PDC DRILL BITS

COMMONLY USED BIT SIZES FOR RUNNING API CASING

<table>
<thead>
<tr>
<th>Casing Size (OD in.)</th>
<th>Coupling Size (OD in.)</th>
<th>Common Bit Sizes Used (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 1/2</td>
<td>5</td>
<td>6, 6 1/8, 6 1/4</td>
</tr>
<tr>
<td>5</td>
<td>5.563</td>
<td>6 1/2, 6 3/4</td>
</tr>
<tr>
<td>5 1/2</td>
<td>6.050</td>
<td>7 7/8, 8 3/8</td>
</tr>
<tr>
<td>6</td>
<td>6.625</td>
<td>7 1/2, 8 1/2</td>
</tr>
<tr>
<td>6 5/8</td>
<td>7.390</td>
<td>8 1/2, 8 3/4, 8 3/4</td>
</tr>
<tr>
<td>7</td>
<td>7.656</td>
<td>8 5/8, 8 3/4, 9 1/2</td>
</tr>
<tr>
<td>7 5/8</td>
<td>8.500</td>
<td>9 7/8, 10 5/8, 11</td>
</tr>
<tr>
<td>8 5/8</td>
<td>9.625</td>
<td>11, 12 1/4</td>
</tr>
<tr>
<td>9 5/8</td>
<td>10.625</td>
<td>12 1/4, 14 3/4</td>
</tr>
<tr>
<td>10 3/4</td>
<td>11.750</td>
<td>15</td>
</tr>
<tr>
<td>13 3/8</td>
<td>14.375</td>
<td>17 1/2</td>
</tr>
<tr>
<td>16</td>
<td>17</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>21</td>
<td>24, 26</td>
</tr>
</tbody>
</table>

PDC BITS

* Increase penetration rates in oil and gas wells
* Reduce drilling time and costs
* Bit cost varies from 2% - 5% of total cost, but bit affects up to 75% of total cost

* Cutters
  - consist of thin layer of bonded diamond particles plus a thicker layer of tungsten carbide
* Diamond
  - 10x harder than steel
  - 2x harder than tungsten carbide
  - Most wear resistant material

APPLICATIONS

* PDC bits are used primarily in deep and/or expensive wells, and are effectively used in soft-medium hard formations.
* Advances in metallurgy, hydraulics, and cutter geometry
* PDC bits drill longer and more effectively
* Most effective in very weak, brittle formations (Sandy, silty claystone, siliceous shales)

* ENPE 521 INTRODUCTION TO DRILLING ENGINEERING UNIVERSITY OF CALGARY PAGES 10-24
PDC stands for Polycrystalline Diamond Compact which refers to the cutters on these drill bits. PDC bits have exceptional rates of penetration when drilling & can out preform other bits in the right conditions. The diamond cutters are 10 times stronger than steel and PDC bits are most effective when drilling through shale, salt, clay, stone, sand, and concrete.

IDEAL FOR: ENVIRONMENTAL DRILLING, MINING, GEOTHERMAL & CONSTRUCTION

BIT 215.9 BT 613 YBM.02

Bit Diameter
Bit Series
Quantity Of Blades
Dominant Size Of Cutters
Additional Options
Design Features

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**Main Cutting Structure**

- High wear-resistant cutters
- Highest abrasion-resistant cutters

**Second Row of Cutting Structure**

- Additional row of PDC cutting structure placed behind main one
- Additional stabilizing inserts placed behind main cutting structure
- Additional tungsten carbide inserts with impregnated diamonds placed behind main cutting structure

**Gauge**

- Backreaming PDC cutters on gauge back taper
- Gauge protected by tungsten carbide inserts with impregnated diamonds
- Gauge reinforced with thermally stable diamond inserts

**Hydraulics**

- Unchangeable Nozzles

**Body**

- Matrix Body

**Thread**

- Box Connection
IADC Code Reference

**FIRST DIGIT:**
Mill Tooth Assign numbers 1-3 for Soft, Medium & Hard Formations. **Tungsten Carbide Inserts** Assign numbers 4-8. The higher the series number the harder more abrasive the rock formation.

**SECOND DIGIT:**
Relative degree of hardness within the series. Higher numbers indicate harder formations. Numbers range from 1-4 further assist in identifying the formation with 4 being the Hardest & 1 being the Softest.

