CHAPTER IV
COMPREHENSIVE SAFETY RECOMMENDATIONS FOR OIL AND GAS WELL DRILLING

According to an evaluation of existing State (Alaska, California, Michigan, Utah, and Wyoming), international (Canada), and the consensus of industry (API, ANSI, NFPA) safety standards, presented in Appendix B, most of the operations, tasks, and equipment utilized in well drilling operations are covered by at least one existing safety standard. For these instances, the applicable standard, or a consolidation of the existing standards, has been incorporated into safety recommendations. For operations not covered in any standards, such as guarding kelly bushings, elevator latching procedures, positioning of slips, techniques for transfer of drill pipe from pipe racks to vee-door, and water rescue equipment for reserve pits, recommendations are based on direct observation of industry in operation, information from industry experts, and good safety practices. No attempt has been made to present safety recommendations for tasks, tools, equipment, or operations common to other industries; e.g., handtools, general machine guarding, sanitary facilities, welding, or blasting. Safety standards and safe work practices for these areas are adequately addressed in OSHA General Industry Standards (29 CFR 1910) and should be applied to the drilling industry.

The safety recommendations for oil and gas drilling operations have been organized into three major areas:

A. General safety recommendations
B. Safety guidelines for well drill machinery and equipment
C. Safe work practices

A. General Safety Recommendations

1. Employee Instruction, Training, and Testing

When initially employed, a worker should receive instruction and training pertinent to the hazards, safety precautions, safe work practices, and use of personal protective equipment applicable to the type of work performed.

The instructions should adequately orient and alert the new employee to:

- The basic principles of a well drilling operation, including the safe work practices and hazards associated with rig equipment
- The purpose and operation of blowout prevention
- Hydrogen sulfide and respiratory protection
- Fire prevention and control
- Confined spaces and entry procedures
- Personal protective equipment.

Each new employee should receive training in the safe use of all equipment or tools that are necessary for use and the safe performance of assigned tasks. The employer should require that the worker demonstrate his ability to safely operate the tool or equipment prior to using it in a drilling situation. If a new employee has been certified as qualified to operate the equipment or tool (by an approved training facility), then the training portion of this recommendation is not required. As an employee advances to new positions and tasks, he should demonstrate his knowledge and ability to safely operate the equipment and perform the tasks before he is required to perform them in a drilling situation. Retraining should be conducted as needed to ensure that employees are able to perform their tasks in a safe manner.

2. First Aid and Emergency Communication

Well sites may be located in remote and inaccessible areas. Anticipation of the emergencies likely to occur and appropriate contingency planning for them may save the lives of injured employees. Employers should develop and post a detailed emergency plan suitable for the current location of the well site, the surrounding population, formation pressures, and contaminants likely to be encountered.

a. First Aid

Drillers, tool pushers, supervisors, and persons in direct charge of crews in field operations should have a current certificate of first-aid training. There should be at least one employee with a current certificate of first-aid training at all well sites employing fewer than 15 persons. At well sites employing more than 15 persons, there should be at least two employees with current certificates of first-aid training.

First-aid equipment should be provided. This equipment should be stored in sanitary places, protected from weather, available to all shifts, and conveniently located. The first-aid kit should be at least a 24-unit size and should be inspected and replenished weekly or whenever 25% of a unit has been used. Additional first-aid equipment should include one set of inflatable arm and leg splints; two all-wool blankets, or blankets equal in strength and fire resistance; and one stretcher.

The stretcher should be designed to adequately support an injured worker during handling and transportaton. In case the ordinary collapsible type is not adequate to support the worker during handling and transportation, a basket stretcher with adequate straps and harness should be provided.

Provisions should be made prior to commencement of the project for prompt transportation of an injured person to a physician or hospital. An effective communication system should be established

to contact and direct the necessary medical/emergency teams to the proper location. Transport of seriously injured workers should not be undertaken by the employer unless personnel trained in moving injured persons are present and/or the injured would be further harmed by the delay. If the employer is going to transport an injured party, then the vehicles provided by the employer should:

- o Be of sufficient size and suitability to accommodate a stretcher and accompanying first-aid attendant within the body of the vehicle
- o Be designed and equipped so that there is a means of oral communication between the operator of the vehicle and the injured worker and accompanying first-aid attendant
- o Protect the injured worker and the first-aid attendant from the elements
- o Be clean.

Whenever possible, any seriously injured worker being transported should be accompanied by at least one person in addition to the driver. The driver or the accompanying person should have valid first-aid qualifications.

In areas where access by conventional transportation is not possible or the conditions of the road or terrain are detrimental to the welfare of the injured worker, an alternate means of transportation should be arranged for by the employer. A helicopter service would be one example of an acceptable alternate means of transportation.

b. Emergency Communication

More than one means of communication may be necessary to ensure prompt help in case of accidents or emergencies.

Telephone numbers of physicians, hospitals, and ambulances should be conspicuously posted. Explicit directions to the well site should be included on the posted notice (people tend to forget names and locations during medical emergencies). Ambulance and/or medical transport services should be kept informed of the rig's location and the best access routes.

In remote areas where telephones are not practical, radio equipment that is capable of communication with a station (manned company base station, police, or emergency base station) in one of the larger communities should be provided. Radio call signs and frequency settings should be posted. Radio schedules should be maintained and coordinated by personnel on drill sites with the nearby community stations.

3. Personal Protective Equipment

Personal protective equipment should comply with current ANSI standards.

a. Clothing

Loose, ragged, or poorly fitted clothing should not be worn. Rotating parts (catheads, kelly bushings, spinning chains) may snag the clothing and cause injuries. Gloves are commonly worn by drilling employees and should be discarded when they become ragged or torn.

If the clothing worn by an employee becomes contaminated by a hazardous substance, the employee should remove the clothing without undue delay. The clothing should not be worn again until the hazardous substance has been removed. Additionally, If the clothing worn by an employee becomes wet with gasoline, naphtha, kerosene, light distillate, or light oils, the employee should not remain, or be required to remain, in a location where his clothing is in danger of igniting.

Employees should not be permitted to work with bare heads, bare arms, or other portions of their bodies uncovered in areas where they may be exposed to burns from corrosives or hot substances. Skin absorption of chemicals is not unusual and may result in skin rashes, chemical burns, and/or systemic poisoning.

Employees should not be permitted to wear jewelry or other adornments subject to snagging. Rings frequently snag on equipment or tools, which may result in the finger being pulled off.

Employees with long hair should keep it contained in a suitable manner while working. Hair and beard styles should not interfere with the wearing of head, eye, face, or respiratory protective equipment. As a condition of employment, employees working in medium or high hazard hydrogen sulfide environments should not be allowed to wear beards since the facial hair lying between the sealing surface of a respirator facepiece and the wearer's skin will prevent a good seal.

b. Foot Protection

Safety-toed boots should be worn in the working area.

c. Head Protection

Safety hats (hardhats) should be worn by each person in the work area. Hardhats should be secured by a chinstrap when worn in the derrick structure. When cold weather conditions dictate,

industrial protective winter liners for the hardhats should be made available to workers.

d. Eye Protection

Properly fitted goggles, face shields, or other eye protection equipment, appropriate to the work being done, should be provided by the employer and worn by workers handling, or exposed to, material liable to injure or irritate the eyes, or when engaged in any work in which there is an eye hazard from flying objects, injurious light, heat rays, or other type of radiation.

- o Goggles or face shields should be worn when mixing mud or chemicals.
- o Goggles and/or face shields should be worn when using a grinder.
- o Cutting goggles (of appropriate density) should be worn when using a cutting torch. Goggles protect the eyes from flash burns and slag.
- o Welders should wear welding shields. Helpers and coworkers should be protected from "flashes" by dark flash glasses. If the welding is of some duration, then the use of flash screens is desirable. Welders or helpers performing chipping operations should be protected from slag "pop" by goggles and/or face shields.

Where harmful chemicals are being used, readily accessible facilities for rapid flushing of the eyes and/or skin should be available. Eyewash facilities should be provided on the drill floor as well as in the mud-mixing area. At a minimum, one quart of potable water, protected from freezing, should be immediately available in those areas. An additional four quarts of flushing liquid should be readily available to continue flushing the eye.

e. Hearing Protection

Whenever noise exposure on a time-weighted average (TWA) is more than 90 db(A) [68], worker protection should be ensured either by using engineering controls which reduce noise levels, or by providing and requiring the use of appropriate protective equipment.

Areas and operations where appropriate engineering controls/ noise abatement techniques should be considered are:

- o Engines - layout, sound barriers, employee isolation, or proximity to rig floor
- o Electrical generators - layout, sound barriers, location
- o Power transfer (belts, pulleys, compounds) - sound barrier.

Hearing protection should be provided to all employees working at the drill site. Disposable earplugs should be readily available at the doghouse or drill floor. Alternatively, individual earplugs or ear muffs could be distributed at the time of employment. Ear muffs should be supplied to, and worn by, employees working on or near engines, transmissions, compounds, or generators that expose workers to excessive sound levels.

4. Fall Protection

Falls from elevated areas account for a relatively low percentage of the accidents that occur in drilling operations; however, those accidents that do occur usually are severe or fatal. Most of the falls occur while erecting the derrick, climbing the derrick ladders, or working from one of the platforms. Adequate worker protection can be provided during most, if not all, of these situations by the use of safety belts, lifelines and lanyards, safety nets, and climbing devices.

a. Safety Belts

When engaged in work 10 feet or more above the derrick floor, a worker should use a safety belt attached to a lanyard adequately secured to the structure, unless he is protected by another approved method. Workers engaged in racking pipe at the stabbing board, finger board, or other platform should be provided with, and wear, a safety belt. The use of a belly buster does not eliminate the need for a safety belt.

b. Lifelines and Lanyards

Lifelines and lanyards should be a minimum of 1/2-inch nylon, 3/4-inch manila, or equivalent, and should have nominal breaking strength of 5,400 pounds [68]. Safety belt lanyards should have a maximum length to provide for a fall of no more than 6 feet [68].

