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KINGDREAM DRILL BIT

2010.04

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COMPANY PROFILE

Kingdream Public Limited Company is a state owned public company with the majority shares held by SINOPEC. The company was initially set up in 1973, and now has become a leading oil and gas drill bit manufacturer in China.

Market oriented, the company pushes forward the technical innovation and product improvement and has formed the world advanced technical system with its own intellectual properties. Kingdream has had technical cooperation with over 30 universities and research institutes both at home and abroad, and the researches done by the company regarding rock bit cutting element material, rock bit bearing structure and material, as well as rock bit hydraulic technologies are at the leading position in China. Performance of the new products such as high speed motor bit, hard formation drill bit and non-standard series bit, etc. developed by Kingdream are at the leading level in the world, which represent the development trend of new type of drilling bits.

Roller cone bit and diamond bit production lines of Kingdream are equipped with more than 300 sets of internationally advanced machineries, such as five-axis machining centers, FMS production line, etc. Roller cone bits from 3 3/4 to 26 inch, both steel body and matrix body PDC bits in the size range of 3 7/8 to 17 1/2 inch can be supplied to customers both at home and abroad.. Kingdream also possesses many advanced and sophisticated inspection and test facilities including plasma spectrometer, TCI image processor, new type of rock drilling tester, 600kN drilling simulator, etc. and so, quality stability of the company's products is greatly improved.

The company has been certified to API / ISO9000 Quality Management System and International HSE Management System successively for many years.

The company is positively acknowledged by customers both at home and abroad because of the company's technical strength, good reputation, strict quality control and excellent customer service. Domestic market share of the company has been kept above 60% for many years, and Kingdream bits has also been sold to more than 30 countries and regions including USA and Russia.

Looking forward to the future, Kingdream shall strive to produce better bit products by taking continuous quality improvement as our main task, making our products suitable for the development of drilling process and satisfying customers' demands as our research direction, so as to provide our customers both at home and abroad with excellent products and service and make Kingdream products finer and perfect.

◎ RESEARCH AND DEVELOPMENT

Along technical innovation path of combining independent research and open-up cooperation and by utilizing domestic and foreign research resources, Kingdream sets up provincial engineering technology center with complete systems. Software & hardware conditions for technical development and related research fruits are all at advanced level in the world. The company has a series of independent property rights, which include 131 patents granted in China and 13 patents granted in other countries, 123 proprietary technologies and the right to use 25 US patents. Kingdream takes market demand as the direction, technical innovation as the support, and standing at the front of market and technology to continuously improve its product technologies and market service quality.

■ PRODUCT STRUCTURE AND FUNCTION TEST & EVALUATION

Kingdream owns advanced rock bit structure and function test lab and computational lab and such tests & evaluations as bit's cutting structure, bearing, seal and hydraulic system, etc. can all be done within the company. The computational lab utilizes advanced non-linear FEA software and fluid dynamic software to simulate real drilling condition to evaluate and optimize bit structures. Specialized bit simulation software and full scale drilling simulator are used to are used to evaluate the bit's overall performance.

■ PRODUCT RESEARCH AND DEVELOPMENT

Kingdream has realized the benign cycle from basic technology research, new technology application & product development and manufacture research to product application service and improvement, so as to turn technical reserve as the backup for product development and market service. Advanced PLM (Product Life Management) system, which is built on the basis of 3-dimensional CAD and PDM (Product Data Management), can technically controls the whole life of products, so that the product development can be done in a fast and precise manner to maximally meet the time & function requirements of the market.

■ MATERIAL RESEARCH AND EVALUATION

In order to meet the development requirement of product structures and functions, Kingdream has set up an excellent team for material research, and the team is responsible for development and application researches on rock bit's structure material, function material and process material, etc.

■ PRODUCT PROCESS RESEARCH

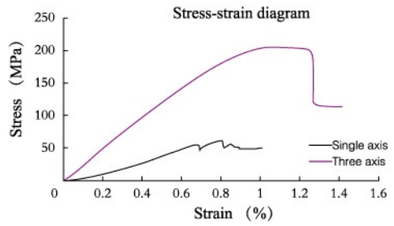
Based on requirements of product technology advancement and market development, Kingdream insists on independent research and development of manufacture process technologies with its own characteristics and has formed integrated and very flexible fast reaction manufacturing process technologies of advanced level of the world.

■ DULL BIT ANALYSIS AND EVALUATION

Bit analysis engineers perform failure analysis on dull bit's cutting structure, bearing and seal, etc., conduct insight and systematic research on the causes to bit wear and failure, instruct customers to use bit properly and also provide design engineers with advices on how to improve the bit's performance and suggested research direction.

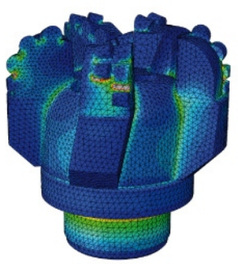
■ DESIGN AND R&D

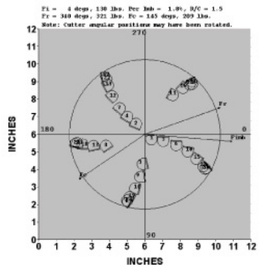
Design optimization: profile design and cutter layout of the diamond bit can be analyzed and optimized based on research and analysis on rock mechanical performance.



■ DESIGN ANALYSIS

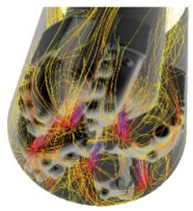
Mechanical analysis and FEA analysis for products design.





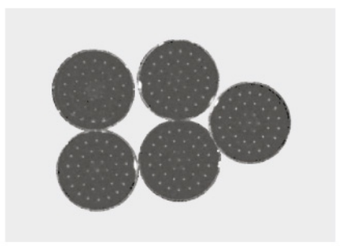
■ HYDRAULIC STIMULATION

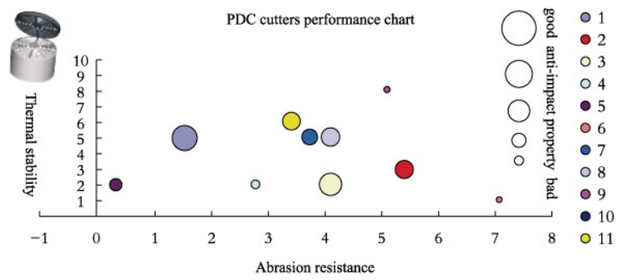
Hydraulic structure of PDC bit based on CFD fluid analysis software is optimally designed.



■ PDC CUTTER TECHNOLOGY

PDC cutters with different performance are developed to meet the requirements of drilling for different drilling condition.





◎ PRODUCT MANUFACTURE AND QUALITY CONTROL

■ FROM NORMAL PRODUCTION TO CREATING FAMOUS BRAND


CERTIFICATE

Rock Bit Division of Kingdream Public Limited Company

Q/SHS 0001.1-2001

Design and manufacture of roller cone bits of Rock Bit Division of Kingdream Public Limited Company Located in Qianjin Road,Guanghua,Qianjiang City,Hubei Province (Manufacture of roller cone bits of Shanghai Branch Company Located in No.577,Dilian Mountain Road, Putuo District,Shanghai).

SIGNATURE:

QINGDAO SINOSUN MANAGEMENT SYSTEM CERTIFICATION CENTER


QMS REGISTERED

Certificate of Registration

APIQR® REGISTRATION NUMBER 0085

KINGDREAM PUBLIC LIMITED COMPANY
Qianjin Road, Guanghua
Qianjiang City, Hubei Province
People's Republic of China

ISO 9001:2000

Design and Manufacture of Roller Bits

No Exclusions Identified as Applicable

Effective Date: October 15, 2007
Expiration Date: May 3, 2010
Registered Since: August 4, 2003

For 35 years and by insisting on the manufacturing principle of 'Flexibility, Precision & Zero-defect', Kingdream continuously improves its production line with technical reconstruction and application of new processes, precisely controls production management and advances its manufacturing technologies so as to create famous Kingdream brand.

In order to satisfy the market demand of 'small lot, multi-types, high product quality and short delivery time', Kingdream unceasingly carries out lean production and increases the investment on enlarging the production capacity. The number of production machines in Kingdream has increased from 12 sets when the company was just set up to 9 production lines for rock bit production with world advanced level at present, and various types of bits ranging from 3 3/4 to 26 inches in diameter can be produced.

Kingdream continually implements integrated machining and utilizes new machining processes to improve its manufacturing technology and guarantee manufacturing flexibility of the production lines and product quality. Ever since 1998, Kingdream's annual rock bit production batch and type has been increased sharply, by 670% and 900% respectively, while average production cycle was shortened by 2/3, rate of timely delivery has reached to 99.7% and rate of acceptable machining has been kept at 99.8%.

Kingdream has set up and keeps improving its quality management system, and the system of quality inspection, monitoring and tracing is also established and being improved continuously. The company has been successively passed the ISO9001, API and HSE certifications.

◎ CUSTOMER SERVICE

■ TECHNICAL EXCHANGE

Kingdream holds a Rock Bit New Technology Forum once every two years to study the application of new technologies regarding rock bit and how to improve drilling efficiency together with our customers. All through the year, Kingdream regularly provides drilling customers with technical lectures and other technical exchange activities to help customers with proper bit selection and application so as to increase their overall drilling efficiency.

■ BIT SELECTION OFTWARE & BIT PERFORMANCE DATABASE

In order to provide customers with excellent technical service, Kingdream has developed Bit Selection software based on logging data analysis and also set up a complete Bit Performance Database to help customers make most appropriate bit selection.

■ FORMATION TESTER

Formation lithology tester is specialized tester for providing technical service at drilling site. Real time testing of mechanical properties of the formation being drilled at normal and confined pressures can be realized with the tester, such as hardness, plastic coefficient, drillability, 3-axis compressive strength, elastic modulus and Poisson's ratio, etc. so that reliable formation data can be obtained for optimizing bit selection. Also, more suitable bits can be recommended for our customers through the use of formation tester.

■ BIT APPLICATION SUMMARY & ANALYSIS

When summarizing and analyzing the bit applications, real drilling time, footage, ROP, hydraulic parameters, drilling cost and other factors which affect drilling efficiency are compared with predicted designing targets, and dull bits are also evaluated and graded. This summary and analysis process is helpful to record the success or failure of bit applications and improve bit design and bit selection.