**THIRD DIGIT:**
Numbers 1-7 indicate the primary Seal/Bearing Design, Seal protection & Special Gauge Wear.

1. Open Bearing
2. Open Bearing [Air Cooled]
3. Open Bearing w/Gauge Protection
4. Roller Sealed Bearing
5. Roller Sealed Bearing w/Gauge Protection
6. Sealed Friction Bearing
7. Sealed Friction Bearing w/Gauge Protection

**LETTER:**
The letter codes below are used in the fourth digit position indicating the most significant feature:

A - Air Application  M - Motor Application
B - Special Bearing Seal  R - Reinforced Welds
C - Center Jet  S - Standard Tooth Bit
D - Deviation control  T - Two Cone Bits
E - Extended Jets  W - Enhanced Cutting Structure
G - Extra gauge protection  X - Chisel Insert
H - Horizontal Application  Y - Conical Insert
J - Jet Deflection  Z - Other Insert Shape
L - Lug Pads

We Sell New Premium Quality Bits for Oil Field Drilling
We Supply Oil Field Reruns & Open Bearing Bits For Mining & Waterwell
# Mill Tooth (Oil Field, Mining, & Waterwell)

<table>
<thead>
<tr>
<th>Formation</th>
<th>Used In</th>
<th>Common IDAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft</td>
<td>Clays, Coal, Salts, Shales, Soft Limestone, Discontinuous Sands etc...</td>
<td>115</td>
</tr>
<tr>
<td>Medium</td>
<td>Sedimentary Rocks, Limestone, Sandstone, Slate etc...</td>
<td>217</td>
</tr>
<tr>
<td>Hard</td>
<td>Varieties of Silica, Basalt, Dolomite, Compact Sands, Limestone etc...</td>
<td>316</td>
</tr>
<tr>
<td>Very Hard</td>
<td>Marble, Quartzite, Granite, Gneiss, Pyrite, etc...</td>
<td>337</td>
</tr>
</tbody>
</table>

## Mill Tooth Bits can be Retipped & Built up with Hard Tungsten

Mill Tooth Bits have very high drilling rates in soft and medium-soft formations. Western Drilling Tools can hard face Milled Teeth so that they sharpen themselves while drilling. Sealed Bearing Mill Tooth Tri-cone Bits come with or without gauge protection.

Both open bearing and sealed bearing Mill Tooth Tri-cone/ Roller cone bit can come with or without gauge protection & skirttail protection.

### Features May Include:

- **Premium Tungsten Carbide Inserts**
- **Application Specific Cutting Structures**
- **Optimized Bearing Design**
- **Premium Shirttail Hard Facing**
- **Enhanced Hydraulics**
**Bearings**
Precision bearings made with the tightest tolerances in the industry! The bearing materials used have extremely low friction and high load capacity. Chemically heat resistant, heat tolerant HNBR materials for bearing seal and pressure compensator. This material is very compatible with oil based muds aircooled and open bearings are also available.

**Reaming Gauge:**
Put more active cutting elements on gauge than anyone in the industry. Perfect for directional applications. Its gauge holding ability is superior for maintaining gage on lateral or extreme build angles. We can offer diamond in this feature for the most abrasive applications. Bearing and seal life are extended by keeping the cone from rubbing the hole-wall and generating additional heat.

**Enhanced Hydraulics:**
Design flexibility offers customers the ability to effectively clean the cutting structure, while minimizing cone erosion. Premium nozzles are used for consistency and reliability.

<table>
<thead>
<tr>
<th>Formation</th>
<th>Used In</th>
<th>Common IDAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOFT</td>
<td>Clays, Coal, Salts, Shales, Soft Limestone, Discontinuous Sands etc...</td>
<td>437</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>Sedimentary Rocks, Limestone, Sandstone, Slate etc...</td>
<td>537</td>
</tr>
<tr>
<td>HARD</td>
<td>Varieties of Silica, Basalt, Dolomite, Compact Sands, Limestone etc...</td>
<td>737</td>
</tr>
<tr>
<td>ULTRA HARD</td>
<td>Marble, Quartzite, Granite, Gneiss, Pyrite, etc...</td>
<td>837</td>
</tr>
</tbody>
</table>
TCI Oil Field TRI-CONEs

Main Cutting Structure
Conical and spherical shapes increase bending resistance of insert. Recommended for hard and very hard formations.

Tough carbide grade. Tungsten carbide material with unique correlation of elasticity and wear resistance.

Reaming Gauge
Diamond protected heel row (100%). Increases bit durability in abrasive formations, prevents diameter loss.

Additional reaming gauge row. Protects shirrtail and reduces thermal effect on sealing, thereby increasing bearing life.

Diamond protected reaming gauge row (25%) RD1 - Diamond protected reaming gauge row (50%) RD2 - Diamond protected reaming gauge row (100%).