When an employee is at the stabbing board, the fall protection lanyard should be securely attached to:

- A manila or wire rope with a breaking strength not less than 9,000 pounds stretched across the derrick at a location approximately 7 feet above the stabbing board
- A solid support secured in the derrick at a location approximately 7 feet above the stabbing board
- A cross-member of the derrick structure at a point approximately 7 feet above the stabbing board [69]
- The derrick board handrail behind the worker.

c. Safety Nets

Safety nets should be provided as an alternative when work areas are more than 25 feet above the ground or water surface, or other

surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical. Operations should not be undertaken until the net is in place and has been tested [68]. To provide adequate worker protection:

- o Nets should extend 8 feet beyond the edge of the work surface where employees are exposed and should not be more than 25 feet below such edge.
- o The mesh size of nets should not exceed 6 inches by 6 inches. All new nets should meet accepted performance standards of 17,500 foot-pounds minimum impact resistance, as determined and certified by the manufacturers, and bear a label-of-proof test. Edge ropes should provide a minimum breaking strength of 5,000 pounds.
- o Forged steel safety hooks or shackles should be used to fasten the net to its supports.
- o Connection between net panels should develop the full strength of the net.

Nets can be augmented by the addition of debris and/or slag netting that protects employees from tools, bolts, and hot slag falling from above.

d. Climbing Devices

Ladder-climbing or fall-arresting devices should be used on the derrick ladder. Derrickmen should always climb the ladder rung by rung and not be permitted to "ride" the climbing device.

5. Confined Workspaces

The most important concept to follow when entering a confined space is to NEVER TRUST YOUR SENSES. What appears harmless may in fact be deadly. Employers and workers should consider each confined space to be life threatening. In general, confined spaces are enclosed areas, having limited access/egress, that may be subject to the formation of toxic atmospheres.

a. Life-Threatening Hazards

(1) Toxic gases and vapors

Tanks, cellars, and enclosures are all examples of areas that can be subject to the accumulation of toxic gases. Hydrogen sulfide may be a contaminant of petroleum formations and as such may be released in deadly concentrations during well drilling operations. Cellars, shale shakers, and deposition areas are subject to buildup of the hydrogen sulfide. Such areas, when confined or enclosed, should be treated as DEADLY. Carbon monoxide is produced by incomplete combustion

of carbon products. It is a likely byproduct of compressors or other gasoline and diesel engines. Enclosed or confined areas adjacent to an engine exhaust should also be treated as contaminated.

(2) Flammables and/or explosives

Tanks, cellars, and enclosures are also subject to the accumulation of flammable vapors (hydrogen sulfide is also combustible and explosive at concentrations between 4.5% and 45% in air). The hydrocarbon gases being drilled for are also highly explosive when mixed with air. Tanks and cellars at well sites should be considered explosive until tests prove otherwise.

(3) Lack of oxygen

The OSHA acceptable minimum oxygen level is 19.5% of the atmosphere. [70]

b. Entry into Confined Spaces

Entry into a confined space should not be permitted until a formal written document is completed and signed by the tool pusher. This document should include what preparations have been made, the results of tests, the work to be done, tools to be used, and precautions to be taken. All personnel involved with the entry should be made familiar with these facts. A copy of this document should be maintained at the job site.

Prior to entry, the atmosphere of the confined space should be tested from the outside for flammability, toxicity, and oxygen content to ensure the absence of material harmful to personnel. Retesting should be done at intervals frequent enough to ensure that this condition is maintained while the space is occupied [71]. There should be provisions for immediately securing and posting a warning against unauthorized entry at the entrance to any confined space tested and found unsafe.

Where it is impossible or impractical to obtain safe conditions, approved personal protective equipment that protects against all entry modes for materials in question should be used. Equipment that may be necessary for safe entry may include [71]:

- Self-contained breathing apparatus (NIOSH/MSHA approved)
- Safety harness and lifelines
- Communication system
- Lights
- Resuscitation equipment
- Protective clothing.

Proper preparation should be the objective--protective equipment is the insurance.

The first person entering a confined space that contains, or is known to have contained, a harmful substance should wear a safety belt with a lifeline attached that is manned by an employee having the equipment and capability to effect a timely rescue. If it can be ascertained that conditions are as tested and can be maintained at that level, work can proceed without safety belts. In all cases, the rescue capability should be maintained at the appropriate entry area to assist in case of emergency.

While any employee is in a confined area, a standby person should remain at the entrance opening. The attendant should be provided with safety equipment similar to that required for employees inside the area. NOTE: If a worker is overcome by a toxic atmosphere, that same toxic atmosphere will affect unprotected persons entering the area to perform a rescue. Attendants and/or rescue personnel should be fully equipped (with a ready standby person) before effecting an emergency entry.

It may be necessary to remove materials such as sludge, polymers, or other materials from a confined space. This task may liberate vapors and/or gases that could change the test results obtained earlier. Monitoring, ventilation, and/or protective equipment should be provided and used to properly handle this task.

6. Signs and Labeling

Warning signs should be posted to denote any unusual or hazardous situation. Warning signs should be posted in areas where the use of personal protective equipment is necessary. Identification signs should be conspicuously posted to locate emergency equipment. Containers of poisonous, toxic, flammable, and/or explosive material should be properly labeled and appropriately stored according to content. Signing must conform to OSHA standards.

7. Hydrogen Sulfide Environments

All well drilling sites should be classified into areas of potential and/or actual exposure to hydrogen sulfide by the definitions outlined below. The safety recommendations made are a minimum. The American Petroleum Institute (API) "RP 49: Recommended Practice for Safe Drilling of Wells Containing Hydrogen Sulfide" [72] details recommendations in more depth and should be followed in all medium and high exposure areas.

Definitions of hydrogen sulfide hazard areas and the precautions to be taken are as follows [73]:

a. No Hazard Area--any well that will not penetrate a known

hydrogen sulfide formation. No special hydrogen sulfide equipment is needed.

b. Low Hazard Area--any well that will penetrate a formation containing hydrogen sulfide that could result in atmospheric concentration of 10 ppm or less and/or in which the hydrogen sulfide zone has been effectively sealed off by casing/cementing and/or cementing method. The following are recommended for low hazard areas:

   o Two 30-minute, self-contained breathing apparatus for emergency escape from the contaminated area only.

c. Medium Hazard Area--any well that will penetrate a formation containing hydrogen sulfide and is not defined as a low or no hazard area, including all exploratory (wildcat) well sites. The following are recommended for medium hazard areas:

   o NIOSH/MSHA approved manifold air masks with emergency escape cylinders for each employee
   o Two NIOSH/MSHA approved, 30-minute, self-contained breathing apparatus for emergency escape from the contaminated area only
   o Two wind socks and streamers
   o Oxygen resuscitator
   o A properly calibrated, metered hydrogen sulfide detection instrument
   o Audible and visual alarm system.

d. High Hazard Area--any operation expected to bring free hydrogen sulfide gas to the surface. The following are recommended for work in high hazard areas:

   o Two NIOSH/MSHA approved, 30-minute, self-contained breathing apparatus for emergency escape from the contaminated area only
   o Three wind socks and streamers
   o Oxygen resuscitator
   o Two hydrogen sulfide detectors. One should be a properly calibrated, metered detection instrument, and the other should be a pump type with detector tubes.
   o A separate audible and visual warning system
   o Employees should not be permitted on location without hydrogen sulfide safety training. Employees may be permitted on location for specific hydrogen sulfide training purposes not to include general rig training.
   o Two means of egress at each location in a high hazard area should be provided.
   o A means of communication or instruction for emergency procedures should be established and maintained on location along with the names and telephone numbers of the person or

persons to be informed in case of emergencies.
- o Signs should be posted 500 feet from the location on each road leading to the location warning of the hydrogen sulfide hazard.
- o All hydrogen sulfide safety equipment should be checked to ensure readiness before each tour change.

e. Employee Instructions

Employees present at all medium and high hazard hydrogen sulfide wells should be instructed in the use of the hydrogen sulfide safety equipment provided onsite. Hydrogen sulfide safety instruction should be given by a qualified person(s). The instruction of personnel should include, as a minimum, the following elements:

- o The characteristics of hydrogen sulfide and its hazards
- o Proper first-aid procedures to be used in a hydrogen sulfide knockdown
- o Use of personal protective equipment
- o Use and operation of all hydrogen sulfide monitoring systems
- o Corrective action and shutdown procedures.

8. Illumination and Lighting

Lighting around a derrick should be sufficient to provide illumination at all times of at least:

- o An average of 5 footcandle (fc) power on the whole of the derrick floor, with no less than 3 fc power at any point
- o 5 fc power at the finger board, mud pumps, and catwalk
- o 3 fc power at the shale shaker, stairways, and other working areas
- o A minimum of 3 fc power at all other walking and working surfaces [69].

(NOTE: The above are minimum recommendations. Many circumstances, including weather, may warrant higher lighting values.)

Vehicle lights should not be used in lieu of rig lights for lighting of rig operations except in emergency. Lamps and reflectors should be cleaned frequently. Light beams should be directed toward the objects to be illuminated and away from the eyes of the workmen. All light cords and plug-ins should be kept in good condition.

9. Fire and Explosion Prevention and Detection

a. General Requirements

The employer should develop a fire protection program to be followed throughout all phases of the operation. Appropriate

firefighting equipment should be provided. Access to the firefighting equipment should be maintained at all times. A minimum of four fire extinguishers having a minimum rating of 40 B:C should be conveniently located at the rig. Additional extinguishers should be provided for the doghouse, the cellar, the generator area, and any flammable liquid storage areas.

Firefighting equipment should be periodically inspected and maintained in operating condition at all times [74]. A record should be kept showing the date when fire extinguishers were last inspected, tested, or refilled. After any use, fire protection and firefighting equipment should be made serviceable and returned to its proper location.

b. Fire Prevention

Smoking, open flames, or spark-producing equipment should be prohibited in areas subject to contamination or accumulation of flammable liquids or gases. Areas for the prohibition of smoking and open flame should include all areas within 75 feet [73] of the:

- o Well head or shale shaker, whenever potentially hydrocarbon-bearing formations are exposed in the well
- o Degasser while it is operating
- o Fuel storage areas.

