Oil and Gas Well Drilling and Servicing eTool

Drilling

Worker safety awareness is necessary for injury prevention during all phases of drilling operations. Procedures and processes will include safety meetings, JSAs, and general and task-specific training. At the end of each card, resources are identified which provide more details for establishing safe work practices and procedures.

Drilling Rig

- Rigging Up
  - Setting up the Substructure
  - Setting up Rig Floor and Mast or Derrick
  - Installing Handrails, Guardrails, Stairs, Walkways, and Ladders
  - Installing the Power Systems
  - Rigging up the Circulating System
  - Installing the Auxiliary Equipment
  - Inspecting the Rig
  - Rigging Down
- Drilling Ahead
  - Handling Tubulars
  - Preparing Drilling Fluid
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    - Preparing to Break Out Pipe
    - Breaking Out Pipe
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- Well Control
  - Monitoring and Maintaining Mud System
  - Installing BOP's, Accumulator, and Choke Manifold
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  - Maintaining Surface Control System

General Safety & Health

- Safety and Health Program
- Hot Work/Welding
- Hydrogen Sulfide Gas
- H_2S Special Precautions

- Working on the Monkeyboard
- Maneuvering Pipe to Racking Area
- Tripping in - Latching Elevators to Top of Stand

- Casing Operations
  - Installing Casing Tools
  - Running Casing into the Hole
  - Installing Casing Accessories
  - Circulating and Cementing

Related Safety and Health Topics

- Powered Industrial Trucks
- Personal Protective Equipment (PPE)
- Ergonomics

This eTool describes potential hazards commonly found on a wide variety of drilling rigs. Specific rig designs may have unique potential hazards which should also be addressed in the site JSA.

Occupational Safety & Health Administration
200 Constitution Avenue, NW
Washington, DC 20210

Oil and Gas Well Drilling and Servicing eTool

Drilling >> Rigging Up

Rigging up is placing and assembling the various parts of equipment that make up the rig, and preparing the rig for drilling.

There are many rig designs, and this eTool does not cover each type individually. This eTool focuses on the common hazards and solutions that many rig designs share.

During assembly of the rig, some equipment may be handled and set with crane, rig up trucks, or forklift, depending on the size of the rig. It should be noted that overhead hazards such as high voltage power lines may be present.

There may be two or more crews (teams) working together in the rigging up process. The rigging up process includes the following steps, some of which are done simultaneously: (See Servicing - Rigging Up)

Fig. 1. Hoisting the mast

- Setting up the Substructure
- Setting up Rig Floor and Mast or Derrick
- Installing Handrails, Guardrails, Stairs, Walkways, and Ladders
- Installing Power Systems
- Rigging up the Circulating System
- Installing the Auxiliary Equipment
- Inspecting the Rig
- Rigging Down

Setting Up the Substructure

^ TOP

Equipment is unloaded and positioned at or near the exact location that it will occupy during operations.

The substructure is assembled, pinned together, leveled, and made ready for other rig components on the floor.

Equipping the cellar begins but can be done throughout the rigging up process. This includes welding on a drilling nipple to the conductor pipe and attaching a flow line.

Fig. 2. Setting up the substructure

Potential Hazards:

- Being struck by the crane, load, truck, or forklift tipping.

- Pinched fingers when assembling equipment.
- Burns from cutting and welding on the drilling nipple.
- Temporary eye irritation from welding light flash.
- Falling from heights.

Possible Solutions:

- Instruct all workers in safety procedures and ensure that they are knowledgeable about job hazards. This can be done during pre-job safety meetings or JSA briefings.
- Instruct workers to stand clear and keep hands and other body parts away from pinch points.
- Wear proper long sleeve clothing to protect from burns.
- Wear proper welding eye/face protection.
- Avoid looking directly at the flame or arc when welding.
- Wear fall protection when working from heights. Fall Protection, Safety and Health Regulations for Construction - [1926.500, part M.]

Setting Up The Rig Floor and Mast or Derrick

^ TOP

Once the substructure is set in place, the process of setting up the rig floor begins. Begin by installing stairways and guardrails to allow access to the rig floor. Then, the drawworks is set in place and secured to the substructure. On mechanical rigs, the engines are set in place and the compound and associated equipment connected to the drawworks. On electric rigs, the electric cables (lines) are strung to the drawworks.

Fig. 3. Raising the doghouse and rig floor

The bottom of the mast is raised to the rig floor and pinned in place. The crown section is then raised into place on the derrick stand. The "A-legs" are raised and pinned into place. The monkey board is pinned in place on the mast and all lines and cables are laid out to prevent tangling when the mast is raised. A thorough inspection of the mast should be made before raising the mast/derrick. The mast is now ready to be raised. The engines are started (see Installing the Power System), and the drilling line is spooled onto the drawworks drum. Once the mast has been raised and pinned, the remaining floor equipment can be set into place. If the rig has safety guylines, they must be attached to the anchors and properly tensioned prior to continuing the rigging up process. A derrick emergency escape device is installed on the mast.

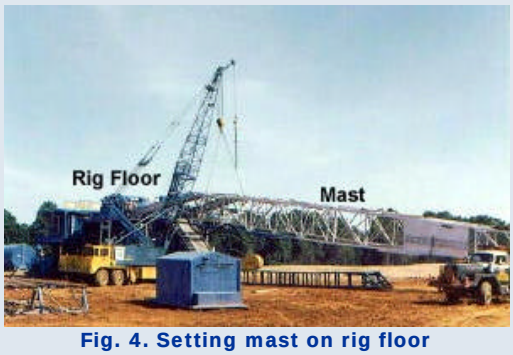

Fig. 4. Setting mast on rig floor

Potential Hazards:

- Falling or tripping during rigging up.

- Falling from rig floor.
- Being struck by swinging equipment.
- Being struck by falling tools.
- Being crushed or struck by equipment due to failure or overloading of hoisting equipment.
- Getting entangled in lines during raising of the derrick or mast.
- Failure to properly install derrick emergency escape device.

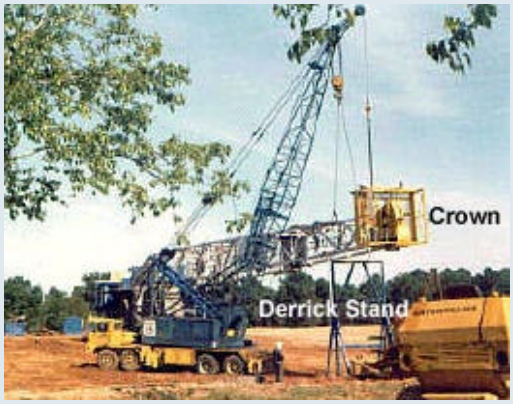

Fig. 5. Setting crown on derrick stand


Fig. 6. Rigging up the mast


Fig. 7. Raising the mast

Possible Solutions:

- Install, inspect, and secure stairs and handrails. [1926.1052]
- Do not use guardrails for anchor points or for lifting or supporting loads.
- Use fall protection when installing or removing guardrails.
- Use a tag line to guide equipment, rather than positioning yourself under suspended loads.
- Check the derrick for unsecured tools before raising it.
- Allow only the operator raising the mast to be on the rig floor.
- Uncoil all lines so that they are clear of all workers when the mast or derrick is raised.
- Attach safety lines to all tools hanging from the rig.
- Keep a safe distance from moving equipment.
- Install derrick emergency escape device properly in accordance with manufacturers recommendations.

Installing Handrails, Guardrails, Stairs, Walkways, and Ladders ^ TOP

Handrails, guardrails, stairways, walkways, and ladders are installed where they are needed for safety and access.

Potential Hazards:

- Falls from ladders.
- Falls or slips from ladders and stairs due to

damaged or missing rungs or steps.

- Slips or falls on walkways due to debris or uneven surfaces.
- Falls from heights.
- Falling into the mud pit or mixing tank.

Possible Solutions:

- Follow established procedures and best work practices.
- Instruct workers on proper procedures for using and installing ladders.
- Use only ladders in good repair that do not have missing rungs.
- Do not install stairs with missing or damaged steps. Repair them before installing them.
- Keep walkways clean and free of debris and tripping hazards. [1910.22]
- Use proper fall protection.

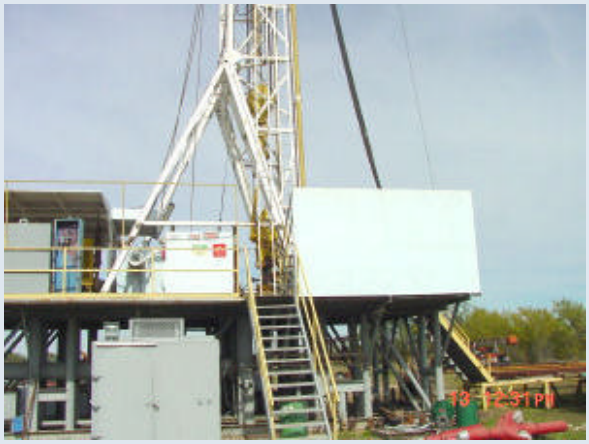

Fig. 8. Stairways, guardrails, and ladders

Fig. 9. Stairways

- Place guardrails in place prior to working in elevated areas. [1910.23]

Installing the Power System

∧ TOP

Installing the power system is usually done simultaneously with setting up the rig floor, because power is needed to operate the equipment. Today there are generally two types of rigs being used on land. A mechanical rig is powered by engines and compound. An electric rig is powered by engines and generators. This type supplies power to electric motors, which drive the machinery.

All power cords, belts, and chains need to be connected to the machinery from their associated power source. Simultaneously, the fuel lines and tanks need to be hooked up. Then, start the engines.

Fig. 10. Engines and generators

Potential Hazards:

- Tripping on power cords and hoses.
- Slips and falls on slick walking services.
- Getting caught in pinch points.
- Exposure to chemical hazards.
- Being shocked or electrocuted.

Fig. 11. Power House

Possible Solutions:

- Keep all cords and hoses orderly and clear of walking spaces.
- Clear and clean all walkways and walking surfaces of slipping hazards.
- Use caution around all chain and belt pinch point areas. Install all guards.
- Use proper PPE when working with chemicals. Toxic and Hazardous Substances: Hazard Communication. - [1910.1200]
- Use proper lockout/tagout/ procedures. The control of hazardous energy (lockout/tagout). - [1910.147]

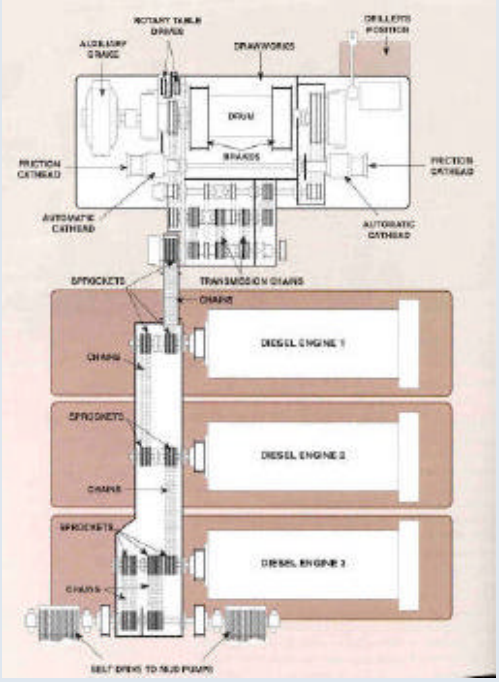

Fig. 12. Compound with chains and sprockets

Rigging Up the Circulating System

∧ TOP

While one crew finishes preparing the rig floor, another crew might be rigging up the circulating system.