Premium Tungsten Carbide Inserts
Application Specific Cutting Structures
Optimized Bearing Design

Shirrtail
Shirrtail hardfacing and leg equipped with increased quantity of tungsten carbide inserts.

Diamond protected leg inserts. Improve gauge protection.

Hydraulics
Center jet. Improves bottomhole cleaning. Recommended for 393.7mm (15 1/2") and larger bits.

Other
Torch applied cone hardfacing. Protects cone material from washout. Recommended for use with high sand content in drilling mud.

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Western Drilling Tools Inc.
**DRAG BITS**

Other than PDC bits, Drag Bits have the lowest cost per bit. Drag bits are a rotary drill bit built with a steel body and tungsten carbide teeth. These bits will out preform other more expensive bits if used appropriately. Drag bits are extremely popular choice for seismic drilling, blast hole drilling and geothermal drilling applications. For best results adjust the rotational speed to 50% less than what you would normally use for a tricone bit of the same size and reduce the weight on bit by the same amount.

**GATORBACK DRILL BITS**

These durable bits are capable of achieving excellent hole depth at exceptional speed. They are an excellent option if you are drilling seismic holes. You can maximize your rate of penetration and hole depth by reducing the rotational speed and the weight on bit by approximately 50% of what you would use on a tri cone bit. Gator back drill bits work well in very soft - medium formations. No lubrication is required as the gator back has no bearings. Since there are no moving parts it is less likely junk will be left in the hole.

**CHEVRON DRILL BITS**

These are also known as fishtail type bits are a very aggressive, fast digging bit excellent for soft - medium soft formations. Reduce the drilling speed to slow and reduce the weight on the bit to less than half of what you would use when drilling with a tricone drill bit.

**STEP BITS**

A Step Bit Drill Bit is an aggressive bit with 3 or more steps. The center step acts like a pilot bit and helps the drill bit to drill straighter holes. These drill bits are made to drill fast and straight in soft to medium soft formations. These drill bits have no moving parts and exceptional hole cleaning.

**OUR DRAG BITS RANGE IN SIZE FROM 3-5/8"(92MM) TO 12 1/4"(311.2MM) WITH A 7 5/8" API REG PIN**
GATORBACK BITS

AVAILABLE SIZES: 3 1/2” – 12 1/4”

<table>
<thead>
<tr>
<th>BIT SIZE</th>
<th>THREAD SIZE</th>
<th>WEIGHT (LBS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 1/2” - 3 5/8”</td>
<td>2 3/8” API</td>
<td>8.5</td>
</tr>
<tr>
<td>4”</td>
<td>2 3/8” API</td>
<td>9</td>
</tr>
<tr>
<td>4 1/8” - 4 1/4”</td>
<td>2 3/8” API</td>
<td>10</td>
</tr>
<tr>
<td>4 1/2” - 4 5/8”</td>
<td>2 3/8” API</td>
<td>11</td>
</tr>
<tr>
<td>5” - 5 1/8”</td>
<td>2 7/8” API</td>
<td>17</td>
</tr>
<tr>
<td>5 1/4” - 5 1/2”</td>
<td>2 7/8” API</td>
<td>18</td>
</tr>
<tr>
<td>5 3/4”</td>
<td>3 1/2” API</td>
<td>22</td>
</tr>
<tr>
<td>5 7/8” - 6” - 6 1/4”</td>
<td>3 1/2” API</td>
<td>26</td>
</tr>
<tr>
<td>6 1/2”</td>
<td>3 1/2” API</td>
<td>28</td>
</tr>
<tr>
<td>7 7/8” - 8”</td>
<td>4 1/2” API</td>
<td>44</td>
</tr>
<tr>
<td>8 1/2” - 8 5/8” - 8 3/4”</td>
<td>4 1/2” API</td>
<td>55</td>
</tr>
<tr>
<td>9 1/2” - 9 5/8” - 9 7/8”</td>
<td>6 5/8” API</td>
<td>85</td>
</tr>
<tr>
<td>10 5/8” - 11”</td>
<td>6 5/8” API</td>
<td>87</td>
</tr>
<tr>
<td>12 1/4”</td>
<td>6 5/8” API</td>
<td>135</td>
</tr>
<tr>
<td>12 1/4”</td>
<td>7 7/8” API</td>
<td>182</td>
</tr>
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</table>

FORMATION: USED IN

<table>
<thead>
<tr>
<th>SOFT</th>
<th>Clays, Coal, Salts, Shales, Soft Limestone, Discontinuous Sands etc...</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEDIUM</td>
<td>Sedimentary Rocks, Limestone, Sandstone, Slate etc...</td>
</tr>
</tbody>
</table>

