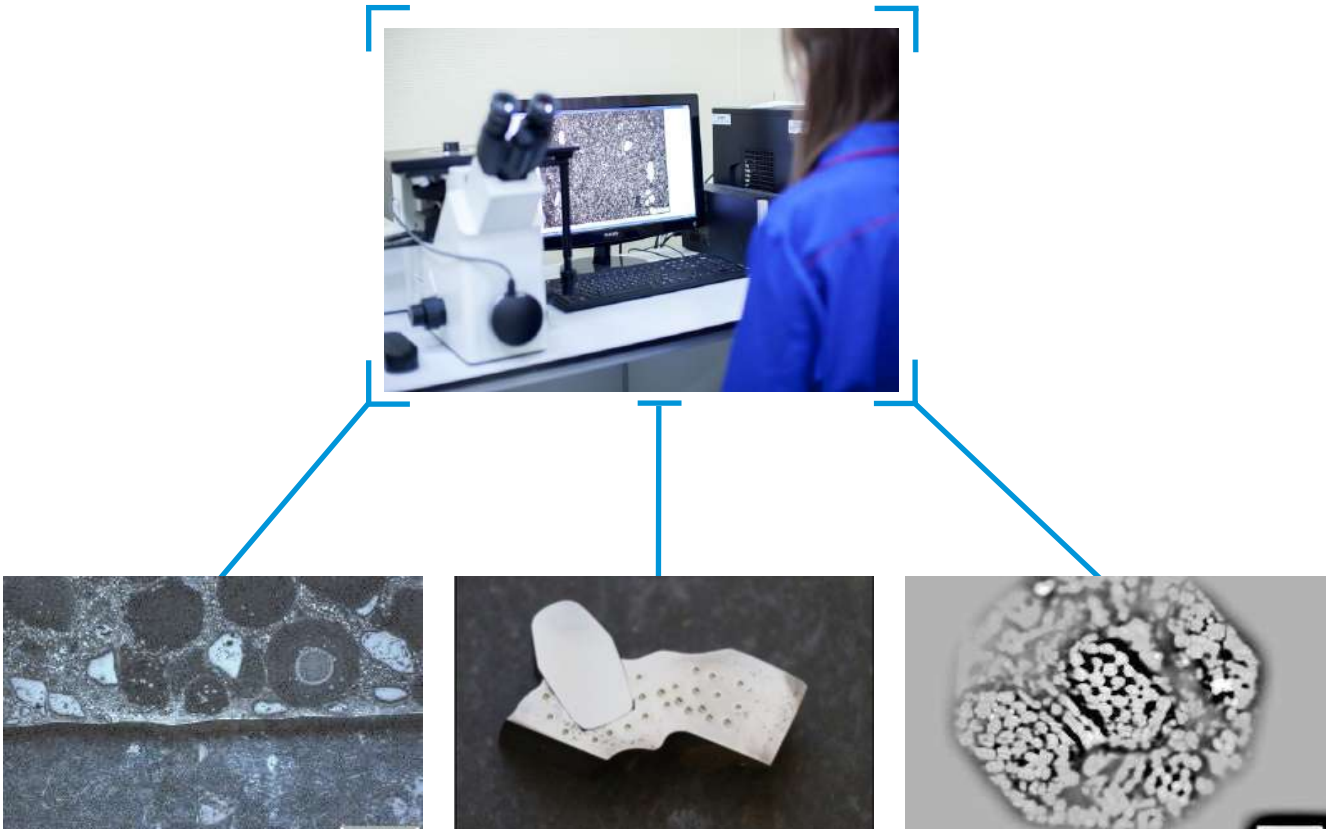
All possible tool operation reports are carefully analyzed entered into the database system and, if necessary, can be re-analyzed at any time. This information is very important for predicting tool operation under various operating conditions for different drilling parameters.



> TEST BENCH TOOL RESEARCH

The company's design engineers have at their disposal a set of test equipment, including mobile drilling rig tests on which are an important part of creating roller-cone bits. These benches allow both testing complete roller-bit and its separate units, including sealing units and cutting structure. Together with the analysis in real conditions this is a powerful tool in designing and predicting the work of roller-cone bits.

DESIGN AND MODELING



> DEVELOPMENT, SELECTION AND TESTING OF MATERIALS

The search for new solutions in the field of increasing the lifetime of roller-cone bits is inseparably connected with the study of new materials, its wear and destruction mechanism. Also the most important task is to increase the physical and mechanical properties of materials already used in the production of bits; for this purpose selection of new processing modes is carried out, which is subsequently comprehensively investigated.

An important field of work in the selection of materials is working with leading domestic and foreign manufacturers of products necessary for the production and assembly of roller-cone bits. The result of this collaboration is the solutions applied in our tool. These solutions are unique in characteristics and obtained as a result of years of research and tests in the most difficult conditions, in order to obtain a guaranteed level of quality.

Company conducts its own developments in the field of creating materials with unique characteristics and has proprietary solutions used in roller-cone bits manufactured by BURINTEKH.

Importantly a regular analysis of run roller-cone bits is performed in order to obtain reliable information on changes in the characteristics of materials used in them. This information is necessary to ensure reliable operation of bits in any application conditions.


OTK

PRODUCTION

> ROLLER-CONE BITS SHOP

The fleet of modern equipment including five-axis machining center units and team of professionals successfully solves the most complex tasks of matching the product to the design documentation.

All operations including special processes are validated for compliance with ISO and API Q1 standards. Production personnel regularly undergo certification confirming the level of their own qualifications.

At the present time production can master new designs within shortest time observing the highest quality standards.

PRODUCTION

> QUALITY CONTROL

The company's objective is to match the quality of products to the customer's expectations. Our goal is to exceed industry standards in the field of production and operation of roller-cone bits. To that effect company has implemented and successfully operates quality management system which includes comprehensive control of products as well as control of suppliers of materials and components involved in the process of manufacturing and assembling roller-cone bits. Company organizes the production and control process to provide customers with high-quality products with a guarantee of reliable operation.

MT BITS (ROLLER–CONE BITS WITH MILLED CUTTING STRUCTURE FOR HIGH PERFORMANCE DRILLING)

Milled tooth bits are designed for drilling intervals with maximum performance.

Variety of different cutting structure configurations allows drilling top intervals with maximum speed in soft formations as well as ensures long lifetime of bits in harder formations.

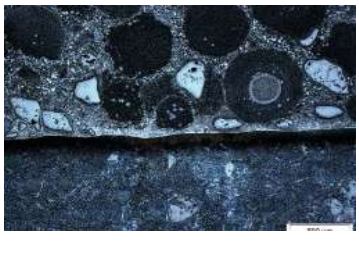
Proprietary volumetric harfacing based on tungsten carbide ensures milled tooth stability throughout the bit lifetime. Carbide inserts specially located on gage together with shirttail hardfacing allow minimizing gage loss even in abrasive formations.

APPLICATION

- soft and medium rocks
- possibility of using high-speed motors and turbines

FEATURES

- aggressive cutting structure for maximum ROP
- hardfacing with reinforcing materials intended for different wear resistance. Combination of such materials allows reducing both abrasive wear and impact load wear on teeth.
- optimized hydraulics for reducing balling and cutting structure wear.



Hardfacing material based on tungsten carbide used for coating cutting structure contact surfaces and reinforcing gage surfaces.

TCI BITS (ROLLER–CONE BITS WITH CARBIDE CUTTING STRUCTURE FOR DRILLING IN ROCKS WITH HIGH ABRASIVENESS AND HIGH HARDNESS)

These bits are designed for high performance drilling long intervals characterized by maximum abrasiveness and increased hardness.

Cutting structure of such bits has special inserts arrangement which prevents tracking; material of inserts combines a high degree of resistance to abrasive wear as well as resistance to transverse fracture. All inserts are pressed in with a specially designed tightness that eliminates cracking and ensures reliable fastening of all cutting structure elements.

APPLICATION

- *drilling all types of rocks from soft to hard with high level of abrasiveness*
- *possibility of using high-speed motors and turbines*

FEATURES

- *aggressive coordinated cutting structure elements arrangement.*
- *variety of inserts shapes for the effective destruction of rocks of any type of hardness*
- *optimized hydraulics for efficient face cleaning to prevent regrinding of cuttings*

Special inserts material with high abrasive wear resistance

ROLLER–CONE BITS FOR DIRECTIONAL AND HORIZONTAL DRILLING

These bits are designed for drilling complex trajectory well, horizontal wells and for drilling with high buildup rate.

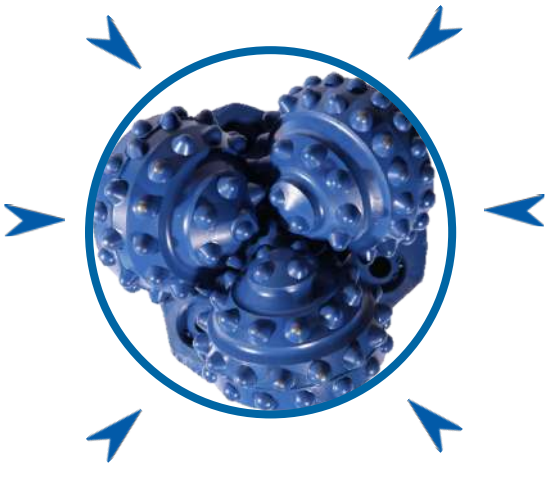
All bits of this series are distinguished by increased steerability and resistance to gage loss. Sealing units of increased lifetime and reliability increase the life of bit bearings. Special shaped shirttail forging with fed into it six-point stabilizing system allows minimizing vibration loads which can significantly reduce bit lifetime.