The mud tanks and mud pumps are set into the predetermined location.

The mud lines are then connected and electric cords are strung.


Fig. 13. Mud pumps

Potential Hazards:

- Being struck by or crushed by equipment being set into place.
- Getting caught in pinch points.
- Being struck by crane, load, truck or forklift tipping.
- Being struck by hammer when connecting mud line unions.


Fig. 14. Mud system

Possible Solutions:

- Keep a safe distance from equipment that is coming together or moving.
- Maintain a safe distance from all pinch points.
- Stand clear of workers that may be swinging hammers.

Installing the Auxiliary Equipment

∧ TOP

All remaining drilling and auxiliary equipment must be set into place and installed where needed.

The catwalk and pipe racks are positioned and the pipe and drill collars are set on the racks.

Fig. 15. Tubulars on pipe racks

Potential Hazards:

- Getting struck or pinched by, or caught in between, tubulars being loaded onto racks.
- Having feet pinched or crushed when setting up the pipe racks and catwalk.

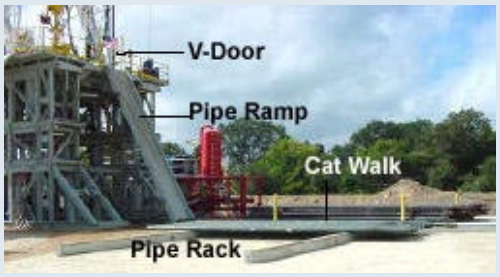

Fig. 16. Pipe rack and v-door

Possible Solutions:

- Keep a safe distance from equipment that is coming together.
- Use a tag line to guide the pipe racks and catwalks into position.

Inspecting the Rig

∧ TOP

Perform a complete inspection of the rig before operating. The driller and/or rig superintendent/toolpusher/manager should walk around the entire rig and inspect for missing or loose pins and bolts, equipment guards, adequate guard railings, proper line and cable placement, and unclear walkways.

Fig. 17. Inspecting the rig

Potential Hazards:

- Falling from the rig.
- Tripping on power cords and hoses.
- Slipping and falling on slick walking services.

Fig. 18. Inspecting rig equipment

Possible Solutions:

- Use proper fall protection. Fall Protection, Safety and Health Regulations for Construction - [1926.500, part M].
- Keep all cords and hoses orderly and clear of walking spaces.
- Clear and clean all walkways and walking surfaces of slipping hazards.

Rigging Down

∧ TOP

After production casing is run and cemented, the rig is taken down and moved to another site. The rigging down process is basically the reverse of rigging up.

The hazards and solutions are similar to those for rigging up.

Fig. 19. Loading doghouse onto trailer

eTool Home | Site Preparation | Drilling | Well Completion | Servicing | Plug & Abandon Well
General Safety | Additional References | Viewing/Printing Instructions | Credits | JSA
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Occupational Safety & Health Administration
200 Constitution Avenue, NW
Washington, DC 20210

Oil and Gas Well Drilling and Servicing eTool

Drilling >> Drilling Ahead

Drilling ahead means the actual drilling of the well.

Specific drilling processes vary, but many of the work hazards are similar. The following generic tasks assume the use of a kelly and rotary table. Other rig designs may include the use of a top drive.

- Handling Tubulars
- Preparing Drilling Fluid
- Starting Drilling
- Making a connection
  - Preparing to Break Out Pipe
  - Breaking Out Pipe
  - Making up Pipe in Mousehole
  - Raising the Kelly and New Joint
  - Adding Pipe to the String
- Resuming Drilling
- Coring

Fig. 1. Drilling rig

Handling Tubulars

^ TOP

The pipe is unloaded from trucks onto the pipe rack. The floor crew brings pipe from the pipe rack and catwalk, using the catline, air hoist or hydraulic winch, up to the drilling floor and places it in the mousehole. This is done for every connection.

Note: The rig supervisor should hold a pre-job meeting with the crew to review responsibilities and to coordinate the operations to be performed.

Potential Hazards:

- Being struck by rolling or falling tubulars.
- Being struck by or caught between tubulars and other objects during movement (for example, being struck by tubulars being tailed into the rig floor).
- Slips, trips, and falls.

Possible Solutions:

- Use powered industrial truck (forklift) properly.
- Work the tubulars from the ends from ground level.
- Chock or pin tubulars on the racks properly.
- Level your pipe racks properly.
- Stand clear of suspended, hoisted, or moving loads. Be aware of tubulars or equipment being lifted through the V-door.

Potential Hazards:

- Getting struck by falling tubulars due to lifting equipment failure.

Fig. 2. Loading tubulars

Possible Solutions:

- Instruct workers in the need for proper use, inspection, and maintenance practices. Before each tour inspect the:
  - Wire rope and slings,
  - Catline ropes and knots (do not allow a rope to lie in standing water), and
  - Chains and hooks.
- Stand clear of suspended, hoisted or moving loads and be aware of your surroundings.

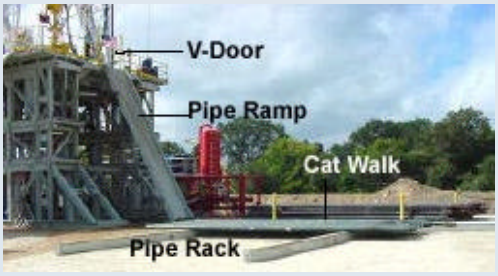

Fig. 3. Catwalk and V-door

Additional Information:

- API, RP 54
- IADC Accident Prevention Guide
- IADC and PETEX, Home Study Courses: Rotary Drilling Series
  - Unit I: The Rig and Its Maintenance
  - Unit II: Normal Drilling Operations
  - Unit III: Non-routine Rig Operations
  - Unit IV: Man Management and Rig Management

Preparing Drilling Fluid

∧ TOP

Drilling fluid is an important component in the drilling process [more]. A fluid is required in the wellbore to:

- Cool and lubricate the drill bit
- Remove the rock fragments, or drill cuttings, from the drilling area and transport them to the surface,

- Counterbalance formation pressure to prevent formation fluids (i.e. oil, gas, and water) from entering the well prematurely (which can lead to a blowout), and
- Prevent the open (uncased) wellbore from caving in.

The mud is monitored throughout the drilling process. A mud engineer and/or the Derrickman may periodically check the mud by measuring its viscosity, density, and other properties.

Fig. 4. Drilling fluid - mud

Potential Hazards:

- Burns, or physical injury caused by contact with skin or eyes.
- Being exposed to explosions or violent reactions from chemicals mixed improperly.
- Being exposed to inhalation hazards.
- Receiving strains and sprains.
- Slips, trips and falls.

Fig. 5. Mud Mixing Hopper

Possible Solutions:

- Ensure workers follow the safe handling procedures found in Material Safety Data Sheets (MSDS). [Example MSDS], [1910.1200]
- Wear appropriate personal protective equipment, including, eye and face protection. [1910.132], [1910.133]
- Wear appropriate respiratory protection when handling chemicals and/or mud additives. [1910.134]
- Provide an eyewash station and other appropriate flushing apparatus as recommended by the MSDS. [1910.151(c)]
- Provide adequate ventilation.
- Use proper mixing procedures.

Fig. 6. Caustic soda mixing container

- Use designated containers for mixing certain chemicals (for example, baffled container with lid).
- Substitute less hazardous materials or use pre-mixed mud.
- See General Safety & Health.

Note: Tank cleaning is a high-hazard operation requiring confined space entry procedures, training for personnel, PPE, and specialized equipment. [1910.146]

Starting Drilling

∧ TOP

Fig. 7. Lowering drill bit

To start drilling, a surface drill bit is attached to a bottomhole drill collar, which is in turn attached to the kelly. Once made up, the driller lowers the bit through the rotary table and engages the mud pump(s) and checks for leaks and other abnormalities. The driller lowers the drill string and the kelly bushing is set in the rotary drive bushing and the rotary is engaged. The driller then slowly lowers the bit to bottom and begins the drilling operation.

Potential Hazards:

- Being struck by the tongs, the make-up chain, or pipe.
- Being caught between collars and tongs, spinning chain, and pipe.

Possible Solutions:

- Implement an effective pipe handling, make-up, break-out procedure:
  - Stand outside the tong swing radius when breaking pipe.
  - Use proper tong latching techniques and use proper hand and finger placement on tong handles.
  - Stand clear of the rotary table when it is rotating.
- Use a tail rope on the spinning chain to keep hands away.

Potential Hazards:

- Receiving strains and sprains during lifting or controlling movement of drill collars, bit breaker, pipe, and tongs.

Possible Solutions:

- Use proper lifting technique.
- Hoist slowly to limit pipe momentum.
- Use mechanical lifting aids such as a rig floor winch.
- Use tail rope to guide as necessary.

Potential Hazards:

- Slips, trips, and falls.

Possible Solutions:

- See Slips, Trips, and Falls.

Potential Hazards:

- Encountering shallow gas

Possible Solutions:

- See well control - Blowout Prevention Program.

Additional Information:

- IADC, WellCAP

Preparing to Break Out Pipe

^ TOP

The driller stops the drill string from rotating, and hoists the drill string with the drawworks until the kelly is out of the rotary table. The driller then shuts down the mud pump(s). The floor hands set the slips around the joint of pipe. The tongs are then latched onto the tool joints above and below the connection.

Fig. 8. Setting slips

Potential Hazards:

- Pinching fingers or other body parts between slips or slip handles and rotary table.
- Experiencing muscle strain from improper lifting technique.
- Pinching fingers when latching the tongs onto the pipe.

Possible Solutions:

- Implement effective, safe work procedures for using slips and tongs, which include:
  - Proper finger and hand placement on slip handles and tong handles
  - Proper stance and slip lifting techniques
  - Proper tong latching techniques

Additional Information:

- API, RP 54
- IADC, WellCAP
- IADC and PETEX, Home Study Courses: Rotary Drilling Series

Breaking Out Pipe

∧ TOP

The tongs and cathead are used to break out the pipe. Either the rotary table or kelly spinner is used to spin the drill string or kelly to unscrew it from the drill pipe joint.

