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# TRICONE DRILL BITS

SHAREATE TOOLS LTD.

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## 01 Product Overview

SHAREATE TOOLS LTD. mining tri-cone drill bit is mainly used in large open-pit mining operations, such as open-pit coal mines, copper mines, molybdenum mines, iron ore mines and other non-ferrous metal mines. Tri-cone drill bits are used on rotary drills, with a proven reputation of high performance and low cost. Shareate has large scale drill bit R&D and manufacturing facilities in China using world class, leading technologies.

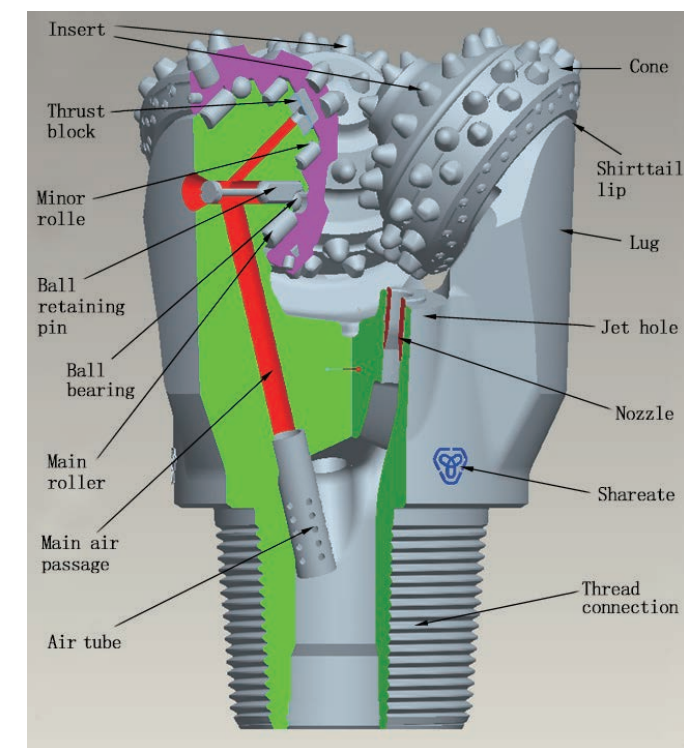
The company has adopted a flexible production system with the incorporation of CNC machining centres, being its core component. The production line consists of manufacturing equipment such as forging, heat-treatment, CNC machining centres, along with advanced inspection equipment.

Our products are designed and manufactured to our certified API Q1 specification and ISO 9001 standards. The tri-cone drill bits range from 6 ¼" to 13 ¾" in size, and the production line is capable of customised design to manufacture for different sizes and series of drill bits to meet our customer's requirements.

### > 1.1 Basic Structure of Mining Drill Bit

Tri-cone drill bits consists of a bearing structure, cutting structure, shirttail and lug enhancement structures, flow channel system, and a thread connections.

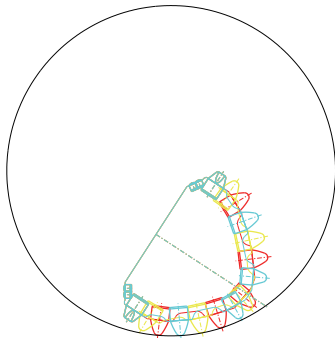
The bearing structure consists of lug bearing, cone bearing, seal ring (sealed bearing), main rollers, minor rollers, locking bearing balls, axle thrust plate, and recess thrust plate. They are categorised into air cooled open bearing or sealed bearing.



1.2 Product Characteristics

Cutting Structure

- Specific insert type and material grade are selected based on ground formation strength and friability to optimize matching of carbide through its wear resistance and toughness.
- Computer simulated bottom hole impact curve design helps to arrange inserts effectively, and balance the working load of drill bit inserts.
- Double bevel inserts: two rows of cross patterned bevel inserts are designed to strengthen the gaging performance.



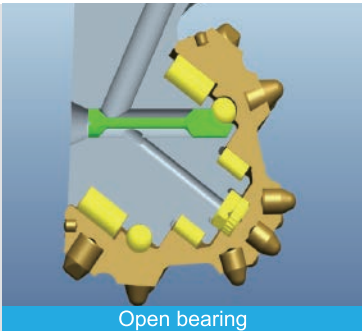
Bottom hole impact curve design

Bearing structure

By calculating the load distribution of each component in the bearing, the bearing geometric structure is designed to distribute bearing load evenly, which enhances the working life.