MD
Series
MINI-MD
Series
SMD
Series
HF
Series
SWT
Series


A
Series
HJ/HJT
GJ/GJT
Series
HA/HAT
GA/GAT
Series
YC
Series
SKF/SKH
SKG/SKW
Series

◎ NOMENCLATURE OF KINGDREAM ROLLER CONE BITS

Based on the development of drilling technology and process and changes of the market in China and worldwide, Kingdream recently introduced 6 new product series, which are easy to be selected by customers and specific to normal drilling problems. These products are named based on specific functions of the bit. Original nomenclature are still used for original product series such as HJ and HA series bits.

Kingdream's MotorDigger bit series (High speed MD bit) is specifically designed for directional, horizontal and horizontal multilateral well drilling applications. Mini MotorDigger bit (MiniMD slim hole bit) series is especially for improving the drilling time and safety of the bit when drilling lower and small diameter section of the deep and ultra-deep wells. Super MotorDigger bit (SMD ultra-speed motor bit) series is specially developed for using with high speed down hole drilling tools such as turbo or screw drills. HardFighter bit (HF hard formation drilling bit) series is introduced to the market for meet the requirement of drilling deeper formations. In order to achieve longer life and higher ROP of the steel tooth bit for drilling upper formations, Swifturn bit (SWT high efficiency steel tooth bit) is developed. Air bit (A series bit for air drilling applications) series is designed for air drilling applications.

Type of Kingdream roller cone bit is indicated by diameter code, series code, IADC classification code and optional feature code.

For example: 8 1/2MD517X

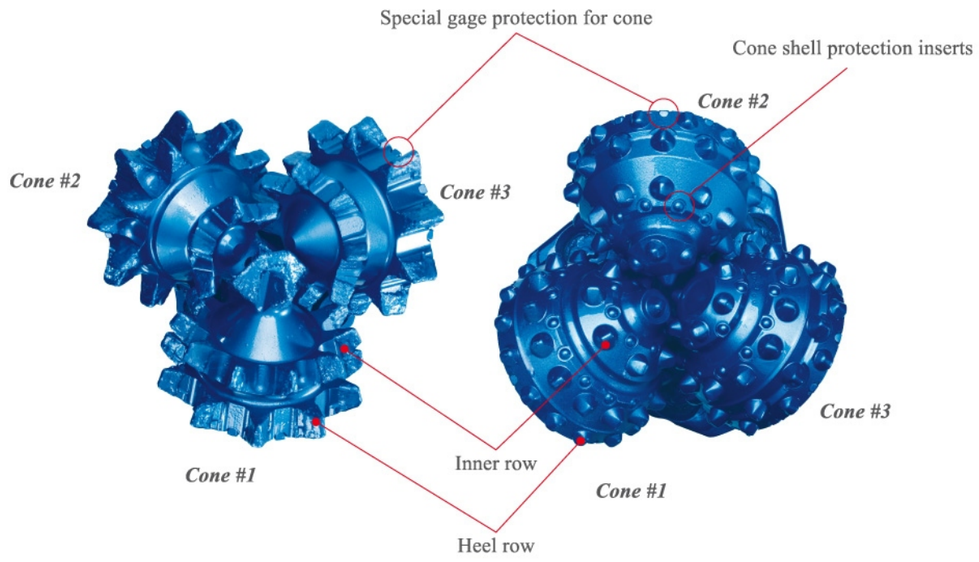
8 1/2 is bit diameter, indicating the bit diameter is 8.5 inches (215.9mm),

MD is series code, indicating the bit is a high speed motor bit,

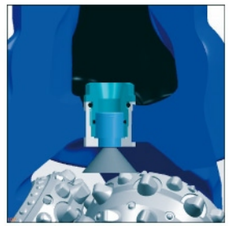
517 is classification code, indicating IADC code,

X is optional feature code, indicating the main cutters are convex crested wedge insets.

Instruction of roller cone bits structure.



OPTIONAL FEATURES



C Center nozzle

Center jet can avoid bit balling, eliminate resorting area of fluid at bottom hole, expedite upward flow of cuttings and improve ROP. It is suitable for drilling in soft to medium soft formations with low compressive strength and high drillability.

D Gage protection by diamond enhanced cutters on head O.D.

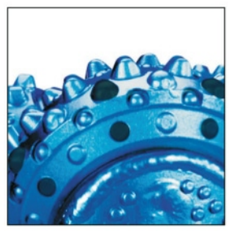
The gage protection is significantly reinforced by adding diamond enhanced gage compacts on head OD. Bit with this feature is suitable for drilling in directional and horizontal well with high abrasive formation.

E Extended double nozzle

The hydraulic system of extended double nozzle can expedite upward flow of cuttings, reduce regrinding of the formation and eliminate resorting area of fluid at bottom hole to achieve effective drilling.

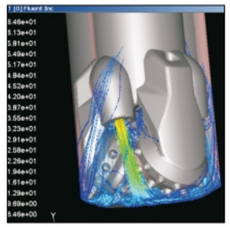
G Head OD enhancement

Special inserts are strategically arranged on head OD to reduce effectively wear of the head and improve bit's gage protection in abrasive formation or directional and horizontal wells. Improved gage protection can extend service life of the bit.



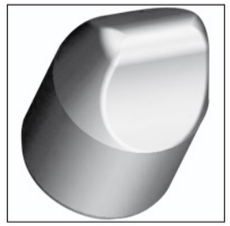
H Gage protection by diamond enhanced cutters on cone

Diamond compacts arranged in heel row or gage row for the cone can enhance gage protection and increase its working life. It is suitable for drilling in high abrasive formation, hard or extreme hard formations.



J Directional jet

Directional jet feature (J) enlarges lateral flow area at bottom hole and is helpful to bottom hole cleaning and increase of ROP. Bit with this feature is suitable for soft to medium soft formations of low compressive strength and high drillability.



K Cutting structure for hard plastic formation

Unique designing parameters and lengthening insert crest enlarge rock-breaking volume at the bottom hole and increase bottom hole coverage and increase ROP of the bit in hard plastic formation.

L Head OD stabilization pad

Better protection of bit head and compensating hole can be achieved in directional and horizontal well drilling applications.

There are two types:
1) Bit head OD is reinforced with stabilization pad and compacts;
2) Spherical inserts are used on the lubrication reservoir closely.

X Convex crested wedge inserts

Inserts of this shape have high cutting efficiency and anti-rock-breaking ability and can effectively increase bit's ROP and working life. Bit with this feature is suitable for drilling medium soft to medium hard formations.

Y Conical-spherical inserts

If bit is equipped with conical-spherical inserts as main cutting elements, then the bit is suitable for drilling in hard and brittle formations.

◎ BIT APPLICATION CHART

Applications	MD	MiniMD	SMD	HF	SWT	A	YC	HJ	GJ	HA	GA	SKF	SKH	SKG	SKW
Ultra-high RPM			•												
High RPM	•	•	•						•						
High Temperature	•	•	•	•				•	•						
High WOB				•				•							
Highly abrasive	•	•	•	•				•							
Slim hole		•					•			•					
Hard formation-Medium & low RPM				•				•							
Hard formation-High RPM	•	•													
Common formation	•	•	•		•		•	•	•	•	•	•	•	•	•
Air/foam drilling						•									

◎ BIT STRUCTURE FEATURES

Structure features	MD	MiniMD	SMD	HF	SWT	A	YC	HJ	GJ	HA	GA	SKF	SKH	SKG	SKW
Journal bearing				•	•	•	•	•		•			•		
Roller bearing					•				•		•			•	•
Floating bearing	•											•			
Bushing bearing		•				•									
Roller-journal bearing			•												
Metal face seal	•	•	•	•	•	•		•	•						
Rubber O ring seal		•			•		•			•	•	•	•	•	
Enhanced gage protection	•	•	•	•	•										

◎ BIT SIZE, RECOMMENDED MAKE UP TORQUE AND API REGULAR PIN

Bit size		API regular pin	Recommended make up torque
Inch	mm	Inch	KN • M
3 3/4	95.3	2 3/8	4.1～4.7
3 7/8	98.4	2 3/8	4.1～4.7
4 1/8	104.8	2 3/8	4.1～4.7
4 1/4	108.0	2 3/8	4.1～4.7
4 1/2	114.3	2 3/8	4.1～4.7
4 5/8	117.5	2 7/8	6.1～7.5
4 3/4	120.7	2 7/8	6.1～7.5
4 7/8	123.8	2 7/8	6.1～7.5
5 1/2	139.7	3 1/2	9.5～12.2
5 5/8	142.9	3 1/2	9.5～12.2
5 2/3	143.9	3 1/2	9.5～12.2
5 3/4	146.1	3 1/2	9.5～12.2
5 7/8	149.2	3 1/2	9.5～12.2
6	152.4	3 1/2	9.5～12.2
6 1/8	155.6	3 1/2	9.5～12.2
6 1/4	158.8	3 1/2	9.5～12.2
6 1/2	165.1	3 1/2	9.5～12.2
6 5/8	168.3	3 1/2	9.5～12.2
6 3/4	171.5	3 1/2	9.5～12.2
7 1/2	190.5	4 1/2	16.3～21.7
7 5/8	193.7	4 1/2	16.3～21.7
7 7/8	200.0	4 1/2	16.3～21.7
8 3/8	212.7	4 1/2	16.3～21.7
8 1/2	215.9	4 1/2	16.3～21.7
8 5/8	219.1	4 1/2	16.3～21.7
8 3/4	222.3	4 1/2	16.3～21.7
9 1/2	241.3	6 5/8	38～43.4
9 5/8	244.5	6 5/8	38～43.4
9 7/8	250.8	6 5/8	38～43.4
10 1/2	266.7	6 5/8	38～43.4
10 5/8	269.9	6 5/8	38～43.4
11	279.4	6 5/8	38～43.4
11 5/8	295.3	6 5/8	38～43.4
12	304.8	6 5/8	38～43.4
12 1/4	311.2	6 5/8	38～43.4
12 5/16	312.7	6 5/8	38～43.4
12 3/8	314.3	6 5/8	38～43.4
12 7/16	315.9	6 5/8	38～43.4
12 5/8	320.7	6 5/8	38～43.4
13 1/8	333.4	6 5/8	38～43.4
13 1/2	342.9	6 5/8	38～43.4
13 5/8	346.1	6 5/8	38～43.4
13 3/4	349.3	6 5/8	38～43.4
14 1/2	368.3	7 5/8	46.1～54.2
14 3/4	374.7	7 5/8	46.1～54.2
15 1/2	393.7	7 5/8	46.1～54.2
16	406.4	7 5/8	46.1～54.2
17 1/2	444.5	7 5/8	46.1～54.2
18 7/8	479.4	7 5/8	46.1～54.2
20	508.0	7 5/8	46.1～54.2
22	558.8	7 5/8	46.1～54.2
24	609.6	7 5/8	46.1～54.2
26	660.4	7 5/8	46.1～54.2