Fig. 9. Breaking out drill pipe

Potential Hazards:

- Being struck by:
  - Swinging tongs if the tong dies fail, or the tong counterweight lines were to break
  - The slip handles if the rotary table is used to spin the drill string
  - Reverse backlash of tongs (backbiting) during spinning out operations
  - The tongs if a snub line breaks or the tongs come unlatched
  - Pipe

Possible Solutions:

- Inspect tong dies, counterweight cables, and snub lines tourly and prior to each trip.
- Implement an effective spinning out pipe procedure:
  - Personnel other than tong operators stand outside the tong swing radius when breaking pipe.
  - No one should stand in the red zone (see Diagram 1)
  - Use proper tong latching techniques and use proper hand and finger placement on tong handles.
  - Stand clear of the rotary table when it is rotating.
  - Use special operational procedures when using a high torque connection.
- Maintain good communication between floor crew and driller.

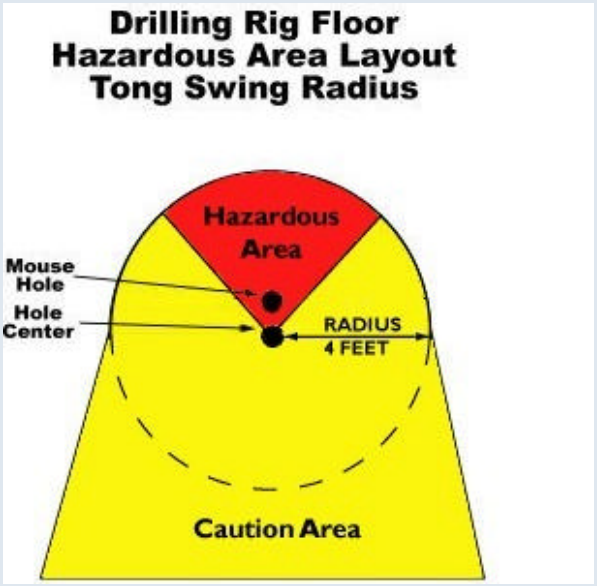

Diagram 1: Drilling rig floor
Hazardous area layout
Tong swing radius

Potential Hazards:

- Release of excess drilling mud resulting in skin contact, loss of footing, etc.

Possible Solutions:

- Use a mud bucket to direct mud down into the rotary table.
- Close the mud saver valve on the kelly (if present).

Additional Information:

- API RP 54
- IADC APRG
- IADC/PETEX Rotary Drilling Series

Making Up Pipe in Mousehole

∧ TOP

The crew swings the kelly out over the mousehole and stabs it into a new joint of pipe. The driller then spins up the kelly using the kelly spinner or spinning chain and the crew uses tongs to torque the joint.

Fig. 10. Making up mousehole joint

Potential Hazards:

- Being struck or pinched by the kelly.
- Losing footing while swinging the kelly out over the mousehole and stabbing it into a new joint of pipe.
- Being struck by or caught in the spinning chain.

Possible Solutions:

- Use proper hand placement
- Keep the work area around the rotating table clean and clear of mud, ice, snow, debris and other materials that may cause slipping or tripping.
- Inspect chain for broken or distorted links. Chains with the metal reduced by wear at any point less than 90 percent of its original cross section area should be discarded.
- Lubricate and maintain guide rollers to prevent undue wear on the chain or cable.

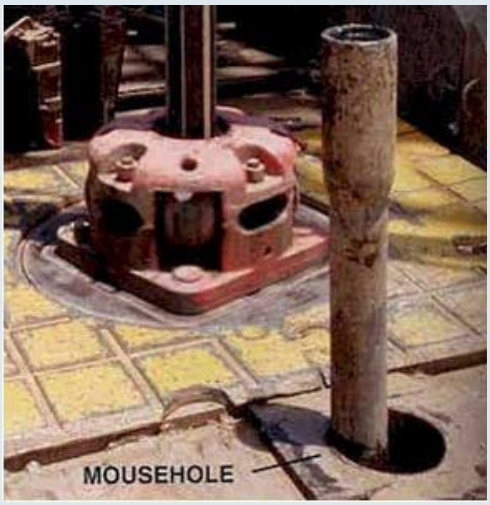

Fig. 11. Pipe in mousehole

Additional Information:

- IADC, APRG
- IADC/PETEX Rotary Drilling Series

Raising the Kelly and New Joint

∧ TOP

The driller uses the drawworks to raise the kelly and attached joint out of the mousehole.

Fig. 12. Raising the traveling block and kelly

Potential Hazards:

- Being struck by debris or overhead objects if the traveling block runs into the crown block or if the traveling block or swivel hits the derrick.
- Being struck by kelly or pipe.

Possible Solutions:

- Install a crown safety device on the drawworks and ensure proper functioning.
- Keep personnel clear of the potential swing path of the kelly and pipe.

Adding Pipe to the String

^ TOP

The new joint is guided over to the drill hole, the tool joint is doped, and stabbed into the end of the pipe suspended in the rotary table with the slips.

The joints are threaded together using the pipe spinner, kelly spinner, or spinning chain. Final torque is provided by the tongs.

The drawworks lifts the kelly and attached string to facilitate removal of the slips.

Fig. 13. Applying pipe dope to a connection

Potential Hazards:

- Being struck by:
  - Swinging kelly and pipe
  - Tongs if the stabber misses the stump
  - The jerk or spinning chain
- Being caught between the swinging pipe and the tongs.
- Being caught between the joint of pipe being stabbed and the stump.
- Getting pinched between tongs or pipe spinner and pipe.
- Slips, trips, and falls.

Fig. 14. Pulling slips

Possible Solutions:

- Never step over a jerk chain and stay clear of spinning chain when a connection is being made.
- Keep hands away from end of stump or inside of pipe.
- Keep feet and legs away from underneath tongs when the pipe is being stabbed.
- Use proper tong latching techniques and hand and finger placement on tong handles.
- Never stand or walk under suspended loads.
- Keep the work area around the rotary table clean and clear of drilling fluids, mud, ice, snow, debris, and other materials that may cause slipping or tripping.
- Inspect chains for worn or damaged links, and replace a chain having a broken or distorted link with the metal reduced by wear at any point less than 90 percent of its original cross section area.
- See Slips, Trips, and Falls.

Resuming Drilling

^ TOP

The driller starts the pump and picks up off the slips. The drill crew then removes the slips. The driller lowers the string until the kelly drive bushing engages the master bushing. Once the bushings are in place, the driller begins rotating the drill string, lowers the bit back to bottom, and continues making hole.

Fig. 15. Lowering kelly bushing

Potential Hazards:

- Being thrown off the rotary table when engaged.
- Getting caught by loose clothing.

Possible Solutions:

- Stand clear of the rotary table.
- See Work Clothes.

Coring

^ TOP

In some cases the operator orders a core sample of the formation for testing. A special core barrel is lowered to the bottom on the drill string and is rotated to cut a core from the formation. This core is brought to the surface and examined in a laboratory.

Fig. 16. Drill core

Potential Hazards:

- Being pinched or struck by the core barrel and associated tools during floor operations.
- Being struck by the core as it is removed from the barrel.
- Encountering other hazards similar to those encountered during tripping out/in.

Possible Solutions:

- Wear appropriate PPE.
- Instruct workers in handling and using the special tools required during drill core extraction.

Occupational Safety & Health Administration
200 Constitution Avenue, NW
Washington, DC 20210

Oil and Gas Well Drilling and Servicing eTool

Drilling >> Drilling Ahead >> Drilling Fluid

Drilling Fluid Functions

∧ TOP

Drilling fluid is an important component in the drilling process. A fluid is required in the wellbore to:

- Cool and lubricate the drill bit,
- Remove the rock fragments, or drill cuttings, from the drilling area and transport them to the surface,
- Counterbalance formation pressure to prevent formation fluids (such as oil, gas, and water) from entering the well prematurely (which can lead to a blowout), and
- Prevent the open (uncased) wellbore from caving in.

Fig. 1 Drilling fluid (Mud)

Drilling Fluid Types

∧ TOP

There are several types of drilling fluids used depending on the drilling conditions encountered:

- Water-based muds are used most frequently. The base may be either:
  - fresh water, or
  - salt water.
- Oil-based muds.
- Synthetic materials. The oil and gas extraction industry has developed many new oleaginous (oil-like) base materials from which to formulate high-performance drilling fluids. A general class of these fluids is called synthetic materials, such as

- The vegetable esters,
- Poly alpha olefins,
- Internal olefins,
- Linear alpha olefins,
- Synthetic paraffins,
- Ethers, and
- Linear alkylbenzenes, among others.

- Air and foam fluids may be used in drilling wells.
  - These fluids are less dense than drilling muds.

Drilling Fluid Additives

∧ TOP

Drilling muds typically have several additives. (Air and foam fluids typically do not contain many additives because the additives are either liquid or solid, and will not mix with air and foam drilling fluids.) The following is a list of the more significant additives:

Fig. 2 Additive mixing hopper

- Weighting materials, primarily barite (barium sulfate), may be used to increase the density of the mud in order to equilibrate the pressure between the wellbore and formation when drilling through particularly pressurized zones. Hematite (Fe_2O_3) sometimes is used as a weighting agent in oil-based muds (Souders, 1998).
- Corrosion inhibitors such as iron oxide, aluminum bisulfate, zinc carbonate, and zinc chromate protect pipes and other metallic components from acidic compounds encountered in the formation.
- Dispersants, including iron lignosulfonates, break up solid clusters into small particles so they can be carried by the fluid.
- Flocculants, primarily acrylic polymers, cause suspended particles to group together so they can be removed from the fluid at the surface.
- Surfactants, like fatty acids and soaps, defoam and emulsify the mud.
- Biocides, typically organic amines, chlorophenols, or formaldehydes, kill bacteria and help reduce the souring of drilling mud.
- Fluid loss reducers include starch and organic polymers and limit the loss of drilling mud to under-pressurized or high-permeability formations.

This Material Safety Data Sheet (MSDS) contains information on the use and procedures for handling Caustic Soda. There are data sheets on all the hazardous chemicals used in the drilling industry. Data sheets must be supplied by the manufacturer and/or supplier each time the chemical is introduced into the workplace. See Hazard Communication: Toxic and Hazardous Substances [1910.1200]

MATERIAL SAFETY DATA SHEET

CAUSTIC SODA (NaOH)

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

TRADE NAME: CAUSTIC SODA (NaOH)
UN/NA (PIN) No.: 1823
CHEMICAL CLASS: Bases, alkalies (inorganic).
APPLICATIONS: Oil well drilling fluid additive. pH modifier.
EMERGENCY TELEPHONE: 281-561-1600
SUPPLIER: Supplied by a Business Unit of M-I L.L.C.
P.O. Box 42842, Houston, Texas 77242-2842
See cover sheet for local supplier.
TELEPHONE: 281-561-1509
FAX: 281-561-7240
CONTACT PERSON: Sam Hoskin

2. COMPOSITION, INFORMATION ON INGREDIENTS

INGREDIENT NAME:	CAS No.:	CONTENTS :	EPA RQ:	TPQ:
Sodium hydroxide	1310-73-2	100 %	1 000 lbs	

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW:

DANGER! CAUSES EYE AND SKIN BURNS. Do not get in eyes or on skin or clothing. Avoid breathing airborne product. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling. Avoid contact with water or moisture, which may generate sufficient heat to ignite combustible materials. This product is a white pellet or flake material. Slippery when wet.