Open bearing

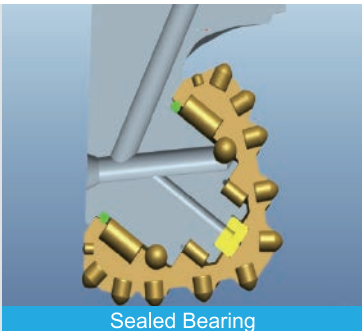
Bearing structure: main roller – ball bearing - minor roller - thrust block, open bearing structure without seal ring



Open bearing

Sealed Bearing

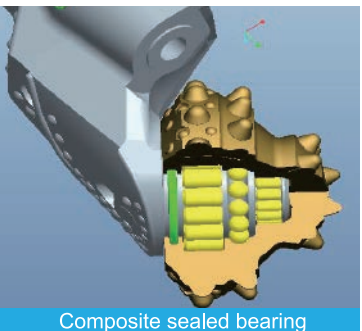
Bearing structure: O-Ring Seal--main roller – ball bearing - minor roller - thrust block, sealed bearing



Sealed Bearing

Composite Sealed Bearing

Bearing structure: Composite seal ring - main roller - ball bearing - minor roller - thrust block, sealed bearing



Composite sealed bearing

Lug Back Protection

Lug back design promotes lift force which increases bailing space, accelerates bailing velocity and reduces wear on drill bit from cutting regrinds.

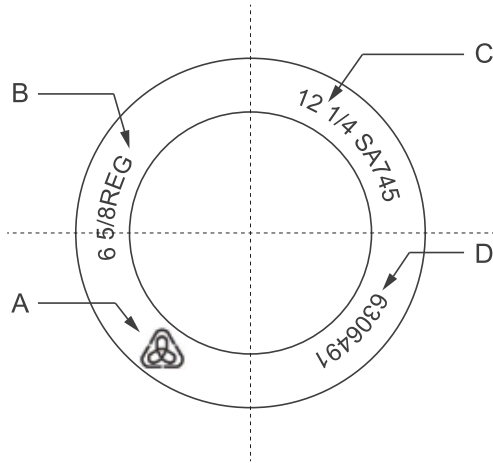


Lug back

Tri-cone Drill Bit Structural Feature Chart

| Bit Structural Characteristics | SG | SGA | SGV |
|--------------------------------|----|-----|-----|
| Open bearing                   | •  |     |     |
| Sealed bearing                 |    | •   | •   |
| O-ring seal                    |    | •   |     |
| Rubber flat seal               |    |     | •   |

Shareate Bit Identification



| A | 6 5/8 REG           | 12 1/4 SA745 | 6306491      |
|---|---------------------|--------------|--------------|
| A | B                   | C            | D            |
| A | Shareate Brand      |              |              |
| B | Thread Connection   |              | 6 5/8 REG    |
| C | Bit Diameter & Type |              | 12 1/4 SA745 |
| D | Bit Serial Number   |              | 6306491      |

## 02 Tri-cone Bits Selection Chart

### 2.1 Naming of Drill Bit Series

Shareate drill bit product model is divided into four sections: drill bit diameter code, drill bit series code, drill bit category code, and additional features code. Using 12 1/4 format to be consistent with others SG745GF as an example:

|                |                  |                    |                     |
|----------------|------------------|--------------------|---------------------|
| 12 1/4         | SGA              | 745                | GF                  |
| Drill bit size | Drill bit series | Drill bit category | Additional features |

- The first part is categorised based on drill hole operation requirement for selecting the correct bit size, displayed in numbers (integer or fraction) to indicate the diameter in inches. Our current tri-cone product range includes 6 1/4, 6 3/4, 7 7/8, 8 1/2, 9, 9 7/8, 10 5/8, 11, 12 1/4, and 13 3/4 (inch).
- The second part is based on drilling operating requirements for selecting the correct drill bit bearing and sealing structure, which is divided into the following series:
  - SG series: Air cooled open bearing structure;
  - SA, SGA series: Sealed bearing structure;
  - SGV series: Composite sealed bearing structure.
  - TJ series: Water circulation cooled pilot hole drill bit series for use with raise boring rig.
- The third part adapts the SPE/IADC codes, consisting of three digits, with the first digit of the IADC code referencing the cutting structure and formation series, the second digit further categorises the formation classification and the last digit is the drill bit structure characteristic code.
  - The first digit ranges from 4 to 8, which designates soft formation, medium-soft formation, medium-hard formation, hard formation and extremely hard formation.
  - The second digit classification ranges from 1 to 4, further categorising the formation. 1 being the softest formation, and 4 being the hardest formation.
  - The third digit classifies the structural characteristics of the drill bit which is divided into air-cooled bearings and sealed bearings, expressed by 2 and 5 respectively.