APPLICATION

- *difficult directional drilling conditions*
- *drilling with downhole motors, rotary drilling and other drives.*

FEATURES

- *special geometry of seal units*
- *six-point stabilizing system*
- *large set of options for bit diameter protection*



Six-point stabilizing system minimizes vibration loads while directional drilling increasing bit performance.

ROLLER–CONE BITS FOR SIDETRACKING, WORKOVER AND COMPLETION

Bits of this type are specially designed for performing complicated sidetracking and drilling long horizontal intervals.

All bits of this type combine high cutting structure aggressiveness, steerability and resistance to abrasive wear.

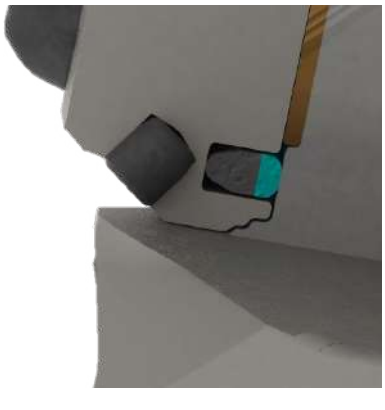
Reduced design height directly affects the steerability. Seal unit made from special material together with "labyrinth" seal increases reliability of bit while operating in the most severe geological conditions.

APPLICATION

- *sidetracking*
- *drilling with downhole motors, rotary drilling and other drives.*

FEATURES

- *special geometry of seal units*
- *six-point stabilizing system*
- *increased aggressiveness of gage rows for increasing "cutting" effect*



Seal unit of special design with complex energy saving sealing element secures bearing from drilled rocks impact.

SINGLE–CONE SMALL DIAMETER BITS FOR SPECIAL WELL OPERATIONS

The bits of this line are designed to perform special operations during well servicing and workover. They are a universal tool for mechanical cleaning of the tube side.

Bits of this line are available both with milled tooth cutting structure, reinforced volumetric coating and carbide cutting structure.

Single-cone bits are produced with a diameter of 48 mm and more.

APPLICATION

- *small and ultra-small diameter sidetracking*
- *tube side cleaning operations*

FEATURES

- *increased strength and adapted geometry to increase bit cutting structure life*
- *adapted to low flow rates bit flushing system for maximum bottomhole cleaning*
- *specially designed shirttail stabilization system to maintain the path while driling*

ROLLER–CONE HOLE OPENER

Roller-cone hole openers are designed to ream the wellbore with simultaneous drilling with a pilot bit.

Roller-cone hole openers are produced with outside diameters up to 72 inches in both MT and TCI modifications

APPLICATION

- *wellbore reaming in various geological conditions*

FEATURES

- *specially designed cutting structure with a special shape of the teeth reinforced with a extra strong hardfacing*
- *modified design of the bearing unit with double seal for maximum load operation at high rpm*
- *optimized flushing system for timely cleaning of the reamer and bottomhole*
- *low torque at rotation of the drilling tool due to the crushing-shearing effect on the rock.*

DESIGN FEATURES

	Code	Description
Prefix – before hardness digital code	**Z**	Journal bearing (sealed by default)
	R	Roller bearing (sealed by default)
	W	Double seal unit (function)
	O	Unsealed bearing (function)*
Suffix – after hardness digital code	**J**	Central jet
	K	Conical inserts
	G	Inserts on reaming gage
	B	Additional row of gage inserts
	S	Shirttail reinforcement with carbide inserts
	L	Six-point stabilization**
	D, D1, D2	Diamond inserts reinforcement (33%, 66%, 100%)
	T	Cone body anti-errosion protection
	E	Elongated nozzles
	H	Cones additional protection with carbide inserts
	J +	Additional flushing ports***

* used only with prefixes Z and R, indicates that these types of bearings are unsealed
** only applicable for bits size 4-3/4" to 12-1/4", not indicated in identification
*** only available upon a request for bits from 20" and more

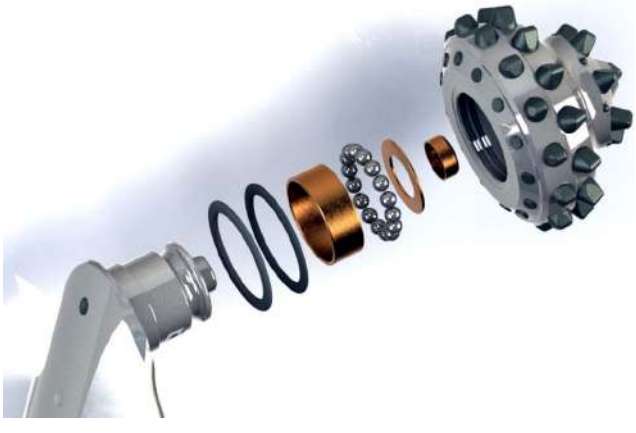
EXAMPLE OF NOMENCLATURE **8 1/2 ZW18GBHJ**

8 1/2 – bit diameter
ZW – journal bearing with double seal
18 – hardness digital code
G – inserts on reaming gage (by default)
B – additional row of gage inserts
L – six-point stabilizing system
H – cones additional protection with carbide inserts
J – central jet

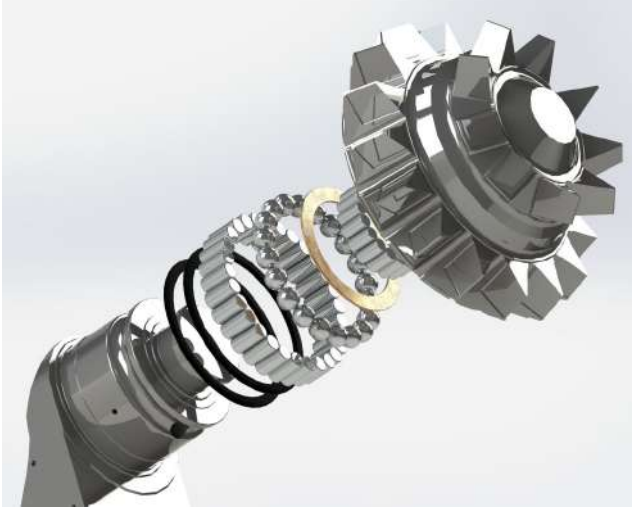
Bearing

Z series

Journal bearing made with the use of anti-friction, "floating" elements made of a special material having a low coefficient of friction able to withstand high revolutions and loads. Sealing unit rings of which are made of wear-resistant rubber compound HNBR reliably protect the entire design of journal. By means of patented assembly system all journals are assembled with optimally calculated clearances which allow equally loading all 3 sections of the bit.



R series



Roller bearing is designed in such a way that roller saddle is located in the bit cone. This made possible to maximize the size of bearing which in turn allows withstanding increased axial loads and high bit rotational speeds. By means of unique manufacturing techniques, all clearances in the bearing are minimized. Guaranteed repeatability accuracy in the manufacture of bearings is essential for steady operation of bits.

DESIGN FEATURES

For the most effective cutting structure operation the widest range of various geometrical shapes of carbide inserts is needed- the mains elements that perform rock destruction. BURINTEKH roller-cone bits use all the variety of inserts, including own designed geometry.

Conical | Chisel | Biconical | Flat | Bevelled | Spherical | Profiled

Features

H

FEATURE H

Cones additional protection with carbide inserts

APPLICATION

High abrasive rocks with the risk of increased cones wear

ADVANTAGES

Carbide inserts of a special shape located on the cones protect cones from undestroyed rocks and reduce abrasive wear

K

FEATURE K

Conical shape of tooth

APPLICATION

Tightly agglomerated rocks of high hardness and abrasiveness, drilling intervals where there is a high risk of shock loads on the bit

ADVANTAGES

Inserts with a special conical shape are more wear and shock resistant compared to teeth of a different shape. The possibility of drilling long both in time and length intervals with minimal wear and tear

G

FEATURE G

Inserts on reaming gage

APPLICATION

Bit protection against gage loss

ADVANTAGES

Due to wear resistant shape and abrasion resistant alloy inserts of this type significantly increase gage loss resistance.

B

FEATURE B

Additional (gage) inserts row

APPLICATION

Improving cutting structure wear resistance

ADVANTAGES

Gage loss wear resistance increase, gage rows protection

T

FEATURE T

Cone hardfacing

APPLICATION

Protection of cones from aggressive abrasive environment as well as prevention of washout and subsequent fall out of carbide inserts from the cone

ADVANTAGES

Tungsten carbide coating applied by HVOF method can significantly reduce the effect of abrasive particles on cones wear thus extending lifetime of cutting structure and bits

DESIGN FEATURES

GD

FEATURE GD, GD1, GD2

Reaming gage reinforced with diamond coating (100%, 50%, 33%)

APPLICATION

Protection of the bit against gage loss in difficult geological conditions

ADVANTAGES

Reinforced with synthetic diamond coating inserts significantly increase the resistance of bit to gage loss when operating in abrasive rocks

D

FEATURE D, D1, D2

Diamond inserts reinforcement (33%, 66%, 100%)

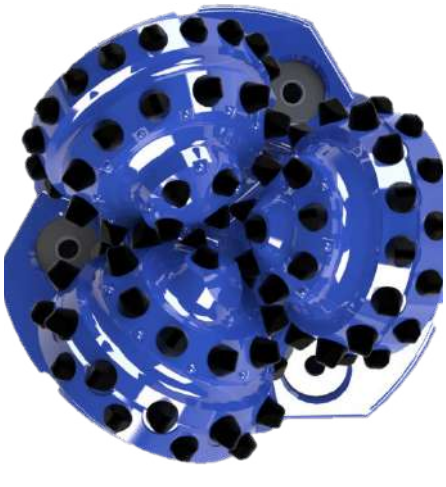
APPLICATION

Drilling wells with high efficiency in difficult geological conditions

ADVANTAGES

Reinforced with synthetic diamond coating profiled inserts in gage row significantly increase the resistance of cutting structure in difficult geological conditions