ACUTE EFFECTS:

HEALTH HAZARDS, GENERAL:

Contact with this product is severely irritating to the eyes, skin, and respiratory tract and may cause severe eye injury.

INHALATION: Severely irritating to the respiratory tract if inhaled.
INGESTION: May cause burns in mucous membranes, throat, esophagus, and stomach.
SKIN: Corrosive to skin.
EYES: Corrosive to eyes.

CHRONIC EFFECTS:

CARCINOGENICITY:

IARC: Not listed. OSHA: Not regulated. NTP: Not listed.
10296 - CAUSTIC SODA (NaOH)

ROUTE OF ENTRY:

Inhalation. Skin and/or eye contact.

TARGET ORGANS:

Respiratory system, lungs. Skin. Eyes.

4. FIRST AID MEASURES

GENERAL: Persons seeking medical attention should carry a copy of this MSDS with them.
INHALATION: Move the exposed person to fresh air at once. Perform artificial respiration if breathing has stopped. Get medical attention.
INGESTION: Drink a couple of glasses water or milk. Do NOT induce vomiting unless directed to do so by a physician. Never give anything by mouth to an unconscious person. Get medical attention.
SKIN: Wash skin thoroughly with soap and water. Remove contaminated clothing. Get medical attention if any discomfort continues.
EYES: Promptly wash eyes with lots of water while lifting the eye lids. Continue to rinse for at least 15 minutes. Get medical attention if any discomfort continues.

5. FIRE FIGHTING MEASURES

AUTO IGNITION TEMP. (°F): N/D
FLAMMABILITY LIMIT - LOWER(%): N/D
FLAMMABILITY LIMIT - UPPER(%): N/D
EXTINGUISHING MEDIA:

Carbon dioxide (CO2). Dry chemicals. Foam.

SPECIAL FIRE FIGHTING PROCEDURES:

No specific fire fighting procedure given.

UNUSUAL FIRE & EXPLOSION HAZARDS:

Upon contact with certain metals and water or moist air, hydrogen gas is generated, forming explosive mixtures with air.

HAZARDOUS COMBUSTION PRODUCTS:

Irritating gases/vapors/fumes.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:

Wear proper personal protective equipment (see MSDS Section 8).

SPILL CLEAN-UP PROCEDURES:

Avoid generating and spreading of dust. Shovel into dry containers. Cover and move the containers. Flush the area with water. Do not contaminate drainage or waterways. Repackage or recycle if possible.

7. HANDLING AND STORAGE

HANDLING PRECAUTIONS:

Avoid handling that causes dust to generate. Wear full protective clothing for prolonged exposure and/or high concentrations. Make eye wash and emergency shower available at the work place. Wash hands often and change clothing when needed. Provide good ventilation. Provide mechanical ventilation or local exhaust ventilation.

STORAGE PRECAUTIONS:

Store at moderate temperatures in dry, well ventilated area. Keep in original container.

8. EXPOSURE CONTROLS, PERSONAL PROTECTION

		OSHA PEL:	ACGIH TLV:	OTHER:	
INGREDIENT NAME:	**CAS No.:**	**TWA: STEL:**	**TWA: STEL:**	**TWA: STEL:**	**UNITS:**
Sodium hydroxide	**1310-73-2**	2	2 C*		mg/m3

*C = Ceiling Limit

PROTECTIVE EQUIPMENT:
ENGINEERING CONTROLS: Use appropriate engineering controls such as exhaust ventilation and process enclosure to reduce air contamination and keep worker exposure below the applicable limits.
VENTILATION: Supply natural or mechanical ventilation adequate to exhaust airborne product and keep exposures below the applicable limits.
RESPIRATORS: Use at least a NIOSH-approved N95 half-mask disposable or reuseable particulate respirator. In work environments containing oil mist/aerosol, use at least a NIOSH-approved P95 half-mask disposable or reuseable particulate respirator.
PROTECTIVE GLOVES: Use gauntlet type rubber gloves.
EYE PROTECTION: Use tight-fitting goggles if dust is generated. Wear splash-proof eye goggles to prevent any possibility of eye contact.
PROTECTIVE CLOTHING: Wear appropriate clothing to prevent any possibility of skin contact. Provide eyewash station and safety shower.
HYGIENIC WORK PRACTICES: Wash promptly with soap and water if skin becomes contaminated. Change work clothing daily if there is any possibility of contamination.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE/PHYSICAL STATE: Pellets or flakes.
COLOR: White.
ODOR: Odorless or no characteristic odor.
SOLUBILITY DESCRIPTION: Soluble in water.
BOILING POINT (°F, interval): 2530 PRESSURE: 760mmHg
MELT./FREEZ. POINT (°F, interval): 604
DENSITY/SPECIFIC GRAVITY (g/ml): 2.13 TEMPERATURE (°F): 68
BULK DENSITY: 133 lb/cu. ft.; 2131 kg/m3
VAPOR DENSITY (air=1): N/A
VAPOR PRESSURE: 42 mmHg TEMPERATURE (°F): 1832
pH-VALUE, DILUTED SOLUTION: 13 CONCENTRATION (%,M): 1%

10. STABILITY AND REACTIVITY

STABILITY: Normally stable.
CONDITIONS TO AVOID: Reacts strongly with water. Avoid contact with acids.
HAZARDOUS POLYMERIZATION: Will not polymerize.
POLYMERIZATION DESCRIPTION: Not relevant.
MATERIALS TO AVOID: Organochlorine solvents, nitro and nitroso compounds, organic peroxides; aluminum, zinc, tin and their alloys.
HAZARDOUS DECOMPOSITION PRODUCTS: No specific hazardous decomposition products noted.

11. TOXICOLOGICAL INFORMATION

Component: Sodium hydroxide

TOXICOLOGICAL DATA:

24 hours. Eye. Rabbit. 1 mg Severe Irritation Corrosive effects.
24 hours. Skin. Rabbit. 500 mg Severe Irritation Corrosive effects.
LDLo. Oral. Rabbit. 500 mg/kg Acute toxicity.

TOXIC DOSE - LD 50: 1350 mg/kg (skn-rbt)

12. ECOLOGICAL INFORMATION

LC 50, 96 HRS, FISH, mg/l: 125 (Mosquitofish)

EC 50, 48 HRS, DAPHNIA, mg/l: 100

ACUTE AQUATIC TOXICITY:

This product passes the mysid shrimp toxicity test required by the U.S. Environmental Protection Agency (EPA) Region VI (Gulf of Mexico) NPDES Permit, which regulates offshore discharge of drilling fluids, when tested in a standard drilling fluid. Contact M-I's Environmental Affairs Department for more information.
This product is approved for use under the U.S. Environmental Protection Agency (EPA) Region IX (California) General NPDES Permit which regulates offshore discharges of drilling fluids. Contact M-I's Environmental Affairs Department for more information.

13. DISPOSAL CONSIDERATIONS

WASTE MANAGEMENT:

This product, should it become a waste, is hazardous by U.S. RCRA criteria.
THIS CONTAINER MAY BE HAZARDOUS WHEN EMPTY. Empty containers retain residues. All labeled precautions must be observed.

DISPOSAL METHODS:

Recover and reclaim or recycle, if practical. Should this product become a waste, dispose of in a permitted industrial landfill. Ensure that containers are empty by RCRA criteria before disposal in a permitted industrial landfill.

14. TRANSPORT INFORMATION

LABEL FOR CONVEYANCE:
PROPER SHIPPING DESCRIPTION II: Sodium hydroxide, solid, 8, UN1823, PG II
GENERAL: RQ = 1000
EMERGENCY RESPONSE GUIDE No.: 154

U.S. DOT:

UN/NA No.: 1823
U.S. DOT HAZARD LABEL: CORROSIVE (Black/white diam.) DOT17
U.S. DOT CLASS: Class 8 - Corrosive Material
U.S. DOT PACKING GROUP: II
U.S. DOT PACKAGING INSTRUCTIONS: 49 CFR 173.154; 173.212; 240

CANADIAN TRANSPORT:

TDGR CLASS: Class 8 - Corrosives
TDGR LABEL: Corrosive

SEA TRANSPORT:

UN No. SEA: 1823
IMDG CLASS: Class 8 - Corrosives
IMDG PAGE No.: 8225-1
IMDG PACK GR.: II
EmS No.: 8-06
MFAG TABLE No.: 705

AIR TRANSPORT:

UN No., AIR: 1823
ICAO CLASS: Class 8 - Corrosives
AIR PACK GR.: II

15. REGULATORY INFORMATION

REGULATORY STATUS OF INGREDIENTS:	CAS No:	TSCA:	CERCLA:	SARA 302:	SARA 313:	DSL (CAN):
NAME: Sodium hydroxide	1310-73-2	Yes	Yes	No	No	Yes

US FEDERAL REGULATIONS:

WASTE CLASSIFICATION: A hazardous waste by U.S. RCRA criteria

REGULATORY STATUS: This product or its components, if a mixture, is subject to following regulations (Not meant to be all-inclusive, selected regulations represented):

SECTION 313: This product does not contain toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendment and Reauthorization Act of 1986 and 40 CFR Part 372.

SARA 311 Categories:

1: Immediate (Acute) Health Effects

5. Reactivity Hazard

The components of this product are listed on or are exempt from the following international chemical registries:

TSCA (U.S.)

DSL (Canada)

STATE REGULATIONS:

STATE REGULATORY STATUS: This product or its components, if a mixture, is subject to following regulations (Not meant to be all-inclusive, selected regulations represented):

Illinois Right-to-Know
New Jersey Right-to-Know
Pennsylvania Right-to-Know
PROPOSITION 65: This product does not contain chemicals considered by the State of California's Safe Drinking Water and Toxic Enforcement Act of 1986 as causing cancer or reproductive toxicity, and for which warnings are now required.