The following procedures should be followed in areas where smoking and open flames are prohibited:

- o Striking matches anywhere should be prohibited.
- o Cigar/cigarette lighters and smoking materials should not be permitted.
- o "No Smoking" or "No Open Flame" signs should be conspicuously posted.

Exhaust pipes from internal combustion engines, located within 75 feet of any well bore or in other nonsmoking areas, should be so constructed and used that any emission of flame or spark is suppressed.

Engine-driven light plants should be located at least 75 feet from the well bore unless properly protected to prevent them from becoming a source of ignition and should have an adequate overload safety device.

Welders' torch lighters of the spark type should be prohibited in areas where the atmosphere is contaminated by flammable vapors or gases or where sources of ignition are forbidden, unless sheathed or otherwise protected against accidental operation.

Employee heating devices involving the use of an open flame or

exposed electrical element should not be allowed in any crew doghouse located on the derrick, mast floor, or within 75 feet of the well bore. Heaters should be safely located more than 75 feet from the well bore or have an explosion-proof design.

c. Flare Pits and Flare Lines

Flammable waste vapors or gases should be burned or controlled to prevent hazardous concentrations from reaching sources of ignition or otherwise endangering employees. When a flare is used to burn flammable waste gases or vapors, the following precautions should be taken:

- o Flare pits should be lit from the upwind side. When there is no wind or when the wind direction is undetermined, no attempt should be made to light the pit unless the operator can position himself in an explosive-free area. The use of hand-thrown rags or similar flaming objects should not be permitted [73].
- o Reliable and safe means of remote ignition should be provided when hydrocarbon gases are released to the air through flares.
- o Flares should be located in such a manner that unburned gases or vapors will be dispersed without creating a hazard to employees.
- o Means should be provided to prevent the prolonged escape of hazardous quantities of unburned gases or vapors from flare installations. Automatic warning devices are acceptable, provided they are tested at such regular intervals that their operation will be assured.
- o Where a flare has been extinguished, and the means of igniting the flare has failed, employees should not enter or be required to enter the involved area for the purpose of relighting, until tests have established that the area is free from flammable gases or vapors.
- o All combustible material should be cleared for a safe distance from the flare pit or end of the flare [75].

d. Lightning and Static Electricity

Each stationary and portable steel derrick and mast in use where flammable vapors or gases are present (or may escape to the atmosphere in sufficient quantity that the ignition would endanger the safety of employees) should be effectively grounded to a ground pipeline, well casing, or other equivalent source of grounding. Where not effectively grounded or bonded by contact or connection, provisions should be made to prevent the accumulation of a static electrical charge, which could create a source of ignition in the presence of flammable vapors or gases.

Conductors, used for bonding and grounding stationary equipment or conductors, should be of copper wire no smaller than No. 8 American Wire Gauge. Bonding and grounding clamps or clips should be attached with secure and positive metal-to-metal contact.

e. Flammable and Combustible Liquids

Only approved containers and portable tanks should be used for storage and handling of flammable and combustible liquids. Approved safety cans should be used for the handling and use of flammable liquids in quantities greater than 1 gallon [68].

No persons (except those having necessary duties or those authorized by the employer) should be permitted within the vicinity of a job or operation where the atmosphere is known to be contaminated with hazardous concentrations of flammable vapors or gases.

Material used for cleaning should not have a flashpoint less than 100° F; therefore, gasoline and naphtha should not be used [73]. Smoking or open flames should not be allowed within 75 feet of the handling of flammable liquids. Oxygen should not be stored or used in the vicinity of flammable liquids.

Any engine being refueled should be shut off during such refueling. An electrical bond should be maintained between containers when a flammable liquid is being transferred from one to the other. Dispensing nozzles and valves should be of the self-closing type [73].

Except for the fuel in the tanks of the operating equipment, no flammable fuel should be stored within 75 feet of a well bore. Drainage from any fuel storage should be in a direction away from the well and equipment. Spills should be immediately cleaned up [73]. The area around all storage facilities should be maintained reasonably free of oil, grease, and other combustible materials.

Fuel storage tanks should be protected by crash rails or guards to prevent physical damage unless by virtue of their location they have this protection. Adequate berms should be placed around storage tanks [70].

10. Electrical

a. Electrical Hazard Zones

Areas of the drilling rig are classified into "electrical hazard zones" based on the operative potential of release and accumulation of flammable gases [74]. Electrical equipment used in these zones must conform to OSHA regulations [70].

b. Grounding and Bonding

All temporary, 120-volt, single-phase, 15- to 20-ampere flexible electrical cords and receptacles must conform to OSHA grounding and bonding requirements by having a ground-fault circuit interrupter system or an assured equipment grounding program [70].

11. Blowout Prevention

Employees should be adequately trained to properly respond in the event of a "kick." Employees should recognize the importance of the circulating fluid in controlling formation pressure and the relationship of increasing mud return rates and subsequent pit gain in increasing formation pressure.

A blowout preventer operating test should be performed on each round trip but not more than once per day [76]. Blowout prevention equipment should be in accordance with the U.S. Geological Survey requirements. Blowout prevention equipment should be substantially constructed and securely fastened in place. Blowout prevention equipment should be maintained in a manner that will assure its proper functioning through the drilling operation. Unobstructed access to all blowout preventer controls should be maintained. Blowout preventer controls should be clearly identified as to their proper function.

Drilling operations should not proceed until blowout prevention equipment is found, upon test, to be serviceable. Additional recommendations for blowout prevention equipment systems, inspection, and testing are contained in API "RP 53: Recommended Practice for Blowout Prevention Equipment Systems" [76] and should be followed.

A kelly cock (upper safety valve) should be placed between the kelly and rotary swivel, and a lower kelly valve should be used below the kelly. Such stopcocks or controls should be of adequate strength to withstand the pressures and stresses imposed on them under normal use and predictable circumstances [76].

If the blind rams are closed for any purpose, the valves on the choke lines or relief lines below the blind rams should be opened prior to opening the rams to bleed off any pressure. Employees should not be permitted to stand near or over the opening in the rotary table when the blind rams or drill pipe rams are opened. Choke lines or relief lines should be secured or tied down to prevent whipping under pressure surges.

Additional controls may be installed wherever desired, provided, however, that such additional controls can in no way interfere with the proper closing function of the controls required by the section above. Such additional controls need not be shielded or sheltered. It is recommended that additional controls be located at a point conveniently near the driller's station so as to facilitate quick action in case of emergency.

12. Inspection, Testing, and Maintenance of Rig Components

A record or log of all inspections, testing, maintenance, and adjustments and repairs should be kept at the well site.

a. Inspection

(1) Initial inspection

- o Prior to initial use, all new and altered rigs should be inspected to ensure compliance with the recommendations made in section B., Safety Guidelines for Well Drilling Machinery and Equipment.
- o The inspection procedure for rigs in regular service is divided into two classifications based on the intervals at which inspections should be performed. The intervals depend on the nature of the critical components of the drilling rig and the degree of their exposure to wear, deterioration, or malfunction. The classifications are: "frequent" inspections, which should be performed at daily to monthly intervals and after every rig-up, and "periodic" inspections, which should be performed at 1- to 12-month intervals.

(2) Frequent inspection

- o The following items should be inspected for defects at daily to monthly intervals or as specifically indicated, including observation during operation for any defects that might appear between regular inspections:
  - All functional operating mechanisms, for maladjustment interfering with proper operation (daily) and for excessive wear of components
  - The weight indicator, for ascertaining whether the indicator is recording the estimated weight of the drill string (daily)
  - Lines, tanks, valves, drain pumps, and other parts of air or hydraulic systems, for deterioration or leakage (daily)
  - Hooks, for cracks, more than 15% in excess of normal throat opening, or more than a 10 degree twist from the plane of the unbent hook (daily); if any of these defects are observed the hooks should be discarded.
  - Hoist or load attachment chains, including end connections, for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer's recommendations (daily)
  - Rope slings, including end connections, for excessive wear, broken wires, stretch, kinking, or

twisting (daily)
- Rope reeving, for noncompliance with manufacturer's recommendations.

o All deficiencies should be examined carefully and a determination made as to whether they constitute a safety hazard.

(3) Periodic inspection

Bails, elevator links, upper side hook saddles, A-leg pins, and housing should be inspected for flaws at least once each year and each time the derrick or mast is rigged up. All derricks should be visually inspected each year of use. A written report of these inspections should be kept on file [77].

A complete inspection of the hoisting mechanism should be performed periodically at 1- to 12-month intervals depending on activity, severity of service, and environment or as specifically indicated below. If any of the following deficiencies exist, the member should be either replaced or repaired:

- o Deformed, cracked, or corroded members
- o Loose bolts or rivets
- o Cracked or worn sheaves and drums
- o Worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers, and locking or clamping devices
- o Excessive wear on brake system parts, linings, pawls, and ratchets
- o Load indicators over their full range, for any significant inaccuracies
- o Gasoline, diesel, electric, or other powerplants for improper performance or noncompliance with applicable safety requirements
- o Excessive wear of chain drive sprockets and excessive chain stretch
- o Electrical apparatus, for signs of pitting or any deterioration of controller containers, limit switches, and pushbutton stations.

b. Testing

(1) Load test

Prior to initial use, all new, extensively repaired, and/or altered rigs should be tested under the direction of an authorized person. Before the drilling line is installed on the drum of the drawworks, the brake lining should be set or

"burned in" by setting the brake and rotating the drawworks unless otherwise specified by the manufacturer of the brake lining. After pressure is applied on the brake, the engines should be loaded to almost stall. Next, the drilling line should be installed on the drum of the drawworks and the drilling line strung through the traveling block and the crown block. The derrick should then be raised a few inches off of the derrick stand, held in that position for several minutes, and checked for excess strain on the mast, substructure, and all hoisting lines and component parts.