DD



FEATURE DD

All cutting structure is reinforced with diamond coating

APPLICATION

High efficiency drilling in high-abrasive rocks

ADVANTAGES

High bit and cutting structure stability at high performance drilling

S

FEATURE S

Shirttail is reinforced with carbide inserts

APPLICATION

Protection of the bit against gage loss in directional and horizontal drilling

ADVANTAGES

Carbide inserts significantly increase the resistance of the bit to gage loss when drilling directional and horizontal wells

SD

FEATURE SD

Shirttail is reinforced with diamond coated inserts

APPLICATION

Directional drilling with high reliability in difficult geological conditions

ADVANTAGES

Reinforced with synthetic diamond coating inserts located on the shirttail significantly increase durability of the entire bit when drilling long intervals in difficult geological conditions and high abrasive tocks

L

FEATURE L

Arm forging is specially designed to create the effect of six-point stabilization of the bit

APPLICATION

Protection of the bit against vibration loads during directional and horizontal drilling

ADVANTAGES

Arm configuration allows maximum stabilizing the bit in the well which reduces harmful vibration loads both on cutting structure and bearing prolonging the lifetime of the bit and increasing its efficiency

DESIGN FEATURES

J

FEATURE J

Central jet

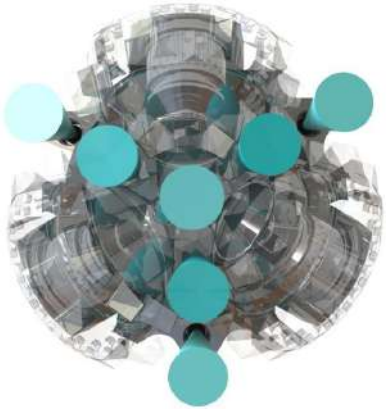
APPLICATION

For drilling in very soft and medium-soft rocks with low compressive strength, as well as for drilling large diameter wells

ADVANTAGES

The presence of a central jet helps preventing balling, improves cleaning of the bottomhole zone and increases the rate of penetration

J+



FEATURE J +

Additional flushing holes in the bit body

APPLICATION

Improved cleaning of large bits when drilling rocks prone to adhesion and balling

ADVANTAGES

Additional flushing holes located in the body of the bit help improving cleaning of cutting structure thus increasing the efficiency of its performance

E

FEATURE E

Elongated side jets

APPLICATION

Drilling of hard high abrasive rocks

ADVANTAGES

Elongated lateral jets improve cuttings transportation reducing the likelihood of re-drilling thus increasing the efficiency of cutting structure and rate of penetration

ROLLER–CONE BITS TYPES

Sizes, in	Hardness digital code	Roller-cone bits types														
		Z	R	W	O	C	J/J+	K	G	B	S	L	D	T	E	H
$2\,^{9}/_{32}$ -$2^{11}/_{16}$	6	•	–	–	•	•	–/–	–	–	–	o	•	–	–	–	–
	47	•	–	–	•	•	–/–	•	–	–	o	•	o	o	–	–
	57	•	–	–	•	•	–/–	–	–	–	o	•	o	o	–	–
$4\,^{3}/_{4}$ - 5	1	•	–	–	–	–	–/–	–	•	–	•	•	–	o	–	–
	2	•	–	–	–	–	–/–	–	•	–	•	•	–	o	–	–
	18	•	–	–	–	–	–/–	–	•	–	•	•	o	o	–	–
	20	•	–	–	–	–	–/–	–	•	–	•	•	o	o	–	–
	47	•	–	–	–	–	–/–	•	•	–	•	•	o	o	–	–
$5\,^{1}/_{2}$	1	•	o	–	–	–	–/–	–	•	–	•	•	–	o	–	–
	4	•	o	–	–	–	–/–	–	–	–	–	•	–	o	–	–
	20	•	o	–	–	–	–/–	–	•	–	•	•	o	o	–	–
	47	•	o	–	–	–	–/–	•	•	–	•	•	o	o	–	–
$5\,^{5}/_{8}$ - $5\,^{3}/_{4}$	1	•	o	–	–	–	–/–	–	•	o	•	•	–	o	–	–
	20	•	o	–	–	–	–/–	–	•	o	•	•	o	o	–	–
	30	•	o	–	–	–	–/–	o	•	o	•	•	o	o	–	–
	47	•	o	–	–	–	–/–	•	•	o	•	•	o	o	–	–
6 - $6\,^{1}/_{8}$	1	•	o	–	–	–	o/–	–	•	o	•	•	–	o	–	–
	4	•	o	–	–	–	o/–	–	•	o	–	•	–	o	–	–
	05	•	o	–	–	–	o/–	•	•	o	•	•	o	o	–	–
	30	•	o	–	–	–	o/–	o	•	o	•	•	o	o	–	–
	47	•	o	–	–	–	o/–	•	•	o	•	•	o	o	–	–
$7\,^{1}/_{2}$	47	•	o	–	–		o/–	•	•	o	•	•	o	o	o	–
$8\,^{1}/_{2}$ - $8\,^{3}/_{4}$	1	•	o	•	o	–	o/–	–	•	o	•	•	–	o	o	o
	3	•	o	•	o	–	o/–	–	•	o	–	•	–	o	o	o
	4	•	o	•	o	–	o/–	–	–	o	•	•	–	o	o	o
	05	•	o	•	o	–	o/–	•	•	o	•	•	o	o	o	o
	18	•	o	•	o	–	o/–	•	•	o	•	•	o	o	o	o
	30	•	o	•	o	–	o/–	o	•	o	•	•	o	o	o	o
	45	•	o	•	o	–	o/–	•	•	o	•	•	o	o	o	o
	47	•	o	•	o	–	o/–	•	•	o	•	•	o	o	o	o
	57	•	o	•	o	–	o/–	•	•	o	•	•	o	o	o	o
$11\,^{5}/_{8}$	1	•	o	o	o	–	o/–	–	•	o	•	•	–	o	o	o
	2	•	o	o	o	–	o/–	–	•	o	•	•	–	o	o	o
	3	•	o	o	o	–	o/–	–	•	o	•	•	–	o	o	o
	4	•	o	o	o	–	o/–	–	–	o	–	•	–	o	o	o
	30	•	o	o	o	–	o/–	o	•	o	•	•	o	o	o	o
	45	•	o	o	o	–	o/–	•	•	o	•	•	o	o	o	o
	47	•	o	o	o	–	o/–	•	•	o	•	•	o	o	o	o

ROLLER–CONE BITS TYPES

Sizes, in	Hardness digital code	Roller-cone bits types														
		Z	R	W	O	C	J/J+	K	G	B	S	L	D	T	E	H
12 $^{1}/_{4}$	1	•	o	o	o	–	o/–	–	•	o	•	•	o	o	o	o
	3	•	o	o	o	–	o/–	–	•	o	•	•	o	o	o	o
	4	•	o	o	o	–	o/–	–	–	o	–	•	–	o	o	o
	08	•	o	o	o	–	o/–	•	•	o	•	•	o	o	o	o
	15	•	o	o	o	–	o/–	•	•	o	•	•	o	o	o	o
	18	•	o	o	o	–	o/–	•	•	o	•	•	o	o	o	o
	30	•	o	o	o	–	o/–	o	•	o	•	•	o	o	o	o
	45	•	o	o	o	–	o/–	•	•	o	•	•	o	o	o	o
15 $^{1}/_{2}$ - 17 $^{1}/_{2}$	1	o	•	o	o	–	•/–	–	•	o	o	–	–	o	o	o
	3	o	•	o	o	–	•/–	–	•	o	o	–	–	o	o	o
	4	o	•	o	o	–	•/–	–	•	o	o	–	–	o	o	o
	08	o	•	o	o	–	•/–	•	•	o	o	–	o	o	o	o
	30	o	•	o	o	–	•/–	o	•	o	o	–	o	o	o	o
	47	o	•	o	o	–	•/–	•	•	o	o	–	o	o	o	o
19 $^{19}/_{64}$ - 22	1	o	•	o	o	–	•/o	–	•	o	•	–	–	o	o	o
	4	o	•	o	o	–	•/o	–	–	o	–	–	–	o	o	o
	20	o	•	o	o	–	•/o	–	•	o	•	–	o	o	o	o
22 $^{1}/_{2}$ - 23	1	–	•	•	o	–	•/o	–	•	o	•	–	–	o	o	o
	18	–	•	•	o	–	•/o	–	•	o	•	–	o	o	o	o
24 - 26	1	–	•	–	o	–	•/o	–	•	o	–	–	–	o	o	o
	4	–	•	–	o	–	•/o	–	•	o	–	–	–	o	o	o
	20	–	•	–	o	–	•/o	–	•	o	–	–	o	o	o	o
HO - 914	1	–	•	•	o	–	–/–	–	•	o	•	–	–	o	o	o

• default feature
o additional option
– not applicable

Nomenclature shown in this table reflects only the main and most popular designs of roller-cone bits manufactured by BURINTEKH. The range of roller-cone bits is constantly growing and changing. For an update of a design of interest, contact the relevant specialists of our company.

CENTRAL JET
SERIES PZ

Central jet unit includes a carbide threaded nozzle PZ series and two sealing rings that reliably protect the assembly from erosion both from cutting structure and pin.

SIDE NOZZLE
SERIES H2

The composition of the side nozzle unit includes the carbide nozzle H2 series, sealing ring, the fastening is provided with expansion C-ring.