CANADIAN REGULATIONS:

LABELS FOR SUPPLY:

REGULATORY STATUS:

This Material Safety Data Sheet has been prepared in compilance with the Controlled Product Regulations.
Canadian WHMIS Classification: E - Corrosive Material D2B - Other Toxic Effects: Toxic Material

16. OTHER INFORMATION

NPCA HMIS HAZARD INDEX: 3 Serious Hazard

FLAMMABILITY: 0 Minimal Hazard

REACTIVITY: 1 Slight Hazard

NPCA HMIS PERS. PROTECT. INDEX: X Ask your supervisor for guidance

USER NOTES: N/A = Not applicable N/D = Not determined

INFORMATION SOURCES:

OSHA Permissible Exposure Limits, 29 CFR 1910, Subpart Z, Section 1910.1000, Air Contaminants.
ACGIH Threshold Limit Values and Biological Exposure Indices for Chemical Substances and Physical Agents (latest edition). Sax's Dangerous Properties of Industrial Materials, 9th ed., Lewis, R.J. Sr., (ed.), VNR, New York, New York, (1997).
Product information provided by the commercial vendor(s).

PREPARED BY: Sam Hoskin

REVISION No./Repl. MSDS of: 1 / June 3, 1996

MSDS STATUS: Approved.

DATE: June 9, 1998

DISCLAIMER:

MSDS furnished independent of product sale. While every effort has been made to accurately describe this product, some of the data are obtained from sources beyond our direct supervision. We cannot make any assertions as to its reliability or completeness; therefore, user may rely on it only at user's risk. We have made no effort to censor or conceal deleterious aspects of this product. Since we cannot anticipate or control the conditions under which this information and product may be used, we make no guarantee that the precautions we have suggested will be adequate for all individuals and/or situations. It is the obligation of each user of this product to comply with the requirements of all applicable laws regarding use and disposal of this product. Additional information will be furnished upon request to assist the user; however, no warranty, either expressed or implied, nor liability of any nature with respect to this product or to the data herein is made or incurred hereunder.

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200 Constitution Avenue, NW
Washington, DC 20210

Oil and Gas Well Drilling and Servicing eTool

Drilling >> Tripping Out / In

Tripping refers to the process of removing and/or replacing pipe from the well when it is necessary to change the bit or other piece of the drill string, or when preparing to run certain tests in the well bore.

The activities that comprise tripping out are listed below. Tripping in essentially comprises the same steps in reverse order.

Additional Information:

- IADC/PETEX Rotary Drilling Series
- IADC APRG
- API RP 54

Fig. 1. Setting back a stand of drill pipe

Tripping Out

- Setting Slips
- Breaking Out and Setting Back the Kelly
- Attaching Elevators to Elevator Links
- Latching Elevators to Pipe
- Working on the Monkeyboard
- Breaking Out Pipe
- Maneuvering Pipe to Racking Area

Tripping In

- Elevators raised
- Latching Elevators to Top of Stand
- Moving pipe to rotary
- Pipe is made up
- Slips are pulled
- Slips are set
- Elevators are unlatched
- Process repeated for all stands
- Pickup kelly and attach to drill string
- Break circulation, and
- Resume drilling

Tripping Out - Setting Slips ^ TOP

The floor crew sets slips around the drill stem.

Potential Hazards:

- Getting fingers or other body parts pinched between

slips or slip handles and rotary table.

- Receiving muscle strain from improper lifting technique.

Possible Solutions:

- Use proper hand placement when setting slips.
- Use proper stance and slip lifting techniques. Slips have three handles and should be lifted jointly by more than one person.

Additional Information:

- IADC/PETEX Rotary Drilling Series
- IADC APRG
- API RP 54

Fig. 2. Setting slips

Breaking Out and Setting Back the Kelly

^ TOP

Breakout the kelly and set it into the rathole.

Potential Hazards:

- Release of excess drilling mud resulting in skin contact, loss of footing, etc.

Possible Solutions:

- Shut down the mud pumps before breaking out the kelly.
- Close the mud saver valve on the kelly (if present).
- Use a mud bucket to divert flow of excess mud.

Fig. 3. Kelly set into rathole

Potential Hazards:

- Being struck by the slip handles if the rotary table is used to spin the drill string.

Possible Solutions:

- Stand clear of the rotary table when it is rotating.
- Consider other technologies (such as a pipe spinner, kelly spinner, or top drive unit) to eliminate this hazard.

Potential Hazards:

- Being struck by the kelly if the pullback line unhooks when kelly is being pulled toward the rathole.

Possible Solutions:

- Implement an effective pullback line attachment procedure.
- Ensure workers stand in a safe location away from the pullback line and rathole during this pullback operation.

Attaching Elevators to the Elevator Links

^ TOP

The crew attaches elevators to the elevator links.

Fig. 4. Red elevator links

Potential Hazards:

- Being pinched by the elevator links while attaching elevators (or attaching elevator links to the hook).
- Being struck by the elevators.
- Receiving strains and sprains.

Possible Solutions:

- Use proper hand placement when attaching elevator links.
- Ensure workers stand away from swing-path of the elevators and elevator links.
- Use lifting equipment and limit manual positioning of elevators.
- Use proper mounting procedures.

Latching Elevators to Pipe

^ TOP

The floor crew latches the elevators onto the pipe.

Fig. 5. Elevators latched onto the pipe

Potential Hazards:

- Getting hands or fingers pinched in elevators.
- Being struck by elevators not securely latched.
- Getting hands or fingers caught between elevators and stump.

Possible Solutions:

- Ensure workers are instructed in proper latching procedure, including the use of handles on elevators as they are descending into place over the stump or tool joint.
- Inspect and maintain elevators.

Additional Information:

- API RP 8B Inspection, Maintenance, Repair, and Remanufacture of Hoisting Equipment

Working on the Monkeyboard

^ TOP

The derrickman climbs up the derrick to the monkeyboard. From here he unlatches the elevators and guides the stands of pipe into the fingerboard.

The elevators are then lowered and attached to the next stand of pipe.

Potential Hazards:

- Falling while climbing up or down the ladder.
- Falling from monkeyboard or fingerboard.
- Slips, trips, and falls.
- Falling during an emergency descent.

Possible Solutions:

- Use climb assist device.
- Wear appropriate fall protection including a full body harness. For Fall Protection guidance, consult:
  - [1910.23(c)(1)], Fall Protection when working from platforms.
  - [1910.66 App (C)], Fall Protection guidelines.
  - [1910 Subpart D], Walking-Working Surfaces.
- Wear the proper Personal Protective Equipment such as:
  - Hard hat
  - Work gloves
  - Safety-toed footwear
- Practice 100% tie-off while working in the derrick.
- Use slip-resistant coatings or materials on working surfaces.
- Train personnel in use of emergency escape device.

Potential Hazards:

- Being caught between pipe and other objects
- Receiving strains and sprains.

Possible Solutions:

- Practice proper hand placement and use of pullback (tail) ropes.

Potential Hazards:

Fig. 6. Climbing Assist Device and PPE

Fig. 7. Derrickman on monkeyboard

Fig. 8. Handling pipe from monkeyboard

- Being struck by dropped objects.

Possible Solutions:

- Implement a dropped objects program, such as tie-off for all tools.
- Use extra caution while personnel are working overhead.
- Do not carry tools while climbing the derrick ladder. Raise tools with a line to any worker above the derrick floor.

Additional Information:

- Fall Protection
  - ANSI Z359.1
  - Personal Fall Arrest Systems (Please recognize that there is a weight limit, including equipment)
  - IADC Fall Protection Guidance

Breaking Out Pipe

∧ TOP

The crew uses the tongs and cathead to breakout the pipe. The rotary table may be used to spin out the pipe after breaking the connection.

Fig. 9. Using the tongs to breakout the pipe

Potential Hazards:

- Being struck by swinging tongs if they break free from the pipe.
- Being struck by the slip handles if the rotary table is used to spin the drill string.
- Being struck by reverse backlash of tongs (backbiting) during breakout operations.
- Being struck by the tongs if a snub line breaks or the tongs come unlatched.

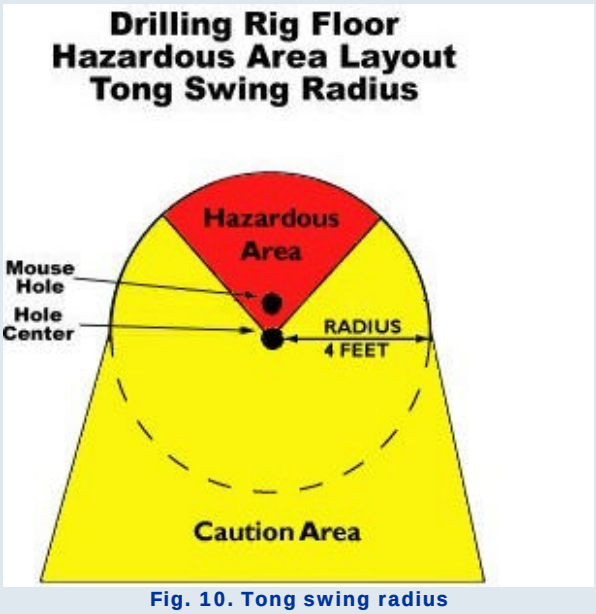

Fig. 10. Tong swing radius

Possible Solutions:

- Implement an effective breakout pipe procedure:
  - Personnel other than tong operators stand outside the tong swing radius when breaking pipe.
  - No one should stand in the red zone. (see Diagram 1)
  - Use proper tong latching techniques and use proper hand and finger placement on tong handles.
  - Stand clear of the rotary table when it is rotating.
  - Use special operational procedures when making high torque connections.
- Inspect tong dies and snub lines each tour.
- Maintain good communication between floor hands and driller.

Maneuvering Pipe to Racking Area

^ TOP

The stand is raised and maneuvered to the pipe racking area.

Fig. 11. Crew maneuvers stand into racking area

Potential Hazards:

- Getting hands and fingers pinched between stands of pipe.
- Getting feet or toes crushed or amputated under a stand of pipe.
- Slips, trips, and falls.
- Receiving strains and sprains.

Possible Solutions:

- Keep hands and fingers from between pipe stands.
- Position feet away from the bottom of the pipe stands.
- See General Safety & Health.

Tripping in - Latching Elevators to Top of Stand

^ TOP

The derrickman latches the elevators onto the pipe from the monkeyboard.

Fig. 12. Derrickman latching elevators onto the pipe

Potential Hazards:

- Getting hands or fingers pinched in elevators.
- Being struck by elevators not securely latched.
- Getting hands or fingers caught between elevators and stump.

Possible Solutions:

- Ensure workers are instructed in proper latching procedure.
- Inspect and maintain elevators.

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Drilling >> Casing Operations

Casing is pipe usually larger in diameter and longer than drill pipe and is used to line the hole. Casing operations occur periodically throughout the drilling process starting with the surface casing, intermediate casing, and ending with production string which takes place during well completion.

The activities involved in casing operations can vary according to the type of casing being installed, but generally fall into these steps:

- Installing Casing Tools
- Running Casing into the Hole
- Installing Casing Accessories
- Circulating and Cementing

Fig. 1. Installing casing

Installing Casing Tools

^ TOP

Specialized casing handling tools are necessary to run casing.

