references:


• *2010 Drill Bit Classifier*. World Oil September 2010.

• *Casing References Tables 2012*. World Oil January 2012.
## Major Rotary Operations

<table>
<thead>
<tr>
<th>Operation</th>
<th>Result</th>
<th>Operational Steps</th>
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<td>Making Hole/Cutting Core</td>
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<td></td>
<td>• Rotating the Bit</td>
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<tr>
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<td></td>
<td>• Circulating Fluid</td>
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<td>Adding Drillpipe</td>
<td>Lengthening the Drillstring</td>
<td>Screwing a new joint of drillpipe to the drillstring</td>
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<tr>
<td></td>
<td></td>
<td>Circulation stopped</td>
</tr>
<tr>
<td>Roundtrip</td>
<td>Changing the Bit</td>
<td>Pulling-Out/Running-In the complete Drillstring</td>
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<tr>
<td></td>
<td></td>
<td>Circulation stopped</td>
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<tr>
<td>Casing</td>
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<td>Running in Casing-Pipe Joint by Joint</td>
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<td>Cementing</td>
<td>Sheath of Cement in Annulus</td>
<td>Pumping cement slurry in annulus</td>
</tr>
</tbody>
</table>
Major Rotary Operations - Drilling

TOTAL weight of the drill string on the hook

Suspended weight = TOTAL - WOB

"Off bottom"

"On bottom"

WOB, weight on bit
Major Rotary Operations - Drilling
Controlling WOB with a Heave Compensation System
Drillers Console
Major Rotary Operations – Adding Drillpipe

A Lowering single in mousehole
B Bringing in single from rack

A Swinging the swivel and kelly over single for mousehole connection
B Stabbing the added single into top joint of drillpipe
C Single added and ready to make new hole
Major Rotary Operations – Adding Drillpipe

A  Rat Hole
B  Mousehole
C  Pipe Wiper

D  Steel Beam
F  Finger
Suspending the Drill String in the Rotary Table by Slip
Rig Components used for Manual Pipe Handling

- Slip type casing elevator
- Links
- Pipe elevator
- Spinning wrench
- Collar rotary slips
- Drillpipe rotary slips
- Rotary tongs
- Rotary table
- Tong
- Slip type casing spider
Roundtrip Operating

- manually
- with pipe handling system
Casing is a string of single steel pipes with length of 8 – 16 m connected by threaded couplings.

Casing is specified by:
- outer diameter of casing pipe
- weight per foot (wall thickness)
- grade of steel
- type of coupling
Reasons for Casing the Hole

Casing is a string of single steel pipes with a length of 8 – 16 m connected by threaded couplings. Casing is specified by:

- outer diameter of casing pipe
- weight per foot (wall thickness)
- grade of steel
- type of coupling
A good drilling and casing program is a decisive factor for technical and economical success of a drilling project.

Planning starts with the minimum borehole or casing diameter required at target depth.

Number of intermediate casing and depths of casing shoes are determined in dependency of the preliminary geological profile moving up progressively to surface.

Bit Diameters and Casing Diameters are standartized. They have to be selected according to given sizes.

Each casing set reduces the diameter that can be drilled through later on.
A good drilling and casing program is a **decisive factor** for technical and economical success of a drilling project.

**Planning Rules for Drilling and Casing Program**

1. **Conductor pipe**
2. **Surface casing**
3. **Intermediate casing**
4. **Production casing**
5. **Perforated interval**

Bit diameters and casing diameters are standardized. They must be selected according to given sizes.

Each casing set reduces the diameter that can be drilled through later on.
Pressure-Depth Diagram for Determination of Casing Shoe Depth

- Wellhead pressure, well full of gas
- Pressure gradient due to gas
- Formation fracture gradient
- Shoe needed at this depth
- Drilling mud gradient
- Gas kick at this depth
Benefits of Slim Hole Drilling:

- hole diameters reduced by 50%
- requires smaller rigs
- site reduced by 75%
- overall costs reduced by 40 – 50%
Slim Hole Drilling with Coiled Tubing Technology
Instead of cutting the total cross-sectional area only an annular ring or kerf of rock is cut leaving a solid cylinder of uncut formation passing into the core barrel above the bit.

Key Components:
- Core Bit
- Core Barrel
- Retrieving Equipment
Reasons for Core Drilling

Coring is the only way to supply intact specimens of the formation anatomy. In hard rocks, core drilling can be an efficient way to make holes at good penetration rates and low costs.

