Introduction :

This chapter lists the main components of a petroleum onshore drilling rig.

Offshore drilling rigs have similar elements, but are configured with a number of different drilling systems to suit drilling in the marine environment.

The equipment associated with a rig is to some extent dependent on the type of rig but typically includes at least some of the items listed below.

I- Components of oil drilling rigs

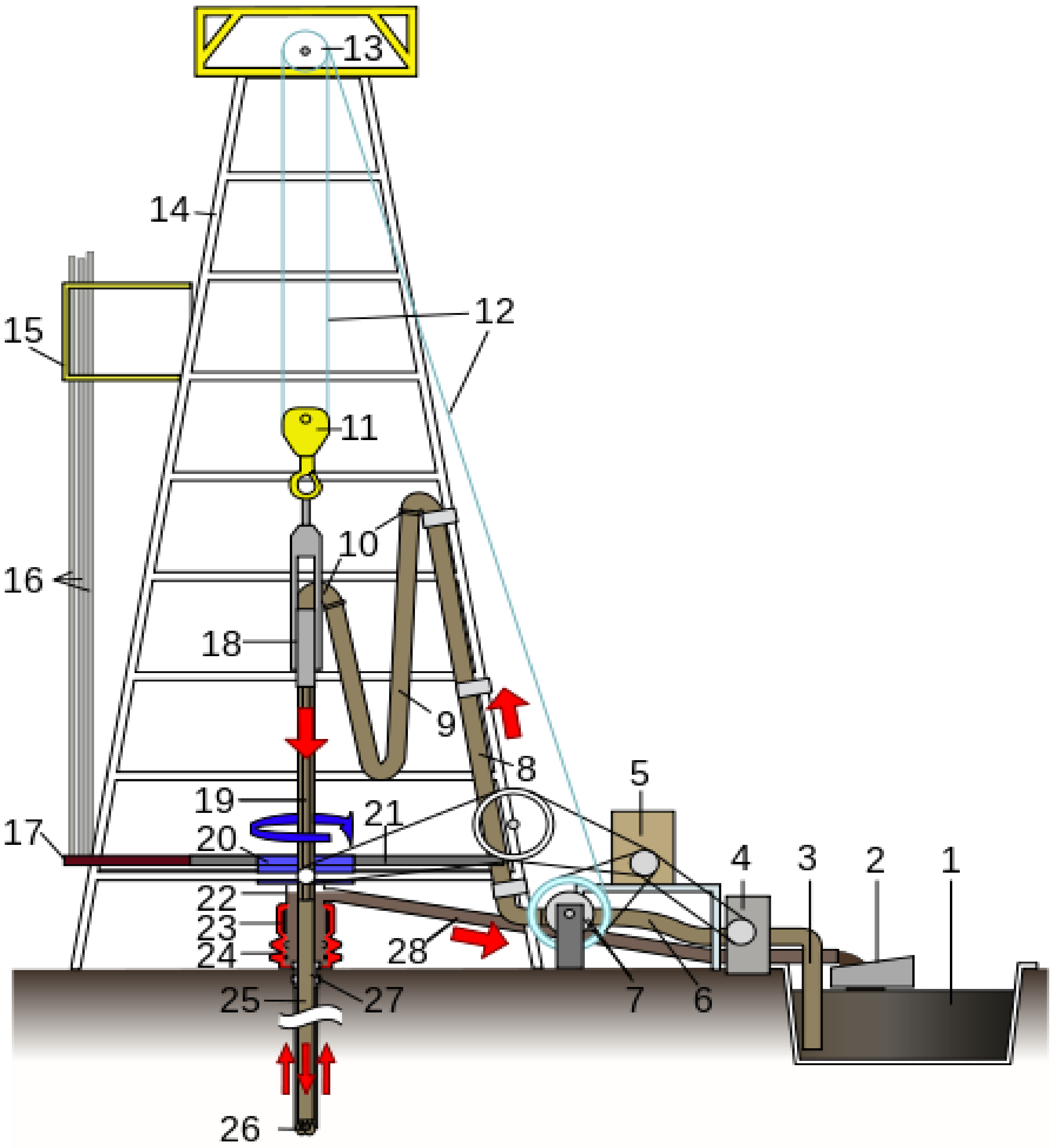
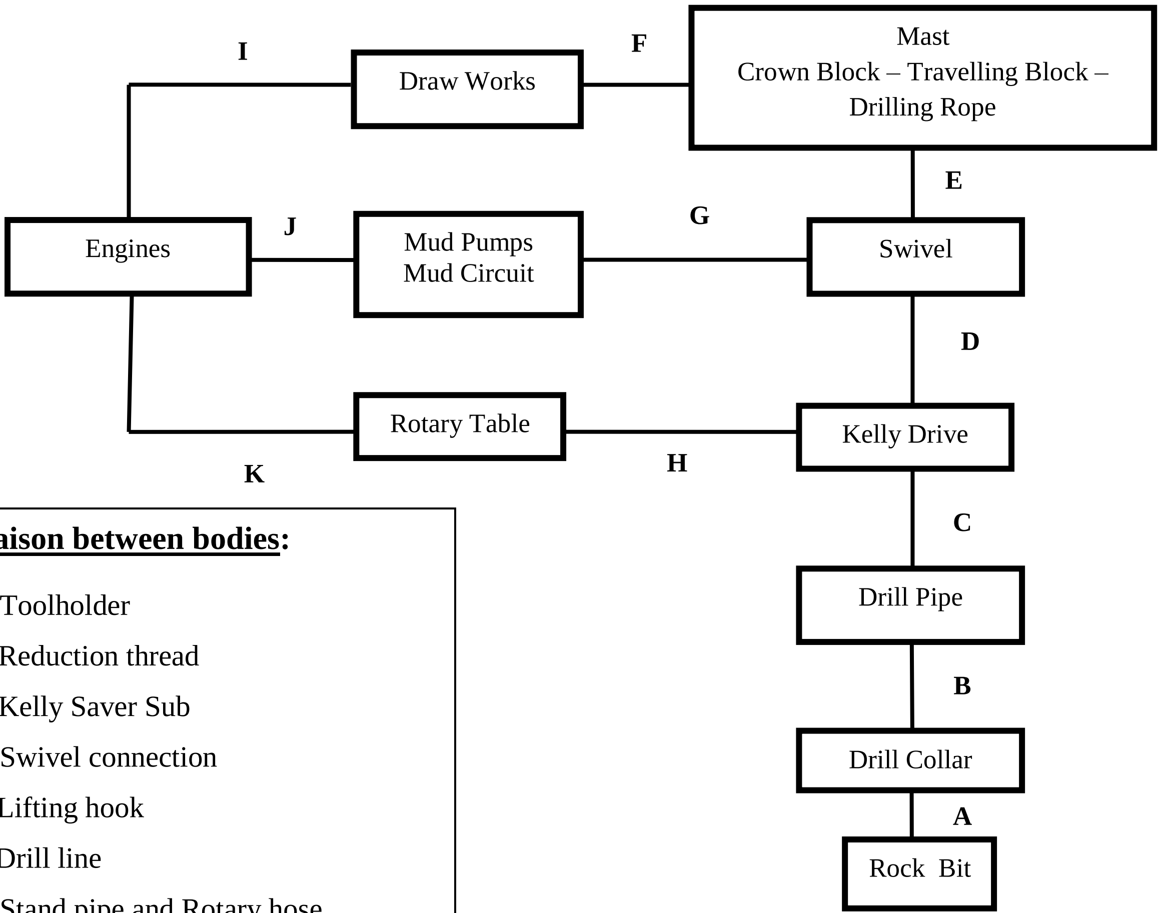