SIDE NOZZLE
SERIES H3

The composition of the side nozzle unit includes the carbide nozzle H3 series, sealing ring, the fastening is provided either by thread locker or expansion C-ring.

Series	Bit diameters, inches				
	$4^3/_4$ - 5	$5\,^1/_2$ - $6\,^1/_8$	$8\,^3/_8$ - $8\,^3/_4$	$11^5/_8$ - $12^1/_4$	$14^1/_2$ - 26
H2	+	+	-	-	-
H3	-	-	+	+	+
Pz	-	+	+	+	+

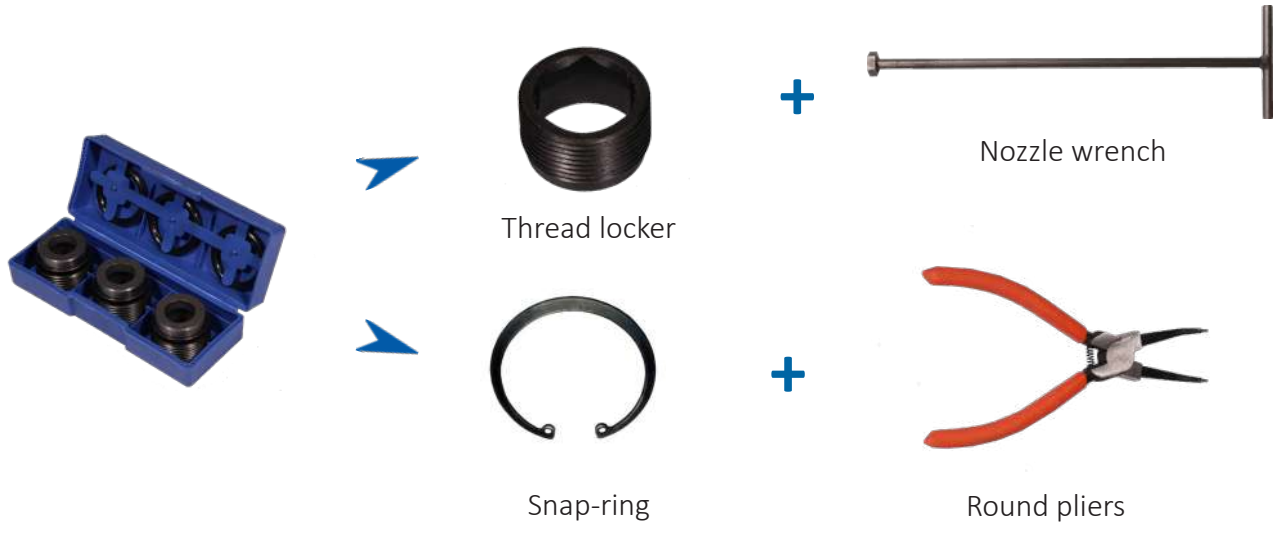
Snap-ring

Thread locker

Threaded nozzle

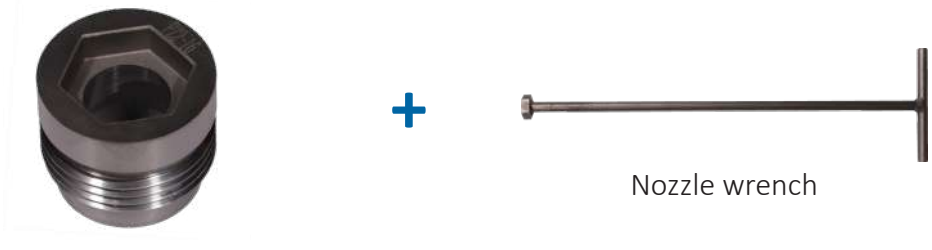
NOZZLES
AND MODE OF MOUNTING

Series H3



Series H2

Series PZ



When changing nozzles it is necessary to be sure that all the mounting surfaces are free of contamination, the geometry of both unit and nozzles is not disturbed, and only after that you can proceed to the installation. We recommend using new sealing and snap-ring, thread lockers and nozzles every time. It is possible to reuse nozzles if there are no signs of damage on them. Rubber rings are recommended to coat with a lubricating reagent to reduce the likelihood of damage during installation.

Important! In order to comply with safety regulations - all nozzles replacement and installation operations should be performed using personal protective equipment.

REFERENCE ROLLER–CONE BITS NOZZLES INFORMATION

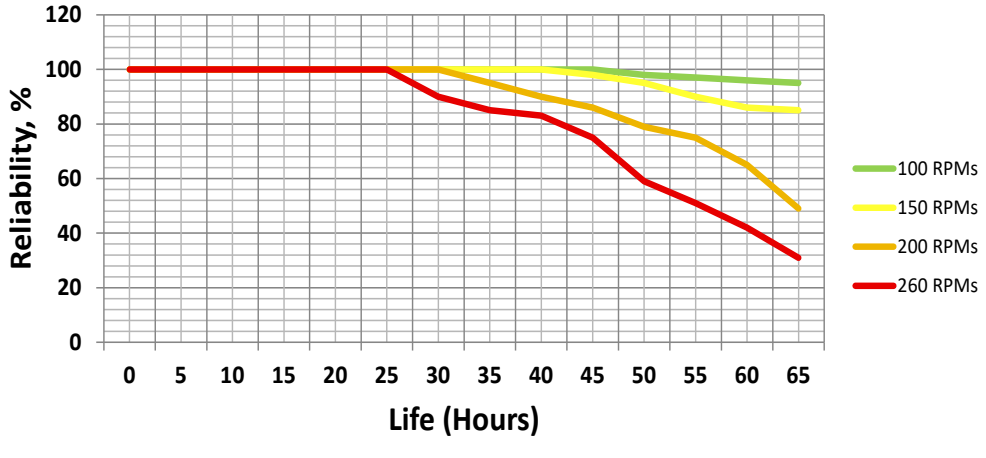
Inner dia in 1/32 inches	Inner dia in mm	H2	H3	PZ2
6	4,8	H2-04	n/a	n/a
7	5,6	H2-05	n/a	n/a
8	6,4	H2-06	H3-06	n/a
9	7,1	H2-07	•	n/a
10	7,9	H2-08	H3-08	PZ2-08
11	8,7	H2-09	•	•
12	9,5	•	H3-09	PZ2-09
13	10,3	H2-10	•	•
14	11,1	H2-11	H3-11	PZ2-11
15	11,9	H2-12	•	•
16	12,7	H2-13	H3-13	PZ2-13
17	13,5	•	•	•
18	14,3	H2-14	H3-14	•
19	15,1	•	•	•
20	15,9	H2-16	H3-16	PZ2-16
21	16,7	n/a	•	•
22	17,5	n/a	H3-17	PZ2-17
23	18,3	n/a	•	•
24	19,1	n/a	H3-19	PZ2-19
25	19,8	n/a	•	•
26	20,6	n/a	H3-21	•
27	21,4	n/a	•	n/a
28	22,2	n/a	H3-22	n/a
29	23,0	n/a	•	n/a
30	23,8	n/a	H3-24	n/a
31	24,6	n/a	•	n/a
32	25,4	n/a	•	n/a

• - to be machined

Total Flow Area, sq. in							
Ø, in	Quantity of nozzles						
	1	2	3	4	5	6	7
6/32	0,03	0,06	0,08	0,11	0,14	0,17	0,20
7/32	0,04	0,07	0,11	0,15	0,19	0,22	0,26
8/32	0,05	0,10	0,15	0,20	0,24	0,29	0,34
9/32	0,06	0,12	0,19	0,25	0,31	0,37	0,43
10/32	0,08	0,15	0,23	0,31	0,38	0,46	0,53
11/32	0,09	0,19	0,28	0,37	0,47	0,56	0,65
13/32	0,13	0,26	0,39	0,52	0,65	0,78	0,91
14/32	0,15	0,30	0,45	0,60	0,75	0,91	1,06
15/32	0,17	0,35	0,52	0,69	0,86	1,04	1,21
16/32	0,20	0,39	0,59	0,79	0,98	1,18	1,37
18/32	0,25	0,50	0,74	0,99	1,24	1,49	1,74
20/32	0,31	0,61	0,92	1,23	1,53	1,84	2,15
22/32	0,37	0,74	1,12	1,49	1,86	2,23	2,60
24/32	0,44	0,88	1,33	1,77	2,21	2,65	3,09
26/32	0,52	1,04	1,56	2,08	2,60	3,11	3,63
28/32	0,60	1,20	1,80	2,41	3,01	3,61	4,21
30/32	0,69	1,38	2,07	2,77	3,46	4,15	4,84

Krevs 120,6-155,6 (4 3/4 – 6 1/8'')														
mean RPM	Hours													
	5	10	15	20	25	30	35	40	45	50	55	60	65	70
60	18	36	54	72	90	108	126	144	162	180	198	216	234	252
70	21	42	63	84	105	126	147	168	189	210	231	252	273	294
80	24	48	72	96	120	144	168	192	216	240	264	288	312	336
90	27	54	81	108	135	162	189	216	243	270	297	324	351	378
100	30	60	90	120	150	180	210	240	270	300	330	360	390	420
110	33	66	99	132	165	198	231	264	297	330	363	396	429	462
120	36	72	108	144	180	216	252	288	324	360	396	432	468	504
130	39	78	117	156	195	234	273	312	351	390	429	468	507	546
140	42	84	126	168	210	252	294	336	378	420	462	504	546	588
150	45	90	135	180	225	270	315	360	405	450	495	540	585	630
160	48	96	144	192	240	288	336	384	432	480	528	576	624	672
170	51	102	153	204	255	306	357	408	459	510	561	612	663	714
180	54	108	162	216	270	324	378	432	486	540	594	648	702	756
190	57	114	171	228	285	342	399	456	513	570	627	684	741	798
200	60	120	180	240	300	360	420	480	540	600	660	720	780	840
210	63	126	189	252	315	378	441	504	567	630	693	756	819	882
220	66	132	198	264	330	396	462	528	594	660	726	792	858	924
230	69	138	207	276	345	414	483	552	621	690	759	828	897	966
240	72	144	216	288	360	432	504	576	648	720	792	864	936	1008
250	75	150	225	300	375	450	525	600	675	750	825	900	975	1050
260	78	156	234	312	390	468	546	624	702	780	858	936	1014	1092