◎ API ROLLER CONE BIT TOLERANCES

API roller cone bit tolerances		
Out side diameter of bit	O.D. tolerances	
Inch	Inch	mm
3 3/8 ~ 13 3/4	0 ~ 0.0313(1/32)	0 ~ 0.79
14 ~ 17 1/2	0 ~ 0.0625(1/16)	0 ~ 1.57
17 5/8 ~ 26	0 ~ 0.0938(3/32)	0 ~ 2.38

◎ KINGDREAM NOZZLES

Size of Kingdream nozzles				
Nozzle size code	Size of tri-cone bit		Nozzle O.D.	Assembly Length of nozzles
	Inch	mm	mm	mm
0	3 3/4 ~ 3 7/8	95.3 ~ 98.4	18.12	15.96
1	4 1/8 ~ 5 1/2	95.3 ~ 139.7	20.30	17.48
2	5 5/8 ~ 7 3/8	142.9 ~ 187.3	23.50	19.05
3	7 1/2 ~ 8 1/4	190.5 ~ 209.6	29.74	20.62
4	8 3/8 ~ 14 5/8	212.7 ~ 371.5	32.89	26.97
5	14 3/4 ~ 26	374.6 ~ 660.4	40.84	26.97

Diameter of nozzle orifice													
Diameter of nozzle orifice (mm)	6	7	8	9	10	11	12	13	14	16	18	20	22	24

(Note: Extended, mini-extended and special nozzles can be customized.)

Example: S2—10

- Diameter of nozzle orifice is 10mm
- For using on 5 5/8″～7 3/8″ bits
- Standard nozzle

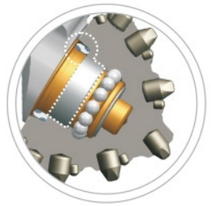
MD

HIGH SPEED MOTOR BIT

Working condition of the bit in directional and horizontal drilling applications is quite different than in vertical well drilling. Kingdream's new MD series motor bit features high RPM, better gage protection and stability, higher reliability, excellent hydraulic effect and longer working life, etc.

MD bit is suitable for drilling at 90～300 RPM and is the ideal choice for directional, horizontal and horizontal multilateral well drilling applications.

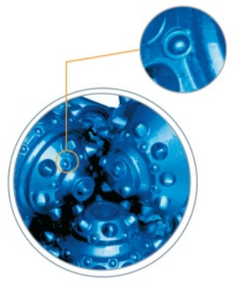
The size range of MD series bit is from 7 7/8 to 12 1/4 inch, and IADC varies from 117 to 647. For example: 8 1/2 MD517X.



■ HIGH SPEED FLOATING BEARING AND METAL FACE SEAL

MD bit is designed with floating bearing and metal face seal structure suitable for high RPM. At the same time, it utilizes new type of synthetic lubricating grease to improve working condition of the bit's bearing, so that the bit can achieve longer service life and higher reliability when used on screw drilling tools.

■ HIGHER ROP AND LONGER WORKING LIFE



Highly efficient cutter shape and optimized cutting structure

The bit's ROP is greatly improved by using Kingdream's patented convex crested cutter shape and other highly efficient cutters.

Special cone shell protection

MD bit is designed and manufactured with special cone shell protection technology so that the cone shell is protected from being excessively worn by drilling cuttings and unbroken rock ridges and consequently, working life of the bit is effectively prolonged when the bit is used for directional and horizontal drilling applications.

■ TO IMPROVE THE BIT'S STABILITY, PREVENT BIT DIAMETER SHRINKAGE, AND EXTEND THE BIT'S WORKING LIFE

Spiral double-stable head O.D.

The double-stable structure can improve the bit's working stability, effectively mitigate vibration of the bit at the bottom hole and improve outer flow field. This structure can facilitate the removal of drilling cuttings at the bottom hole and wall of the borehole and therefore improve drilling efficiency.

Enhanced gage protection

To meet specific requirement of directional and horizontal drilling applications, MD bit is designed with high density cutter placement that covers the whole head O.D. area and the cutter exposure changes in a ladder pattern so as to effectively protect the shirttail and seal and greatly improve the bit's ability against diameter shrinkage.

■ OPTIONAL FEATURES: C、D、H、K、X、Y

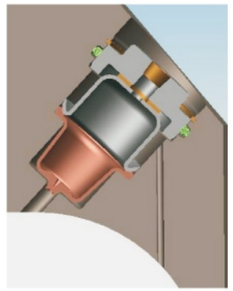
MINI-MD

ROLLER CONE BIT FOR SLIM HOLE DRILLING APPLICATIONS

In addition to the features of MD motor bit, MiniMD slim hole bit is also designed with special bearing & seal structure and lubrication system. MiniMD bit's cutter material and cutting structure are reasonably matches with rock properties of the formation and this eliminated the specific problems such as low drilling efficiency and cutter breakage and loss, etc.

MiniMD slim hole bit is the ideal choice for drilling slim hole sections in deep and ultra-deep well drilling applications.

The size range of MINI-MD series bit is from 5 3/4 to 6 1/2 inch, and IADC varies from 437 to 647. For example: 6 1/2 MD537.



■ HIGH RELIABILITY AND LONG WORKING LIFE

New type of lubrication system

Precisely designed and processed lubrication system and the use of new type of synthetic grease can improve balancing speed of the pressures inside and outside of the bearing package and achieve better protection of the bearing and seal system of the bit.

■ IMPROVE BIT STABILITY, PREVENT BIT DIAMETER SHRINKAGE AND EXTEND THE BIT'S WORKING LIFE

Inclined double-stable head O.D.

Improved stability of small size head O.D. and reduced bit vibration at the bottom hole are achieved by using specially designed inclined double-stable head body. Hydraulic system of the bit is also optimized on the basis of the special head O.D. design and as a result, bottom flow field under the condition of insufficient hydraulic power in lower section in deep well is largely improved, removal of drilling cuttings is also improved and wear out of the bit and other drilling tools by drilling cuttings is reduced and therefore, ROP is further improved.

■ OPTIONAL FEATURES: D、H、K、X、Y

SUPER-MD

ULTRA-HIGH SPEED MOTOR BIT

In consideration of this high speed drilling condition, Kingdream specially developed the SUPER-MD ultra-high speed motor bit that is designed with roller-journal composite bearing and metal face seal. The bit is also equipped with advanced cutting structure and special hydraulic system with double extended nozzles that are suitable for high RPM drilling operations. This new Super-MD bit features high bearing reliability and long working life under high speed drilling conditions. SMD bits have been used on turbo drills in Russian oilfields achieved more than 30 hours of stable working life and the rotary speed is above 400 RPM.

It is recommended that SMD bits should be run within the range of 250 to 600 RPM in order to get better and economic drilling result.

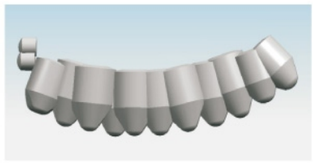
The size range of SMD series bit is from 8 3/4 to 11 5/8 inch, and IADC varies from 117 to 617. For example: 8 1/2 SMD537X.

■ SMD BIT FEATURES LONG SERVICE LIFE, HIGH RELIABILITY AND HIGH ROP UNDER ULTRA-HIGH ROTARY SPEED CONDITIONS

Roller-journal composite bearing with metal face seal

Patented roller-journal composite bearing technology is used on SMD bit. This new bearing package combines the advantages of both roller bearing and journal bearing, together with metal face seal, insures higher reliability of the bit under high RPM and high WOB.

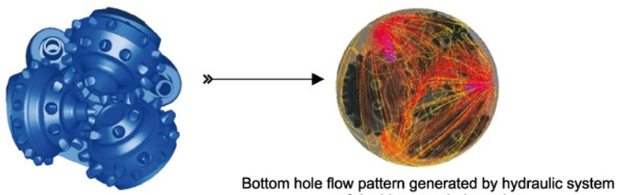
Advanced cutting structure suitable for high RPM drilling



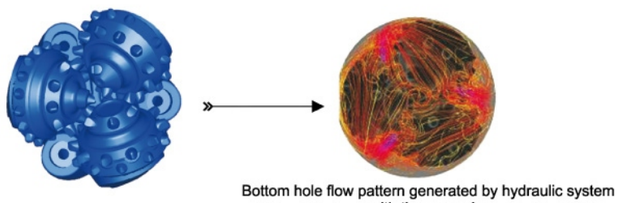
Working environment of the bit's cutting structure becomes more severe under ultra-high RPM conditions. SMD bits uses selected carbide inserts with the strength and hardness of the inserts are matched properly. Cutter layout is optimized and new machining process for drilling insert hole is used to reduce or even eliminate insert breakage and loss during drilling.

■ HIGHLY EFFICIENT HYDRAULIC SYSTEM

Special hydraulic system with double extended nozzles can remove large amount of drilling cuttings generated from fast drilling operations and eliminate drilling cutting logjamming area at the bottom hole and therefore facilitate up removal of the drilling cuttings.



Bottom hole flow pattern generated by hydraulic system of double extended nozzles



Bottom hole flow pattern generated by hydraulic system with three nozzles

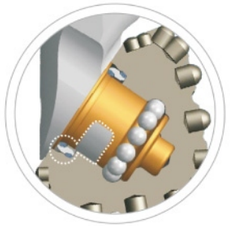
■ OPTIONAL FEATURES: C、D、E、H、K、X、Y

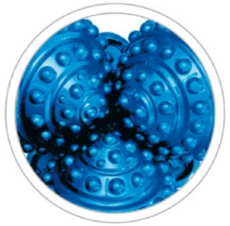
HF

SERIES BIT FOR HARD FORMATION DRILLING

HF series bit has the advantages of long service life, high reliability, fast ROP and strong gage protection ability etc.. HF series bit is the ideal choice for drilling in hard formations and high abrasive formations effectively and safely.