Performance Parameters of Coring Operation:

Core Quality

| Core Quality | 22 |

...
Types of Thick Kerfed Rotary Core Bits

- Surface Set Diamond Bit
- PDC-Diamond Bit
- 4- and 6-Roller Cone Bit

Used in KTB-VB
Types of Diamond Drilling Core Bits

- Diamond Wireline Core Bits used in KTB-VB
- No Wireline
- Surface Set Diamond Bit
- Impregnated Diamond Bit
- Thin Kerfed Impregnated Diamond Core Bit
Performance of Core Bits in Crystalline Rock

6" Impregnated Diamond Core Bit

10 5/8" Roller Cone Core Bit

Average Core Recovery: 97.8%

Average Core Recovery: 42.9%
Large Diameter Diamond Coring in KTB Ultradeep Hole
12 ¼” Hole Section
(6013 – 8328 m)

Large Diameter Core 9 ¼” (234.7 mm)

Core from KTB Pilot Hole
Diamond Bits Recommended for Various Rock Types

**Diamond Bits**

- **Sedimentary Rocks**
  - Coal
  - Laps
  - Marls
  - Shales
  - Limestone, Dolomites
  - Sandstones
  - Quartzites
  - Banded Ironstone, Shale

- **Metamorphic Rocks**
  - Marble
  - Slate
  - Quartzite
  - Gneiss
  - Slate, Schist
  - Basalts, Diorites, Granites

- **Igneous Rocks**
  - Dolerites

**Uniaxial Compressive Strength (UCS)**

**Legend**

- **PCD**
- **SURFACE SET**
- **MPREG**

**Note:** UCS = Uniaxial Compressive Strength
### Recommended Diamond Stone Sizes for Various Rock Types

<table>
<thead>
<tr>
<th>ROCK</th>
<th>4-8 SPC</th>
<th>20-30 SPC</th>
<th>60-80 SPC</th>
<th>80-110 SPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOFT SANDSTONE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SHALE</td>
<td></td>
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<tr>
<td>PLASTIC SHALE</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>SOFT SCHIST</td>
<td></td>
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</tr>
<tr>
<td>HARD SCHIST</td>
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<tr>
<td>DOLOMITE</td>
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</tr>
<tr>
<td>MARBLE</td>
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<tr>
<td>ANDESITE</td>
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<tr>
<td>GRANITE</td>
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</tr>
<tr>
<td>BASALT</td>
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<td></td>
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</tr>
<tr>
<td>GABBRO</td>
<td></td>
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<tr>
<td>CONGLOMERATE</td>
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</tr>
<tr>
<td>QUARTZITE</td>
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<tr>
<td>Chert</td>
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</tr>
</tbody>
</table>

**SPC = Stone per Carat (0.2 g)**

- **Set Pattern for Diamond Stones**
  - 3-5
  - 6-9
  - 15-25
  - 25-30
  - 50-75
  - 80-110
Types of Core Barrels

- Core Barrel
  - Single Tube
  - Double Tube
  - Rotating
  - Stationary

Main Components:
- outer core barrel
- inner core barrel
- core lifter/catcher
- thrust bearing
- ball valve

- Oilfield
- Diamond Drilling
- WL - Retrievable
- Rubber Sleeve
- Oriented
core is lifted after inner core barrel is filled by lifting the outer barrel which subsequently is transferred to the inner barrel (force for catching the core is supported by the outer barrel) wedging the core in the core lifter
Mechanism of Core Jamming

Consequences of Core Jamming:
- premature tripout of core barrel (additional roundtrip time)
- damage of core if not recognized
Mechanism of Core Jamming Indicator

- **Spring loaded flow path open**
  - Valve
  - Spring
  - Bearing
  - Inner Core Barrel
  - Drilling Fluid
  - Normal coring operation

- **Spring loaded flow path reduced**
  - Inner barrel is pushed up
  - Core jammed in inner barrel
Reasons for Wireline Coring

**Formation: Argillite**

- Time Savings dependent on
  - Bit Life of Wireline Core Bit
  - Core Run Length
  - Depth

**Graph: Time for Drilling and Retrieving Core (min/m)**

- NXL Double Core Barrel
- NX Wireline Core Barrel

**Time Savings**

- Depth (m)

- Time for Drilling and Retrieving Core (min/m)
Schematic of Wireline Core Barrels

- Latching Mechanism
- Overshot
- Bearing
- Outer Barrel
- Reaming Shell
- Inner Barrel
THE END!!!

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