– «green zone» – enough bit life
– «yellow zone» – bit life runs out
– «orange zone» – bit life exhausted
– «red zone» – no data, operation is impossible

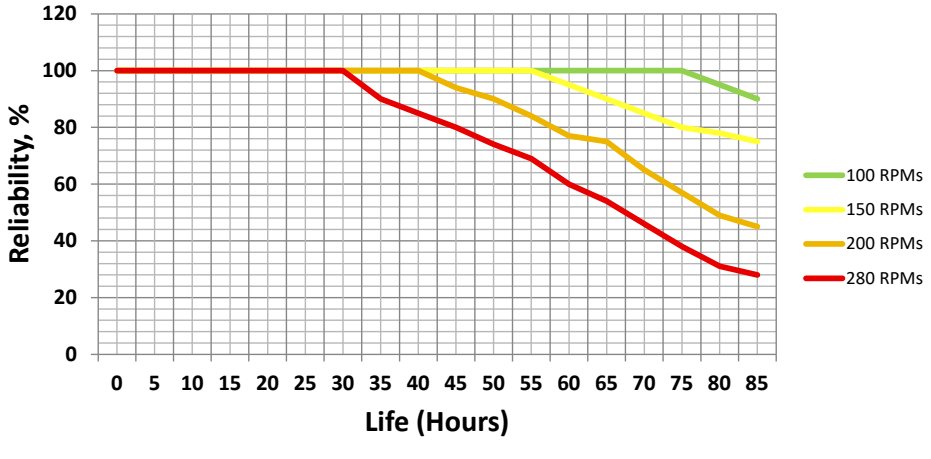


Data presented on this page is based on a statistical analysis of the operation of the tool and does not constitute warranty obligations for the service life of roller-cone bits manufactured by BURINTEKH. These diagrams are intended to serve as a guideline for the reliability of operation depending on the time of operation and the type of rotator.

REFERENCE
APPLICATION INFORMATION

Krevs 215,9-222,3 (8 1/2-8 3/4")																	
mean RPM	Hours																
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85
60	18	36	54	72	90	108	126	144	162	180	198	216	234	252	270	288	306
70	21	42	63	84	105	126	147	168	189	210	231	252	273	294	315	336	357
80	24	48	72	96	120	144	168	192	216	240	264	288	312	336	360	384	408
90	27	54	81	108	135	162	189	216	243	270	297	324	351	378	405	432	459
100	30	60	90	120	150	180	210	240	270	300	330	360	390	420	450	480	510
110	33	66	99	132	165	198	231	264	297	330	363	396	429	462	495	528	561
120	36	72	108	144	180	216	252	288	324	360	396	432	468	504	540	576	612
130	39	78	117	156	195	234	273	312	351	390	429	468	507	546	585	624	663
140	42	84	126	168	210	252	294	336	378	420	462	504	546	588	630	672	714
150	45	90	135	180	225	270	315	360	405	450	495	540	585	630	675	720	765
160	48	96	144	192	240	288	336	384	432	480	528	576	624	672	720	768	816
170	51	102	153	204	255	306	357	408	459	510	561	612	663	714	765	816	867
180	54	108	162	216	270	324	378	432	486	540	594	648	702	756	810	864	918
190	57	114	171	228	285	342	399	456	513	570	627	684	741	798	855	912	969
200	60	120	180	240	300	360	420	480	540	600	660	720	780	840	900	960	1020
210	63	126	189	252	315	378	441	504	567	630	693	756	819	882	945	1008	1071
220	66	132	198	264	330	396	462	528	594	660	726	792	858	924	990	1056	1122
230	69	138	207	276	345	414	483	552	621	690	759	828	897	966	1035	1104	1173
240	72	144	216	288	360	432	504	576	648	720	792	864	936	1008	1080	1152	1224
250	75	150	225	300	375	450	525	600	675	750	825	900	975	1050	1125	1200	1275
260	78	156	234	312	390	468	546	624	702	780	858	936	1014	1092	1170	1248	1326
270	81	162	243	324	405	486	567	648	729	810	891	972	1053	1134	1215	1296	1377
280	84	168	252	336	420	504	588	672	756	840	924	1008	1092	1176	1260	1344	1428

– «green zone» – enough bit life
– «yellow zone» – bit life runs out
– «orange zone» – bit life exhausted
– «red zone» – no data, operation is impossible



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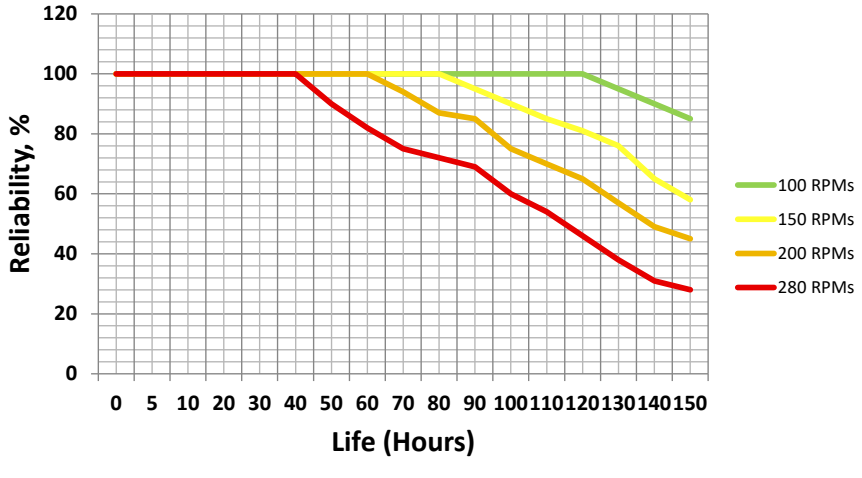
Krevs 295,3-311,1 (11 5/8-12 1/4")																
mean RPM	Hours															
	5	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
60	18	36	72	108	144	180	216	252	288	324	360	396	432	468	504	540
70	21	42	84	126	168	210	252	294	336	378	420	462	504	546	588	630
80	24	48	96	144	192	240	288	336	384	432	480	528	576	624	672	720
90	27	54	108	162	216	270	324	378	432	486	540	594	648	702	756	810
100	30	60	120	180	240	300	360	420	480	540	600	660	720	780	840	900
110	33	66	132	198	264	330	396	462	528	594	660	726	792	858	924	990
120	36	72	144	216	288	360	432	504	576	648	720	792	864	936	1008	1080
130	39	78	156	234	312	390	468	546	624	702	780	858	936	1014	1092	1170
140	42	84	168	252	336	420	504	588	672	756	840	924	1008	1092	1176	1260
150	45	90	180	270	360	450	540	630	720	810	900	990	1080	1170	1260	1350
160	48	96	192	288	384	480	576	672	768	864	960	1056	1152	1248	1344	1440
170	51	102	204	306	408	510	612	714	816	918	1020	1122	1224	1326	1428	1530
180	54	108	216	320	424	528	632	736	840	944	1048	1152	1256	1360	1464	1568
190	57	114	228	342	456	570	684	798	912	1026	1140	1254	1368	1482	1596	1710
200	60	120	240	360	480	600	720	840	960	1080	1200	1320	1440	1560	1680	1800
210	63	126	252	378	504	630	756	882	1008	1134	1260	1386	1512	1638	1764	1890
220	66	132	264	396	528	660	792	924	1056	1188	1320	1452	1584	1716	1848	1980
230	69	138	276	414	552	690	828	966	1104	1242	1380	1518	1656	1794	1932	2070
240	72	144	288	432	576	720	864	1008	1152	1296	1440	1584	1728	1872	2016	2160
250	75	150	300	450	600	750	900	1050	1200	1350	1500	1650	1800	1950	2100	2250
260	78	156	312	468	624	780	936	1092	1248	1404	1560	1716	1872	2028	2184	2340
270	81	162	324	486	648	810	972	1134	1296	1458	1620	1782	1944	2106	2268	2430
280	84	168	336	504	672	840	1008	1176	1344	1512	1680	1848	2016	2184	2352	2520

– «green zone» – enough bit life
– «yellow zone» – bit life runs out
– «orange zone» – bit life exhausted
– «red zone» – no data, operation is impossible