(2) Operational tests

Prior to initial use, all new and altered hoisting mechanisms should be tested to ensure the safe operation of:

- o All hoisting and lowering equipment
- o All limit switches and locking and safety devices.

c. Maintenance

A preventive maintenance program based on the drilling rig manufacturer's recommendations should be established. Adjustments and repairs should be made only by designated, qualified personnel.

When maintenance or servicing is to be accomplished on electrical lines, air lines, gas lines, or other lines containing hazardous materials, the line being worked on should be rendered safe by disconnecting, emptying, purging, or other means before work is begun.

Energized systems (electrical, mechanical, or thermal) should be locked out and tagged prior to initiating maintenance or repair work.

After adjustments and repairs have been made, the rig should not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.

d. Adjustments and Repairs

Adjustments should be maintained to ensure correct functioning of components. The following are examples:

- o All functional operating mechanisms
- o Limit controls
- o Control systems
- o Brakes
- o Powerplants.

Repairs or replacements should be made promptly as needed for safe operation. The following are examples:

- o Hooks showing defects should be discarded. Repairs by welding or reshaping are not acceptable.
- o Load attachment chains and rope slings showing defects
- o All critical parts that are cracked, broken, bent, or excessively worn.

B. Safety Guidelines for Well Drilling Machinery and Equipment

1. General Recommendations

Setting depths of all casing strings should be determined by taking into account formation fracture gradients and the maximum anticipated pressure to be maintained within the well bore [73, 78].

If and when it becomes necessary to run a production tubing, such casing should be cemented by the pump and plug method and should be properly tested by the pressure method before cement plugs are drilled [73, 78].

Drilling should not commence until:

- o All guards, including those for the drawworks, are in place on all equipment to be operated
- o All platforms, stairways, and handrails are secured in position
- o The mast is secured; if pins are used, they should be secured by safety pins.

The escape line with buggy (geronimo) should be installed before the derrickman's first exposure in the derrick, usually at the time of the first trip. Machinery or equipment should be constructed, protected, placed, operated, and maintained to afford reasonable safety from accident to persons in and around drilling facilities.

Machinery and equipment should be operated only by persons authorized by the employer.

Cleaning and oiling machinery while it is in motion should be prohibited in all cases where exposure to harmful contact with moving parts is possible. Before any machinery or equipment is to be repaired, it should be shut down. The power should be disconnected, the control device tagged and locked out or otherwise made inoperative, and the key retained on the person making the repairs. Tags used for this purpose should warn against starting such machinery. Before any person starts any machinery or equipment, he should make certain that no person will be endangered by the equipment's being put into motion.

All belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, or other reciprocating and rotating parts, with the exception of the rotary table, kelly, kelly-drive bushing, and cathead, should be guarded

unless they are guarded by location; i.e., so positioned as to prevent any person from coming in contact with them. Specific safety recommendations for the design, guarding, and operation of the kelly bushings, catheads, and rotary tables are made in applicable categories.

On rotary drilling rigs, every counterweight above the derrick or mast floor and located inside the mast when not fully encased or running in permanent guides, should be attached to the frame of the derrick with a separate wire rope or chain safety line, adequate to prevent the counterweight from coming within 8 feet of the floor.

Tools, machine parts, or material of any kind should not be kept in a derrick or mast above the floor unless they are in use, in which case reasonable precautions should be taken to prevent their falling on persons below. Where pipe hooks are used above the derrick floor, every pipe hook should be secured to the derrick in a manner that will prevent the hook from falling.

Whenever it is reasonably practicable, the engine room, pump house, derrick floor, and racking platform should be adequately enclosed to a sufficient height to provide suitable protection for workers during seasons of inclement weather.

Machines designed for a fixed location should be securely anchored to prevent vibrational walking or moving.

An emergency stop device should be provided for each prime mover for drilling machinery. The device should be one that, once placed in the stop position, should be manually reset to the starting or running position before the prime mover can be started.

2. Weight Indicators

A weight indicator should be provided and used on every drilling rig and should be so constructed, installed, and maintained that it will register $\pm$5% of the load suspended from the hoisting lines. Calibration of the weight indicator should be performed by comparing the indicated drill string weight with the calculated weight. The calibration should be performed monthly, after each rig relocation, or more frequently as dictated by driller experience. The results should be recorded. Any weight indicator hung above the floor should be secured to the derrick by means of a wire rope, safety line, or chain, or equivalent means.

3. Derricks and Masts

a. General

Derricks and masts should have a permanent nameplate attached to the structure indicating the following:

- Name of manufacturer

- o Model number and serial number
- o Rating including static hook load capacity with number of lines
- o Whether guying is applicable and, if so, the recommended guying pattern [74, 79, 80].

(NOTE: Derricks or masts constructed before this safety recommendation should have this same information recorded and available at the well site.)

Every derrick and its component parts should be constructed to conform to good engineering practices and should be maintained in safe condition. Bolts, nuts, and pins on elevators, wire lines, and catlines, as well as sheave and other anchor bolts in the derrick or mast, should be secured with cotter pins and lockwashers, or equivalent means.

b. Foundations

Every derrick in operation should be supported by a foundation. The derrick or mast and foundation should not be loaded beyond its design capacity. Where necessary to avoid exceeding the safe bearing capacity of soil on the location, supplemental footing should be provided to distribute concentrated loads from the derrick or mast and mast mount to the ground. The area and type of supplemental footing should be capable of distributing the gross weight of the derrick or mast under maximum anticipated hook load and loads imposed during raising and lowering of the structure [74]. Table IV-1 indicates the typical safe bearing capacity of several types of soils.

Foundation pads for drilling rigs should be graded and adequately drained. Location sites should be constructed and maintained so that oil, water, drilling fluid, and other fluids will drain away from the working area.

All auxiliary parts of derricks should be substantially constructed and maintained in a safe condition.

Reasonable provisions should be made to prevent derricks from collapsing as a result of wind velocity. This may be accomplished by using either one or both of the following methods:

- o Using an adequate number of sufficiently strong guy lines arranged and anchored as specified by the rig manufacturer or in accordance with accepted engineering practices
- o Constructing the derrick and foundations to resist overturning in accordance with accepted engineering practices.

TABLE IV-1
SAFE BEARING CAPACITY OF SOILS

Type of Soil	Safe Bearing Capacity (pounds/sq ft)
Soil ledge of hard rock, such as granite, trap, etc.	50,000-200,000
Sound shale and other medium rock requiring blasting for removal	20,000-30,000
Hard pan, cemented sand, and gravel difficult to remove by picking	16,000-20,000
Soft rock, disintegrated; in natural ledge difficult to remove by picking	10,000-20,000
Compact sand and gravel requiring picking for removal	8,000-12,000
Hard clay requiring picking for removal	8,000-10,000
Gravel, coarse sand in natural thick beds	8,000-10,000
Loose, medium, and coarse sand; fine, compact sand	3,000-8,000
Medium clay, stiff but capable of being spaded	4,000-8,000
Fine, loose sand	2,000-4,000
Soft clay	2,000

Source: Mark's Standard Handbook for Mechanical Engineers [81].

c. Anchors and Guying

Expanding anchors, pipe anchors, concrete anchors, or anchors otherwise engineered to prevent overturning should be used in accordance with the manufacturer's recommendations. Trees, rocks, driven stakes, or other temporary, movable objects should not be used for anchoring. Soil conditions, terrain, and use of surrounding land will determine the most applicable type of anchor. All anchors should satisfy the following conditions:

- All installed ground anchors, permanent or temporary, should meet the pullout recommendations for the conditions of service. The anticipated climatic conditions, including wind forces, for the geographic area should be a prime consideration in determining the anchor pullout recommendations and pattern spacing. Anchor breaking strength and pullout safety factors should be in accordance with the recommendations included in API "Spec 4E: Specification for Drilling and Well Servicing Structures" [82].
- Where soil is corrosive, metal components or permanent ground anchors should be galvanized or otherwise protected against corrosion [78].

Pull tests for all permanent-type ground anchors should be made for the geographical area and size and type of anchor involved. Representative pull tests should be conducted along the anchor working plane. Records of representative anchor pull tests for the area should be maintained.

Permanent anchors should be visually inspected by the user prior to each use. If significant damage or deterioration is apparent on inspection, anchors should be pull tested.

Temporary ground anchors should be of such type and so installed to provide pullout strengths that exceed the maximum anticipated guy line pull of the equipment to be used and conditions of service. Records of representative anchor pull tests for the area and size and type of anchor should be maintained by the installing company.

Portable masts, both structural and pole type, that require use of external guy lines to assure overturn stability should have the external guy lines in place immediately following raising of the mast.

Guy lines should be maintained in good condition sufficient for the loads to be incurred. Guy line strength, including auxiliary devices such as chains, boomers, and clamps, should be capable of withstanding loads for the anticipated service conditions.

Guy lines should be visually inspected prior to each rig-up. Guy lines should be removed from service and replaced if in any length of 10 diameters the total number of visible broken wires exceeds 10% of the total number of wires in the line, or if the guy line shows other signs of excessive wear, corrosion, or defect.

If a derrick or mast requires guying, neither should be rigged up on a worksite unless the anchors have been installed and tested in accordance with these recommended safe work practices.

Prior to imposing any load on a derrick or mast, all recommended load guys should be tensioned.

d. Gin Poles

A gin pole should consist of no less than two upright members supporting a horizontal header member, and the header should extend in a horizontal plane across the approximate center of the opening in the derrick top [75]. A gin pole should be installed on standard derricks when it is necessary to install, remove, or lift a crown block or to hoist or lower any material through the opening in the derrick top that is too heavy to be handled manually.

The minimum clearance between the bottom of the horizontal header member of the gin pole and the tops of the beams on the derrick top that support the crown block should be no less than twice the overall height of the crown block or other material being handled.

A gin pole should be designed and constructed to sustain the maximum compression load imposed thereon.

When a standard derrick gin pole is used to install a crown block, access should be provided to the top of the derrick gin pole by means of a fixed ladder.