Figure 25 :explaining graph of drilling rigs

1. Mud tank
2. Shale shakers
3. Suction line (mud pump)
4. Mud pump
5. Motor or power source
6. Vibrating hose
7. Draw-works
8. Standpipe
9. Kelly hose
10. Goose-neck
11. Traveling block
12. Drill line
13. Crown block
14. Derrick
15. Monkey board
16. Stand (of drill pipe)
17. Pipe rack (floor)
18. Swivel (On newer rigs this may be replaced by a top drive)
19. Kelly drive
20. Rotary table
21. Drill floor
22. Bell nipple
23. Blowout preventer (BOP) Annular type
24. Blowout preventer (BOP) Pipe ram & blind ram
25. Drill string
26. Drill bit
27. Casing head or Wellhead
28. Flow line

Summary Description of Device Rotary Drilling



Liaison between bodies:

A/ Toolholder

B/ Reduction thread

C/ Kelly Saver Sub

D/ Swivel connection

E/ Lifting hook

F/ Drill line

G/ Stand pipe and Rotary hose

H/ Kelly bushings

I/ Transmission

J/ Transmission

K/ Transmission

Figure 26:graphe present the relation between the drilling rig equipment

1- Derrick

Figure 27:derrick

A **derrick** is a lifting device composed at minimum of one guyed mast, as in a gin pole, which may be articulated over a load by adjusting its guys. Most derricks have at least two components, either a guyed mast or self-supporting tower, and a boom hinged at its base to provide articulation, as in a *stiffleg* derrick.

The most basic type of derrick is controlled by three or four lines connected to the top of the mast, which allow it both to move laterally and cant up and down. To lift a load, a separate line runs up and over the mast with a hook on its free end, as with a crane.

Forms of derricks are commonly found aboard ships and at docking facilities. Some large derricks are mounted on dedicated vessels, and known as floating derricks and sheerlegs.

The term derrick is also applied to the framework supporting a drilling apparatus in an oil rig.

The derrick derives its name from a type of gallows named after Thomas Derrick, an Elizabethan era English executioner.

Oil derrick

It is a kind of derrick is used around oil wells and other drilled holes. This is generally called an oil derrick and is a complex set of machines specifically designed for optimum efficiency, safety and low cost. This is used on some offshore oil and gas rigs.

2- Drill floor

The Drill Floor is the heart of any drilling rig. This is the area where the drill string begins its trip into the earth. It is traditionally where joints of pipe are assembled, as well as the BHA (bottom hole assembly), drilling bit, and various other tools. This is the primary work location for roughnecks and the driller. The drill floor is located directly under the derrick.

The floor is a relatively small work area in which the rig crew conducts operations, usually adding or removing drill pipe to or from the drill string. The rig floor is the most dangerous location on the rig because heavy iron is moved around there. Drill string connections are made or broken on the drill floor, and the driller's console for controlling the major components of the rig are located there. Attached to the rig floor is a small metal room, the doghouse, where the rig crew can meet, take breaks and take refuge from the elements during idle times.

Figure 28:drill floor

3- Crown block

crown block is the stationary section of a block and tackle that contains a set of pulleys or sheaves through which the drill line (wire rope) is threaded or reeved and is opposite and above the traveling block.

The combination of the traveling block, crown block and wire rope drill line gives the ability to lift weights in the hundreds of thousands of pounds. On larger drilling rigs, when raising and lowering the derrick, line tensions over a million pounds are not unusual.

Figure 29: crown block

3-1 maintenance :

-Lubrication of the sheaves

-Control the wear of sheaves

4- Traveling block

A traveling block is the freely moving section of a block and tackle that contains a set of pulleys or sheaves through which the drill line (wire rope) is threaded or reeved and is opposite (and under) the crown block (the stationary section).

The combination of the traveling block, crown block and wire rope drill line gives the ability to lift weights in the *hundreds of thousands* of pounds. On larger drilling rigs, when raising and lowering the derrick, line tensions over a million pounds are not unusual.

Figure 30:traveling block

4-1 maintenance

-Lubrication of the sheaves

-Control the wear of sheaves

5- Drill line

In a drilling rig, the drill line is a multi-thread, twisted *wire* rope that is threaded or reeved through the traveling block and crown blockto facilitate the lowering and lifting of the drill string into and out of the wellbore.

On larger diameter lines, traveling block loads of over a *million* pounds are possible.