BENEFITS:
* Long Life
* Low Cost
* No lubrication required
* High Rate of penetration
* Drill Full-Guage, Straight Hole
* Soft-medium and soft only formations
* Longer lifespan than conventional chevron or step bits

WEIGHT ON BIT:
1000–1665 lbs / diameter

RPM:
70 - 20 reduce weight as RPM increases

Environmental Drilling, Waterwells Drilling, Blast Hole Drilling, Mining, and Geothermal Drilling.
Seismic drilling is a form of exploration drilling which allows sound waves to penetrate the earth's geology. This provides readings to seismologists in the form of images & data containing information about the surrounding geology.

Out-Rigger Seismic Bit
Available Sizes: 3 5/8" – 3 3/4"
Can be built to special order or oversized.

Chevron Seismic Bits
Available Sizes: 3 5/8" – 6"

Gatorback Seismic Bits
Available Sizes: 3 5/8" – 3 3/4"

One Step (Ripper) Seismic Bits
Available Sizes: 3 5/8" – 3 3/4" – 4"

Two-Way Seismic Bits
Available Sizes: 3 5/8" – 3 3/4"

Western Drilling Tools has the seismic bit to suit any application.

Our Seismic Bits
* Very cost effective
* Allow for a very high rate of penetration & hole depth while drilling.
* Made from premium quality materials
* Available for all varieties of seismic drilling & associated formations
Claw Bits

Claw bit drill bits are an excellent choice for soft to medium formations. Claw bits devour gravel, and drill well through, clays; shale’s and sand stones. There are many different styles of claw bits available.

At Western Drilling Tools we can recommend the appropriate claw bit for your drilling needs.

A nice advantage of using a claw bit is that the teeth and pilot bits are easy to replace and repair both in the field and the shop.

Our claw bits range in size from 4-3/4 (120.6mm) Claw bit with a 2-3/8 API REG Pin to a 9-7/8 (250.8mm) Claw bit with a 6-5/8 API REG Pin.

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# Core Bits

## Specifications

<table>
<thead>
<tr>
<th>Outside Gauge</th>
<th>152.4 mm</th>
<th>158.8 mm</th>
<th>146.1 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 1/4 in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 3/4 in</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core Diameter</td>
<td>2 3/4 in</td>
<td>69.9 mm</td>
<td></td>
</tr>
<tr>
<td>Cutter Size</td>
<td>0.5&quot;/16 (in pcs.)</td>
<td>13/16 (mm/pcs)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.39&quot;)/2 (in/pcs.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total PDC Cutters</td>
<td>18 pcs</td>
<td>18 pcs</td>
<td></td>
</tr>
<tr>
<td>Non Changeable</td>
<td>6/0.39&quot; (pcs/in)</td>
<td>6/10 (pcs/mm)</td>
<td></td>
</tr>
<tr>
<td>Nozzles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>8.5 in</td>
<td>215.9 mm</td>
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## Drilling Parameters

<table>
<thead>
<tr>
<th></th>
<th>RPM</th>
<th>Weight on Bit</th>
<th>Flow Rate</th>
<th>Rotator Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60-120</td>
<td>4000 - 12000 lbs</td>
<td>17-32 cfm</td>
<td>RSS, Motor</td>
</tr>
<tr>
<td></td>
<td>60 - 120</td>
<td>2 - 6 tones</td>
<td>8 - 16 L/sec</td>
<td>RSS, Motor</td>
</tr>
</tbody>
</table>

WDTC 6 Blade Core Bits are designed to be the primer drilling bit with the greatest amount of core recovery in soft interbedded with medium formations of 2-5 category of hardness.

These Bits are distinguished by an increased core recovery rate as they cut through the formation smoothly & focus a consolidated core sample through the centre of the barrel.

WDTC Core Bits are equipped with stabilizing inserts and cutters of increased abrasive and wear resistance. These core heads are designed to track symmetrically and produce straight non-deviating holes & cores.

### Core Bits Come in Matrix or Steel Body

Our PDC Core Bits are the most cost effective way to drill or a core sample. Our bits have 9 or 12 PDC cutters standard. The Bit can be constructed from matrix body or steel body. The Matrix Body bit will last longer initially but can crack after substantial use. The steel body bit is can be repaired and re-tipped at a considerable cost savings compared to purchasing a new bit.

### Expect the Highest Core Recovery Rate with Our Coring Tools

Western Drilling Tools is capable of manufacturing nearly any coring system or core drilling tool you may require.

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