Note: The special service supervisor should hold a pre-job meeting with the special service crew and other involved personnel to review responsibilities and to coordinate the operations to be performed.

Potential Hazards:

- Being struck by or caught between tubulars and other objects during movement (such as being struck by tubulars being tailed into the rig floor).
- Experiencing strains and sprains from maneuvering tools.
- Falling from work platform and/or stabbing

Fig. 2. Special casing elevators

board.

Possible Solutions:

- Stand clear of suspended, hoisted or moving loads. Be aware of tubulars or equipment being lifted through the V-door.
- Use proper hand and foot placement to avoid pinch points, including use of tag lines.
- Use rig floor winch or other powered equipment to handle heavy casing tools.

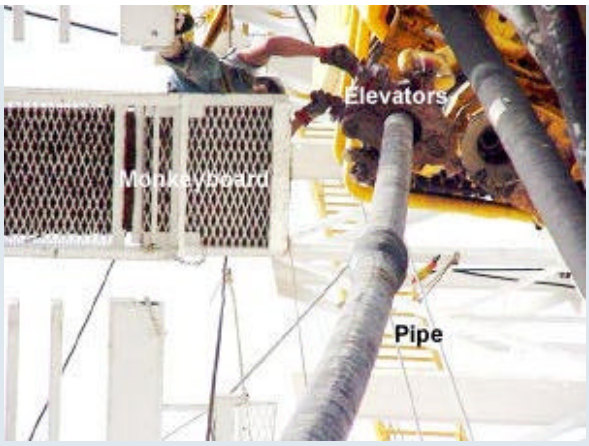

Fig. 3. Derrickman latching elevators

- Use fall protection while installing equipment in the derrick.
- See Slips, Trips, and Falls.

Running Casing into the Hole

∧ TOP

Casing is run into the hole to a pre-determined depth.

Note: The special service supervisor should hold a pre-job meeting with the special service crew and other involved personnel to review responsibilities and to coordinate the operations to be performed.


Fig. 4. Lifting casing onto rig floor

Potential Hazards:

- Hazards are similar to those for drilling ahead or tripping.
- Getting caught between, struck by, or pinched by the power tongs, casing or other equipment.
- Being struck by or caught between tubulars and other objects during movement (for example, struck by tubulars being tailed into the rig floor).
- Falling from the stabbing board or work platform.
- Getting struck by dropped objects.


Fig. 5. Casing stabber

Possible Solutions:

- Include the casing crew and the drilling crew when conducting a JSA and pre-job safety meeting to coordinate the activities of casing operations.
- Stand clear of suspended, hoisted, or moving loads. Be aware of tubulars or equipment being lifted through the V-door.

- Emphasize all normal worker safety procedures, such as fall protection, PPE, placement of hands and feet, and teamwork and communication between workers.
- Implement full fall protection program for the casing stabber.
- Identify clearance between the stabbing board and casing elevators.
- Secure all items used by the casing stabber overhead with a safety line.

Installing Casing Accessories

∧ TOP

As casing is being run, accessories such as centralizers, scratchers, guide shoe, and a float collar are installed and used as needed.

Note: The special service supervisor should hold a pre-job meeting with the special service crew and other involved personnel to review responsibilities and to coordinate the operations to be performed.

Fig. 6. Casing guide shoe

Potential Hazards:

- Dropping guide shoe or float collar onto legs or foot.
- Getting fingers pinched between tools and casing tongs when manually moving guide shoe or float collar.
- Back strain
- Exposure to hazardous materials, especially thread lock compounds.

Fig. 7. Installing casing centralizer

Possible Solutions:

- Use winch, air hoist, or other powered equipment to handle guide shoe, float collar, or other heavy casing equipment.
- Use appropriate PPE as required by the MSDS.

Circulating and Cementing

∧ TOP

After the casing is landed, drilling fluid is circulated through the casing and annulus to remove any residual gases and to condition the mud.

After circulating and conditioning the mud, the casing is cemented. During this process the casing is reciprocated or rotated to allow the scratchers to work to remove excess wall cake to give the cement a better bond.

Usually another special servicing company is hired to conduct cementing operations.

Fig. 8. High pressure lines

Potential Hazards:

- Being struck by high-pressure lines failing if not secured properly.
- Having a high pressure connection failure caused by mismatched or excessively worn hammer unions.

Possible Solutions:

- Hobble high-pressure lines properly.
- Use proper equipment inspection techniques to include hammer unions (Note: This is a particular problem with 602 and 1502, as they will couple but will not hold beyond the lower pressure rating number).
  - See IADC Alert 98-01, High Pressure Lines And Hammer Unions.
  - See IADC Alert 99-33, More On Mismatched Hammer Unions.
  - See IADC Alert 00-15, Additional Serious Incidents With Mismatched Hammer Unions.
  - See IADC Meeting Minutes 02 November1999, Mismatched Hammer Unions, Industry wide meeting.

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Drilling >> Maintenance Activities

Proper maintenance prevents premature equipment failure, which may cause injuries or fatalities. Drilling equipment is subjected to stress and vibration during operations. Maintenance is a necessary and ongoing activity on the drilling site.

Maintenance activities include maintaining the:

- Rig Floor
- Drilling Line Maintenance
- Wire rope maintenance
- Mud Circulating System
- Generator, Electric Motors and Electrical Systems
- Engines
- Derrick Equipment Maintenance

Fig. 1. Welding

Rig Floor

^ TOP

Maintenance activities include inspecting, adjusting, and servicing on equipment such as drawworks, rotary, catheads, tongs, air hoists, and wire rope.

Potential Hazards:

- Slips, trips, and falls.

Possible Solutions:

- Wear personal protective equipment (such as hard hats, work gloves, safety shoes, and eye protection).
- Be aware of the slipping and falling hazards when performing maintenance on the drilling floor.
- Keep all work areas clean and clear of oil, tools, and debris.
- Use non-skid surfaces where appropriate.

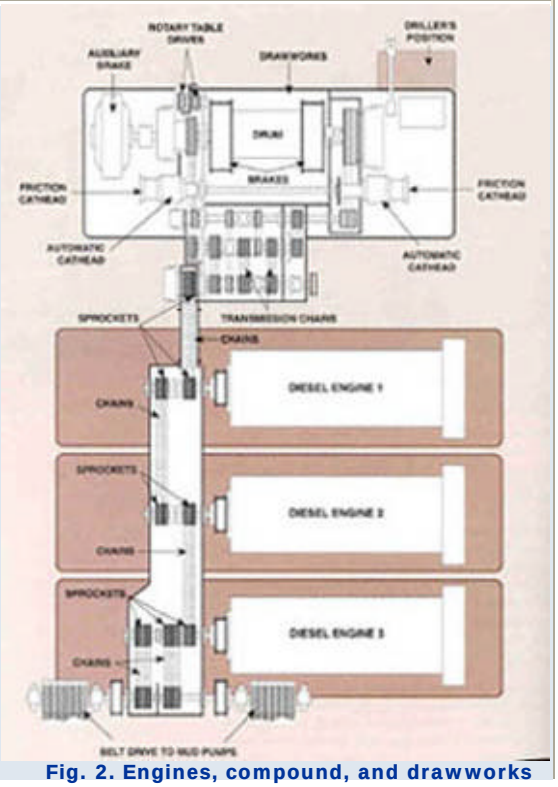

Fig. 2. Engines, compound, and drawworks

Potential Hazards:

- Being caught in chains or other moving equipment.
- Getting fingers and hands pinched in machine guards or covers.
- Receiving sprains and strains.

Possible Solutions:

- Wear personal protective equipment (such as hard hats, work gloves, safety shoes, and eye protection).
- Use proper lockout/tagout procedures. [1910.147]
- Seek assistance when moving awkward and heavy guards and covers.
- Maintain all machinery free of leaks by regular preventive maintenance and repairing when necessary.

Drilling Line Maintenance

^ TOP

The drilling line is the steel wire rope reeved through the crown block and traveling block. It must be inspected, slipped and cut regularly.

Fig. 3. Drilling line

Potential Hazards:

- Receiving injuries to face and eyes from flying chips of metal when slipping and cutting the line.
- Being caught in moving equipment.
- Slips, trips, and falls.
- Being struck by drilling line.

Possible Solutions:

- Use proper lockout/tagout procedures. [1910.147]
- Wear proper personnel protective equipment when cutting line.
- Attach a red flag or other warning device to the drawworks clutch lever as a reminder to the driller whenever the crown safety device is moved or deactivated to allow the traveling block to be raised above the the preset stopping point.
- Secure drilling line ends prior to cutting.

Wire Rope Maintenance

∧ TOP

Visually inspect wire ropes daily or per maintenance schedule.

Potential Hazards:

- Getting cuts from the wickers or loose strands on the rope.
- Receiving injuries to face and eyes from flying chips when cutting wire rope.

Possible Solutions:

- Wear proper personnel protective equipment when cutting wire rope.
- Seize wire rope before cutting.

Fig. 4. Improper wire rope clamp placement "Never saddle a dead horse"

Fig. 5. Proper wire rope clamp placement

Mud Circulating System

∧ TOP

Maintenance activities include inspecting, adjusting, servicing on equipment such as mud pumps, hoses, hose connections, pop-off valve, shale shakers, belts, and guards.

Potential Hazards:

- Being caught between, or struck by equipment.
- Slips, trips, and falls.
- Receiving a foreign body or fluid in the eye.
- Burned by fluid contact.
- Drowning in mud tank/pit.
- Receiving strains and sprains.

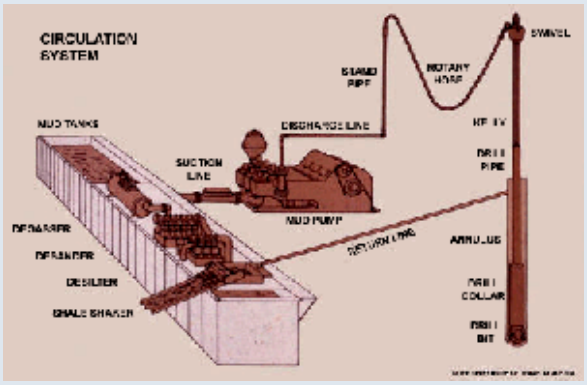

Fig. 6. Circulating system

Possible Solutions:

- Use proper lockout/tagout procedures.
- Wear personal protective equipment (such as hard hats, work gloves, safety shoes, and eye protection).
- Be aware of the slipping and falling hazards when working on the mud circulating system.
- Provide guardrails and guards around mud tanks.

Generator, Electric Motors and Electrical Systems

^ TOP

Electrical connections and power cords need to be checked for wear for deterioration and replaced if needed.

Electric motors need to be serviced at recommended intervals. All guards should be present and correctly installed and motors electrical connections need to be kept sealed.