To make a connection is to add another segment of drill pipe onto the top the drill string. A segment is added by pulling the kelly above the rotary table, stopping the mud pump, hanging off the drill string in the rotary table, unscrewing the kelly from the drill pipe below, swinging the kelly over to permit connecting it to the top of the new segment (which had been placed in the mouse hole), and then screwing this assembly into the top of the existing drill string. Mud circulation is resumed, and the drill string is lowered into the hole until the bit takes weight at the bottom of the hole. Drilling then resumes.

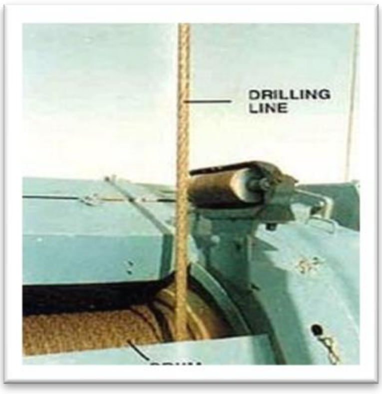


Figure 31 : drill line

5-1 maintenance :

- Cabling :it ‘s an operation to move the places in direct contact, by unroll the cable

-Cut : after several operation of cabling

-lubrication with grease and oil.

6- Swivel

A Swivel is a mechanical device used on a drilling rig that hangs directly under the traveling block and directly above the kelly drive, that provides the ability for the kelly (and subsequently the drill string) to rotate while allowing the traveling block to remain in a stationary rotational position (yet allow vertical movement up and down the derrick) while simultaneously allowing the introduction of drilling fluid into the drill string.

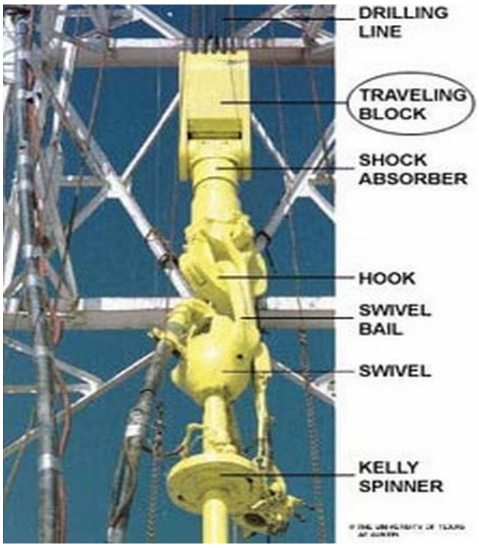


Figure 32 :swivel

6-1 maintenance :

-greasing

- control the oil lively and make oil change

-control the garnityr and wash-pipe wear.

7- Draw-works

A **draw-works** is the primary hoisting machinery that is a component of a rotary drilling rig. Its main function is to provide a means of raising and lowering the traveling blocks. The wire-rope drilling line winds on the draw-works drum and extends to the crown block and traveling blocks, allowing the drill string to be moved up and down as the drum turns. The segment of drilling line from the draw-works to the crown block is called the "fast line". The drilling line then enters the sheaves of the crown block and is makes several passes between the crown block and traveling block pulleys for mechanical advantage. The line then exits the last sheave on the crown block and is fastened to a derrick leg on the other side of the rig floor. This section of drilling line is called the "dead line".

A modern draw-works consists of five main parts: the drum, the motor(s), the reduction gear, the brake, and the auxiliary brake. The motors can be AC or DC-motors, or the draw-works may be connected directly to diesel engines using metal chain-like belts. The number of gears could be one, two or three speed combinations. The main brake, usually operated manually by a long handle, may be friction band brake, a disc brake or a modified clutch. It serves as a parking brake when no motion is desired. The auxiliary brake is connected to the drum, and absorbs the energy released as heavy loads are lowered. This brake may use eddy current rotors or water-turbine-like apparatus to convert to heat the kinetic energy of a downward-moving load being stopped.

Power catheads (winches) located on each side provide the means of actuating the tongs used to couple and uncouple threaded pipe members. Outboard catheads can be used manually with ropes for various small hoisting jobs around the rig.

The drawworks often has a pulley drive arrangement on the front side to provide turning power to the rotary table, although on many rigs the rotary table is independently powered.

Drawworks can be used to hoist or lower several hundred thousand pounds of weight and can come in AC, DC or mechanical power units. Horsepower ratings for drawworks can also have a wide range, often ranging from 1000 HP to over 3000 HP.

Figure 33:draw work

7-1Maintenance :

The maintenance of draw work usually it make on Rim drum, and the operation are :

-cooling from the beginning the maneuver

- control the brake strap

8- Rotary table

A **rotary table** is a mechanical device on a drilling rig that provides clockwise rotational force to the drill string to facilitate the process of drilling a borehole. Rotary speed is the number of times the rotary table makes one full revolution in one minute (rpm).

Figure 34: rotary table

8-1 Components

Most rotary tables are chain driven. These chains resemble very large bicycle chains. The chains require constant oiling to prevent burning and seizing. Virtually all rotary tables are equipped with a rotary lock'. Engaging the lock can either prevent the rotary from turning in one particular direction, or from turning at all. This is commonly used by crews in lieu of using a second pair of tongs to makeup or break out pipe. The rotary bushings are located at the center of the rotary table. These can generally be removed in two separate pieces to facilitate large items, i.e. drill bits, to pass through the rotary table. The large gap in the center of the rotary bushings is referred to as the "bowl" due to its appearance. The bowl is where the slips are set to hold up the drill string during connections and pipe trips as well as the point the drill string passes through the floor into the wellbore. The rotary bushings connect to the kelly bushings to actually induce the spin required for drilling.