The size range of HF series bit is from 6 to 12 1/4 inch, and IADC varies from 537 to 737. For example: 8 1/2 HF637GHLM.





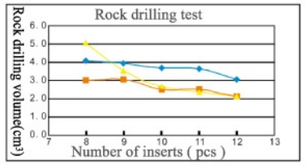
■ LONG WORKING LIFE AND HIGH RELIABILITY

Head bearing of HF series bit is adopted advanced automatic welding technology with wear-resistant alloy on surface hardfaced and cone bearing surface is plated by using third-generation high-performance composite solid lubricating materials to increase bearing's capacity. Composite solid lubricating material and new type of grease are applied to improve bearing's working environment. The bearing can receive higher WOB under using those bearing technology.

Cutter crest enhancement

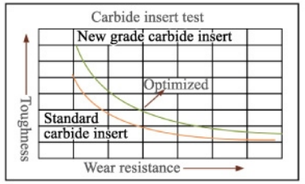
Wear between cones of HF series bit is reduced to prolong service life by utilizing top inserts enhancing technique.

■ NUMERICAL EXPERIMENT AND OPTIMIZED CUTTER MATERIAL & SHAPE ENSURE HIGH EFFICIENCY OF CUTTING



Numerical experiment

Actual bit performance is simulated by advanced computer 3D simulation technology. The cutting structure applied in hard formation is designed under combination of physical experiments.



Optimized cutter material and shape

Cutter materials and shapes are scientifically matched with each other according to drillable difference of formation so as to reduce cutter breakage and increase cutter aggressiveness and wear resistance.

■ APPLYING SUPER-HARD MATERIAL AND ENHANCED HEEL ROW & GAGE DESIGN TO PREVENT BIT FROM DIAMETER SHRINKAGE

Enhanced heel row and gage design

High dense heel row and double gage rows arranged on HF series bit which prevent bit from diameter shrinkage effectively.

Super-hard material diamond-enhanced inserts

Adopting predominant diamond enhanced inserts developed by Kingdream in heel row and gage row to increase gage protection capability and service life. The cutters are used for drilling in hard formations with high abrasive and super-hard formations.

■ OPTIONAL FEATURES: D、G、H、K、L、X、Y

SWT

STEEL TOOTH BIT WITH HIGH EFFICIENCY

SWT series steel tooth bit with high efficiency can solve these problems, with strong wear resistant teeth and fast ROP, bit can work more stably, which is more suitable for drilling in soft or middle soft formations with high rotary speed.

The size range of SWT series bit is from 8 1/2 to 17 1/2 inch, and IADC varies from 117 to 127. For example: 9 1/2 SWT127.

■ HIGHER WEAR-RESISTANT CUTTER

Enhanced structure of cutter shape

Optimized structure design of cutter shape is thickened hardfacing on surface and crest of cutters to enhance aggressiveness for cutters. Enhanced hardfacing on leading edge and trailing edge of cutters improve wear-resistance of cutters.

Optimized hardfacing technology

New welding material is used to enhance further wear resistance of cutters.

■ HIGH ROP

Optimized cutting structure

Based on rock mechanics features, adopt calculation and analysis tools to optimize cutter row arrangement, parameter of cutter shape and number of cutter. Then the maximum cutting efficiency and direction of movement for cutters of each row are calculated accurately to maximize breakage area and volume of bottom hole when each cutter contacted with the bottom hole. Finally, ROP of the bit is also improved.

Enhanced wear resistance of cutters can keep longer aggressiveness, so that the bit can keep high ROP till end.

High efficient hydraulic structure can clean out cuttings at bottom hole and create good working condition.

■ OPTIONAL FEATURES: C、G、L

A
SERIES BIT FOR AIR DRILLING

In hard formation with less water content, formations with serious leakage or with low pressure, in order to achieve higher drilling speed, air drilling process is usually adopted. Problems such as short service life, low ROP, weak gage protection ability etc. appear frequently for conventional cone bit in air drilling conditions. Aim at air drilling condition, Kingdream has developed A series bit for air drilling which can solve these problems.

The size range of A series bit is from 5 7/8 to 12 3/8 inch, and IADC varies from 537 to 627. For example: 8 1/2 A617HD.

■ LONG SERVICE LIFE

Metal face seal journal bearing

High stress spots are eliminated by new bearing enhancement process and the design requirements of high accuracy is obtained with high precision machineries to ensure good impact resistance load capability and high-temperature resistant property.

■ HIGH ROP

High effective cutting capability can be obtained by optimized cutting structure

According to characteristics of air drilling, inserts of highly wear resistance and high toughness as well as optimized cutter shape are utilized. The wear-resistance and anti-breakage ability of inserts can help to keep constant aggressiveness and increase ROP.

Fine cuttings is suitable for upward flow of cuttings in air drilling to reduce repeated breakage and improve drilling efficiency by optimized arrangement density and height of cutters.

Jet system with high efficiency

Three side jet holes and one center jet hole form a jet structure. Unique center hole will spurt air flow into bottom hole center directly, so that increase capacity of cleaning well bore, expedite upward flow of cuttings and cool cone and bearing.

■ STRONG GAGE PROTECTION

Appropriately added cutter's number of heel row and adopted inserts with good wear-resistance to enhance gage protection.

Widened & thickened hardfacing on shirttail to protect the seal.

Full head OD protection to improve further capability of gage protection.

■ OPTIONAL FEATURES: D、H、X、Y

HJ/HJT

METAL SEALED BIT WITH JOURNAL BEARING

HJ/HJT series bit adopts metal seal with journal bearing, which can drill stably with high rotary speed.

The size range of HJ/HJT series bit is from 7 1/2 to 18 7/8 inch, and IADC varies from 117 to 547. For example: 8 1/2 HJT537G.

■ MAIN STRUCTURE FEATURES

1. Metal face seal journal bearing. New processes of head bearing hardfacing and cone bearing silver plating are used to improve the load capacity, anti-galling ability and stability of the bearing.

2. Various shapes of inserts can be equipped on this series of bits, including scoop inserts, wedge inserts, conical-spherical inserts and double spherical inserts, etc. Drilling process & formation and bit are efficient integrated by scientific insert shape selection to realize safety and high efficient drilling.

3. For HJT， a row of inserts is added between gage row and heel row to trim borehole wall and protect cone shell.

GJ/GJT

METAL SEALED BIT WITH ROLLER BEARING

GJ/GJT series bit adopts metal seal with roller bearing, which can drill stably with middle to low WOB and middle to high RPM, it's the ideal choice for higher part of well section.

The size range of GJ/GJT series bit is from 8 1/2 to 17 1/2 inch, and IADC varies from 115 to 545. For example: 17 1/2 GJT515GC.

■ MAIN STRUCTURE FEATURES

1. Sizes of bearing journal and rollers are made larger by arranging the rollers in recesses in cone body.

2. All rubber compensator is used which can limit pressure differential and prevent drilling fluid from entering the lubrication system and this provides the bearing system with good assurance of lubrication.

3. Shirttail and head OD are hardfaced for enhanced gage protection. Center nozzle is equipped for bits of larger sizes.

4．For GJT，a row of inserts is added between gage row and heel row to trim borehole wall and protect cone shell.

HA/HAT

RUBBER SEALED BIT WITH JOURNAL BEARING

HA/HAT series bit adopts rubber seal with journal bearing, which can sustain higher WOB under normal rotary speed and is suitable for drilling in formations from very soft to middle hard by properly selecting different cutting structure.

The size range of HA/HAT series bit is from 3 3/4 to 12 1/4 inch, and IADC varies from 116 to 547. For example: 6 HA537G.

■ MAIN STRUCTURE FEATURES

1. Journal bearing. Hardfaced head bearing surface. Inner hole of cone is silver-plated. The load capacity and seizure resistance of the bearing is greatly improved.

2. O ring seal is made of the more wear resistant and high saturated buna-N with the increased seal section and precisely designed sealing flange in the cone sealing area has increased the reliability of the seal.

3. All rubber compensator is used which can limit pressure differential and prevent drilling fluid from entering the lubrication system and this provides the bearing system with good assurance of lubrication.

4. High wear resistance and excellent cutting ability of the insert bit are given full play by using carbide compacts of high strength and high toughness in combination with optimized compact numbers and rows, the exposure height and special shaped compacts. For steel tooth bit, the tooth surface is hardfaced with new type of wear resistant material and thus has extended working life of the cutting structure while still maintaining high ROP.

5. For HAT, a row of inserts is added between gage row and heel row to trim borehole wall and protect cone shell.

GA/GAT

RUBBER SEALED BIT WITH ROLLER BEARING

GA/GAT series bit adopts rubber seal with roller bearing, which is the ideal and economical tool for drilling applications where middle to low WOB and high RPM are required.

The size range of GA/GAT series bit is from 12 1/4 to 17 1/2 inch, and IADC varies from 114 to 545. For example: 13 3/4 GA515G.

■ MAIN STRUCTURE FEATURES

1. Sealed roller bearing structure. With rollers arranged in grooves recessed in the cone body, the size of the bearing journal is increased, therefore, with the ability of enduring high WOB and applying for high RPM.

2. Thrust bearing surfaces are hardfaced and treated with friction reducing technology.

3. All rubber compensator is used which can limit pressure differential and prevent drilling fluid from entering the lubrication system and this provides the bearing system with good assurance of lubrication.

4. For GAT, a row of inserts is added between gage row and heel row to trim borehole wall and protect cone shell.

YC

SERIES SINGLE CONE BIT

This series of bit is suitable for slim hole drilling operations such as sidetracking and reentry operations.

The size range of YC series bit is from 3 1/2 to 6 1/2 inch, and IADC varies from 437 to 637. For example: 4 5/8 YC517.

■ MAIN STRUCTURE FEATURES

1. With particular structure of the cone, equal worn of the compacts in permanent contact area and alternative contact area of the bit is realized.

