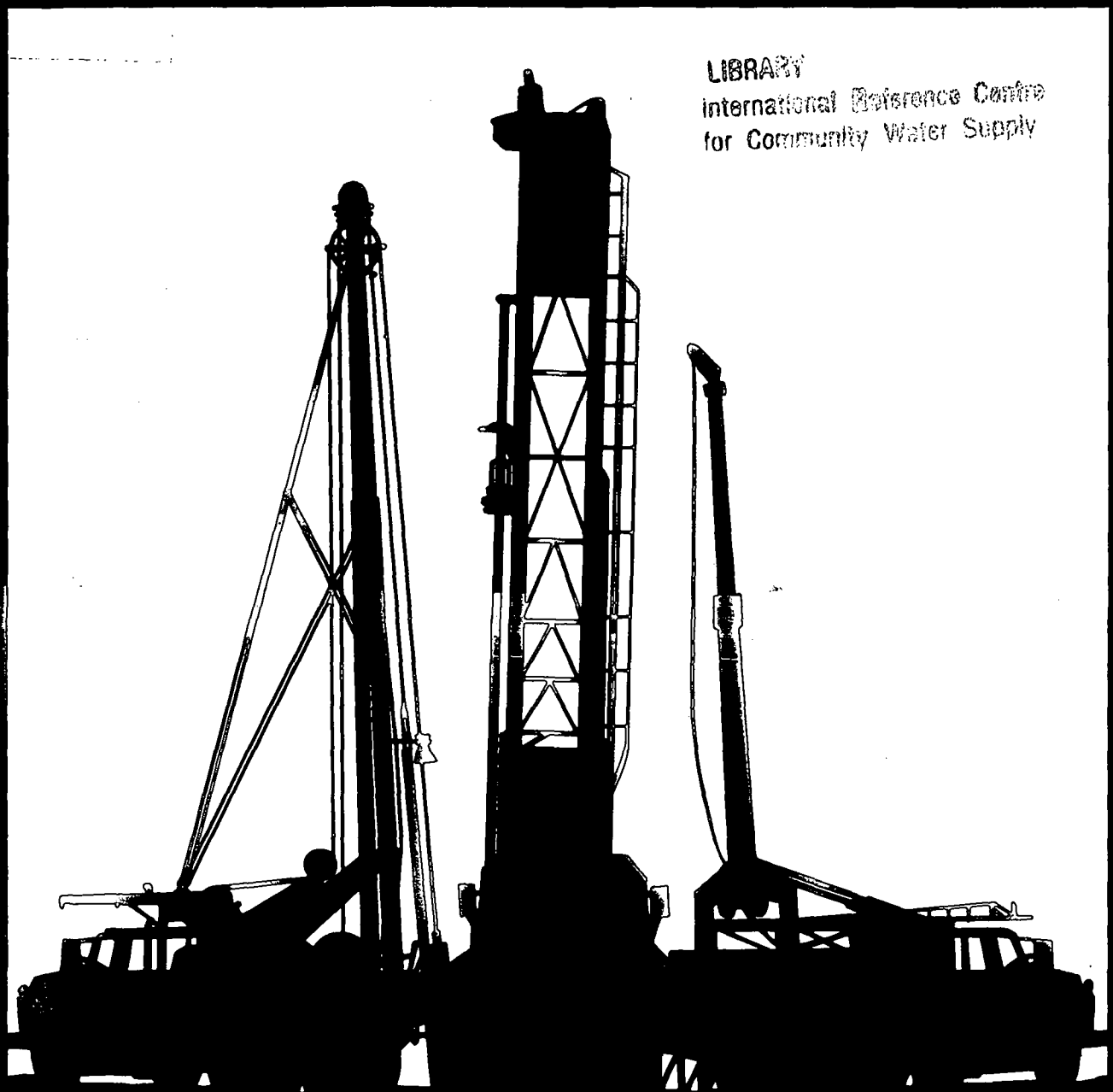

MANUAL OF RECOMMENDED SAFE OPERATING PROCEDURES AND GUIDELINES FOR WATER WELL CONTRACTORS AND PUMP INSTALLERS

MANUAL OF RECOMMENDED SAFE OPERATING PROCEDURES AND GUIDELINES FOR WATER WELL CONTRACTORS AND PUMP INSTALLERS

Prepared by the Safety Committee of the National Water Well Association

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The information contained in this manual does not propose to be a complete Accident Prevention Manual; it does represent, however, the results of the NWWA Safety Committee's research and experience in order to help you prepare your own meaningful safety program.

ACKNOWLEDGEMENT

The editor would like to especially thank Max Clay, Executive Vice-President of the Planning Corporation, Bob Holder, NWWA Safety Committee Chairman and Wayne Fuller, Manager, Loss Control Department, Maryland Casualty Company, for their guidance and support in this project.

FOREWORD

All applicable governmental rules, regulations or restrictions now in effect, or which may be promulgated, take precedence over the recommendations in this manual.