Fig. 7. Electric control panel

Potential Hazards:

- Receiving flash burns or shocks when servicing motors, generators, and breaker panels.

Fig. 8. Electric rig motor

Possible Solutions:

- Do not wash down generators, electric motors and breaker panels with water hose.
- Use proper lockout/tagout procedures.
- Wear appropriate personal protective equipment.
- Avoid wearing jewelry.
- Do not stand directly in front of breakers when operating.
- Use dielectric mat in front of control panel or breaker panel.

Potential Hazards:

- Being caught in moving equipment.

Possible Solutions:

- Avoid wearing jewelry.
- Use proper lockout/tagout procedures.
- Wear appropriate personal protective equipment.
- Cover with appropriate shields or guards all exposed revolving parts such as belts, flexible drives, generators, shafts and other moving parts to prevent contact and injury.

Additional Information:

- Proper Electrical Safety (including hot sticks). AESC, 20 KB PDF, 4 pages.
- OSHA Safety and Health Topics:
  - Electrical
  - Machine Guarding

Engines

^ TOP

Engines require servicing at recommended intervals.

Fig. 9. Diesel rig engines

Potential Hazards:

- Getting burned by hot fluids or engine parts.

Possible Solutions:

- Wear appropriate personal protective equipment.
- Let engine cool down before working on it.
- Use proper lockout/tagout procedures.

Potential Hazards:

- Being caught in moving equipment or moving parts.

Possible Solutions:

- Wear appropriate personal protective equipment.
- Use proper lockout/tagout procedures.
- Cover all exposed revolving parts with appropriate shields and guards.

Derrick Equipment Maintenance

^ TOP

Maintenance activities in the derrick consists of lubricating the swivel, traveling block, and crown block, and replacement of swivel packing.

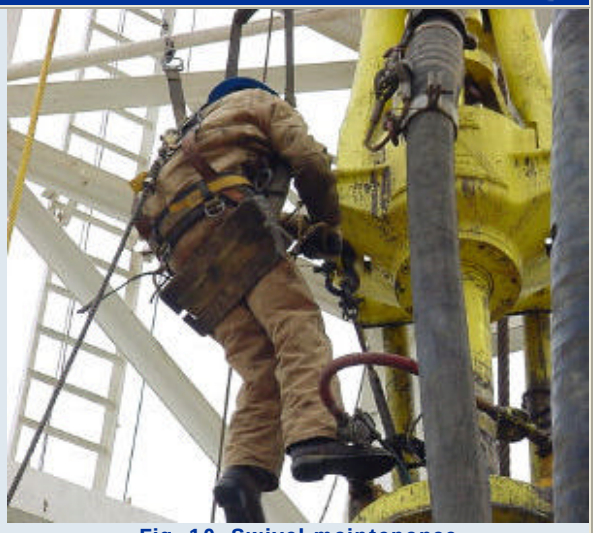

Fig. 10. Swivel maintenance

Potential Hazard:

- Getting caught between equipment and objects.

Possible Solutions:

- Use proper lockout/tagout procedures.

Potential Hazard:

- Falling from heights.

Possible Solutions:

- Use appropriate fall protection.

Potential Hazard:

- Being struck by falling tools or equipment.

Possible Solutions:

- Wear appropriate personnel protective equipment.
- Minimize the number of personnel working on the rig floor.
- Tie off tools.

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Drilling >> Well Control

Properly trained personnel are essential for well control activities. Well control consists of two basic components: an active component consisting of drilling fluid pressure monitoring activities, and a passive component consisting of the Blowout Preventers (BOPs). [More... BOPs]

The first line of defense in well control is to have sufficient drilling fluid pressure in the well hole. During drilling, underground fluids such as gas, water, or oil under pressure (the formation pressure) opposes the drilling fluid pressure (mud pressure). If the formation pressure is greater than the mud pressure, there is the possibility of a blowout.

The activities involved in well control are:

- Blowout Prevention Program
- Monitoring and Maintaining Mud System
- Installing BOPs, Accumulator, and Choke Manifold
- Testing BOPs Accumulators, and Choke Manifold
- Maintaining BOPs

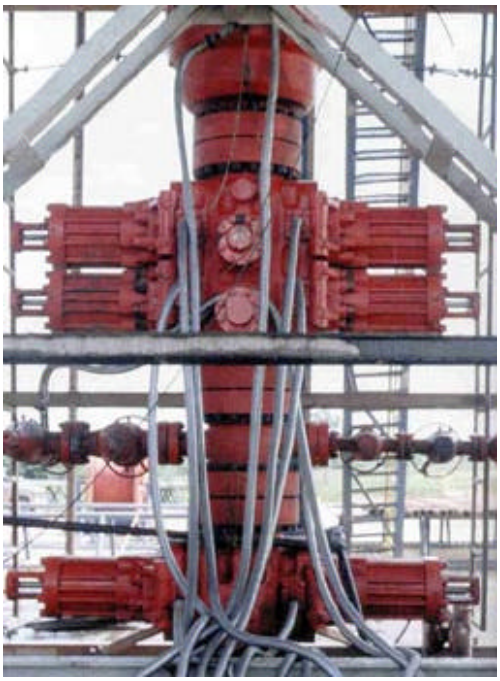

Fig. 1. Blowout preventer stack (BOP)

Blowout Prevention Program

^ TOP

Potential Hazard:

- Receiving injuries caused by loss of well control.

Possible Solutions:

- Appropriate training for tasks performed. Example topics include the following: (per IADC WellCAP)
  - Causes of kicks, including detection
  - Pressure concepts and calculations
  - Well control procedures
  - Gas characteristics and behavior

- Fluids
- Constant bottom hole pressure well control methods
- Well control equipment
- Regulatory information

- Use of appropriate well control equipment per API RP 53
  - Specification
  - Installation
  - Maintenance

Monitoring and Maintaining Mud System

∧ TOP

The mud circulatory system consists of the elements shown in the graphic to the right.

Each part of this system must function and be in good repair to maintain well control. [See Maintenance Activities for more...]

If the mud level increases, it may be a sign that a kick is in progress.

On some rigs there is a mud float level gage which sounds an automatic alarm if the mud exceeds a pre-specified level.

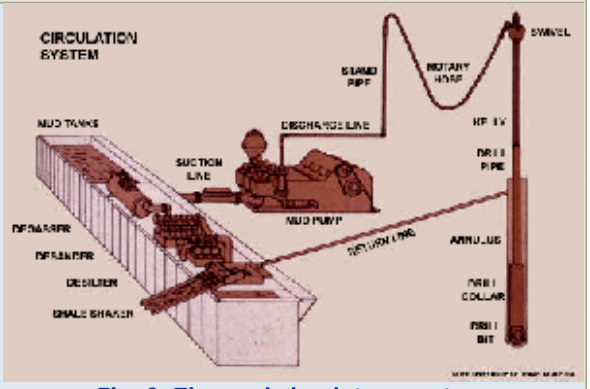

Fig. 2. The mud circulatory system
View larger image

Potential Hazard:

- Loss of well control (blowout)

Possible Solutions:

- Keep the mud circulating system in good working order.
- Check and maintain the properties of the drilling fluid, including proper pit level periodically.
- Properly train crew in monitoring and well control procedures.
- Maintain a properly functioning surface control system.

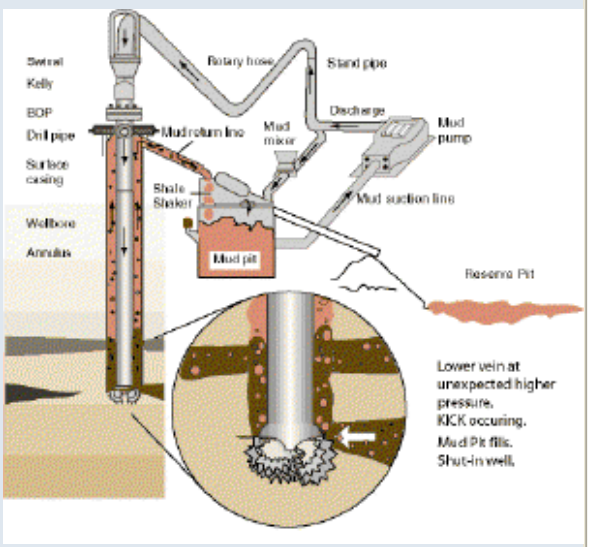

Fig. 3. Kick animation
View kick animation

Installing BOPs, Accumulator, and Choke Manifold

^ TOP

The blowout preventer (BOP), accumulator and choke manifold are installed by the rig crew after the surface casing is set and cemented. The accumulator and choke manifold have been set into place during rigging up and now need to be hooked up and tested.

Potential Hazards:

- Being crushed by falling equipment if hoisting slings fail.
- Being struck by, pinched by or caught between equipment during installation.

Possible Solutions:

- Ensure workers stand clear of equipment being hoisted and tag lines are used where appropriate.
- Coordinate hoisting tasks with rig crew.
- Inspect the hoisting slings for wear before any hoisting operation.
- Ensure all personnel wear proper PPE.

Additional Resources:

- The API has a recommended specification for the installation, use, and maintenance of this equipment: *RP 53 Blowout Prevention Equipment Systems for Drilling Operations, Current Edition.*

Fig. 4. Blowout Preventer (BOP)

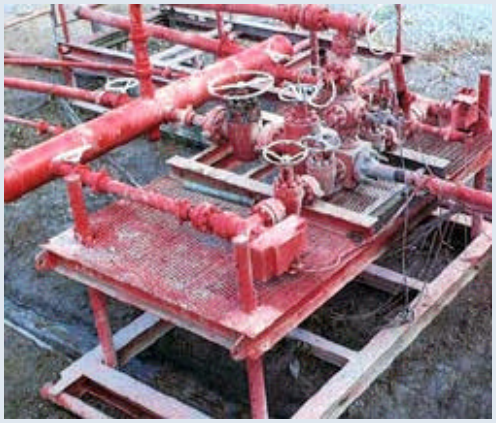

Fig. 5. Choke manifold

Testing BOPs, Accumulators, and Choke Manifold

^ TOP

The BOPs, accumulators, and choke manifold should be tested and properly maintained.

Potential Hazards:

- Being hit by hoses or sprayed by hydraulic fluid if there is a seal or hydraulic line failure during pressure testing.

Possible Solutions:

- Ensure workers stand clear of pressurized lines during testing procedures.

Fig. 6. Choke manifold

Maintaining Surface Control System

^ TOP

Properly maintain the surface control system.