2. Wear resistance of the cutting structure is enhanced by setting PDC cutters in the permanent contact area of the cone where compacts are most severely worn.

3. Optimized hydraulics structure improved the cleaning ability of hydraulic system on cone and bottom hole, and assure higher ROP.

4. The bit has excellent gage protection and up reaming abilities by setting active cutting conical spherical gage compacts on head body.

SKF

RUBBER SEALED BIT WITH FLOATING BEARING

SKF series bit is a kind of high efficiency bit for vertical and directional drilling applications, especially suitable for these kinds of drilling applications in relatively homogenous formation with good drillability. This bit is designed with floating bearing and rubber 'O' ring seal, and also utilizes optimized cutting structure and enhanced gage protection technology and therefore, it can achieve longer footage and higher ROP.

The size range of SKF series bit is from 8 1/2 to 12 1/4 inch, and IADC varies from 117 to 537. For example: 8 1/2 SKF517G.

■ MAIN STRUCTURE FEATURES

1. This series bit adopts the bearing and seal system with the feature of low relative linear velocity of bearing couple and low temperature of friction surface. Applying of new type of synthetic grease enhance the ability of resisting high temperature, wear and extreme pressure of bearing, which can get longer service life and higher reliability in vertical well and directional well.

2. Optimize cutting structure of insert bits, choose offset crested scoop compacts with strong attacking ability as main cutting compacts, so as to make the bit with the feature of longer footage and higher ROP.

3. Properly arrange compacts on Head OD to enhance the security of bit in directional well. As well as improve the drilling operation in reducing well section or under the situation of up-reaming.

SKH

RUBBER SEALED BIT WITH JOURNAL BEARING

SKH series bit adopts journal bearing rubber O-ring seal along with more aggressive cutting structure. This bit is with the features of longer footage and higher ROP and is the ideal choice for drilling applications in upper homogenous formations.

The size range of SKH series bit is from 8 1/2 to 17 1/2 inch, and IADC varies from 116 to 537. For example: 8 1/2 SKH517G.

■ MAIN STRUCTURE FEATURES

1. Hardfaced head bearing surface. Inner hole of cone is silver-plated. The load capacity and seizure resistance of the bearing is greatly improved.

2. O ring seal is made of the more wear resistant and high saturated buna-N with the increased seal section and precisely designed sealing flange in the cone sealing area has increased the reliability of the seal.

3. High wear resistance and excellent cutting ability of the insert bit are given full play by using carbide compacts of high strength and high toughness in combination with optimized compact numbers and rows, the exposure height and special shaped compacts. For steel tooth bit, the tooth surface is hardfaced with new type of wear resistant material and thus has extended working life of the cutting structure while still maintaining high ROP.

SKG

RUBBER SEALED BIT WITH ROLLER BEARING

SKG series bit is designed with roller bearing and rubber O-ring seal. This bit can achieve longer footage and higher ROP when drilling under medium to low WOB and high RPM.

The size range of SKG series bit is from 10 5/8 to 26 inch, and IADC varies from 114 to 535. For example: 17 1/2 SKG515G.

■ MAIN STRUCTURE FEATURES

1. Roller bearing structure. With rollers arranged in grooves recessed in the cone body, the size of the bearing journal is increased, therefore, with the ability of enduring high WOB and applying for high RPM.

2. All rubber compensator is used which can limit pressure differential and prevent drilling fluid from entering the lubrication system and this provides the bearing system with good assurance of lubrication.

SKW
NON-SEALED BITS

SKW series bit is non-sealed roller bearing bit. This bit is suitable for surface hole drilling for every kind of wells and upper sections with good drillability. It's with the advantages of low cost and high ROP, etc.

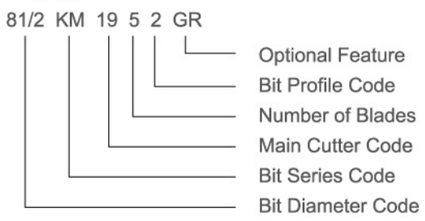
The size range of SKW series bit is from 14 3/4 to 26 inch, and IADC varies from 111 to 241. For example: 26 SKW111C.

■ MAIN STRUCTURE FEATURES

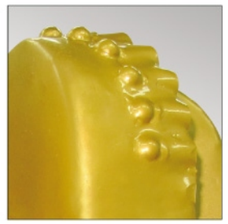
1. The drilling fluid can flow into bearing cavity directly to cool due to no seal.
2. For bit size of 14 3/4 inch and larger, bearing structure of roller-ball- roller-thrust is utilized.

■ NOMENCLATURE OF KINGDREAM DIAMOND BITS

Example:



■ OPTIONAL FEATURE

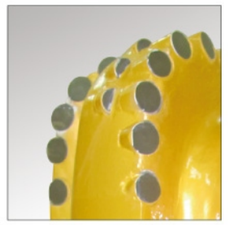


A Vibration absorber

Enhancing crossing stringer ability of the bit in order to protect PDC cutters.

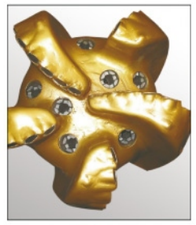
R Back-reaming

Making the bit more suitable for various drilling processes to prevent sticking.



D Double row cutters

Penetration ability and wear resistance can be improved.



S Spiral blade

Cutter layout densities are increased and adaptive abilities of hard formations are improved.

G Spiral gage protection

Bit is balanced that resulting better stability of the bit.

T Special gage protection

enhancing gage protection ability of the bit and drilling speed.

■ CHART OF KINGDREAM PDC BIT TYPES

Series Code	Name of the series	Main Cutter Code		Number of Blades		Bit Profile Code			Optional Features	
		Code	Size	Code	No. of blades					
KM	Matrix body PDC bit	19	19.050	3	3	Parabolic	1	Short	A	Vibration absorber
				4	4		2		D	Double-row cutters
KS	Steel body PDC bit			5	5		3	Long	G	Spiral gage protection
KMH	Matrix body PDC bit for hard formation	16	15.875	6	6	Round	4	Short	R	Back reaming
				7	7		5		S	Spiral blade
				8	8		6	Long	T	Special gage protection
KMD	Matrix body PDC bit for directional drilling applications	13	13.437	9	9	Cone		Short		
				0	10					
KSD	Steel body PDC bit for directional drilling applications			1	11		9	Long		
		8	8.001	2	12	Other				
KMC	Matrix body PDC core bit									

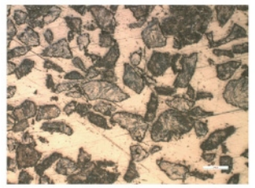
■ API DIAMOND BIT TOLERANCES

Dia. size (inch)	Dia. tolerances (mm)
3 7/8—6 3/4	-0.38—0
7 1/2—8 3/4	-0.51—0
9 1/2—12 1/4	-0.76—0
14 3/4—17 1/2	-1.14—0

KM Series

MATRIX BODY PDC BIT FOR FULL SCALE DRILLING APPLICATIONS.

Features of KM series



1. Via Patent matrix materials and FEA analysis can be designed in order to ensure bit with better wear resistance and higher density.
2. Matrix body PDC bit sintering process is monitored and controlled by using flexibility thermocouple to ensure sintering quality of the matrix body PDC bit.
3. PDC cutters of different features are selected to suit different drilling applications in different formations to satisfy different requirements when drilling soft to medium hard formations.
4. Cutting structure is force balanced and non-symmetrical blade and wide gage are designed so that the force on bit is balanced resulting better stability of the bit.
5. Hydraulic system of the bit is optimized using dynamic flow pattern simulation technology to enhance cleaning and cooling effects of the bit to effectively prevent bit from balling.

KM series PDC bit selection guide

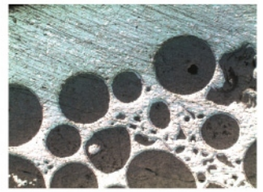
No.	Formation	IADC code	Lithology	Example
1	Very soft	M124	Clay Mudstone Marlite	KM1944
2	Soft	M223	Marlite Saline rock Shale	KM1952R、KM1952G、KM1952A、KM1952AG KM1652AR、KM1652R、KM1652AGR
3	Medium soft	M323 M324	Shale Sandstone Chalk	KM1662、KM1662GR KM1953DGR
4	Medium	M423 M433	Sandstone Limestone Shale	KM1665GR、KM1665ADR KM1362、KM1365D、KM1375D

KS Series

STEEL BODY PDC BIT FOR FULL SCALE AND FAST DRILLING APPLICATIONS

Features of KS series

1. The bit's body material is made of steel of high quality. The good steel material and thinner blade design as well as deeper junk slot design helps to get higher ROP.
2. Wear-resistant materials with high wear resistance are hardfaced on the surface of blade which can prevent eroding of body materials.



3. Five-axis machining center with high performance, milling technology with high speed and special cutter structure are designed to ensure machining precision of the bit.
4. Hydraulic system of the bit is optimized using special inner flow channel design to enhance cleaning and cooling effects of the bit to effectively prevent bit from balling.

KS series PDC bit selection guide

No.	Formation	IADC code	Lithology	Example
1	Very soft	S124	Clay Mudstone Marlite	KS1944S
2	Soft	S223 S233	Marlite Saline rock Shale	KS1952GS、KS1952AGS、KS1952A KS1652S
3	Medium soft	S323 S324 S334	Shale Sandstone Chalk	KS1952GRS、KS1952AGRS、KS1652S KS1963AGS、KS1653S KS1363AGRS
4	Medium	S423 S433	Sandstone Limestone Shale	KS1652DGS KS1392D

KMD/KSD Series

MATRIX BODY /STEEL BODY PDC BIT FOR DIRECTIONAL DRILLING APPLICATIONS

Features of KMD/KSD series

1. Shallow inner cone and short gage design brings the bit with better steerability to meet requirements of directional drilling applications.
2. Optimized bit profile and enforced cutter density of shoulder design result in higher lateral cutting ability.
3. Angle gage design to increase stability and gage ability for directional drilling application.
4. Enhanced gage design to improve gage protection ability of PDC bits.
5. Optimized Hydraulic design and enhanced cleaning and cooling effects of the bit to prevent bit from balling.