4. Escape Equipment

An auxiliary means of escape should be provided from the finger board of a standard-type derrick, from the pipe-racking platform on others, and from temporary stabbing boards. This auxiliary means of escape should be a specially rigged escape line by which an employee can reach the ground safely if a blowout, fire, or other emergency in or around the derrick should cut off his escape by way of the derrick or mast ladder.

- o The escape line on masts and derricks that are 110 feet or more in height should be a 1/2-inch minimum diameter wire line in good condition. A safety trolley or buggy equipped with a cam-type brake should be installed on the derrick exit line and kept at the level of the derrickman's working platform (monkey board). When the derrickman mounts the trolley, the cam brake holds the trolley in place until it is released by pushing the handle forward. With this type of trolley, he can easily control the speed of his descent.
- o The escape buggy should be secured in a manner to ensure easy, but not premature, release.
- o The derrick exit line and trolley should be in operational condition before drilling begins.
- o Tension on the escape line should be periodically checked and adjusted to ensure safe landing of the user. Tension should be such that a person descending on the escape line can stop 20-25 feet from the anchor point. The ground anchor point of the escape line should be located a minimum lateral distance from derrick or mast equal to the height above ground to the point where the escape line is fastened to the derrick or mast. Tension lines should not be tied to power poles, pipelines, trees, rocks, vehicle bumpers, or other equipment [74].

The escape buggy should not be tested by "test runs." A daily visual inspection by the derrickman and testing for freedom of movement and braking are adequate. Other means of escape, such as an escape chute or slide, are acceptable if they provide the employee with an equal or better escape method.

5. Floors

Every floor, platform, walk, or runway should be kept reasonably free of drilling fluids, mud, oil, grease, or other substances that create a slipping hazard or prevent or hamper the escape of workers in an emergency. The rig floor should be constructed of material designed and maintained to be slip resistant when wet or dry.

Every rig floor should completely cover the space within the perimeter of the derrick or the outer boundary of the floor when it extends beyond the perimeter of the derrick, except for openings necessary for the installation of equipment used in connection with the operations. When the openings are not occupied by the equipment or when it is not necessary to keep them open, they should be covered or otherwise guarded to prevent workers from accidentally stepping or falling in. Specifically, ratholes and mouseholes should be covered unless occupied by the kelly or drill pipe or constructed with a tube that extends 18 inches or more above the rig floor.

6. Platforms

With the exception of the stabbing board, every platform erected on the inside of a derrick should completely cover the space from the working edge of the platform back to the legs and girts of the derrick. All elevated platforms should be constructed to withstand four times the maximum intended load. All platform planks and other components should be secured adequately to prevent displacement.

a. Crown Platforms

On every jackknife derrick, a platform at least 2 feet wide should be provided on at least one side of the crown block. This platform should be equipped on its outer edges with a two-rail guard railing and a toeboard. Smaller platforms may be used if the employees are provided with, and required to use, safety belts and lanyards.

Every standard derrick used for drilling, except a jackknife derrick, should have a continuous outside derrick platform at least 2 feet wide completely around the derrick at an elevation no more than 2 feet above and no more than one girt (not to exceed 8 feet) below the monkey board. This platform should be equipped on its outer edges with a two-rail guard railing and toeboards [75].

Additional access platforms should be provided with openings that should be at least 30 inches by 30 inches to permit the passage of workers climbing derrick ladders. Standard railings around the outer edges of the platforms and toeboards should be 4 inches high around the inside and outside edges of the platform, except at access points.

Direct access should be provided to each outside derrick platform

by the main derrick ladder, by an auxiliary derrick ladder from any lower outside derrick platform to which the main derrick ladder does not provide direct access, or by extending the outside derrick platform to the main derrick ladder.

b. Racking Platforms

A monkey board should be provided in a standard derrick or mast at each elevation where an employee is normally required to handle pipe or other equipment racked in the derrick tower.

The working edge of monkey boards should be placed to permit sufficient clearance for safe passage of the traveling block and so that the elevator can be easily reached. A monkey board should not be positioned so that the hoisting line running to the hoist drum runs through, or is in contact with, the platform unless provisions are made to prevent the line from dangerously abrading the platform and to guard employees working on the platform from contact with the line.

Every monkey board on a standard derrick should completely cover the space from the working edge back to the legs and derrick girts. The monkey board or racking platform on a mast should be securely fastened to a structural member or mast legs and completely surround the working area. Every monkey board should be secured to the derrick with bolts or equivalent fastenings to resist being shifted or accidentally dislodged under normal operating conditions.

A vertical clearance of at least 6-1/2 feet should be maintained above the decking of each monkey board [77]. Access to a monkey board on a standard derrick that is more than four feet above the outside derrick platform that serves it, and to which the main derrick ladder does not provide direct access, should be provided by means of an auxiliary derrick ladder. The ladder should run from the platform below to a point no less than 3-1/2 feet above the monkey board.

A standard finger or finger brace should not be used as a racking platform except when it meets the recommendations for one and provides a safe working space between the traveling block or hoisting lines and the pipe racked in the derrick tower.

c. Stabbing Boards

A stabbing board should be provided for and used by employees when a platform is necessary for regular operating duties and the work cannot be safely performed from a fixed platform or monkey board.

A stabbing board should be at least 12 inches wide and should be strong enough to safely withstand the total weight of persons,

equipment, or material that may be required or permitted to be placed thereon. When it is in position, the ends of a stabbing board should be fastened in a manner that will prevent the board from accidentally shifting off its supports or falling on the floor. Placing the boards across a girt without firmly securing the ends is not adequate because they are easily displaced.

A safety line should be attached to each end of the stabbing board and secured to the derrick structure to prevent pieces from falling to the floor below in the event of accidental breakage or displacement.

After the stabbing board is used, it should be removed from the derrick.

7. Guardrails

The outer edges of all floors, platforms, walks, and runways that are four feet or more above the ground or another floor level, except entry- and exitways and loading and unloading areas, should be guarded with standard guardrails [70]. The Vee-door or other material access ways to platforms or the rig floor should be guarded by a chain or cable capable of withstanding 200 pounds applied at the midpoint. The chain should be in place at all times except when material, such as drill pipe, is actually being moved through the platform access way.

A standard railing should not be used for other than personnel protection purposes.

A guardrail used and/or needed for the purpose of actual or potential containment of equipment or material should be of such construction and strength as to effectively contain the full load or stress expected to be applied. (For example, if 25 pieces of 6-inch pipe are contained by a guardrail, or any attachment to the guardrail, such guardrail and attachment should be capable of safely holding that quantity of pipe, plus an additional allowance for at least two employees, assuming 200 pounds per employee) [78].

Toeboards should be provided to prevent material from falling off whenever the floor, platform, walkway, or runway is 10 feet or more above the next floor level or when persons are likely to be below. The hole opening resulting from the removal of the rotary table for installation of the blowout preventer is exempted.

Standard toeboards should be a minimum of 4 inches in vertical height from the top edge to the level of the floor, platform, walkway, or runway. Toeboards should be securely fastened in place and not have more than 1/4-inch vertical clearance above floor level. They may be constructed of any substantial material, either solid or with openings, not to exceed 1 inch in greatest dimension [70].

If material is stacked to such height that a standard toeboard does not provide protection, substantial paneling or screening from floor to intermediate rail or top rail height should be provided as required.

Rig floors, derrick walks, and engine room floors should not be used as storage platforms for idle equipment or material that is not for immediate use, unless it is properly racked or stored to avoid obstruction or congestion of the work area or access way.

8. Exits and Stairs

Where the difference in elevation is more than 18 inches between the ground and other working levels, platforms, or floors, an exit should be provided by means of a stairway, ramp, walkway, or a combination of these. Typical areas that should be provided with safe exits are:

- o A place along an edge of the drawworks enginehouse floor or platform that is as remote from the derrick floor as operating conditions will permit. This exit should be readily accessible from all areas of the enginehouse unless an alternate accessible exit remote from the derrick floor is provided.
- o The end of the catwalk furthest from the derrick floor
- o The junction of the derrick floor and Vee-door ramp
- o The junction of the drilling fluid ditch walk and derrick floor.

Every runway should be at least 2 feet in width. When guardrails are provided on a runway, the clearance on the runway should still be at least 18 inches wide [68].

Derrick floors at wells having no connection walk, platform, or other floor should have at least one means of exit provided if the derrick floor is more than 18 inches but less than 4 feet above ground level. When the derrick floor is more than 4 feet above ground, two means of exit should be provided and located so that they offer alternative means of escape in case of emergency. One means of exit should be provided by a stairway, ramp, walkway, or a combination of these. A ladder may be used as the other means of exit. Where the derrick floor is 20 feet or more above ground, an additional, rapid means of descent, such as a slide, should be provided as a third exit for emergency use only and so posted [73].

All "EXIT" doors of a drilling rig should open outwards and should not be held closed with a lock or an outside latch when workmen are working on the rig.

Standard railing should be provided on the open sides of all exposed stairways and stair platforms with four or more risers. Every stairway, ladder, ramp, runway, floor, and platform should be kept reasonably free of objects and substances that may create a slipping or tripping hazard, or prevent or hinder the escape of workers in an emergency.

9. Ladders

Every derrick should be equipped with a fixed ladder or ladders arranged to provide access from the floor level, or from the vehicle bed on which it is mounted, to the crown safety platform and to any intervening fixed platforms.

Fall protection should be provided and used by all persons climbing the derrick ladder(s). If the ladder is not constructed with approved cages and landing platforms, then a ladder climbing device or a fall arresting device should be provided. Platforms should be provided wherever fixed ladders are offset laterally, unless a ladder climbing safety assist device is utilized.

Where sections of ladders are spliced, they should be supported at the splice so the ladder will be aligned and the splice will not be stressed beyond its safe working limit.

Along the length and width of the back of the ladder, a space of at least 7 inches should be maintained clear of all obstructions that present a tripping hazard, prevent safe footing, or prevent a secure handhold to the ladder rungs or steps.