8-2 maintenance and preventive

ROTARY TABLE DRIVE DIRECT OR REVERSE CIRCULATION; MECHANICAL OPERATION Consult Rig Service Manual for porper lubrication points and specific lubricants. Be sure proper lube tools as specified in Check each operation as performed or contracted					
A-CHECK	**B-CHECK**	**C-CHECK**	**D-CHECK**	**SEASONAL**	**OTHER**
- Daily checklist - Engine (G) oil change - Filter change - Air system - Drain air tank - Drain air filter - Inspect for	**Repeat "A"** 9 Engine oil change (D) 9 Change fuel filter 9 Air filter-engine-compressor 9 Fuel filter 9 Lubricate	**Repeat "A" & "B"** 9 Oil change • Drawworks • Transfer quad • Rotary table • Right angle gear box • Compound case (also	**Repeat "A", "B" & "C"** 9 Hydraulic oil & filter* 9 Mud pump - oil change 9 Rotary chain case change	**Fall** 9 Engine coolant change 9 Fill air system anti-freeze with methylalcohol in cold weather	9 Before raising or lowering mast, bleed all air from hydraulic raising cylinders. See operating instructions. 9 Lube mast

maladjustment, excessive wear • Mechanical controls and linkage • Locking devices • Brake pads **Lubricate** 9 Mast pivot pins 9 Clutch cone assemblies • Mud pump • Rotary • Pull down • Master clutch • Compressor • Sand reel 9 Air system lubricator 9 Driver chains 9 Pull down idlers	• Drawworks brake linkage • Catheads, if required • Rotary clutch linkage • Mast cylinder pins • Parkersburg brake • Mud pump jackshaft • Jackshaft bearing 9 Mud pump sheave bearing 9 Drawworks drum bearings, lube 9 Inspect wire rope and lube to prevent rush when accessing drum bearings 9 Oil change • Mud pump rod oiler • Rotary trans • Circulating pump- Parkersburg 9 Check tire and wheels	filter) • Pull down gear box • Rotary trans 9 Hydraulic filter* replace 9 Change oil filters 9 Engine- compressor air filter, change 9 Pull down chains, remove, bathe in kerosene, lube and install	oil 9 Mechanical hoist worm gear box **On these* *components check* *the O&M* *specifications for* *procedures*	9 Anti-freeze protection, Parkersburg brake 9 Change gear box lubricants where needed for cold weather operations **Spring** 9 Clean rig and inspect • Mast for damaged members, cracks 9 Appearance and paint	extension cylinder rod and cover with boot when mast is up 9 Truck mounted rig, perform maintenance as per applicable truck maintenance schedule. 9 Trailer mounted rig, perform maintenance as per applicable trailer maintenance schedule
Interval					
weekly	Monthly	6 months	12 months		
50 hours	250 hours	1250 hours	250000hours		

Table 2 : maintenance plan of rotary table

9- -Mud pump

A **mud pump** is a reciprocating piston/plunger device designed to circulate drilling fluid under high pressure (up to 7,500 psi (52,000 kPa)) down the drill string and back up the annulus.

Mud pump is a large reciprocating pump used to circulate the mud (drilling fluid) on a drilling rig. It is an important part of the oil well drilling equipment

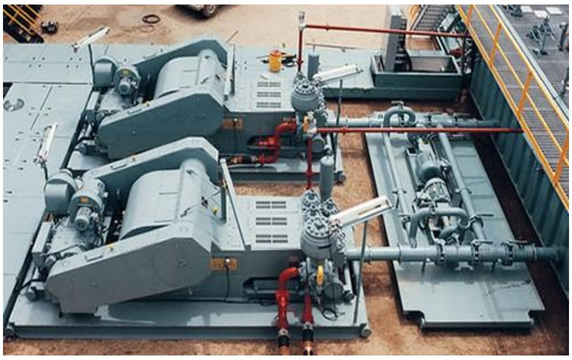


Figure 35: mud pump

9-1 Classification

a)According to the acting type

Mud Pumps can be divided into single-acting pump and double-acting pump according to the completion times of the suction and drainage acting in one cycle of the piston's reciprocating motion.

b)According to the quantity of liners (piston/plunger)

Mud Pumps come in a variety of sizes and configurations but for the typical petroleum drilling rig, the triplex (three piston/plunger) Mud Pump is the pump of choice. Duplex Mud Pumps (two piston/plungers) have generally been replaced by the triplex pump, but are still common in developing countries. Two later developments are the hex pump with six vertical pistons/plungers, and various quintuplex's with five horizontal piston/plungers. The advantages that these new pumps have over convention triplex pumps are a lower mud noise which assists with better MWD and LWD decoding.

9-2Composition

The "normal" Mud Pump consists of two main sub-assemblies, the fluid end and the power end.

a)Fluid End

The fluid end produces the pumping process with valves, pistons, and liners. Because these components are high-wear items, modern pumps are designed to allow quick replacement of these parts..

To reduce severe vibration caused by the pumping process, these pumps incorporate both a suction and discharge pulsation dampener. These are connected to the inlet and outlet of the fluid end.

b)Power End

The power end converts the rotation of the drive shaft to the reciprocating motion of the pistons. In most cases a crosshead crank gear is used for this.

***Mud Pump Parts**

A Mud Pump is composed of many parts including Mud Pump liner, Mud Pump piston, modules, hydraulic seat pullers, and other parts. Parts of Mud Pump: 1. housing itself, 2. liner with packing, 3. cover plus packing, 4. piston and piston rod, 5. suction valve and discharge valve with their seats, 6. stuffing box (only in double-acting pumps), 7. gland (only in double-acting pumps), 8. pulsation dampener.