KMD/KSD series PDC bit selection guide

No.	Formation	IADC code	Lithology	Example
1	Very soft	M(S)124	Clay Mudstone Marlite	KM(S)D1944GR
2	Soft	M(S)223 M(S)224	Marlite Saline rock Shale	KM(S)D1952GR、KM(S)D1652GR KM(S)D1953GR
3	Medium soft	M(S)323 M(S)324	Shale Sandstone Chalk	KM(S)D1662GR KM(S)D1653GR、KM(S)D1963GR
4	Medium	M(S)424 M(S)433	Sandstone Limestone Shale	KM(S)D1663GR KM(S)D1365GR、KM(S)D1375GR

KMH Series

HIGH QUALITY MATRIX BODY PDC BIT FOR MEDIUM AND MEDIUM-SOFT FORMATION

Features of KMH series

1. High performance PDC cutters with good wear resistance, impact resistance, and thermostability is designed so that overall performance of cutting element is improved.
2. High performance matrix body material is designed to improve ability of body's abrasive resistance.
3. Crown profile and cutters placement are optimized brings the bit with higher abrasive resistance ability and impact resistance ability in medium and medium-hard formation.
4. Hydraulic system of the bit is optimized and cooling effects of the bit is improved to prevent the compact failure under high temperature.

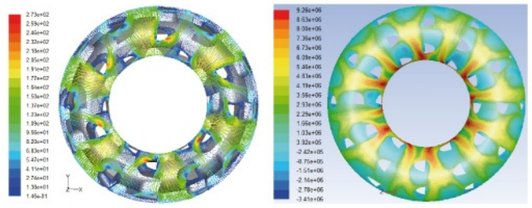
KMH series PDC bit selection guide

No.	Formation	IADC code	Lithology	Example
1	Medium hard	M423 M424 M433	Shale Sandstone Limestone Anhydrite Dolomite	KMH1662ADR KMH1653ADR、KMH1673ADR KMH1375AR

KMC Series
HIGH PERFORMANCE PDC CORING BIT

Features of KMC series

1. Arc crown design and blade arrangement have higher ROP, high rate of core recovery and longer service life.
2. Service life of bit can be improved by using PDC cutters and diamond complex gage.
3. Hydraulic system of the bit is optimized using dynamic flow pattern simulation technology to enhance cleaning and cooling effects of the bit to effectively prevent bit from balling.



4. Diamond ID&OD gage, course set on ID gage to ensure a better cleaning and cooling of the bit.
5. Force balance technology is designed and bit's stability is improved to prevent the bit from premature failure normally.
6. High quality PDC cutters are employed and cutters placement technologies are optimized so that the bit has higher ROP.

■ DIAMOND DRILL BIT APPLICATION INSTRUCTION

1. Selection for PDC bit

Please reading lithology description and bit records of adjacent wells carefully, and analyzing formation characteristics.

Selecting appropriate PDC type in accordance with lithology.

2. Preparation before drilling

Inspect previous bit for body damage, lost cutters or inserts etc. Make sure there are no any junk on bottom hole, and clean the bottom hole if necessary.

Bit must be handled with care in order not to damage cutters and .hard substances.

Check if there is any damage on bit cutters and if there is any foreign matter inside the bit.

Check if installing nozzle is meet requirements, and replace nozzles if necessary.

3. Making up the bit

Clean bit threads and apply grease on threads.

Fit the breaker to the bit, lower the drill string onto the pin and engage the threads.

Locate the bit and breaker in the rotary bushing, and make-up the bit to the recommended torque.

4. Tripping in the hole

Remove the breaker and carefully lower the bit through the wellhead device in order not to damage it.

Shrinkage, shoulder, dogleg and key seat of borehole should be cautious when bit through blank hole.

Wash the last three joints to bottom with full flow at 60rpm.

Approach the bottom cautiously by observing the weight and rotary torque indicators. Tag bottom hole gently and pick up off bottom approximately half meter. Circulate for 5 to 10 minutes with full flow.

5. Reaming

Reaming long sections of undergauge hole is not recommended.

If reaming operation is necessary, it is strongly recommended that the reaming operation should be done with maximum flow rate circulation, specific weight on bit not exceed 90N/mm (diameter), rotary speed not exceed 60 rpm where stuck was encountered when tripping in.

6. Bit break-in

Overusing display instruments when bit approach bottomhole. If the WOB and torque increase, that shows bit have arrived at bottomhole.

Use not more than 90N/mm,weight-on-bit and 40 to 60rpm to establish the bottomhole pattern at least half meter.

Bit break-in is finished and should be adjusted RPM to obtain optimal drilling parameter combination.

Drilling parameters adjustment should be selected within the limits of the recommended parameters refer to recommended drilling parameters optimization method.

7. Normal drilling

Drilling situations should be monitored and analyzed during normal drilling, so that we can judge complex condition and take corresponding measures.

See the table of complex circumstance in this manual for any conditions and treatment action.

METHOD TO OPTIMIZE DRILLING PARAMETERS

1. When drilling 5 minutes, selecting a appropriate WOB and medium speed（60～100r/min）, and record ROP (as shown in the table).
2. While maintaining constant rotary speed, increase the WOB to drill 5 minutes and record ROP (as shown in the table); Repeat the above steps.
3. In the same range according to decrease WOB, repeat the above step 2.
4. Maximum WOB of ROP was found in two groups.
5. Under the best WOB, Varying rotary speed and recording ROP (as shown in the table)
6. Select the rotary speed during the fastest drill speed.
7. Vary parameters to optimum drilling parameters, WOB: 60KN，rotary speed: 120 r/min.

Table

Times	Rotary speed：100 r/min		WOB：60KN	
	WOB(KN)	Drill time(min/m)	Rotary speed(r/min)	Drill time (min/m)
1	80	8	100	7
2	100	9	120	5.5
3	60	7	80	8
Selection	60	7	120	5.5

TABLE OF TREATMENT ACTION FOR DOWNHOLE PROBLEMS

No.	Surface situation of downhole problems	Reason	Corrective action
1	Torque increase	Formation change harder Not optimum WOB and rotary speed Gage wear Well deflection increase Filtercake increase Drill stem washout	Corrective actions for bit balling are: 1) Pick up off approximately half meter, and circulate for 10 to 15 minutes with full flow; 2) Use different means according to drill rig. The bit was swiveled by using different means according to drill rig. Waste matters adhered on the surface of a bit threw off by using centrifugation. Corrective actions for bit bouncing are: 1）Drilling parameters can be changed to stop the bit bouncing caused by formations. If the problem is not resolved and ROP still decreased after drilling parameters are changed, trip out can be considered; 2）Following measures can be taken to stop the bit bouncing caused by fallen matters, broken insert or lost insert, etc.: a) The bit is put up to 0.5 meter from bottom-hole, the high-duty mud circulated and the bit ran about 5 minutes under low RPM (40～60 r/min); b) The high-duty mud circulated continuously and the bit with low RPM is slow put down the bottom-hole; c) Above steps are repeated after the bit is put up again. Then the bit drilled 0.5 meter under low RPM (40～60 r/min) and low WOB (5～10KN), so that fallen matters are crushed to sidewall; d) the bit can drill continuously after the bit bouncing is resolved. Please consider trip out and fishing. Corrective actions for drilling in hard interbed, abrasiveness and hard mud sandstone are: 1）If forecast of interbed thickness is thin, a bit must drill through the interbed slowly under low RPM so that the bit has longer service life. 2）If forecast of interbed thickness is thin, new drilling parameters are set up after bottom-hole is formed in interbed or abrasive hard formation.
2	orque decrease	Formation change softer Not optimum WOB and rotary speed Well deflection decrease Filter cake decrease Bit balling	
3	Standpipe pressure increase	Flow rate increase Well plugging Bit wear or cored Mud density or viscosity increase Bit balling	
4	Standpipe pressure decrease	Drill stem washout Flow rate decrease Mud density or viscosity decrease Air fill into mud Gas kick Mud lost in broken formation	
5	ROP decrease	Formation change harder Mud density increase or performance deterioration Bit wear Not optimum WOB and rotary speed Cleaning effective decrease Bit balling Drill stem washout	
6	ROP is instability	laminar formation Soft layer and hard layer Broken formation Bit balling	
7	Bit bouncing	The bit can result in an oscillation due to the biggest friction torque drilling in plastic formation Uneven formation, fracture formation and broken formation result in bit bouncing Fallen matters, broken insert or lost insert result in bit bouncing	

■ API PIN AND MAKE UP TORQUE

Bit size（in）	Pin size (in)	Torque（KN.m）
3 7/8～4 1/2	2 3/8	4～4.8
4 3/8～5	2 7/8	8～9.5
5 7/8～6 3/4	3 1/2	9.5～12
7 1/2～8 3/4	4 1/2	16～22
9 1/2～14 1/2	6 5/8	38～43
14 3/4～17 1/2	7 5/8	46～54

■ NOZZLE DATA FOR DIAMOND DRILL BITS

TFA Values of Nozzle Size (mm^2)

No.	Diameter of Nozzle (mm)	Number of Nozzles								
		1	2	3	4	5	6	7	8	9
06	4.76	17.81	35.63	53.44	71.26	89.07	106.88	124.70	142.51	160.33
07	5.56	24.25	48.49	72.74	96.99	121.23	145.48	169.73	193.97	218.22
08	6.35	31.67	63.34	95.01	126.68	158.35	190.02	221.68	253.35	285.02
09	7.14	40.08	80.16	120.24	160.33	200.41	240.49	280.57	320.65	360.73
10	7.94	49.48	98.97	148.45	197.93	247.42	296.90	346.38	395.87	445.35
11	8.73	59.87	119.75	179.62	239.50	299.37	359.25	419.12	479.00	538.87
12	9.53	71.26	142.51	213.77	285.02	356.28	427.53	498.79	570.05	641.30
13	10.32	83.63	167.25	250.88	334.51	418.13	501.76	585.39	669.01	752.64
14	11.11	96.99	193.97	290.96	387.95	484.93	581.92	678.91	775.90	872.88
15	11.91	111.34	222.67	334.01	445.35	556.69	668.02	779.36	890.70	1002.03
16	12.70	126.68	253.35	380.03	506.71	633.38	760.06	886.74	1013.41	1140.09
17	13.49	143.01	286.01	429.02	572.03	715.03	858.04	1001.04	1144.05	1287.06
18	14.29	160.33	320.65	480.98	641.30	801.63	961.95	1122.28	1282.60	1442.93
19	15.08	178.63	357.27	535.90	714.54	893.17	1071.81	1250.44	1429.07	1607.71
20	15.88	197.93	395.87	593.80	791.73	989.66	1187.60	1385.53	1583.46	1781.39
21	16.67	218.22	436.44	654.66	872.88	1091.10	1309.32	1527.54	1745.77	1963.99
22	17.46	239.50	479.00	718.50	957.99	1197.49	1436.99	1676.49	1915.99	2155.49