- The fourth part affirms additional features. Shareate tri-cone drill bits can be manufactured with the following additional features:

#### >> G feature: Specific lug back strengthening



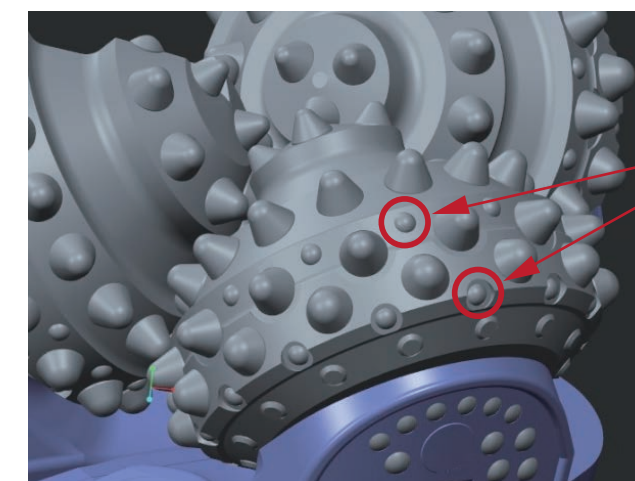
New Enhanced Lug Back



Conventional Lug Back

The new enhanced lug back with additional carbide effectively reduces the wear in abrasive ground conditions, improving the gage performance and bit life. In addition to the previous lug back protection inserts, more carbide have been added onto the chamfer, which is located just above oil storage port. This feature helps to prolong bit life by reducing the back reaming wear on the lug area especially in the scenario of a collapsed hole.

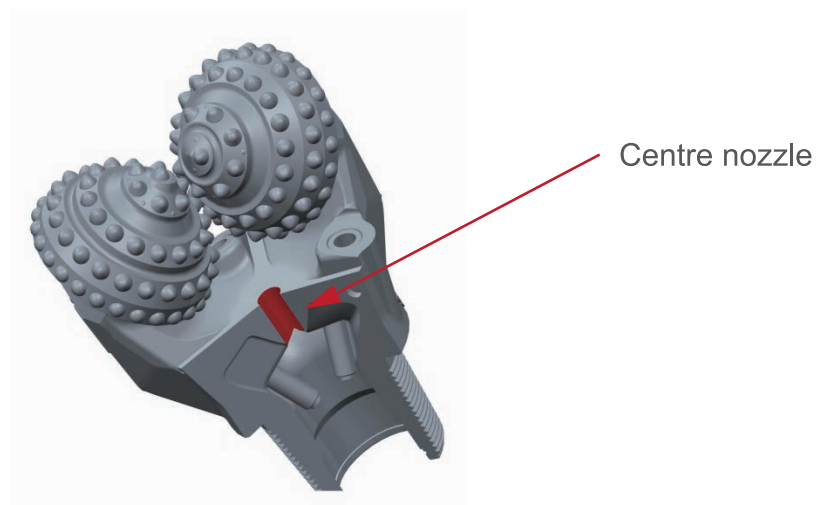
#### >> F feature: Cone auxiliary carbide protection



Auxiliary carbide

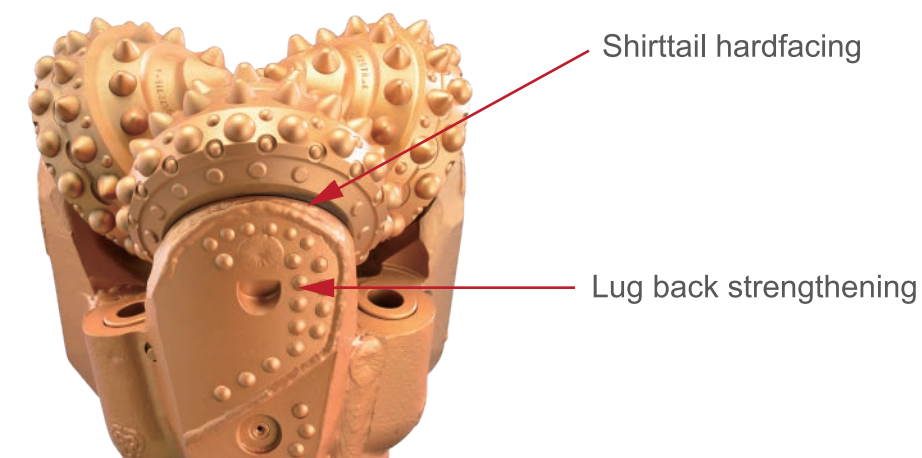
Auxiliary carbides are embedded in between the main cutting rows and outer rows on each cones, effectively protecting the cone body from erosion and enhancing drill bit life in abrasive formations.