A ladder should not lean backwards from a vertical position. A ladder should not lean sideways more than 5-3/4 degrees (1 foot horizontal in 10 feet vertical). Ladders from cantilever-type masts should not lean sideways more than 3 degrees or approximately 1 foot horizontal in 20 feet vertical [77].

Ladders should be constructed so that the rungs or steps are approximately horizontal at the normal operating position of the derrick. The distance between rungs should be uniform [77]. Every ladder should be substantially constructed and secured to the derrick with bolts, brackets, or equivalent safe fastenings.

The top end of each terminating ladder or ladder section providing access to any fixed platform in or on a derrick should extend at least 3-1/2 feet above the platform unless suitable handholds are provided [68]. An opening to permit the passage of employees climbing the ladder should be provided in every platform through which the ladder passes.

- o The width of the opening should be at least 22 inches but no more than 30 inches.
- o The ladder should be placed midway along the width of the opening.
- o The openings should be clear and unobstructed for at least 30 inches outward on the climbing side.

10. Mud Pits, Tanks, and Reserve Pits

Portable tanks should be located where it is not possible for employees

or equipment to come into contact with overhead powerlines.

All discharge lines should be properly secured. All fixed mud guns used for jetting should be pinned or whip checked when unattended. Hoses used for jetting operations should be manned when operational, and an employee should be stationed at the pump control to shut down the pressure in the event of an emergency [78].

When it is necessary for an employee to enter a mud tank that has contained toxic fluid, the safety recommendations presented in section 5.b., Entry into Confined Spaces, should be followed.

Standard railings should be provided on the inside of all mud tank walkways. Where such walkways are 4 feet or more above ground level, both sides should be provided with standard railings. Guardrails should be installed on both sides of walkways located over mud tanks.

Reserve pits should be:

- o Equipped with a standard ring buoy and 90 feet of line
- o Equipped with a readily accessible rescue hook similar to the type used at swimming pools
- o Guarded if located in a high-traffic area
- o Lighted well enough to ensure that employees will not inadvertently fall into them at night.

11. Pumps and Pressure-Relieving Safety Devices

All pressure vessels, safety pressure relief valves, pumps, fittings, piping, and hoses should be constructed, installed, operated, inspected, and repaired to conform to the ASME "Boiler and Pressure Vessel Code". [83]

Pumps should not be operated at unsafe speeds or in excess of their safe working pressure. Every power-driven piston or plunger-type pump should have the manufacturer's specification plate or markings showing the manufacturer's ratings of the pump. Where there is a likelihood of developing a pressure in the pump in excess of its safe working pressure, the pump should be equipped with an adequate pressure-relieving safety device such as a direct spring-loaded safety valve, a shear pin-set safety valve, a rupture disk, or other equivalent device.

Pressure-relieving devices should be installed and maintained as follows:

- o There should be no intervening stop valves between the pump and its pressure-relieving device or between the pressure-relieving device and the point of discharge.
- o The point of discharge from pressure-relieving devices should be at a place where the safety of employees is not endangered by the discharge fluids.

- Pressure-relieving devices should be set to relieve at a pressure not in excess of the maximum allowable safe working pressure of the pump [77].

Every shear pin-set safety valve should have a metal plate affixed to it with holes drilled in it as a gauge for each size shear pin to be used with the valve and a table with stamped or raised letters and figures showing the pressure at which each size shear pin will shear.

Shear pins used in pressure-relief devices should be of a design and strength specified by the manufacturer. Allen wrenches or other hardened steel items should not be substituted. Every shear pin-set safety valve should have the valve stem and the shear pin enclosed in a manner that will prevent accidental contact with the valve stem and prevent the shear pin from flying when sheared.

Adequate drainage should be provided to prevent the accumulation of oils or drilling fluids around pump bases.

The piping on the discharge side of the pressure-relief device should be securely tied down.

The use of hydraulic, pneumatic, or gas pressure inside a pump to remove pump liners should not be permitted. This does not mean that the use of hydraulic or pneumatic tools made for this purpose is unsafe.

No pump should be set in motion when the fluid-end cylinder head is not secured in place unless precautions are taken to prevent injury to employees.

Every pump should be equipped with a bleeder pipe and valve through which the pressure in any part of the pump can be bled off to atmospheric or as near atmospheric pressure as is practicable, unless other piping and valves connected to the pump can be effectively used for this purpose.

Each disk used in a rupture disk-type, pressure-relieving device should have stamped on it the approximate pressure at which it will rupture, or be identified by an equivalent means.

Before beginning the removal of any cap, plug, plate, or cover from a pump or otherwise opening a pump, the pressure within the pump should be bled off to atmospheric or as near atmospheric pressure as is practicable.

Employees should be instructed in the dangers of high pressure systems and the sudden release of contained pressure.

12. Circulating Hose and Standpipe

The upper end of the standpipe should be securely fastened to the

derrick or mast leg or to the derrick or mast girts, unless other adequate support is provided [75].

The standpipe end of the rotary hose should be secured to the standpipe or to the derrick or mast, and the other end to the swivel by a substantially constructed clamping device and safety chain or wire rope. The hose coupling is exposed to high pressure and vibration, a combination that can result in coupling disconnect [75].

The safety chain should be strong enough to safely support the rotary hose, contained circulating fluids, and dynamic circulating fluid pressures in the event of a coupling separation.

The ends of connecting hose sections should be secured together (whip checked) by means of clamps and a safety chain or wire rope. The clamps should be tightly fitted to and near the ends of the connecting hose sections, and the chain or wire rope securely fastened to each of the clamps.

When hose is used under pressure in a fluid circulating system of a well (in addition to that section between the swivel and standpipe), the ends of each section should be secured to the end of the adjoining hose or pipe in the manner described above [75].

13. Cellars

Stairways, runways, and ladders providing entry to a cellar should be substantially constructed to conform with good engineering practices and should be kept in safe condition. Well cellars, well floors, and ground areas adjacent to derricks should be kept free of oil accumulation that might create or aggravate fire hazards.

Cellars more than 6 feet deep and/or containing hazardous substances or water should be guarded with standard guardrails unless guarded by location [74].

When employees are required to be in a cellar, the cellar and the exits from it should be kept reasonably free of water, oil, drilling fluid, and other like substances that may endanger them. Loose equipment or material, except what is in use or about to be used, should not be kept in the cellar or in the shaft or exits.

14. Pipe and Pipe Racks

Every pipe and equipment storage rack and platform should be designed, constructed, and placed on substantial foundations and maintained to safely support the loads placed on it.

Each finger of a finger board should be bolted, welded, hinged and pinned, or attached by other equivalent means to its support beam and be capable of restraining the maximum intended load.

Pipe racks should be set level laterally on a stable foundation. They may slope front to back to facilitate laying down or picking up pipe [78].

Adequate provision should be made to prevent pipe, drill collars, drill stems, or similar round, rolling stock material from accidentally rolling off any storage rack. This may be achieved by nailing chock blocks to the decking of the rack and to the planks or spacers used between the layers of pipe or other material on the rack, or by other equally effective means.

When pipe is being transferred between pipe racks, catwalks, or trucks, the temporary supports or skids should be so constructed, placed, and anchored so that they will support their loads [78].

Pipe joints temporarily placed on the inclined ramp or Vee-door area should be:

- o Chocked at the base to prevent kickback
- o Positioned at the upper end in a manner to prevent them from falling sideways.

15. Blocks

All traveling blocks and their component parts should be substantially constructed to conform with good engineering practices and maintained in a safe condition. Traveling blocks, crown blocks, and related equipment should not be subjected to any load in excess of their design limitations.

a. Crown Blocks

Each sheave assembly of a crown block should be provided with a complete metal-bearing housing, a metal strap, or an equivalent housing, securely fastened to the crown block beams so that the sheaves, sheave bearings, or housings cannot accidentally be dislodged under normal operating conditions [84].

Each crown block should be securely fastened in place with bolts, metal clamps, or equivalent fastenings that will prevent it from being accidentally shifted or dislodged. Each crown block sheave should be securely fastened in place in a manner that will prevent it from jumping out of its bearings or becoming accidentally shifted or dislodged.

b. Traveling Blocks

The sheaves of a traveling block should be equipped with adequate guards that will prevent accidental contact by an employee with the sheaves or with the nip point where the hoisting lines run on and off the sheaves.

Every traveling block sheave guard should be securely fastened to the traveling block to prevent it from becoming accidentally displaced under the most severe operating conditions, such as jarring on a stuck string of pipe, contact with the finger boards, or pipe standing in the derrick.

Every traveling block hook or other hook or line suspended from the traveling block, to which an elevator, elevator link, swivel bail, or other equipment is attached, should be equipped with a safety latch or device that will provide a completely and securely closed hook or link. The latch or device should be adequate enough to prevent material from becoming accidentally disengaged when used under the most severe operating conditions, such as jarring on a stuck string of pipe, or impact with the finger boards or pipe standing in the derrick [73].

Every traveling block, traveling block hook, elevator and elevator link, or similar traveling equipment should be free of projecting bolts, nuts, pins, or other parts on which the clothing of workmen might be caught or that may foul the derrick members or other equipment or material in the derrick.

The hoisting hook should be equipped with a safety latch or other equivalent device to prevent accidental release of the load being hoisted or lowered.

Traveling blocks should not be moved while the crown block is being lubricated.

16. Drawworks, Hoisting Lines, and Operations

The drawworks should not be operated without all guards in place. The front of the drawworks should be guarded by means adequate to prevent a worker from falling into the drum except during such operations as cutting or inspecting a drilling line.

a. Hoisting Ropes

API "RP 9B: Recommended Practice on Application, Care, and Use of Wire Rope for Oil Field Service" [85] should be followed.

Rope should be secured to the drum as follows:

- o No less than five wraps of rope should remain on the drum when the hook is in its extreme low position.
- o The rope end should be anchored securely to the drum.