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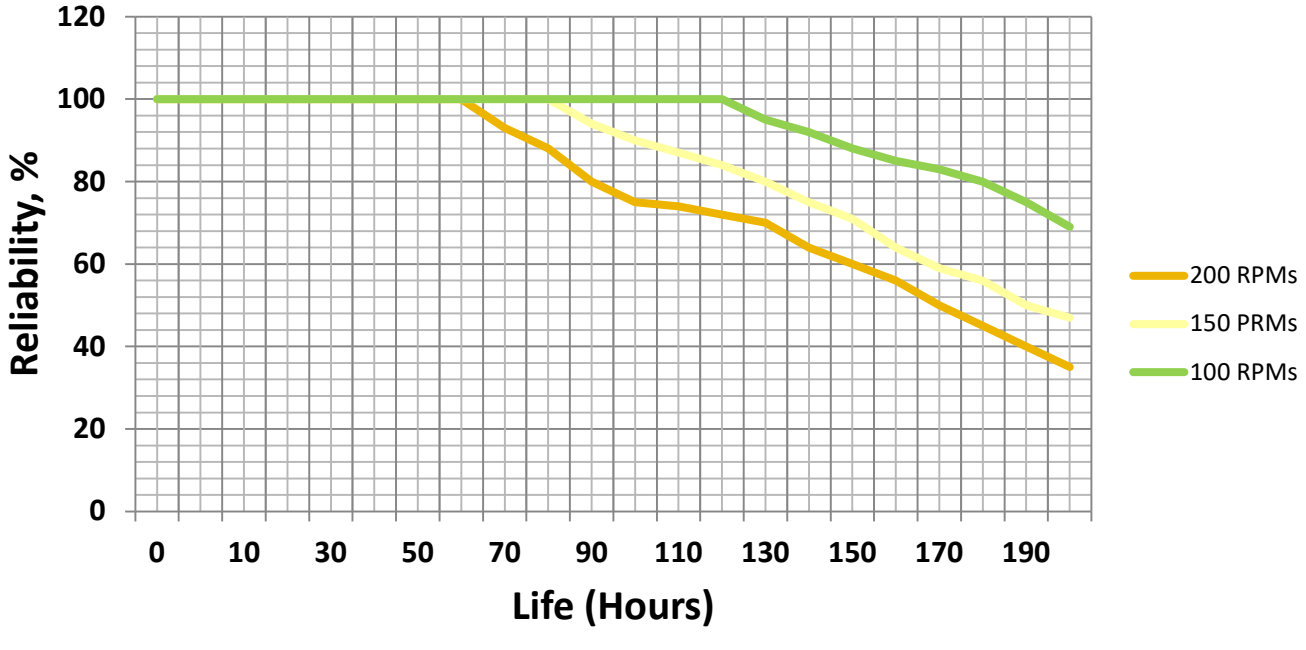
REFERENCE
APPLICATION INFORMATION

Krevs 368,3-558,8 (14 1/2 – 22'')																					
mean RPM	Hours																				
	5	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
60	18	36	72	108	144	180	216	252	288	324	360	396	432	468	504	540	576	612	648	684	720
70	21	42	84	126	168	210	252	294	336	378	420	462	504	546	588	630	672	714	756	798	840
80	24	48	96	144	192	240	288	336	384	432	480	528	576	624	672	720	768	816	864	912	960
90	27	54	108	162	216	270	324	378	432	486	540	594	648	702	756	810	864	918	972	1026	1080
100	30	60	120	180	240	300	360	420	480	540	600	660	720	780	840	900	960	1020	1080	1140	1200
110	33	66	132	198	264	330	396	462	528	594	660	726	792	858	924	990	1056	1122	1188	1254	1320
120	36	72	144	216	288	360	432	504	576	648	720	792	864	936	1008	1080	1152	1224	1296	1368	1440
130	39	78	156	234	312	390	468	546	624	702	780	858	936	1014	1092	1170	1248	1326	1404	1482	1560
140	42	84	168	252	336	420	504	588	672	756	840	924	1008	1092	1176	1260	1344	1428	1512	1596	1680
150	45	90	180	270	360	450	540	630	720	810	900	990	1080	1170	1260	1350	1440	1530	1620	1710	1800
160	48	96	192	288	384	480	576	672	768	864	960	1056	1152	1248	1344	1440	1536	1632	1728	1824	1920
170	51	102	204	306	408	510	612	714	816	918	1020	1122	1224	1326	1428	1530	1632	1734	1836	1938	2040
180	54	108	212	316	420	524	628	732	836	940	1044	1148	1252	1356	1460	1564	1668	1772	1876	1980	2084
190	57	114	228	342	456	570	684	798	912	1026	1140	1254	1368	1482	1596	1710	1824	1938	2052	2166	2280
200	60	120	240	360	480	600	720	840	960	1080	1200	1320	1440	1560	1680	1800	1920	2040	2160	2280	2400

– «green zone» – enough bit life
– «yellow zone» – bit life runs out
– «orange zone» – bit life exhausted
– «red zone» – no data, operation is impossible



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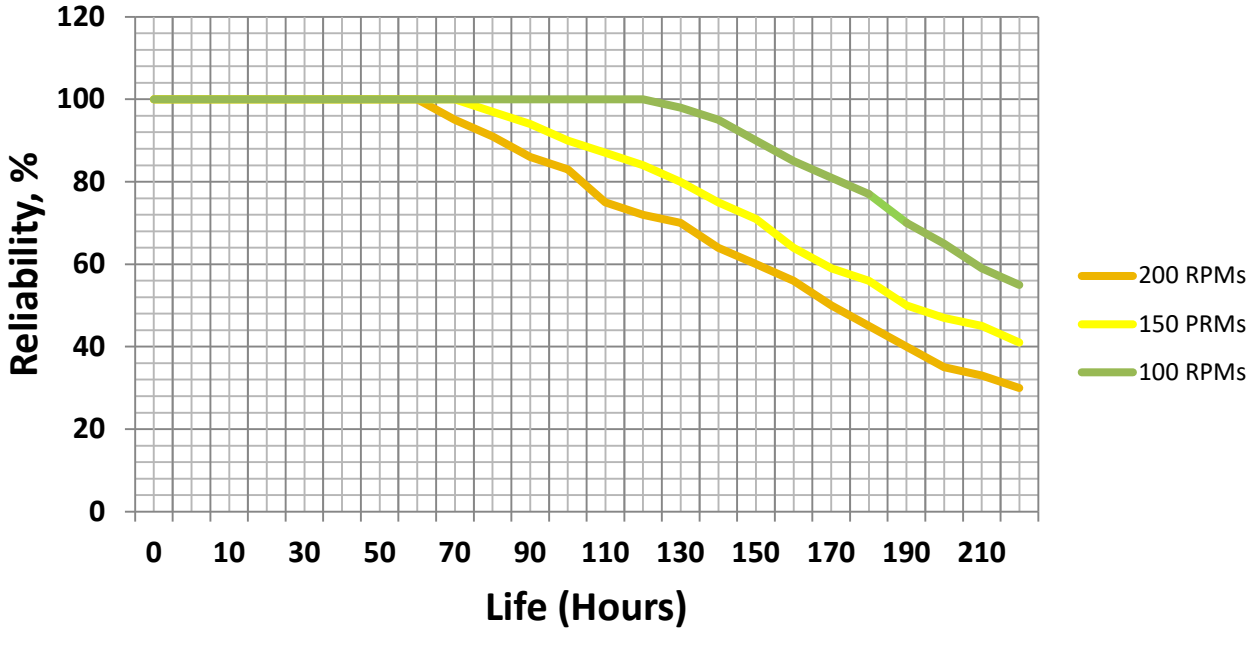
Krevs 571,5-660,4 (22 1/2 - 26'')																							
mean RPM	Hours																						
	5	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
60	18	36	72	108	144	180	216	252	288	324	360	396	432	468	504	540	576	612	648	684	720	756	792
70	21	42	84	126	168	210	252	294	336	378	420	462	504	546	588	630	672	714	756	798	840	882	924
80	24	48	96	144	192	240	288	336	384	432	480	528	576	624	672	720	768	816	864	912	960	1008	1056
90	27	54	108	162	216	270	324	378	432	486	540	594	648	702	756	810	864	918	972	1026	1080	1134	1188
100	30	60	120	180	240	300	360	420	480	540	600	660	720	780	840	900	960	1020	1080	1140	1200	1260	1320
110	33	66	132	198	264	330	396	462	528	594	660	726	792	858	924	990	1056	1122	1188	1254	1320	1386	1452
120	36	72	144	216	288	360	432	504	576	648	720	792	864	936	1008	1080	1152	1224	1296	1368	1440	1512	1584
130	39	78	156	234	312	390	468	546	624	702	780	858	936	1014	1092	1170	1248	1326	1404	1482	1560	1638	1716
140	42	84	168	252	336	420	504	588	672	756	840	924	1008	1092	1176	1260	1344	1428	1512	1596	1680	1764	1848
150	45	90	180	270	360	450	540	630	720	810	900	990	1080	1170	1260	1350	1440	1530	1620	1710	1800	1890	1980
160	48	96	192	288	384	480	576	672	768	864	960	1056	1152	1248	1344	1440	1536	1632	1728	1824	1920	2016	2112
170	51	102	204	306	408	510	612	714	816	918	1020	1122	1224	1326	1428	1530	1632	1734	1836	1938	2040	2142	2244
180	54	108	212	316	420	524	628	732	836	940	1044	1148	1252	1356	1460	1564	1668	1772	1876	1980	2084	2188	2292
190	57	114	228	342	456	570	684	798	912	1026	1140	1254	1368	1482	1596	1710	1824	1938	2052	2166	2280	2394	2508
200	60	120	240	360	480	600	720	840	960	1080	1200	1320	1440	1560	1680	1800	1920	2040	2160	2280	2400	2520	2640

– «green zone» – enough bit life
– «yellow zone» – bit life runs out
– «orange zone» – bit life exhausted
– «red zone» – no data, operation is impossible



Data presented on this page is based on a statistical analysis of the operation of the tool and does not constitute warranty obligations for the service life of roller-cone bits manufactured by BURINTEKH. These diagrams are intended to serve as a guideline for the reliability of operation depending on the time of operation and the type of rotator.

REFERENCE ROLLER–CONE BITS APPLICATION INFORMATION

To increase ROP and achieve maximum durability of roller-cone bits a number of simple rules for burnishing in and operation are required.
The information in this section is provided for reference and may be useful when using BURINTEKH roller-cone bits.