■ IADC DULL BIT GRADING

Cutting structure				Bearing seal B	Diameter G	Description	
Inner row I	Outer row O	Main dull char. D	Position L	Bearing/Sealing B	Dia. G(mm)	Other dull char. O	Cause of trip out R

0—no wear;
……
8—all wear

BC—broken cone[a];
BF—boss failure[b];
BT—broken teeth/cutters;
BU—balled up;
CC—chipped cone[a];
CD—cone locked[a];
CI—cone shaking[a];
CR—cored;
CT—chipped teeth/cutters;
ER—erosion;
FC—flatted crest[a];
HC—heat cracking;
JD—junk damage;
LC—lost cone[a];
LN—lost nozzle;
LT—lost teeth/cutters;
OC—off center wear[a];
PB—pinched bit[a];
PN—plugged nozzle/ flowing passage;
RG—rounded gage[a];
RO—rounded groove[b];
SD—shirttail damage[a];
SS—self-sharpening wear[a];
TR—tracked wear[a];
WO—bit washed out;
WT—worn teeth/cutters;
NO—no major/other dull characteristics
NR—no reuse;
RR—rerunable
a dull chrematistic of roller cone bits;
b dull chrematistic of diamond bits.

Roller cone bits
1—NO. #1;
2—NO. #2;
3—NO. #3;
N—Inner row;
M—Medium row;
H—Outer row;
A—all rows。

Diamond bits
C—inner cone;
N—nose;
T—taper;
S—shoulder;
G—gage;
A—all areas。

Non-sealing bearing:
0—no wear;
……
8—all wear ;
Sealing bearing:
E—effective;
F—failure;
X—diamond bits.

I—dia. not reduced;
1—wear off 1mm;
2—wear off 2mm;

BHA—change bottom hole assembly;
CM—condition mud;
CP—core point;
DP—drill plug;
DMF—down hole motor failure;
DTF—down hole tool failure;
DSF—drill stem failure;
DST—drill stem test;
HP—hole problem;
HR—arrived hole;
FM—formation change;
LOG—run log;
PP—pump pressure abnormal;
PR—low penetration rate;
RIG—rig repair;
TD—total depth; TQ—high torque;
TW—twist off;
WC—weather condition;
WO—washout drill string

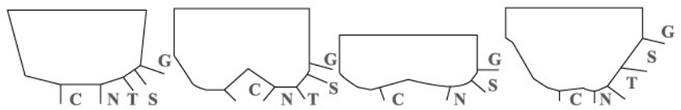
■ IADC GRADING OF BIT ABRASION

Bit profile and code.

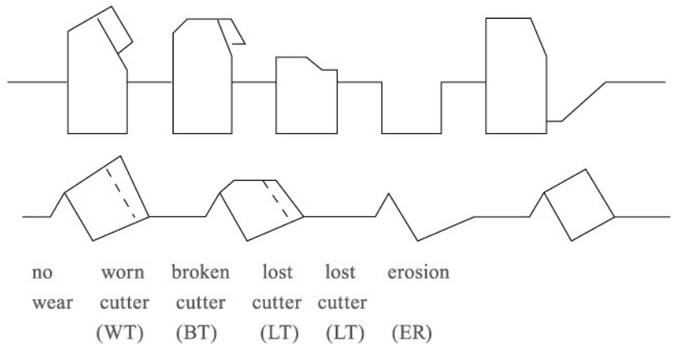
C-inner cone S-shoulder

N-nose G-gage

T-taper A-all areas



Stud cutters characteristic and code.



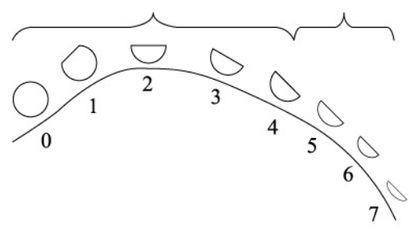
no wear	worn cutter (WT)	broken cutter (BT)	lost cutter (LT)	lost cutter (LT)	erosion (ER)

Cylindrical cutters characteristic and code.

no wear	worn (WT)	lost cutter (LT)	break off (BF)

Dull cutter grading.

Inner row (2/3 radius) Outer row (1/3 radius)



O - no wear 4 - 50% worn 8 - all worn

KINGDREAM

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IADC CLASSIFICATION OF KINGDREAM BITS

Bit type	Formation			1	2	4		5		6		7				
	Series	Lithology	Classi-fication	Non-sealed roller bearing	Air cooled roller bearing	Sealed roller bearing		Sealed roller bearing / gage protection		Sealed journal bearing		Sealed bearing / gage protection				
						Metal face seal	Rubber O ring seal	Metal face seal	Rubber O ring seal	Metal face seal	Rubber O ring seal	Metal face seal	Rubber O ring seal	Metal face seal	Rubber O ring seal	Metal face seal
												Journal	bearing	Floating	bearing	Roller-journal bearing
Steel tooth	1	Soft	1	SKW111			GA114	GJT115G	GA115GC SKG115		HA116G	HJT117CGL	SWT117C HA117	MD117		SMD117C
			2	SKW121			GA124G	GJT125GL	GA125G SKG125		HA126G	HJT127CGL	SWT127C HA127			
			3	SKW131			GA134	GJT135GC	GA135C SKG135	HJ136	HA136G	HJT137GC	HA137GL			SMD137C
			4													
	2	Medium hard	1				GAT214		GA215 SKG215		HA216	HJT217GL	HA217G			
			2						SKG225							
			3						SKG235							
			4													
	3	Hard	1						SKG315		HA316		HA317G			
			2													
			3													
			4													
Insert bit	4	Soft	1					GJT415G	GA415G			HJ417GL	HA417GC			SMD417
			2						GA425				HA427G YC427			
			3					GJT435G	GA435C			HJ437G	HA437G YC437	MD437	SKF437G	SMD437X
			4					GJT445GC	GA445G			HJT447G	HA447G	MD447	SKF447G	SMD447
	5	Soft to medium hard	1					GJT515GC	GAT515L SKG515GK			HJT517G HF517HV	HAT517G SKH517GK YC517	MD517X	SKF517G	SMD517EX
			2					GJT525GC	GA525Y			A527G HJ527G	HA527G YC527	MD527		
			3					GJT535GH	GA535GYC SKG535GK			HF537H HJ537G A537CGK	HA537GC SKH537GK YC537	MD537X MD537HX		SMD537EX
			4					GJT545	GA545GYC			HF547H HJ547G A547CGY	HA547GLY	MD547Y		SMD547EX
	6	Medium hard	1					GJT615GH HF615H	GAS615GYC			HF617H HJ617G/Q617CGY	HA617GL SKH617G	MD617 MD617Y		SMD617EX
			2					GJT625GHC HF625H33	GAT625GC			A627CGY HF627Y	HA627GY	MD627Y MD627		
			3					GJT635GH	GAT635GHY			HF637H HJ637G	HA637GLY YC637	MD637HDX MD637HDY		
			4									HF647HY	HA637GLY	MD647HDY		
	7	Hard	1													
			2										HA727GH			
			3									HF737HY HJ737GHL	HA737GY			
			4													
	8	Extremely hard	1													
			2									HF827H	HA827GY			
			3									HF837HY	HA837GY			
			4													