Nothing herein shall be deemed to establish arbitrary minimum or maximum standards of drilling safety or operating procedures. No recommended method, practice, precaution or program set forth in this manual shall be deemed to establish a legal standard of conduct or a legal duty, the violation of which would constitute negligence of any degree in any legal proceeding.

The purpose of this manual is to provide the water well drilling industry with recommended safe operating procedures. It is designed to supplement individual company accident prevention programs and company operating procedures. The recommendations are purely advisory and not a warranty, representation or guarantee of the utility or applicability to any specific well drilling situation. It is based on experience and careful study over many years.

This manual cannot cover all potential problems. Employees and management must be alert to changing conditions and new equipment which present additional hazards and problems. It does present an approach to safety in any situation.

The driller must share the greatest responsibility for the success of any accident prevention program. However, the whole-hearted support and cooperation of all personnel is necessary, from the rawest recruit to top management.

If the recommendations in this manual are followed, the number of drilling operation accidents should be materially reduced. Each person must do his part. Don't expect someone else to do it.

YOU MUST DO IT — YOUR INVOLVEMENT MAY SAVE YOUR LIFE

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Appendices

SAFETY ON THE RIG

Introduction: Why Safety?

Following safety rules and practices is a must in the drilling business. The importance of protective measures on and around drilling rigs cannot be exaggerated.

Safety must be emphasized around a drilling rig because drilling is a hazardous business. It is also a rewarding business for those who grow with it safely, day by day. Drilling personnel must know how to work safely on a rig in order to protect themselves and the expensive equipment they operate.

Safety is an important aspect of daily life; it is important in the home, at work or play, on streets and highways wherever we go.

Drilling is a highly competitive business and a driller's valuable time represents considerable expense to the drilling contractor and his customer. Drilling crews must be as fast and efficient as possible but they must not compromise safe operating practices. Accidents and lack of safety precautions can be extremely costly—not only in injuries and damaged or lost equipment but in loss of life.

Everybody loses from an accident. Injuries not only result in pain and suffering but can leave a man crippled or handicapped the rest of his life. Even minor injuries can cause loss of time from work and lost pay. Of course, a man's family suffers as well. Although insurance benefits are helpful, insurance will not restore a life, a hand, an eye or a leg once lost.

The drilling crew involved cannot be as efficient after an accident since each member functions as part of a team. When a man suddenly loses his place on the team and drops out from injury or death, this affects the morale and efficiency of the rest of the crew and tends to slow down the costly rig operations.

Certainly the drilling firm management loses from an accident. Expenses continue when an accident causes a rig operation to cease. Every lost-time accident affects the rig insurance rates. The contractor pays a "pretty penny" both for drilling rig insurance and for insuring the crew personnel due to the hazardous nature of the business. When accidents occur, the contractor's insurance costs go up—he must pay more for his insurance because of the losses that occurred.

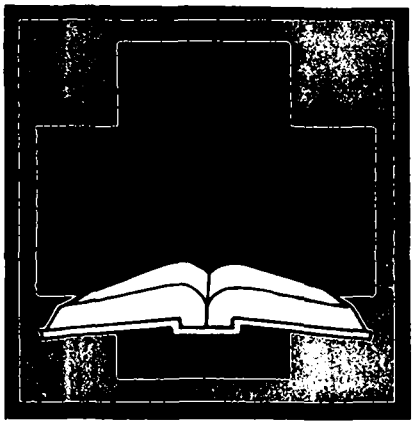
The Harvard School of Business published a survey of studies made of the relationship of sales to losses. Among other facts, it revealed that $25 worth of product must be processed and sold for every dollar spent on accidents. For every $1,000 accident, $25,000 worth of product must be earmarked to pay the loss.

How many wells and pumps would you have to install to pay for one $1,000 accident?

It follows that everybody else loses from accidents. Customers want to hire contractors who have good safety records because this generally means the contractor can be depended on to do a good, safe drilling job. A drilling firm must have a good safety record in order to stay competitive and make a profit which benefits all personnel.

As promotions occur within drilling crews, safety responsibility grows. This makes the safety supervision of others of utmost importance, especially since drilling operations sometimes must continue around the clock in all kinds of weather conditions. It is well known in drilling operations that the driller is responsible for his own crew. This supervision, including safety instructions, extends on to all management pesonnel. In practicing safety, one must continually think of others as well as oneself.

CHAPTER I



ACCIDENT STUDY

NOTE: Although this chapter is applicable to everyone involved in water well construction and pump installation work, it may be particularly important to supervisors who must be responsible for administering the company safety program at the field level. Accident study is the basis of understanding why accidents occur and is a powerful tool in accident prevention.

Study Accidents To Prevent Accidents

Since every accident is caused by one or a combination of the five basic elements of an accident, thorough review of these basic elements will isolate the cause of accidents, making it possible to remedy situations and prevent more accidents and their attendant miseries.