Whenever rope is exposed to temperatures at which fiber cores would be damaged, rope with an independent wire rope or wire strand core or other temperature-resistant core should be used. Replacement rope should be the same size, grade, and construction as the

original rope furnished by the drilling rig manufacturer, unless otherwise recommended by a wire rope manufacturer due to actual working condition requirements. A ton-mile program for wire rope use and replacement should be followed [84].

b. Rope Inspection

When any of the following conditions are present, a wire rope should be immediately removed from service:

- o Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear or scraping of one-third the original diameter of outside individual wires
- o Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay
- o Evidence of heat damage
- o Corroded or broken wires at end connections
- o Corroded, cracked, bent, worn, or improperly applied end connections
- o Severe kinking, crushing, cutting, bird caging, or unstranding.

All rope that has been idle for a period of a month or more due to shutdown or storage of a rig on which it is installed should be given a thorough inspection before it is placed back in service. This inspection should be for all types of deterioration. The following limitations apply to the use of wire rope:

- o Eye splices made in any wire rope should have not less than three full tucks. However, this recommendation should not operate to preclude the use of another form of splice or connection which can be shown to be as efficient and which is not otherwise prohibited [68].
- o Eyes in wire rope bridles, slings, or running line should not be formed by wire rope clips or knots.
- o The "Flemish eye," "farmer's eye," "contractor's standby", or any other knot should not be used in any wire rope.
- o When U-bolt wire rope clips are used for form eyes, spacing and number of all types of clips should be in accordance with Table IV-2. Clip bolts should be retightened after the rope has been in use for 1 hour. Clips should be applied so that the "U" portion of the clip contacts the dead end of the rope [68].

c. Deadline Anchors

Deadline anchors for hoisting lines should be so constructed, installed, and maintained that their strength equals or exceeds the working strength of the hoisting line.

TABLE IV-2
NUMBER AND SPACING OF U-BOLT WIRE ROPE CLIPS

Improved Plow Steel, Rope Diameter (inches)	Number of Clips		Minimum Spacing (inches)
	Drop Forged	Other Material	
1/2	3	4	3
3/8	3	4	3-3/4
3/4	4	5	4-1/2
7/8	4	5	5-1/4
1	5	6	6
1-1/8	6	6	6-3/4
1-1/4	6	7	7-1/2
1-3/8	7	7	8-1/4
1-1/2	7	8	9

Source: OSHA Construction Industry Standards, 29 CFR 1926/1910 [68].

Provisions should be made to prevent the deadline from becoming accidentally disengaged from the tiedown.

d. Line Spoolers or Winches

Metal parts of line spoolers and line stabilizers should be guarded against contact with the hoisting line by rubber or other suitable nonmetallic material. Moving parts of power takeoff (cathead) line spoolers should be guarded.

Every overhead sheave or pulley on which a line spooler counterweight rope runs should be mounted in steel or iron brackets that are securely fastened to its support by bolts, wire cable, or adequate welding.

Control for line spoolers should be of the "deadman" type.

17. Catheads and Catlines

a. Manual Catheads

If a cathead is mounted on the end of a shaft that projects beyond the guard for other moving parts of machinery, the shaft end, key, or other device for securing the cathead to the shaft should be covered with a smooth thimble. The thimble cover should be of such design that a rope cannot wind around it.

There should be at least 20 inches of working area between the

outer flanges of a cathead and a substructure guardrail or prefab wall [75].

Every cathead on which a rope is manually operated should have a reasonably smooth surface and should be free of projections on which employees' clothing may be caught. Cracked or broken catheads should not be used.

The horizontal friction surface of every cathead on which a rope is manually operated should be of uniform diameter between the inner and outer flanges, within a 1/4-inch tolerance. A cathead on which a rope is manually operated should be replaced or rebuilt when wear has created grooves or deformations in excess of three-sixteenths of an inch below the true surface line.

Every cathead on which a rope is manually operated should be equipped with an antirope-fouling device that will separate the beginning of the second wrap of rope from the first wrap at the point where the first wrap begins contact with the cathead. The device should be so designed and fitted in place that its inner edge is not more than three-eighths of an inch at any point from the friction surface of the cathead. Antirope-fouling devices and rope guides should be maintained free of sharp edges that could cut or abrade the ropes in use on the cathead.

Every cathead on which a rope is manually operated should have a suitable rope guide that will hold the on-running break rope, spinning rope, snapping-up rope, and kelly pull-back rope in alignment with their normal running position against the inner flange of the cathead.

b. Automatic Catheads

Rotating and reciprocating parts of every automatic cathead not protected by guards used for other moving parts of the machinery should be protected by shield guards. Openings of such sizes as are necessary for the run of the rope to the cathead are permitted.

Every cathead that uses chain should be equipped with a manually operated cathead clutch or with another device that is adequate enough to keep the rotation of the cathead under control when it is in use. The clutch or device should be of the "nongrab" type and should release automatically when not manually held in the engaged position.

Wire rope lines used on automatic catheads should be designed to withstand the stresses imposed on them. End fastenings for a wire rope used on an automatic cathead should be made in accordance with the manufacturer's recommendations. A "contractor's standby" (half hitch and clips) should not be used as an end fastening on the rope.

c. Catlines

Catlines and high lines should be designed to safely lift or otherwise handle the loads. The maximum allowable working loads should be based on manufacturers' tables.

A post or guard should be provided to deflect cathead lines away from the driller's position. Where posts are of the rotating type, the top and bottom ends should be guarded to contain the post in case the shaft fractures.

A catline grip should be provided and used to keep the catline tight when the line is not in use.

18. Chains and Spinning Chains

All chains should be discarded or repaired if:

- o They have been stretched to the point where links bind, kink, or lock
- o There is a link showing more than 10% distortion or when a link has been broken [75]
- o There is a link with metal reduced by wear, at any point, to less than 90% of its original cross-sectional area [75].

Chains that have been connected together for use as a spinning line should be connected and used as follows:

- o A section of unbroken chain fastened to the cathead may be connected to a section of unbroken chain of smaller size.
- o The connector link should be located where it will not come in contact with pipe being rotated.
- o If there is a broken link in a spinning chain and the other links of the chain are not deformed or weakened, it is permissible to repair the chain with a tempered connecting link of the proper size for that chain.
- o A cold-shut connecting link that is not tempered should never be used to repair a chain of any kind.

In the event of rupture of a link in the section of larger chain, both sections of chain should be discarded at once from further use as a spinning line. No part of any chain that has been broken should be used in a spinning line. To eliminate any necessity for use of broken chain, every rig where chain is used in a spinning line should be provided with spare chain in good condition. Every chain used in a spinning line should have a fiber tailrope between 8 and 12 inches in length fastened to the pipe end of the chain.

Connections between lengths of cathead chain, tong chains, and spinning chain should be of the connecting link or swivel type and of strength equal to the lighter chain. Connecting links and swivels should be of a

size and type suitable for the chain in use.

If chains of different sizes are connected together for use in a spinning line, a spare chain of like size should be provided for each chain so connected.

19. Elevators

Elevators should be equipped with a positive locking/latching device designed to prevent drill pipe or casing from prematurely disengaging. Every drill pipe casing and tubing should be provided with a complementary (to the elevator latch) collar or protrusion designed to prevent elevator links/latches from becoming accidentally disengaged.

Elevators should be free of projections that could catch on derrick structure or rigging items.

20. Slips

The handles of drill pipe slips should be long enough to extend at least 2 inches beyond the greatest radial dimension of the drill pipe elevator box (except in those instances where the handles would be so long they would project beyond the inner edge of the circular guard covering the top outer surface of the rotary table). In such cases they should be as long as possible without projecting beyond the inner edge of the guard [77]. Any slip hook used for lifting should be equipped with a safety latch.

21. Tongs, Tong Backup Posts, Kelly Pull-Back Posts, and Safety Lines

Each pipe tong should be attached to the derrick or a back-up post by means of a wire rope known as a safety line. This safety line should have a breaking strength above the capacity of the pull that is exerted on the tongs by means of the automatic cathead. Both ends of the safety line should be secured by the required number of clamps (Table IV-2) properly installed, with the U-bolt of the clamp on the dead end of the cable.

The wire rope and connections should be frequently inspected and replaced according to the manufacturer's specifications. Special attention during inspection should be paid to wire rope rot from weathering and to cable clamp tightness.

Each tong to which a breaking or making-up line is attached and being used on a cathead should have a safety line attached to prevent the tongs being pulled to the cathead and also to prevent the tongs from traveling with the rotating pipe in case the breaking line should fail.

Tong backup posts, kelly pull-back posts, and tong safety lines should not be secured to derrick or mast girts or to derrick or mast legs unless the legs are so constructed and the lines so attached that the

stresses imposed will not result in structural damage to the legs [77].

A kelly pull-back post with device attached, onto or through which to run the pull-back rope, should be provided for pulling the kelly back to the rathole. The pull-back post should be secured either to the derrick foundation, side sills, or floor sills and should not be attached to or come in contact with the derrick legs, girts, or braces.

Tong dies should be inspected regularly and replaced as a set as they become worn. The tongs should be inspected and greased before each tripping operation.

22. Power Tongs

The control device on power tongs should be designed or guarded to prevent accidental activation [77]. The power input pressure line used on power tongs should be disconnected before any repair, replacement, or other work of a similar nature is done on tongs, chains, dies, or their component parts [73, 74].

High pressure lines (hydraulic or air) should have a safety pressure relief valve that should never be set higher than the manufacturer's specifications for the working pressure of the lines or valve [74].

Hydraulic tongs should be backed up with a safety device able to withstand the full torque of the power tool.

23. Kelly Bushings, Rotary Tables, and Machine/Equipment Guarding

All belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, or other reciprocating or rotating parts, with the exception of the kelly and the cathead, should be guarded by a guard of sufficient strength to prevent any person from coming in contact with them, unless they are guarded by location [73]. The kelly bushing should be guarded when the outer and/or upper exposed surface(s) have corners, bolts, grabs, handles, "J" hooks, or other projections that are likely to catch or snag employees or their clothing or ropes, lines, hoses, chains, and similar equipment.