BIT SETTING UP

Before tripping bit in well it is necessary to make sure that the selected bit corresponds to the drilling tasks, properties of rocks, technological parameters of drilling and tool joints are correctly selected. It is important to visually inspect the bit for defects, condition of the flushing units. When connecting the bit choose the right bit breaker; when connecting with BHA elements carefully lubricate the threads, tighten the threaded connection according to the passport makeup torques. When operating with roller-cone bits with elongated nozzles it is important to prevent damage to the nozzles by bit breaker.

TRIP IN HOLE

Pay attention to the passage of bit through blowout equipment. Perform TIH at the lowest possible speed not allowing the tool to land on BOP. When tripping in take into account zones of possible narrowing, if necessary pass zones of narrowing with rotation and circulation.

BOTTOMHOLE APPROACH AND TAG

Approach the bottomhole slowly paying close attention to tool weight and torque. The change of its values refers to bottomhole tag. When starting work with a new bit it is very important to carefully develop the bottomhole profile in accordance with the bit design.
Performance of bit seriously depends on accuracy of this operation. It is necessary to take due care when developing bottomhole profile especially if the new bit differs from the previous one in its design, for example, if the PDC bit was previously used. It is also important to note that the well drilled with a roller-cone bit has a slightly larger diameter. A new bottomhole profile can be developed within 0,3-0,5 m.
It is optimal to approach the bottom with 15-30 rpm with a subsequent increase to 40-60 rpm. WOB should be gradually increased from 1-2 tons to passport values. Soft and loose rocks should be passed with maximum flushing. When switching to normal drilling practices it is necessary to start with an increase in WOB followed by RPM increase.

REAMING

Perform reaming with a small load and low speed. Use the maximum allowable flush. Reduce the speed of the tool when reaming hard and abrasive rocks. In thigh holes bit shirttails work only with gage rows which can lead to bit jamming. It is necessary to keep an eye on torque when reaming long intervals of abrasive rocks. Usually its consistent increase is associated with the loss of gage rows and contact of the bit body or BHA elements with the borehole walls. Borehole with a slight loss of diameter requires a smaller load value during reaming than with a larger value of loss of diameter.

DRILLING OUT CEMENT PLUGS AND BRIDGES, CHECK VALVES, CASING SHOES

Reciprocation should be carried out at full flushing for cleaning bit from drilled material. Reciprocate every 5-7 minutes of drilling with a lifting tool 1-1,5 m for confident cleaning of the bottom from the drilled material. At sharp decrease of ROP repeat this procedure until complete cleaning of the bottom and bit. Avoid increasing pressure which may indicate plugging of flushing holes. If vibrations of the tool occur it is necessary to change rpm. Maintain a load of up to 3-4 tons and rotation up to 40 rpm.
The appearance of signs of instability in the behavior of the tool such as bumps, torque jumps may indicate cone jams. Try to keep WOB and torque constant to prevent cementing plug turning. Torque jumps may indicate plug turning.

"DRILL-OFF" TEST RECOMMENDATIONS

"Drill-off" test is a method for determining the optimal combination of weight on bit and rotations per minute which provides the highest value of rate of penetration. These tests are recommended at the start of drilling with a new bit, as well as with significant changes in drilling conditions. Optimization of WOB and RPM values should be carried out after reaching a stable drilling process when BHA is released into open hole.
Optimal values are determined only for specific conditions of use and can only be used in homogeneous rocks. "Drill-off" tests will be needed every time when changing the drillability of rocks. Usually the range of WOB and RPM values is determined for the drilling of an interval composed of different rocks. The initial rotational speed is usually taken from the offset data or the minimum value is taken from the operating characteristics. Maximum WOB value is usually taken from the maximum allowable values determined by technological criteria. If the highest ROP values are achieved by using several combinations of WOB and RPM then it is advisable to use the smallest combination which will reduce the likelihood of vibrations. Values become optimal when with increasing WOB and RPM there is no increase in ROP in linear dependence.

There are a variety of different methods of "Drill-off" tests.
Here is the simplest method:
- Lift off the bottom and set constant RPM and flow rate.
- Trip back to bottom increasing the WOB to a certain selected value.
- Drill a pre-selected interval for a set period of time (usually 5 minutes) or a set interval of length (about 1,5 meters) with a constant WOB.
- Calculate ROP for this interval.
- Repeat the test at other load values until the optimal value is determined.
- Repeat the test increasing RPM by 5-10 rpm. Continue testing until optimal parameters are determined.
- If the shortest time intervals are recorded at different values of load and speed, then use the lowest combination.

ROCKS DRILLABILITY

SHALES

Shales are more sensitive to RPM changes than to WOB. Choose the highest RPM values among the recommended operating parameters. Monitor and change RPM values when drilling interbedded sections to prevent cutting structure damage in sandstones, carbonates, etc. When drilling shale formations with increased reservoir pressure usually rate of penetration increases. It is important to create the maximum possible hydraulic parameters when drilling shales. Torque change may indicate the formation of ball on a bit.

SANDSTONES

Sandstones are more sensitive to WOB changes than to RPM. Sandstone porosity is the main factor determining the rate of penetration. All other things being equal higher sandstone porosity will give a greater penetration rate. In sandstones with increased reservoir pressure ROP also increases. Drilling depleted sandstones is difficult due to the high differential pressure along the drilled rocks. Bit can drill slower in this situation. Also the bit can perform eccentrically with respect to the axis of the well which will also reduce ROP. It is desirable to maintain the minimum speed value in order to minimize the wear of the gage rows. In the intervals of extremely abrasive rocks known in advance keep an eye on torque to make sure that the well does not lose diameter.

CARBONATES

Carbonates more are more sensitive to WOB changes than to RPM. It is important to monitor the vertical vibration of the bit. Siliceous inclusions often found in limestones and dolomites can move and rotate under the cutting structure of the bit along the bottomhole- a similar thing happens when drilling fractured rocks. This can overload elements of cutting structure leading to cutting structure chipping and breaking. Do not use maximum WOB and RPM values.

QUARTZITE AND PYRITE

Use the minimum RPM value to reduce damage of age rows, but maintain the necessary WOB for efficient drilling of rocks with high strength. Monitor torque on bit- an indicator of the possible loss of the diameter of the bit. Pyrite is extremely abrasive and hard. Pyrite pieces can move and rotate under the cutting structure of the bit along the bottomhole- similar happens when drilling fractured rocks.

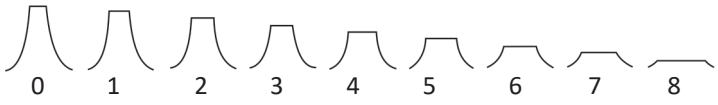
DULL GRADING OF ROLLER–CONE BITS BY IADC

	Cutting structure				Bearing/seal	Gauge loss	Other dull	Reason pulled
	Inner rows	Outer rows	Dull	Dull location				
Column no.	1	2	3	4	5	6	7	8
Example	2	4	LT	A	EEF	I	SD	TD

1. Inner rows of main cutting structure (all except for gage).

2. Outer rows of main cutting structure (only gage row).

In columns 1 and 2 are used numbers from 0 to 8 where 0 – no cutting structure wear; 8 – total cutting structure wear. Example: if the bit with carbide cutting structure has 42 inserts in gage row 6 of which fell out,3 partially broken and the rest were worn 20%, this will correspond to number 3 because: the percentage of damaged cutting structure: ((6*1+3*0,5+33*0,2)/42)*100% =33,6% which corresponds to figure: 8*0,336=2,688=3.



WEAR CHARACTERISTICS

Code	Description	Code	Description
BC	Broken cone	LN	Lost nozzle
BT	Broken teeth	LT	Lost teeth
BU	Balled up bit	PB	Pinched bit
CC	Cracked cone	PN	Plugged nozzle
CI	Cone interference	RG	Rounded gage
CD	Cone dragged	RO	Ring out
CR	Cored	RR	Rerunnable
CT	Chipped teeth	SS	Self-Sharpening Wear
ER	Erosion	WO	Washed Out Bit
HC	Heat checking	WT	Worn Teeth
JD	Junk damage	NO	No Dull Characteristic
LC	Lost cone		

3. Wear characteristics (table on top).

4. Dull location:

N – Nose Row, G – gage row, M – middle row, A – all rows.

5. Bearing/seal.

The three letters designating the first, second and third cone respectively

E – Effective seal, F – failed seal.

6. Gauge loss:

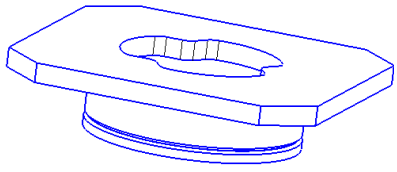
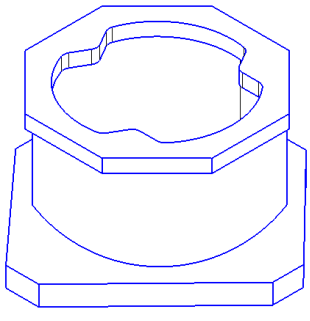
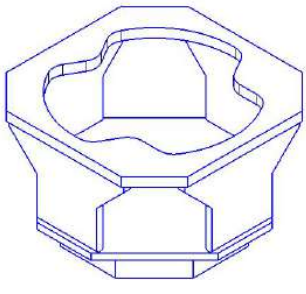
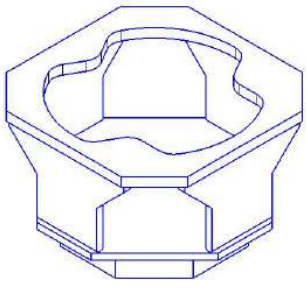
I – nominal diameter, 1, 2, 3... – gauge loss in mm.