## >> C feature: Centre nozzle port



The centre nozzle port helps to clean the cuttings around the bottom of the drill bit, accelerates the bailing of cuttings, reducing the cone edge wear and increases the drill bit penetration rate.

## >> R feature: Shirttail hardfacing(W feature)and lug back strengthening(G feature)



Shirttail hardfacing (W feature) and lug back strengthening (G feature) can effectively reduce wear on lug while improving the drill bit gage performance and bit life.

## >> W feature: Shirttail hardfacing



WC (tungsten carbide) wear-resistant material is welded on the lug shirttail, which effectively reduces wear, protects the sealing structure, and prolongs the life of the bit.

## >> B feature: Cone groove/bevel hardfacing



WC (tungsten carbide) wear-resistant material is welded on the cone groove or bevel to protect cone body against wear and enhancing bit life in abrasive formations.

> 2.2 Drill Bit Selection Chart

(selection based on rock characteristics, compressive strength, friability, etc.)

>> Shareate Mining Tri-cone Drill Bit Series and Applicable Rock Compressive Strength Chart

| Drill Bit Series | Rock Compressive Strength (Psi) | Rock Compressive Strength (MPa) |
|------------------|---------------------------------|---------------------------------|
| 412/415          | 4000—7000                       | 27—48                           |
| 422/425          | 5000—8000                       | 34—55                           |
| 432/435          | 6000—9000                       | 41—62                           |
| 442/445          | 7000—10000                      | 48—69                           |
| 512/515          | 9000—15000                      | 62—103                          |
| 522/525          | 12000—19000                     | 83—131                          |
| 532/535          | 15000—23000                     | 103—159                         |
| 542/545          | 18000—27000                     | 124—186                         |
| 612/615          | 23000—30000                     | 159—207                         |
| 622/625          | 26000—34000                     | 179—234                         |
| 632/635          | 29000—38000                     | 200—262                         |
| 642/645          | 32000—42000                     | 221—290                         |
| 712/715          | 37000—44000                     | 255—303                         |
| 722/725          | 40000—48000                     | 276—331                         |
| 732/735          | 43000—52000                     | 296—359                         |
| 742/745          | 46000—56000                     | 317—386                         |
| 812/815          | 49000—58000                     | 338—400                         |
| 822/825          | 52000—62000                     | 359—427                         |
| 832/835          | 55000—66000                     | 379—455                         |
| 842/845          | 58000—70000                     | 400—483                         |

> 2.3 Nozzle Selection Chart

| Nozzle Size | Bit Size | mm   | 152   | 171   | 200   | 216   | 229 | 251   | 270    | 279 | 311    | 349    |
|-------------|----------|------|-------|-------|-------|-------|-----|-------|--------|-----|--------|--------|
|             |          | inch | 6 1/4 | 6 3/4 | 7 7/8 | 8 1/2 | 9   | 9 7/8 | 10 5/8 | 11  | 12 1/4 | 13 3/4 |
| mm          | inch     |      |       |       |       |       |     |       |        |     |        |        |
| 8           | 0.315    |      | ●     | ●     | ●     | ●     | ●   | ●     |        |     |        |        |
| 9           | 0.354    |      | ●     | ●     | ●     | ●     | ●   | ●     |        |     |        |        |
| 10          | 0.394    |      | ●     | ●     | ●     | ●     | ●   | ●     |        |     |        |        |
| 11          | 0.433    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 12          | 0.472    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 13          | 0.512    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 14          | 0.551    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 15          | 0.591    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 16          | 0.630    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 17          | 0.669    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 18          | 0.709    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 19          | 0.748    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 20          | 0.787    |      | ●     | ●     | ●     | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 21          | 0.827    |      |       |       |       | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 22          | 0.866    |      |       |       |       | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 23          | 0.906    |      |       |       |       | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 24          | 0.945    |      |       |       |       | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 25          | 0.984    |      |       |       |       | ●     | ●   | ●     | ●      | ●   | ●      | ●      |
| 26          | 1.024    |      |       |       |       |       |     | ●     | ●      | ●   | ●      | ●      |
| 27          | 1.063    |      |       |       |       |       |     | ●     | ●      | ●   | ●      | ●      |
| 28          | 1.102    |      |       |       |       |       |     | ●     | ●      | ●   | ●      | ●      |