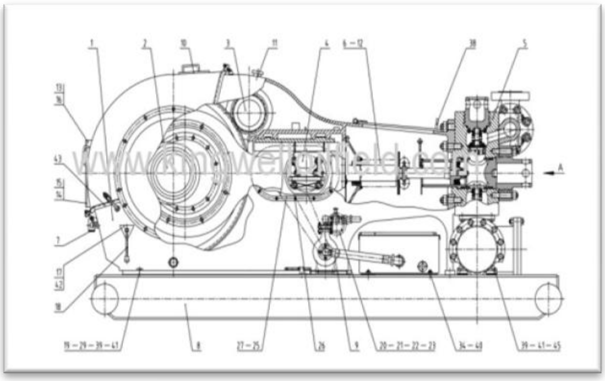


Figure 36: general drawing of drilling pump

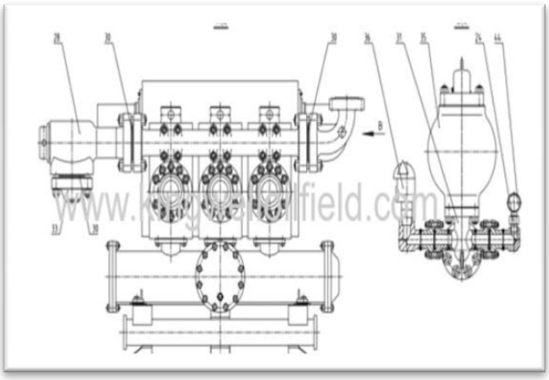


figure37:fluid end

No	Name	Qty
01	Frame assembly	1
02	Crankshaft assembly	1
03	Pinion shaft assembly	1
04	Crosshead assembly	3
05	Fluid end assembly	1
06	Screw :8(0.164)-3244NC-24X10	8
07	Power end lube assembly	1
08	Substructure	1
09	Spraying pump assembly	1
10	Seal gasket	2
11	Breather cap	1
12	Nameplate	2
13	Caver plate assembly	1
14	Bolt :1/2-UNC	14
15	Washer :14	14
16	Seal pad	1

17	Indication plate	2
18	Oil level gauge	2
19	Adjusting gasket	8
20	Clean out cover	2
21	Washer: 16	24
22	Bolt :1/2-134 NC-2AX35	8
23	Seal gasket	2
24	Screw slug	1
25	Cover crushed hole	2
26	Bolt: 5/8-114NC-2AX45	24
27	Seal pad	2
28	Braining filter assembly	1
29	Bolt :184NC-21X90	8
30	Ring gasket R44	3
31	Elbow assembly	1
32	Special tools	1
33	Flange:51/8X35	1
34	Bolt : 51/8-114NC-2AX45	4
35	KB-75 surge damper	1
36	JA-3 relive valve	1
37	Spare parts delivered with	1
38	Cover plats assembly	1
39	nut : 1-8 UNC-2B(SPL)	12
40	Nut :5/8-8UNC-2B(SPL)	4
41	Washer :27	12
42	Rivet:3X10	6
43	Rubber :30X10X4880	1
44	Pressure gauge	1
45	Bolt :1-8UNC-2AX70	4

Table 3 : mud pump component

9-3 Performance Parameters

There are two main parameters to measure the performance of a Mud Pump: Displacement and Pressure.

a) Displacement

Displacement is calculated as discharged liters per minute, it is related with the drilling hole diameter and the return speed of drilling fluid from the bottom of the hole, i.e. the larger the diameter of drilling hole, the larger the desired displacement. The return speed of drilling fluid should reach the requirement that can wash away the debris and rock powder cut by the drill from the bottom of the hole in a timely manner, and reliably carries them to the earth surface. When drilling geological core, the speed is generally in range of 0.4 to 1.0 m^3/min.

b) Pressure

The pressure size of the pump depends on the depth of the drilling hole, the resistance of flushing fluid (drilling fluid) through the channel, as well as the nature of the conveying drilling fluid. The deeper the drilling hole and the greater the pipeline resistance, the higher the pressure needed.

With the changes of drilling hole diameter and depth, it requires that the displacement of the pump can be adjusted accordingly. In the Mud Pump mechanism, the gearbox or hydraulic motor is equipped to adjust its speed and displacement. In order to accurately grasp the changes in pressure and displacement, a flow meter and pressure gauge are installed in the Mud Pump.

9-4 Characteristics

1. The structure is simple and easy for disassembly and maintenance,
2. smooth operation, small vibration and low noise,
3. it can deliver high concentration and high viscosity (less than 10000 PaS) suspended slurry,
4. the drilling fluid flow is stable, no overcurrent, pulsation and stirred, shear slurry phenomena,
5. the discharge pressure has nothing to do with the speed, low flow can also maintain a high discharge pressure,
6. displacement is proportional to the speed, by shifting mechanism or motor, one can adjust the displacement,
7. it has high self-absorption ability, and can suck liquid directly without bottom valve.

9-5 Maintenance

The maintenance department or service should have a special maintenance worker that is responsible for the maintenance and repair of the machine. Mud Pumps and other mechanical equipment should be inspected and maintained on a scheduled and timely basis to find and address problems ahead of time, in order to avoid unscheduled shutdown. The worker should attend to the size of the sediment particles; when finding large particles, the Mud Pump wearing parts should frequently be checked for repairing needs or replacement. The wearing parts for Mud Pumps include pump casing, bearings, impeller, piston, liner, etc. Advanced antiwear measures should be adopted to increase the service life of the wearing parts, which can reduce the investment cost of the project, and improve production efficiency. At the same time, wearing parts and other Mud Pump parts should be repaired rather than replaced when possible.

* preventive maintenance :

a) mechanic part :

- change and control oil ; lubrication

- control the wear of pieces

b) hydraulic part :

-change the wear garniture;

- change the valves and seat valves

10- Shale shakers

Shale shakers are components of drilling equipment used in many industries, such as coal cleaning, mining, oil and gas drilling. They are the first phase of a solids control system on a drilling rig, and are used to remove large solids (cuttings) from the drilling fluid ("Mud").

Shale shakers are the primary solids separation tool on a rig. After returning to the surface of the well the used drilling fluid flows directly to the shale shakers where it begins to be processed. Once processed by the shale shakers the drilling fluid is deposited into the mud tanks where other solid control equipment begin to remove the finer solids from it. The solids removed by the shale shaker are discharged out of the discharge port into a separate holding tank where they await further treatment or disposal.

Shale shakers are considered by most of the drilling industry to be the most important device in the solid control system as the performance of the successive equipment directly relates to the cleanliness of the treated drilling fluid.

Mud loggers usually go out and check the shakers for rock samples that have circulated from bottom. They separate the rock from the drilling fluid and take it into an onsite lab where they dry out the samples and label them according to depth. They then look at the samples and anaylze what kind of rock they have at a certain depth. This helps determines what depth that type of rock was encountered.