Rotary tables should have a substantially constructed metal guard adequately covering the outer edge of the table and extending downward to completely cover all the exposed rotating side of the table including the pinion gear [73]. All rotary table gears in motion should be enclosed with a substantially constructed metal guard.

- All sprockets and power-driven chains (except spinning chains) should be enclosed to prevent accidental contact of employees with the moving parts.
- Guards should be constructed of heavy metal, strong enough to withstand the impact of a broken flying chain, and should be adequately secured in place.

- o Lag screws, spikes, or nails should not be used as the primary means of securing guards in place.

Rig machinery should not be operated without all guards properly maintained and in position, except during maintenance, repair, or rig-up work or when limited testing is being performed by a qualified person.

No employee should clean or lubricate any machinery where there is danger of contact with a moving part until such machinery has been stopped, deenergized, tagged, and a safety lock installed.

Any counterweight above the derrick floor when not fully enclosed should be directed away from the working surfaces or be guarded.

C. Safe Work Practices

1. General

Alcohol, drugs, or other intoxicants should not be permitted on the well site, and employees should not be allowed to work while intoxicated or under the influence of drugs.

The offgoing driller should inform the oncoming driller of any special hazards or ongoing work that may affect the safety of the crew. Oncoming tour employees should be alerted by the driller to ongoing work that could affect their safety.

Firefighting equipment should not be tampered with and should not be removed for other than the intended firefighting purpose or for servicing.

If lubrication fittings are not accessible with guards in place, machinery should be stopped for oiling and greasing.

Rigging equipment for material handling should be checked prior to use on each shift and as necessary during its use to ensure that it is safe. Defective rigging equipment should be removed from service.

Combustible materials, such as oily rags and waste, should be stored in covered metal containers. The contents should be disposed of daily.

2. Housekeeping

Good housekeeping is the first prerequisite of accident prevention and should be a primary concern of all supervisors and workmen. An excessively littered or dirty work area should not be tolerated as it constitutes an unsafe, hazardous condition of employment.

- o The area around the base of the derrick ladder should be kept clear to provide unimpeded access to the ladder.
- o Work areas and walkways should not be obstructed.

- o The rotary table of the rig floor should be kept picked up and free of undue accumulation of oil, water, ice, or circulating fluids.

Bagged materials should be stacked by stepping back the layers and cross-keying the bags at least every 10 bags high. Noncompatible materials should be segregated in storage.

3. Hoisting and Rotary Operations

Drillers should never engage the rotary clutch without watching the rotary table. The rotary clutch should not be engaged until the rotary table is clear of personnel and material.

Unless the drawworks is equipped with an automatic feed control, the brake should not be left unattended without first being tied down. Except during drilling, drawworks controls should not be left unattended while the hoisting drum is in motion.

Drill pipe or casing should not be picked up suddenly--a sudden jerk may cause the bottom end to whip about, endangering employees working on the floor.

The driller should never begin hoisting drill pipe until he has ascertained that the pipe is latched in the elevator or the derrickman has signaled that he may safely hoist the drill pipe.

When visibility on the rig floor is obscured, no worker should be required or permitted to work on the rig floor while the rotary table is in motion.

During instances of unusual loading of the derrick or mast, such as when making any unusually hard pull, only the driller or other essential supervisory personnel should be on the rig floor and no one should be in the derrick or mast.

The brakes on the drawworks of every drilling rig should be tested by each driller when he comes on shift to determine whether they are in good order, and brakes should also be examined at weekly intervals by the tool pusher or other person authorized by him.

A hoisting line with a load imposed should not be permitted to be in direct contact with any derrick member, stationary equipment, or material in the derrick unless specifically designed/intended for line contact.

Workers should never stand near the well bore whenever any wire line device is being run.

Hoisting control stations should be kept clean and controls labeled as to their function.

4. Riding Hoisting Equipment

Employees should not be permitted to ride the traveling block or elevators except in an emergency and then they should:

- o Wear an approved safety belt with appropriate lanyard and safety attachment anchored and adjusted to prevent a fall of more than 5 feet.
- o Have the full and undivided attention of the employee operating the hoisting equipment. The operator should be a trained and competent person.

The catline should not be used as a personnel carrier except under emergency conditions; the person operating the cathead should be fully trained and competent.

In an emergency, workers should not slide down any pipe, kelly hose, cable, or rope line other than the escape line and buggy.

In an emergency, an injured worker may be lowered from the derrick by means of the traveling blocks or catlines, in which case the rotary table should be stopped. An experienced employee should operate the controls. Approved fall protection should be provided and used.

5. Catline Operations

An experienced worker should attend the controls while a manually operated cathead is in use and should stop the rotation of the cathead promptly in case of an emergency. The cathead operator should check the kill switch at the cathead position before using the catline. The kill switch should be clearly labeled.

Operators of manually operated catheads should keep their operating area clear at all times and should keep that portion of the catline not being used coiled or spooled. They should never be permitted to stand within the catline coil. The operator should not use more wraps than necessary to pick the load--the heavier the load, the more wraps needed. No more than a single layer of wrap should be permitted on the cathead.

Precautions should be taken to prevent entanglement of other lines with a line in use on a cathead. Personnel should not stand near, step over, or go under a cable or catline while it is under tension.

A line should not be left wrapped on or in contact with an unattended, manually operated cathead. Catlines should not be wrapped around the cathead until the load has been secured at the rigging end.

A splice should not be allowed to come in contact with the friction surface of a cathead. It can easily grab the rotating head. Wire line should not be used on a mechanical cathead.

No part of a rope being used on a cathead should be touched except the free end. Catlines should not be wrapped around any portion of an employee's body. The tight line should not be touched for the purpose of guiding or removing fouled loops. The engine clutch should be disengaged before removing fouled rope.

Employees rigging loads on catlines should:

- o Keep out from under the load
- o Keep fingers and feet where they will not be crushed
- o Be sure to signal clearly when the load is to be picked
- o Use standard visual signals only and not depend on shouting to coworkers
- o Make sure the load is properly rigged, since a sudden jerk in the catline will shift or drop the load.

6. Pipe Handling

Pipe should be loaded and unloaded, layer by layer, with the bottom layer pinned or blocked securely on all four corners. Each successive layer should be effectively chocked or blocked.

During loading, unloading, and transferring of pipe or other similar tubular material (rolling stock), workers should not be permitted on top of the load. Employees should not be permitted to go between pipe racks and a load of pipe during loading, unloading, and transferring operations. Boomers should not be released from trucks loaded with pipe until the trucks are in position and all employees have been informed that the offloading is to begin. Pipes should be loaded on or unloaded from trucks one layer at a time.

Pipe or casing should be rolled from the ends or from behind in order to get out of the way if the joint gets out of control. Employees should never attempt to stop rolling pipe or casing--they should be instructed to stand clear and get out of the way. To prevent incidents of finger wounds from sharp pipe threads or wickers, pipe threads should be cleaned with a brush.

Slips are heavy; slip handles should be used to lift and move slips. Employees should not be permitted to kick slips into position. Rat- and mouseholes should be kept covered when not occupied by the kelly or pipe joint.

When pipe is hoisted, especially during tripping operations, floor-hands should not stand where the bottom end of the pipe can whip and strike them. Employees should be instructed to never turn their backs on pipe being tailed to the rotary table.

Pipe stored on racks or catwalks should be chocked to prevent rolling.

Subs should be screwed completely into and made up tightly to the drill collars before the collars are lifted.

Employees should not be permitted to work immediately below pipe stored on the inclined ramp. All rigging and pipe handling should be performed from above where the employee is not exposed to falling or tipping pipe. Pipe hoisting lines should be properly attached to the joint of pipe to be lifted.

7. Derrick Operations

The derrick climber should be used when climbing the derrick. Derrickmen should be tied off or otherwise protected from falling whenever working from an unguarded platform.

The pipe elevators or traveling blocks are not to be used as a means of access to the derrick platforms.

The safety buggy and escape line should be checked by the derrickman prior to each tripping operation.

A means, such as a pipe hook or tag line, should be available for use by the derrickman to assist in maneuvering, stacking, and securing pipe in the derrick. If pipe hooks are used above the derrick floor, then the pipe hook should be secured to the derrick in a manner that will prevent the hook from falling.

All stands of pipe and drill collars racked in a derrick should be secured with rope or otherwise adequately secured.

An adequate horizontal supporting member should be provided in the derrick with each end secured to and on the outside of adjacent derrick legs. The stands of pipe and drill collars should be tied to the horizontal member unless the derrick girts are of adequate strength to be used for that purpose without being broken, permanently bent, or otherwise damaged, or unless other adequate provisions are made for securing the pipe and drill collars.

Drill pipe, collars, or tubing should be racked to safely distribute the load in the finger boards.

Whenever drill pipe, drill collars, or tubing are racked in the derrick, provision should be made for drainage of any fluids from the pipe stands. A drain pan should be installed on the derrick floor pipe rack into which the drill pipe and drill collars can drain.

Tools, derrick parts, or materials of any kind should not be thrown from any point above the first girt of a derrick. A handline should be used to lower the item to the level below. A canvas bucket should be used as a hoisting container for bolts or other small items. Tools, equipment, or materials of any kind should not be left unsecured in or on a derrick

where they may become accidentally dislodged. Tools or other materials should not be carried up or down a ladder unless properly secured to the body, leaving both hands free for climbing.

The derrickman should ensure that the elevators are properly clamped onto all pipe joints prior to signaling the driller to engage the load.

8. Making and Breaking Joints

Tongs should be used for the initial making up and breaking of the joint. The rotary table should not be used for the initial breaking of a joint.

Employees engaged in making or breaking joints should not be permitted to stand within the arc of the tong handles when the tong pull line is tensioned. Employees should handle the tongs only by the appropriate handles.

Employees should be trained in the safe use of spinning chains. Spinning chains should not be handled near the rotary table while it is in motion. Workers should not place the chain on the joint of pipe in the mousehole while the rotary table is in motion. Spinning chain should not be permitted to lodge in the threaded area of the pipe joint. Damaged, torn, or loose clothing should not be worn during spinning chain operations.