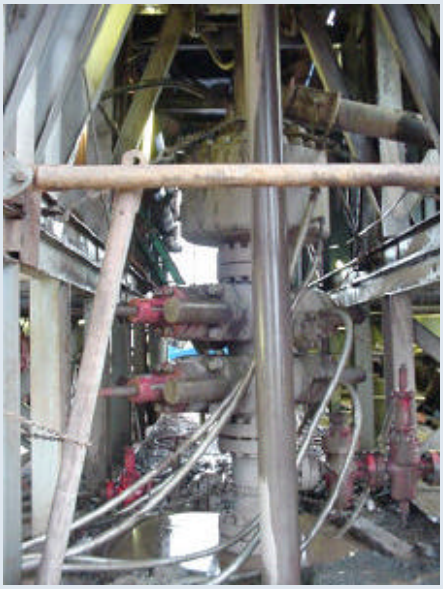

Fig. 7. BOP

Potential Hazards:

- Protruding pipes and objects
- Being struck by dropped objects.
- Slips, trips, and falls.
- Atmospheric hazards

Possible Solutions:

- Wear appropriate personal protective equipment (such as hard hats, work gloves, safety shoes, and eye protection).
- Implement injury awareness training (such as dropped objects, working from heights)
- Use appropriate fall protection.
- Ensure workers are aware of the slipping and falling hazards.
- Monitor for potential hazards (H_2S, methane, O_2 deficiency).

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Drilling >> Well Control >> Blowout Preventers

The second line of defense for the workers and the well to prevent a blowout is the group of equipment called blowout preventers (BOPs). BOPs and associated valves are installed on top of the casing head before drilling ahead after rigging up. These high-pressure safety valves and associated equipment are designed to shut off the well hole and prevent the escape of the underground fluids and prevent a blowout from occurring.

After installation, the BOP and associated valves are pressure tested to insure integrity and proper operations.

The BOP and associated equipment consists of:

- BOP Stack
- Annular BOP
- Ram-Type BOP
- Choke Manifold
- Accumulator

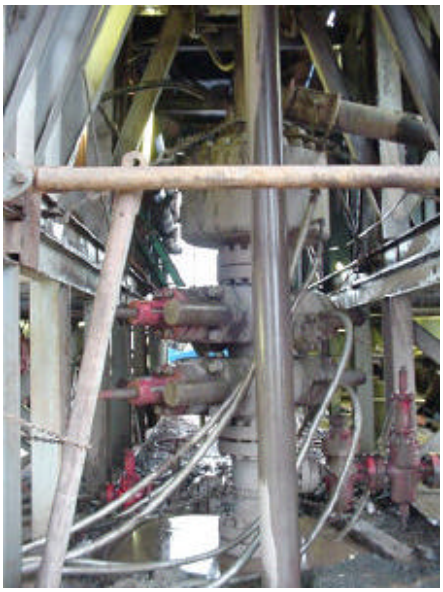

Fig. 1. Blowout preventer stack

BOP Stack

^ TOP

A BOP installation could consist of both annular and ram type BOPs assembled into a stack. Also, there can be a kill line valve and a choke line valve.

The choke line valve is used to redirect the mud from the well bore to the choke manifold during a kick.

The kill line valve is used to direct drilling fluid to the BOP during a kick.

Fig. 2. Blowout preventer stack

Annular BOP

∧ TOP

Annular BOPs are designed to form a seal in the annular space between the drill pipe and the wellbore and are usually mounted at the top of the BOP stack.

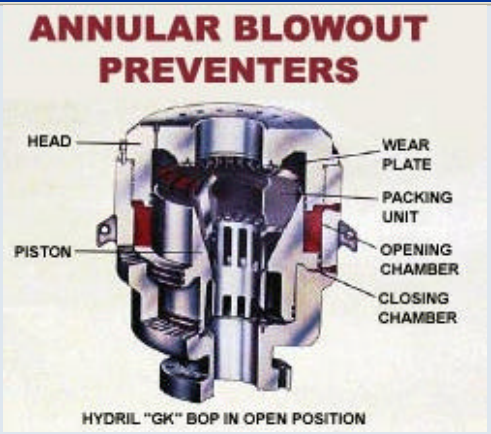

Fig. 3. Annular blowout preventer

Ram Type BOP

∧ TOP

Ram type BOPs have rubber faced steel rams that come together with great force to seal the wellbore. Usually two or more ram-type BOP's are mounted in the BOP stack.

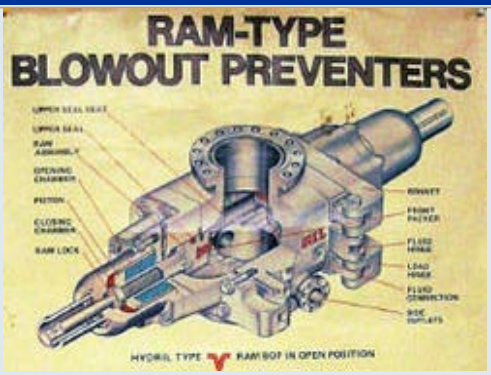

Fig. 4. Ram type blowout preventer

Choke Manifold

∧ TOP

A choke manifold is a system of valves used to circulate out a kick and to circulate mud in of the proper weight. This device responds automatically to a kick and can prevent a blowout if properly installed and maintained.

Fig. 5. Choke manifold

Accumulator

∧ TOP

The BOP control system, called an accumulator, provides the energy to operate the blowout preventers.

This system consists of:

- Compressed gas bottles,
- Regulator valves,
- Pumps,
- Hydraulic reservoir,
- Control manifold, and
- Control valves.

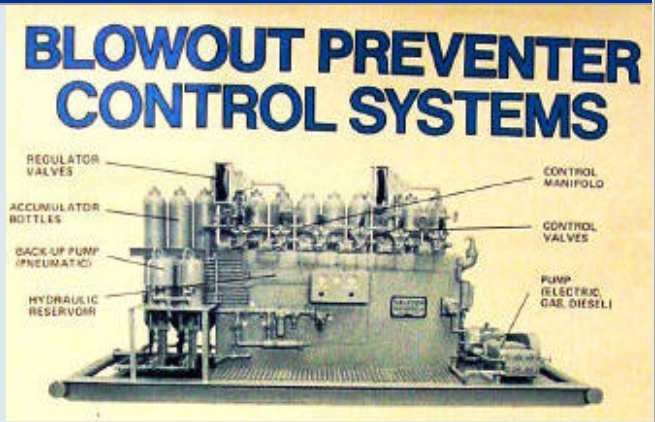

Fig. 6. Accumulator

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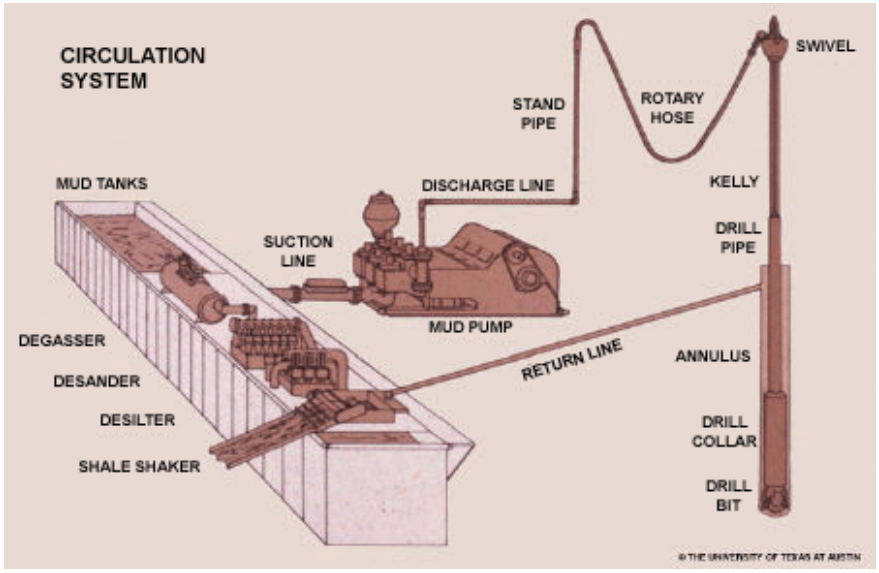
CIRCULATION SYSTEM
SWIVEL
STAND PIPE
ROTARY HOSE
KELLY
DISCHARGE LINE
MUD TANKS
SUCTION LINE
DRILL PIPE
MUD PUMP
DEGASSER
RETURN LINE
ANNULUS
DESANDER
DESILTER
DRILL COLLAR
SHALE SHAKER
DRILL BIT
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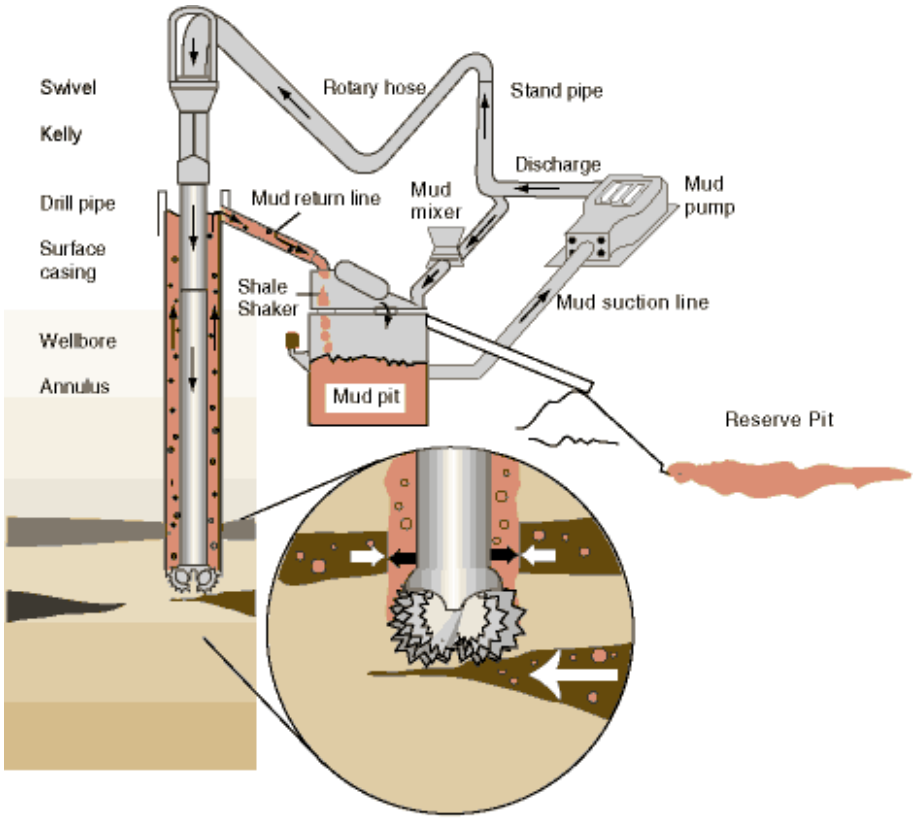
Swivel
Kelly
Drill pipe
Surface casing
Wellbore
Annulus
Rotary hose
Stand pipe
Discharge
Mud return line
Mud mixer
Mud pump
Shale Shaker
Mud suction line
Mud pit
Reserve Pit