Figure 38: shale shaker

10-1Structure

Shale shakers consist of the following parts:

- **Hopper** - The Hopper, commonly called the "base" serves as both a platform for the shaker and collection pan for the fluid processed by the shaker screens, also known as "underflow". The hopper can be ordered according to the needs of the drilling fluid, aka "mud" system. It can come in different depths to accommodate larger quantities of drilling fluid as well as have different ports for returning the underflow to the mud system.
- **Feeder**- The Feeder is essentially a collection pan for the drilling fluid before it is processed by the shaker, it can come in many different shapes and sizes to accommodate the needs of the mud system. The most commonly used feeder is known as the weir feeder, the drilling fluid enters the feeder usually through a pipe welded to the outside wall near the bottom of the feeder tank, it fills the feeder to a predetermined point and like water flowing over a dam the mud (drilling fluid) spills over the weir and onto the screening area of the shaker. This method of feeding the shaker is most widely used due to its ability to evenly distribute the mud along the entire width of the shaker allowing for maximum use of the shaker's screening deck area.
- **Screen Basket**- Also known as the screen "bed" it is the most important part of the machine, it is responsible for transferring the shaking intensity of the machine, measured in "G's", while keeping the "shaking" motion even throughout the entire basket. It must do all that while holding the screens securely in place, eliminating drilled solids bypass to the hopper and allowing for easy operation and maintenance of the machine. Different brands of shakers have different methods of fulfilling these demands by using specialized screen tensioning apparatus, rubber seals around the screens, basket reinforcement to limit flex, rubber Float Mounts rather than springs, rubber Deck seals and selective vibrator placement.

- **Basket Angling Mechanism-** The shaker basket must be capable of changing its angle to accommodate various flow rates of drilling fluids and to maximize the use of the shaker bed, this is where the angling mechanism plays an important part. The drilling fluid flowing over the shaker bed is designated into two categories:
  - *Pool:* Which is the area of the screening deck that consists mostly of drilling fluid with drilled cuttings suspended within it?
  - *Beach:* Is the area where the fluid has been mostly removed from the cuttings and they begin to look like a pile of solids.

  As a rule of thumb the Beach and pool are maintained at a ratio of 80% pool and 20% beach, this of course can change depending on the requirements of cutting dryness and flow rates.

  There are various angling mechanisms currently in use which vary from hydraulic to pneumatic and mechanical, they can be controlled from either one side of the shaker or must be adjusted individually per side. Mechanical angling mechanisms can be very dependable often requiring less maintenance but usually take more time to operate than their hydraulic or pneumatic counterparts where as the hydraulic/pneumatic angling mechanisms are much faster to operate and require less a physical means of operation.

- **Vibrator-** This is the device which applies the vibratory force and motion type to the shaker bed. A vibrator is a specialized motor built for the purpose of vibrating, While containing an electric motor to provide the rotary motion it uses a set of eccentric weights to provide an omnidirectional force. To produce the proper Linear motion a second, counter rotating, vibrator is added in parallel to the first. This is what gives us the linear motion, "high G" shaking of the basket.

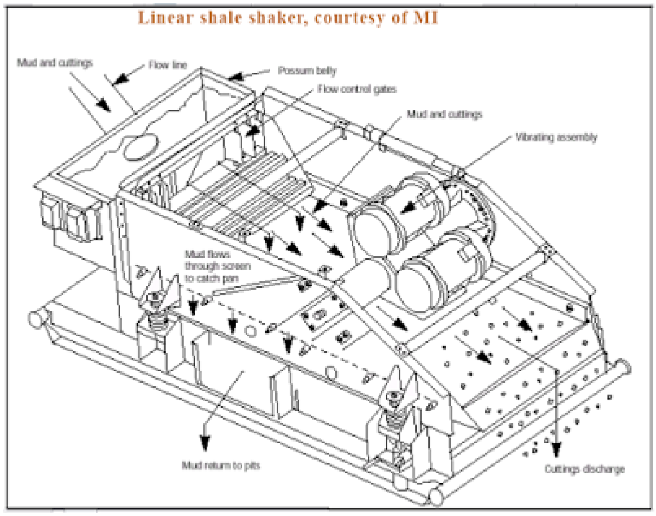


Figure 39: shale shaker stricter

10-2Causes of screen failure

The causes of premature screen failure are:

- Mishandling of screen panels during storage
- Improper handling during installation
- Improper installation of shaker screen to shaker basket
- Over/Under tensioning
- Dirty, worn or improperly installed deck rubbers
- Improper cleaning of the screens while in storage
- Extremely high mud weight
- Heavy solids loading
- Improperly manufactured screens
- Use of high pressure wash guns to clean or un-blind screens

10-3API standards

The American Petroleum Institute (API) Screen Designation is the customary identification for screen panels. This includes:

- **API Number**: the sieve equivalent as per API RP 13C
- **Conductance**: the ease with which a liquid can flow through the screen, with larger values representing higher volume handling
- **Microns**: a unit of length equal to one-thousandth of a millimeter
- **Non-blanked area**: an evaluation of the surface area
- available for liquid transmission through the screen

10-4 Shale shaker technicals parameters

Model	GNZS752E-DM	GNZS703E-HB	GNZS703E-DZ	GNZS594E-HB	GNZS594HGE-LD
Vibration Mode	Linear Motion				
Capacity	45m3/h(200GPM)	120m3/h(528GPM)		140m3/h(616GPM)	
Vibration Motor	2×0.75Kw	2×1.72Kw			2×1.94Kw
Screen Qty	2pcs	3pcs		4pcs	
Screen Size: L×W	750×900mm	700×1250mm		585×1165mm	
Screen Area	1.35m2	2.63m2		2.73m2	
Adjustable G Force	≤7.1G	≤7.5G			≤8.0G
Vibration Amplitude	3.92~5.62mm	4.14~5.96mm			4.4~6.34mm