ROCK BIT COMPARISON CHART

ROLLER CONE BIT			SEALED ROLLER BEARING GAGE PROTECTED					SEALED FRICTION BEARING GAGE PROTECTED				
Series	FORMATIONS	Types	**KINGDREAM**	Hughes Christensen	Smith	Reed-Hycalog	Security DBS	**KINGDREAM**	Hughes Christensen	Smith	Reed-Hycalog	Security DBS
1	Soft formations with low compressive strength and high drillability	1	SKG114,SKG115,GA114, GAT114 GJ114, GJT114, GA115, GAT115, GJ115, GJT115, SWT115	GTX-1, GTX-G1	MSDSH, MSDSSH, XR+	T11, EMS11G, ETS11G	XT1	MD117, SMD117,SWT117,HA116, HAT116, HA117, HAT117, HJ116, HJT116, HJ117, HJT117,	GT-1, GT-G1H, GX-1V, GX-1X, MX-1, MXL-1, MX-X1, STX-1	FDS, FDS+, XR+	HP11, TC10, TC11, RT1G,	XS1
		2	SKG124,SKG125,GA124, GAT124 GJ124, GJT124, GA125, GAT125, GJ125, GJT125, SWT125					MD127, SMD127,SWT127,HA126, HAT126, HA127, HAT127, HJ126, HJT126, HJ127, HJT127,		FDT	HP12, SL12	QH2
		3	SKG134,SKG135,GA134, GAT134 GJ134, GJT134, GA135, GAT135, GJ135, GJT135	GTX-3, GTX-G3	GGH+, MSDGH, SDGH, MGGH+	T13, ETS13G,	XT3	MD137, SMD137,HA136, HAT136, HA137, HAT137, HJ136, HJT136, HJ137, HJT137	MX-3	FDGH, MFDGH	HP13, HP13G	QH3
2	Medium to medium hard formations with high compressive strength	1	SKG214,SKG215,GA214, GAT214 GJ214, GJT214, GA215, GAT215, GJ215, GJT215		SVH, MSVH		XT4	MD217,HA216, HAT216, HA217, HAT217, HJ216, HJT216, HJ217, HJT217	ATJ-G4, ATJ4	FVH, GFVH	HP21G	QH4, XS4
		2										
3	Hard semi-abrasive and abrasive formation	1						HA316, HA317				
		2										
4	Soft Formations / Low-Compressive Strength	1	SKG415,GA415, GAT415, GJ415, GJT415	GTX-00, GX-00, MAX-GT00, MXL-00, GTX-03, GX-03, MAX-GT03, MXL-03	GSi01B, GS01, GS01B GS02B, GS02T, GS03B, Gi03B, G04B, GS04B, TCTi01	T41, EMS41H	XT00-05, EBXT00-05	MD417, MD417X, SMD417, SMD417X, HA417, HAT417, HJ417, HJT417	GT-00, MX-00, GT-03 MX-03, GX-00, GX-03 STR-03, H-03 MXL-00, MXL-03	GFSi01, GFS04, GFS04B MFS04, MFi04	TD41H, TD41 TD41A, R01A R03A	XS00-05, XL00-05, EBXS00-05 EBXL00-05, XS4
		2	GA425, GAT425, GJ425, GJT425	GXT-03C	GS05, GS05B GSi06B, G08B, GS08B	T42, EMS42H, EMS41H	XT06-09, EBXT06-09	MD427, SMD427,HA427, HAT427, HJ427, HJT427	STR-05C, HX-05C	GF05, GF05B, GFi05B GFSi06, MF05B	TD42H R07A	XS06-09, XL06-09 EBXS06-09 EBXL06-09
		3	SKG435,GA435, GAT435, GJ435, GJT435	GTX-09, MAXGT-09 MX-09, GTX-11, MX11 MX11S, MXL-09	G10B, G10T GS10B, GSi12B GSi12UB, TCT10	T43, EMS43A, EMS43H	XT10-13, EBXT10-13	MD437,MD437X,SMD437,SMD437X, YC437HA437,HAT437,HJ437,HJT437,	GT-09, STR-09 STX-09, STX-09H HX-09, GX-11, MX-09 MX-11, MX11H MXL-09, MXL-11	F10,F10B,F12, F12Y,GF08B GF10B, GF10HB, GFS10B GF12T, XR12,MF10T, MFS10T XR10T, TCT11, TCT12	SL43H, TD43 TD43A, TD43H D43, HP43A HP43H, R09A R12A, RD12, R14	XS10-13, XL10-13 EBXS10-13 EBXL10-13
		4	SKG445,GA445, GAT445, GJ445, GJT445	MAXGT-18 MX-18	GSi15B, G15, GSi18B GSi20B, G11Y, M15S 15JS	T44, EMS44H, EMS44A	XT14-17, EBXT14-17	MD447, MD447X,MD447Y,SMD447, SMD447X,SMD447Y,HA447, HAT447, HJ447, HJT447, HJ447X, HJT447X	GT-18, STR-18 STX-18, H-18, HX-18 GX-18, MX-18 MXL-18	FH16,FH16B, FHi18,MF15 MF15T,MF15B, MF19,GF15 GF15B,GF15Y, GFS15B XR15, XR15T, XRi15G	TD44, TD44H TD44X, D44 HP44H, HP44X R14A,RD15 R15A, R15	XS14-17 XL14-17 EBXS14-17 EBXL14-17
5	Soft to Medium-Hard Formations / Low-Compressive Strength	1	GA515, GAT515, GJ515, GJT515, GJ515Y, GJT515Y	GTX-20, MAXGT-20 MX-20, MXL-20 GTX-22 MX-22	G20, GS20B, G25 G20B, 20GMS, 2JS GSi20B	T51, EMS51A, EMS51H	XT18-23, EBXT18-23	MD517,MD517X,MD517K,MD517Y, SMD517,SMD517K,SMD517X, SMD517Y,YC517,HA517,HAT517, HA517Y,HJ517,HJ517GK,HJT517, HJT517GK	GT-20, STR-20 STX-20, H-20, HX-20 GX-20, MX-20, GX-22 MX-22, GX-23, GX-25 MXL-20	F15H, F2, MF2, MF15H FHi20, FHi21, FHi23, GFi20 GF21, GF25, GFS20 MFS20, XR20, XR20B, XR25 F25Y, GF20Y, XR20Y,TCTi20	SL51H,TD51 TD51A,TD51H TD51X,D51, HP51H P51A, HP51H HP51X, R19A,R20A R21A, R22A, RD21	XS18-23 XL18-23 EBXS18-23 EBXL18-23
		2	GA525, GAT525, GJ525, GJT525, GJ525Y, GJT525Y	GTX-20C MAX-GT20CG MX-20C, MX-28G	G28B	T52, EMS52H	XT24-27, EBXT24-27	MD527,MD527X,SMD527,SMD527X, YC527,HA527,HAT527,HA527Y, HJ527, HJ527GK,HJT527, HJT527GK	GT-20C, GT-28, H-28 HX-28, GX-20C GX-28, MX-20C, MX-28 MXL-28	GF26, F27, GFS28, FHi28 GFi28B, FHi29, Fhi25, F26Y MF26Y, FHi24Y, F27A, F27IY GF27Y, XR20TY	TD52,TD52A, TD52H TD52i, TD52X, HP52 HP52X, R24A, R25A R26A, RD25, R27 R28A	XS24-27, XL24-27 EBXS24-27 EBXL24-27
		3	GA535, GAT535, GJ535, GJT535, GJ535X, GJT535X, GJ535Y, GJT535Y	MX-30H MAX-GT30	G30, GS30B 3JS	T53, EMS53 EMS53A, ETS53A	XT28-33, EBXT28-33	MD537,MD537K,MD537X,MD537Y, SMD537,SMD537K,SMD537X, SMD537Y,YC537,A537,HF537, HF537Y ,HA537, HAT537,HA537Y, HJ537, HJ537GK,HJT537, HJT537GK	STR-30, STX-30 GT-30, STX-35, GX-30 H-30, HX-30, MX-30 MXL-30	F3, F30, FH30, F30T FHi30, FHi31, FH32, GF30 GF30B, GF30T, MF30T XR30, XR32, F30Y, FH30Y	SL53,SL53A, TD53 TD53A, TD53B TD53H, D53,HP53 HP53A, HP53H JA53, R30,R30A RD33	XS28-33, XL28-33 EBXS28-33 EBXL28-33
		4	GA545, GJ545, GJ545X, GJ545Y	GTX-30C, GTX-33 MAX-GT30CG MX-33CG		T54	XT34-39 , EBXT34-39	MD547,MD547K,MD547X,MD547Y, SMD547,SMD547K,SMD547X, SMD547Y,A547,HF547,HF547Y, HA547, HAT547,HA547Y, HJ547, HJ547GK,HJT547, HJT547GK	GT-30C, STR-30C, STR¬35C, STX-30C, HR-38C HR-30C, HR-35, GX-30C GX-35, GX-38, MX-35C	FHi35, GFi35, F30Y, F37Y FHi37Y,FHi38Y, F39Y,GFi35YG F37Y, XR30Y, XRi35, XR35Y	TD54A TD54X, TD54 R34A, R35A R36A	XS34-39, XL34-39 EBXS34-39 EBXL34-39
6	Medium-Hard Formations / High-Compressive Strength	1	GA615, GJ615, GJ615X, GJ615Y		G40, G40Y, G40YB 4JS	ETS61A	XT40-45, EBXT40-45	MD617,MD617Y,SMD617,SMD627Y, A617,HF617X,HF617Y ,YC617, HA617, HA617Y, HJ617,HJ617Y	STR-40, HR-40, HR-44 STX-40, GX-44, MX-40 MX-44	FH40, FHi45, F40, F45H, MF4H GF40H, GF40Y, Xr38, XR40 XR45Y, F40Y, F40YA, F47Y F47YA, FH43Y, GF47Y	SL61, SL61A TD61, TD61A HP61A, HP61H R40A, R40	XS40-45, XL40-45 EBXS40-45 EBXL40-45
		2	GA625, GJ625, GJ625X, GJ625Y	GT-40C, MX-44C		EMS62	XT46-51, EBXT46-51	MD627,MD627Y,SMD627,SMD627Y, A627,HF627X,HF627Y ,HA627, HA627Y, HJ627,HJ627Y	STR-40C, STR-44C STX-44C, HR-40C HR-44C, GX-44C GX-45C, MX-40C MX-44C, MXL-44C	F50, FHi50, FHi50Y F46HY, F47HY, GF45Y, GF50Y, XR40Y, XR40YA, XR45Y, XR50	SL62,SL62A, SL62X TD62, TD62A HP62, HP62A HP62H, JA62 R44A, R45, R48	XS46-51, XL46-51 EBXS46-51 EBXL46-51
		3	GA635, GJ635, GJ635X, GJ635Y	MX-55			XT52-58	MD637,MD637Y,SMD637,SMD637Y, A637,HF637X,HF637Y ,YC637,HA637, HA637Y, HJ637,HJ637Y	STR-50, STR-50A STX-50, HR-50, HR-55 GX-55, MX-50, MX-55	F57Y, F57HY GF50YB, F50YA, XR50Y	SL63, TD63 HP63, R50	XS52-58, XL52-58 EBXS52-58 EBXL52-58
		4					XT61-69	HF647,MD647,SMD647, A647,HJ647,HA647	HR-60, HR-66, HR-68 STX-60, MX-66, MX-68	F59Y, F59HY, F67Y GF67Y, XRi65Y	TD64, TD64H HP64, HP64H R60, R65	XS61-69, EBXS61-69
7	Hard, Semi-Abrasive and Abrasive Formations	1										
		2					XT71-75	HF727,HJ727,HA727				XS71-75, EBXS71-75
		3					XT77-81	HF737,HJ737,HA737	STR-70, STX-70 HR-70	F7, XR68Y XR68HY, XR70Y	SL73 HP73	XS77-81, EBXS77-81
		4					XT83-89			XR75Y	TD74,HP74, R75	XS83-89, EBXS83-89
8	Extremely Hard and Abrasive Formations	1					XT91-93		HR-80, HR-88, STX-80 STX-88, STR-80, MX-88	F80Y, GF80Y, XR80Y	TD81, HP81 R80, R85	XS91-93, EBXS91-93
		2					XT95-97	HF827,HJ827,HA827	HR-89	F85Y		XS95-97, EBXS95-97
		3					XT99	HF837,HJ827,HA827	HR-90, HR-99, STX-90,STX-99 STR-90, HR-95, GX-95 ,MX-99	F90Y, FHi90Y, XR90Y	SL83, TD83 HP83, R90, R95	XS99, EBXS99