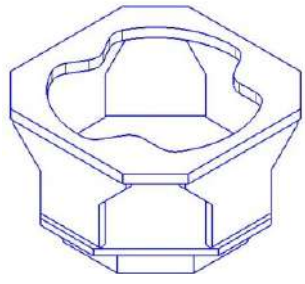
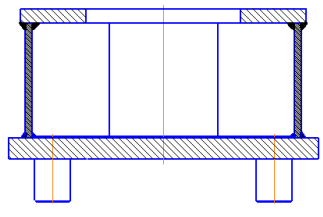
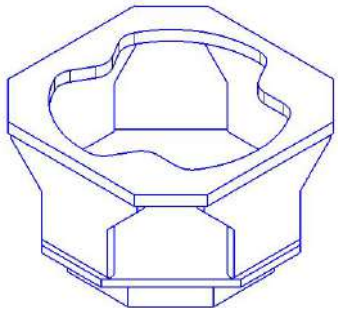
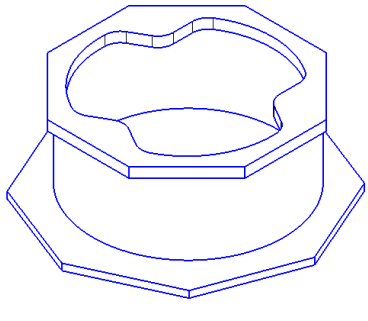
7. Other dull (clause 3).

8. Reason pulled.

Code	Reason pulled	Code	Reason pulled
BHA	Change BHA	HR	Hours on bit
DMF	Downhole motor failure	PP	Pump pressure
DSF	Drill string failure	PR	Penetration rate
DST	Drill stem test	TD	Total depth
RIG	Rig repair	TQ	Torque
CM	Condition mud	TW	Twist off
CP	Core point	WC	Weather conditions
LOG	Run logs	WO	Washout
FM	Formation change	LIH	Left in hole
HP	Hole problems		

ROLLER–CONE BIT BREAKERS

Name:	parameters:	Appearance (sketch):
CBB – $4^3/_4$" – $4^7/_8$".13" CBB – $4^3/_4$" – $4^7/_8$".$13^3/_8$"	Bit size: $4^3/_4$" - $4^7/_8$" Dimensions: 13"x13"x$3^1/_4$" Square size for rotor: 13"x13" Possible to make for rotor: $13^3/_8$" x $13^3/_8$" (13-$^1/_2$"x13-$^1/_2$") Weight: 20 kg (44.1 lb)	
CBB – $5^1/_2$" – $5^5/_8$".13" CBB – $5^1/_2$" – $5^5/_8$".$13^3/_8$"	Bit size: $5^1/_2$" – $5^5/_8$" Dimensions: 13"x13"x$3^1/_4$" Square size for rotor: 13"x13" Possible to make for rotor: $13^3/_8$" x $13^3/_8$" (13-$^1/_2$"x13-$^1/_2$") Weight: 22,3 kg (49.16 lb)	
CBB – 6" – $6^1/_4$".13" CBB – 6" – $6^1/_4$".$13^3/_8$"	Bit size: 6" – $6^1/_4$" Dimensions: 13"x13"x$3^1/_4$" Square size for rotor: 13"x13" Possible to make for rotor: $13^3/_8$" x $13^3/_8$" (13-$^1/_2$"x13-$^1/_2$") Weight: 23 kg (50.7 lb)	
CBB – $8^3/_8$" – $8^3/_4$".$12^4/_5$" CBB – $8^3/_8$" – $8^3/_4$".13" CBB – $8^3/_8$" – $8^3/_4$".$13^3/_8$"	Bit size: $8^3/_8$" – $8^3/_4$" Dimensions: $12^4/_5$"x$12^4/_5$"x$6^4/_5$" Square size for rotor: $12^4/_5$"x$12^4/_5$" Possible to make for rotor: 13"x13"; $13^3/_8$"x$13^3/_8$" (13-$^1/_2$"x13-$^1/_2$") Weight: 33 kg (72,8 lb)	
CBB – $11^5/_8$".13" CBB – $11^5/_8$".$13^3/_8$"	Bit size: $11^5/_8$" Dimensions: 13"x13"x6 $^4/_5$" Square size for rotor: 13"x13" Possible to make for rotor: $13^3/_8$"x$13^3/_8$" (13-$^1/_2$"x13-$^1/_2$") Weight: 59 kg (130.1 lb)	
CBB – $12^1/_4$ ".13" CBB – $12^1/_4$".$13^3/_8$"	Bit size: $12^1/_4$" Dimensions: $14^{61}/_{64}$"x$14^{61}/_{64}$"x$11^1/_{32}$ Square size for rotor: 13"x13" Possible to make for rotor: $13^3/_8$"x$13^3/_8$" (13-$^1/_2$"x13-$^1/_2$") Weight: 70 kg (154.3 lb)	
CBB – $15^1/_2$".13" CBB – $15^1/_2$".13 " CBB – 15 .$17^3/_8$"	Bit size: $15^1/_2$" Dimensions: $18^{57}/_{64}$"x$18^{57}/_{64}$"x12 $^{63}/_{64}$" Square size for rotor: 13"x13" Possible to make for rotor: 13 "x13 " (13-$^1/_2$"x13-$^1/_2$"); $17^{21}/_{64}$"x$17^{21}/_{64}$" Weight: 112 kg (246.9 lb)	
CBB – 16".$13^3/_8$" CBB – 16".$17^{21}/_{64}$"	Bit size: 16" Dimensions: $18^{57}/_{64}$"x$18^{57}/_{64}$"x$12^{63}/_{64}$" Square size for rotor: 13 $^3/_8$"x$13^3/_8$" Possible to make for rotor: $17^{21}/_{64}$"x$17^{21}/_{64}$" (13-$^1/_2$"x13-$^1/_2$") Weight: 114 kg (251.3 lb)	
CBB – $17^1/_2$".13" CBB – $17^1/_2$".$13^3/_8$" CBB – $17^1/_2$.$17^{21}/_{64}$"	Bit size: $17^1/_2$" Dimensions: $21^{17}/_{64}$"x$21^7/_{64}$"x$14^9/_{16}$" Square size for rotor: 13"x13" Possible to make for rotor: 13 $^3/_8$"x$13^3/_8$" (13-$^1/_2$"x13-$^1/_2$"); $17^{21}/_{64}$"x$17^{21}/_{64}$" Weight: 118 kg (260.1 lb)	

Name:	parameters:	Appearance (sketch):
CBB – $19^{19}/_{64}$" – 20".13"	Bit size: $19^{19}/_{64}$" – 20" Dimensions: $23^{5}/_{8}$"x$23^{5}/_{8}$"x$14^{61}/_{64}$" Square size for rotor: 13"x13" Weight: 146 kg (321.9 lb)	
CBB – $19^{19}/_{64}$" – 20".$17^{21}/_{64}$"	Bit size: $19^{9}/_{64}$" – 20" Dimensions: $23^{5}/_{8}$"x$23^{5}/_{8}$"x$14^{61}/_{64}$" Octagon size for rotor: $17^{21}/_{64}$"x$17^{21}/_{64}$" Weight: 152 kg (335.1 lb)	
CBB – $19^{19}/_{64}$" – 20".$25^{19}/_{32}$"	Bit size: $19^{19}/_{64}$" – 20" Dimensions: $25^{19}/_{32}$"x$25^{19}/_{32}$"x$15^{15}/_{16}$" Square size for rotor: 25 "x25 " Pins layout: $25^{5}/_{16}$"x$25^{5}/_{16}$" Weight: 201 kg (443.1 lb)	
CBB – 20" – 22".$17^{21}/_{64}$"	Bit size: 20" – 22".$17^{21}/_{64}$" Dimensions: $25^{19}/_{32}$"x$25^{19}/_{32}$"x$25^{19}/_{32}$"x$15^{23}/_{64}$" Octagon size for rotor: $17^{21}/_{64}$"x$17^{21}/_{64}$" Weight: 168 kg (370.4 lb)	
CBB – $22^{1}/_{2}$".$13^{3}/_{8}$"	Bit size: $22^{1}/_{2}$" Dimensions: $27^{9}/_{16}$"x$27^{9}/_{16}$"x$14^{9}/_{16}$" Square size for rotor: $13^{3}/_{8}$"x$13^{3}/_{8}$" (13-$^{1}/_{2}$"x13-$^{1}/_{2}$") Weight: 132 kg (291 lb)	
CBB – 23".13"	Bit size: 23" Dimensions: $27^{9}/_{16}$"x$27^{9}/_{16}$"x$14^{9}/_{16}$" Square size for rotor: 13"x13" Weight: 130 kg (286.6 lb)	
CBB – 26".$17^{21}/_{64}$"	Bit size: 26" Dimensions: $29^{17}/_{32}$"x$29^{17}/_{32}$"x$19^{19}/_{64}$" Octagon size for rotor: $17^{21}/_{64}$"x$17^{21}/_{64}$" Weight: 180 kg (396.8 lb)	
CBB – $19^{19}/_{64}$" – 20".$27^{61}/_{64}$	Bit size: $19^{19}/_{64}$" – 20" Dimensions: $27^{61}/_{64}$"x$27^{61}/_{64}$"x$11^{13}/_{16}$" Octagon size for rotor: $27^{61}/_{64}$" x$27^{61}/_{64}$" Weight: 146 kg (321.9 lb)	
CBB – 24".$27^{61}/_{64}$	Bit size: 24" Dimensions: $27^{61}/_{64}$"x$27^{61}/_{64}$" x14 $^{1}/_{64}$" Octagon size for rotor: $27^{61}/_{64}$" x$27^{61}/_{64}$" Weight: 150 kg (330.7 lb)	

FOR NOTES

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