Deck Angle Range	+2°	-1°~+5° (Adjustable)			
Feeding Type	Box Feeder	Weir Feeder	Box Feeder	Weir Feeder	Hopper Feeder
Weir Height	710mm	895mm	1042mm	895mm	
EX Standard	ExdIIBt4 / IEC EX/ ATEX				
Weight (Kg)	893	1675	1742	1722	1638
Dimension: L×W×H(mm)	1676×1689×1062	2717×1998×1428	2419×2055×1474	2937×1998×1428	2761×1998×1428
Remarks:	Low Weir Feeding Shale Shaker GNZS703E-LW weir height 500mm is available for option				

Table 4: parameters of shale shaker

10-5 The maintenance of vibrating motor

- (1)Clean dust on shell regularly
- (2)Before operating, must check the bolts to confirm whether there is loose or not. Otherwise, we must screw bolts tight before running shaker
- (3) Inspect the cable, whether there is wear, hold down, crushing, etc.
- (4) the vibration motor should be under good lubrication during operation:
- Motors before fixed on shaker, the bearing is filled with SKF specific lubricate grease, the temperature range is -40 ~ 200℃
- During running, every 2000 working hours user should makeup LGHP2 lubricate grease once. Every bearing can not be filled over 25.8g.
- To make sure bearing operated well, we must use LGHP2 grade high temperature lubrication grease. Before adding new lubrication grease we should clean the input hole.
- GN provide spare parts including vibrating motor for shale shaker, if you need any maintenance suggestion, pls contact GN solids control.

11- **Mud tank**

A mud tank is an open-top container, typically made of square steel tube and steel plate, to store drilling fluidon a drilling rig. They are also called *mud pits*, because they used to be nothing more than pits dug out of the earth.

11-1The role of mud tank for solids control

Mud tanks play an important role in solids control system. It is the base of solids control equipments, and also the carrier of drilling fluids. Solids control equipments that are all mounted on the top of mud tanks include the followings:

- shale shaker

- vacuum degasser
- desander
- desilter
- centrifuge
- mud agitator
- Vertical slurry pump

Drilling fluids flow into the shale shaker directly after it returns to the surface of the well, and the solids that are removed by the screen would be dischanged out of the tank, and the drilling fluids with smaller solids would flow through the screen into mud tank for further purification.
A centrifugal pump would sucks the shaker-treated fluids up to the desilter or mud cleaner for further purification. And vertical slurry pump is used to pump the drilling fluids up to the centrifuge, and mud pump would pump the drilling fluids from mud tank into the borehole after it is treated by centrifuge. And the circulation system would continues.

The number of the mud tanks that are needed on the drilling rig depends on the depth of the well, and also the mud demands of drilling. Nomally the shale shaker and vacuum degasser and desander are mounted together on the same mud tank as the first tank at the oilfield, while desilter and centrifuge on the second tank. Also the drilling rig has other different tank as reserve tank, emergency tank, etc.

11-2The classification of mud tank

Mud tanks is an important part in the solids control system. Based on functions, mud tank includes metering tank, circulating tank, chemical tank, aggravating tank, precipitating tank, storing tank, etc.

12- Blowout preventer BOP

Figure 40: photo of BOP

A blowout preventer is a large, specialized valve or similar mechanical device, usually installed redundantly in stacks, used to seal, control and monitor oil and gas wells. Blowout preventers were developed to cope with extreme erratic pressures and uncontrolled flow (formation kick) emanating from a well reservoir during drilling. Kicks can lead to a potentially catastrophic event known as a blowout. In addition to controlling the downhole (occurring in the drilled hole) pressure and the flow of oil and gas, blowout preventers are intended to prevent tubing (e.g. drill pipe and well casing), tools and drilling fluid from being blown out of the wellbore (also known as bore hole, the hole leading to the reservoir) when a blowout threatens. Blowout preventers are critical to the safety of crew, rig (the equipment system used to drill a wellbore) and environment, and to the monitoring and maintenance of well integrity; thus blowout preventers are intended to provide fail-safety to the systems that include them.

Two categories of blowout preventer are most prevalent: *ram* and *annular*. BOP stacks frequently utilize both types, typically with at least one annular BOP stacked above several ram BOPs.

12-1 Use

The primary functions of a blowout preventer system are to:

- Confine well fluid to the wellbore;
- Provide means to add fluid to the wellbore;
- Allow controlled volumes of fluid to be withdrawn from the wellbore.

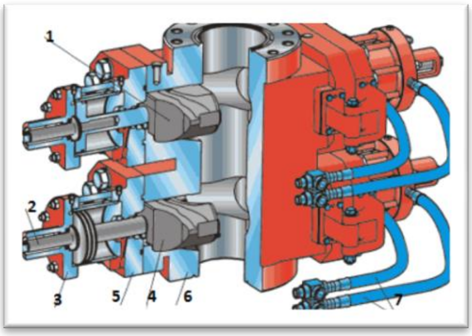
Additionally, and in performing those primary functions, blowout preventer systems are used to:

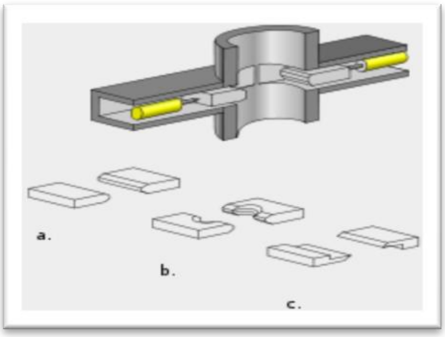
- Regulate and monitor wellbore pressure;
- Center and hang off the drill string in the wellbore;
- Shut in the well (e.g. seal the void, annulus, between drillpipe and casing);
- “Kill” the well (prevent the flow of formation fluid, influx, from the reservoir into the wellbore) ;
- Seal the wellhead (close off the wellbore);
- Sever the casing or drill pipe (in case of emergencies).

12-2 Types

BOPs come in two basic types, *ram* and *annular*. Both are often used together in drilling rig BOP stacks, typically with at least one annular BOP capping a stack of several ram BOPs.

1*Ram blowout preventer





1 - blind ram;
2 - hydraulic cylinder piston with a manual lock;
3 - hydraulic cylinder;
4 - pipe ram;
5 - lid;
6 - body;
7 - pipeline to the accumulator unit.