> 2.4 Drill Pipe Connection Thread Selection Chart

| Bit Diameter | mm   | 152   | 171   | 200   | 216   | 229   | 251   | 270    | 279   | 311    | 349    |
|--------------|------|-------|-------|-------|-------|-------|-------|--------|-------|--------|--------|
|              | inch | 6 1/4 | 6 3/4 | 7 7/8 | 8 1/2 | 9     | 9 7/8 | 10 5/8 | 11    | 12 1/4 | 13 3/4 |
| API(REG)     |      | 3 1/2 | 3 1/2 | 4 1/2 | 4 1/2 | 4 1/2 | 6 5/8 | 6 5/8  | 6 5/8 | 6 5/8  | 6 5/8  |
| BECO         |      |       |       | 4 1/2 | 4 1/2 | 4 1/2 | 6     | 6      | 6     | 6      | 6      |

★ Note: We can design and manufacture to custom sizes and connection thread specifications according to the customer's requirements.

03 Operating Instructions

Tri-cone drill bits are mainly used in large open-pit mining operations for blast hole drilling. Due to the harsh mining environment and complex formation changes, the bit must be correctly used in order to improve bit service life and increase cost-effectiveness.

3.1 Drill Bit Requirements

- Do not soak new drill bit in thin oil or solvent, as this will cause seal ring failure and loss of lubricant.
- Before replacing a new bit, check in detail whether the rotation of the three cones is flexible; also, check if the thread connection and inserts are in good condition.
- The drill rod stabilizer shall be replaced regularly to ensure it has sufficient outside diameter to stabilise the drill pipe and protect the drill bit.
- It is not advised to use bent drill pipe to avoid uneven force on the three cones which will accelerate damage to the drill bit.
- When working in different formations, the drill bits series should be selected accordingly.
- During the running-in process of new bits, the pull down and rotation speed need be lower, which means 1/3 for first hole, 2/3 for second hole, 3/3 for the subsequent holes.
- When starting a new hole with a new bit, remove any foreign objects around the area (such as bulk rock or metal objects), start the hole with air, slow rotation, and slow feed, to avoid damaging the bit from impact.
- When drill bit is being replaced in the middle of the operation in soft formation, cones and inserts of the dead drill bit should be checked to see whether any foreign material has been left at the bottom of the hole. If there are remnants of the dead bit in the hole, it is not advised to use the new bit to redrill the same hole. Doing so may immediately fail the new bit.
- If a bit is replaced because it is not suitable for current ground conditions, the bit can be reused in softer areas to maximise the economic benefit of the bit.
- When drilling operations cease, it is important to clean the bit in a timely manner. The bit should not be left in the hole, especially if the hole contains water. This prevents the backflow of rock cuttings or water getting into the bearing and damaging the bit.
- It is necessary to use bits with back flow valves when working in conditions which contain water, and increase the air pressure appropriately to prevent backflow of cuttings or water.
- Tri-cone drill bits must be used within the recommended operating parameters; air pressure, axial pressure and rotation speed. These factors should be checked regularly and adjusted to suit drilling conditions.
- When drilling through fragmented rock, cavities, or if the hole collapses, the axial pressure and rotational speed should be reduced to prevent inserts from breaking.
- When the drill tool is in the hole, it is strictly forbidden to engage reverse rotation to prevent the bit from unscrewing.
- When the air is turned off, it is possible for rock cuttings to enter the bearing; rotation without air clearing the cutting will result in accelerated bit wear and bearing wear. Therefore, rotation should cease when the air is turned off.

- Monitor the air circuit for leakage during drilling operation regularly to ensure there is no leakage or significant loss of pressure. The air volume and pressure are important for clearing the cuttings, which can affect the bit life.
- Regularly check the concentricity or run out of the drill pipe. If eccentricity occurs, it must be replaced or repaired immediately.
- Always record meters drilled, time in the hole, RPM, WOB (weight on bit), air pressure (psi), formation drilled and any unusual drilling conditions.

3.2 Drill Bit Size, Thread Connection and Recommended Make-up Torque

| Bit Size |            | API REG Thread | Make-up Torque |
|----------|------------|----------------|----------------|
| Inch     | Millimetre | Inch           | kN/m           |
| 6 1/4    | 158.8      | 3 1/2          | 9.5 ~ 12.2     |
| 6 3/4    | 171.5      | 3 1/2          | 9.5 ~ 12.2     |
| 7 7/8    | 200.0      | 4 1/2          | 16.3 ~ 21.7    |
| 8 1/2    | 215.9      | 4 1/2          | 16.3 ~ 21.7    |
| 9        | 228.6      | 4 1/2          | 16.3 ~ 21.7    |
| 9 7/8    | 250.8      | 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      |
| 12 1/4   | 311.2      | 6 5/8          | 38 ~ 43.4      |
| 13 3/4   | 349.3      | 6 5/8          | 38 ~ 43.4      |

3.3 Drilling Parameter Selection Chart

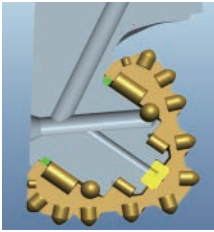
(Weight on Bit and Rotary Speed)

| IADC       | Weight on Bit<br>per Inch of Bit<br>Diameter<br>(lb/in) | Rotary<br>Speed<br>(r/min) | Cutting Structure                                               | Applications                                                                                                                                                    |
|------------|---------------------------------------------------------|----------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 412<br>415 | 1000—2000                                               | 90—120                     | Conical on gage and inner rows                                  | Designed for very soft formations with low compressive strength and high friability such as shale, soft limestone, sandstone, gravel clay, soft dolomite, coal. |
| 432<br>435 | 1000—4000                                               | 90—120                     | Conical/Chisel on gage,<br>Conical inner rows                   | Designed for very soft formations with low compressive strength and high friability such as shale, soft limestone, sandstone, gravel clay, soft dolomite, coal. |
| 532<br>535 | 2000—5000                                               | 80—110                     | Conical/Chisel on gage,<br>Conical inner rows                   | Designed for soft formations with low compressive strength, such as shale, soft limestone, interbedded dolomite, coal.                                          |
| 612<br>615 | 3000—5000                                               | 60—100                     | Conical/Spherical on gage,<br>Conical inner rows                | Designed for high compressive strength, medium hard and abrasive formations, such as limestone, sandstone, interbedded dolomite.                                |
| 632<br>635 | 3000—6000                                               | 60—100                     | Conical/Spherical on gage,<br>Conical inner rows                | Designed for high compressive strength, medium hard and abrasive formations, such as limestone, sandstone, interbedded dolomite.                                |
| 732<br>735 | 4000—7000                                               | 60—90                      | Spherical on gage,<br>Conical/Double spherical<br>on inner rows | Designed for high compressive strength, hard and abrasive formations, such as granite, limestone, sandstone, dolomite.                                          |
| 832<br>835 | 5000—8000                                               | 50—80                      | Spherical on gage,<br>Double spherical on inner<br>rows         | Designed for high compressive strength, hard and abrasive formations, such as magnetite quartzite, quartzite, granite.                                          |

☆ Note: Maximum weight on bit and rotation speeds should not be both applied at the same time.

3.4 Bit failure types and product selection

The common failure types for tri-cone bits are bearing failure, cutting structure failure, and cone body wear.

| Failure types                   | Failure image                                                                         | Recommendation                                                               | Image                                                                                 |
|---------------------------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Bearing failure                 |    | Recommend sealed bearing                                                     |    |
| Broken Insert<br>(Cutting rows) |    | Select a bit suitable for harder formation                                   |    |
| Broken Insert<br>(Gage rows)    |   | Choose the feature F for drilling in soft formation to reduce cone body wear |   |
| Broken Insert<br>(Coring)       |  | Choose the feature F for drilling in hard formation to reduce cone body wear |  |
| Shirttail and lug<br>back wear  |  | Choose the feature R for strengthened shirttail and lug back protection      |  |
| Wear on the top of<br>lug back  |  | Choose the feature R with protection on the top of lug back                  |  |