(a) blind ram
(b) pipe ram
(c) shear ram

Figure 41:BOP ram and different rams

The ram BOP was invented by James Smither Abercrombie and Harry S. Cameron in 1922, and was brought to market in 1924 by Cameron Iron Works.

A ram-type BOP is similar in operation to a gate valve, but uses a pair of opposing steel plungers, rams. The rams extend toward the center of the wellbore to restrict flow or retract open in order to permit flow. The inner and top faces of the rams are fitted with packers (elastomeric seals) that press against each other, against the wellbore, and around tubing running through the wellbore. Outlets at the sides of the BOP housing (body) are used for connection to choke and kill lines or valves.

Rams, or ram blocks, are of four common types: *pipe*, *blind*, *shear*, and *blind shear*.

a)- Blind rams (also known as sealing rams), which have no openings for tubing, can close off the well when the well does not contain a drill string or other tubing, and seal it.

b)-Pipe rams close around a drill pipe, restricting flow in the annulus (ring-shaped space between concentric objects) between the outside of the drill pipe and the wellbore, but do not obstruct flow within the drill pipe. Variable-bore pipe rams can accommodate tubing in a wider range of outside diameters than standard pipe rams, but typically with some loss of pressure capacity and longevity.

c)-Shear rams cut through the drill string or casing with hardened steel shears.

Technological development of ram BOPs has been directed towards deeper and higher pressure wells, greater reliability, reduced maintenance, facilitated replacement of components, facilitated ROV intervention, reduced hydraulic fluid consumption, and improved connectors, packers, seals, locks and rams. In addition, limiting BOP weight and footprint are significant concerns to account for the limitations of existing rigs.

The highest-capacity large-bore ram blowout preventer on the market, as of July 2010, Cameron's EVO 20K BOP, has a hold-pressure rating of 20,000 psi, ram force in excess of 1,000,000 pounds, and a well bore diameter of 18.75 inches.

2* Annular blowout preventer

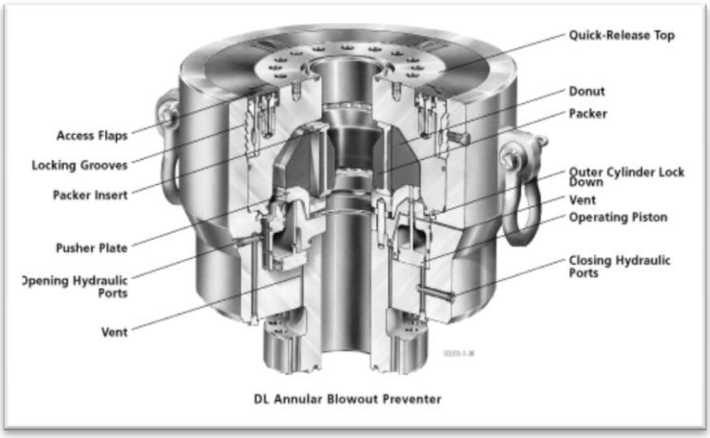


Figure 42:annular BOP *Figure 43: components of annular BOP*

The annular blowout preventer was invented by Granville Sloan Knox in 1946; a U.S. patent for it was awarded in 1952. Often around the rig it is called the "Hydril", after the name of one of the manufacturers of such devices.

An annular-type blowout preventer can close around the drill string, casing or a non-cylindrical object, such as the kelly. Drill pipe including the larger-diameter tool joints (threaded connectors) can be "stripped" (i.e., moved vertically while pressure is contained below) through an annular preventer by careful control of the hydraulic closing pressure. Annular blowout preventers are also effective at maintaining a seal around the drillpipe even as it rotates during drilling. Regulations typically require that an annular preventer be able to completely close a wellbore, but annular preventers are generally not as effective as ram preventers in maintaining a seal on an open hole. Annular BOPs are typically located at the top of a BOP stack, with one or two annular preventers positioned above a series of several ram preventers.

12-3 Control method

When rigs are drilled on land or in very shallow water where the wellhead is above the water line, BOPs are activated by hydraulic pressure from a remote accumulator. Several control stations will be mounted around the rig. They also can be closed manually by turning large wheel-like handles.

In deeper offshore operations with the wellhead just above the mudline on the sea floor, there are four primary ways by which a BOP can be controlled. The possible means are :

- Electrical Control Signal: sent from the surface through a control cable;
- Acoustical Control Signal: sent from the surface based on a modulated/encoded pulse of sound transmitted by an under water transducer;
- ROV Intervention: remotely operated vehicles (ROVs) mechanically control valves and provide hydraulic pressure to the stack (via “hot stab” panels);
- Deadman Switch / Auto Shear: fail-safe activation of selected BOPs during an emergency, and if the control, power and hydraulic lines have been severed.

Two control pods are provided on the BOP for redundancy. Electrical signal control of the pods is primary. Acoustical, ROV intervention and dead-man controls are secondary.

An emergency disconnect system, or EDS, disconnects the rig from the well in case of an emergency. The EDS is also intended to automatically trigger the deadman switch, which closes the BOP, kill and choke valves. The EDS may be a subsystem of the BOP stack’s control pods or separate.

Pumps on the rig normally deliver pressure to the blowout preventer stack through hydraulic lines. Hydraulic accumulators are on the BOP stack enable closure of blowout preventers even if the BOP stack is disconnected from the rig. It is also possible to trigger the closing of BOPs automatically based on too high pressure or excessive flow.

Individual wells along the U.S. coastline may also be required to have BOPs with backup acoustic control. General requirements of other nations, including Brazil, were drawn to require this method. BOPs featuring this method may cost as much as US$500,000 more than those that omit the feature.

Conclusion

Drilling has developed into a specialized and technologically advanced business. The size of the equipment is enormous. The technical challenges to overcome as wells become deeper and are drilled in increasingly hostile environments are equally enormous. The technology of the most advanced drilling rig is computer-controlled and can be monitored from any office in the world. The guidance systems used in directional drilling rival those found on modern jet aircraft or spacecraft.