These basic elements are:

- **The agency:** the tool, material, equipment or piece of equipment most closely associated with injury.
- **The type of accident:** the manner in which the injured person made contact with the agency. Examples would be slip, trip, struck by, etc.
- **Unsafe conditions:** of the agency that, if left uncorrected or uncontrolled, will cause another loss. Examples are oil spills, cracked ladder rungs and exposed drive belts.
- **Unsafe acts:** any deliberate or unknowing violation of a commonly accepted or designated procedure of operations.
- **The personal factor:** the reason for any unsafe action or practice by the injured person. Examples are lack of knowledge, disregard of working rules, emotional upset or physical handicap.

Supervisors who act as accident investigators must begin their work immediately after the accident. Delay will only obscure the facts, and there could be reporting time limits required by federal and state authorities.

The supervisor must be just as thorough in probing near-misses or smaller accidents as in larger accidents. Next time, the small accident or near-miss may result in a severe loss.

By keeping investigations within the framework of the five basic elements, management assures meaningful accident reports that go beyond the catch-all explanations of "poor housekeeping" and "He didn't follow instructions." Only specifics can lead to remedies.

Once an accident has occurred, it is important that the supervisor gains the injured worker's agreement on the cause; otherwise, the employee will see no reason to support remedial action to prevent further accidents.

Supervisors should be assigned the responsibility to assure that necessary accident reports are properly completed. Forms provided by your insurance company or forms containing similar information should be used for the reports.

People Make Safety

More than 90 percent of accidents are avoidable. These accidents are caused by human error of some kind, not by mechanical failure. This means that **people** are to blame for almost all accidents.

Thus, it is important for all drilling operations personnel to develop a built-in "safety sense" and to use the same good judgment it takes to drive a car or do any number of things. This requires constant self-improvement, safety education and safe operating practices in order to protect a drilling rig and especially the men that run it.

Everybody benefits when accidents are prevented.

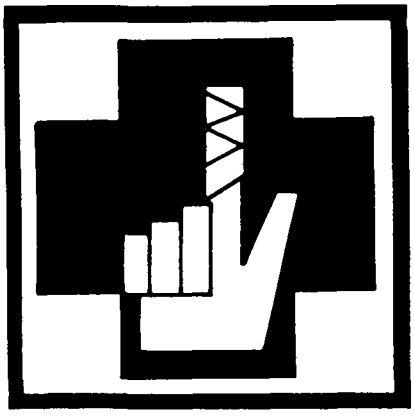
The "No-Injury" Accident

Not every accident results in personal injury or loss of life. All of us at one time or another have been the victim of an unsafe condition or our own unsafe acts with the only damage being to our pride. The spilled drink at a restaurant, stumbling over your own feet and falling onto the soft, carpeted floor of your living room or running into someone at work as you hurry around a blind corner are all seemingly harmless accidents. But in reality we were simply lucky.

Every harmless accident has the same underlying reasons as a harmful accident. The spilled drink at the restaurant was caused by the same carelessness and failure to see accident potential that causes personal injury or fatal accidents on the job site. The only difference between the two is luck; luck that the place where the accident occurred was not a hazardous area and the materials involved were not dangerous alone or in combination.

The "no-injury" accident will continue to happen as long as there are people on earth. It is the responsibility of every safety-conscious individual to see that these accidents are kept to a minimum on the job by personal safety awareness. This responsibility also extends to the task of keeping "no-injury" accidents from turning into accidents resulting in injury by not committing unsafe acts and preventing unsafe conditions from occurring. The hospitals and cemeteries are filled every day by "lucky" people who gambled their life and health and lost.

CHAPTER II



WATER WELL INDUSTRY ACCIDENTS

The Maryland Casualty Company compiles a Loss Anaylsis Report quarterly. This document lists in detail every accident which results in a claim paid to water well and pump contractors insured by this company.

Basically the report lists each accident in terms of cause and effect. Examination of these figures yields recognition of the most frequent types of accidents which occur in our industry. Using this data, it is possible to predict the types of accidents which are most likely to occur and thereby plan against their occurrence by specific safety measures.

Tables 1 and 2 are condensed tables taken from the insurance records with names, policy numbers and dates omitted. The data shown represents accidents which occurred between January 1, 1977 and December 31, 1978.

Another study conducted by The Maryland Casualty Company assesses the areas of most frequent accident loss among water well and pump contractors since 1971. The results of the study and reasons for the majority of the accidents are given in Table 2.

TABLE I
CAUSES OF INJURIES/ACCIDENTS IN 1977-1978

Number of Occurrences	Accident	% of all Accidents
6	Fall into stationary object	1.4
3	Fall into moving object	0.7
4	Fall from rig	0.9
23	Fall/trip	5.2
3	Jumped from rig	0.7
4	Slipped/jumped from rig mast	0.9
1	Stub toe	0.2
4	Stepped on sharp object	0.9
2	Step from elevation	0.5
3	Step in hole	0.7
4	Struck by vehicle	0.9
29	Struck by sharp object	6.6
68	Struck by falling object	15.4
39	Struck by flying object	8.8
17	Struck by moving object—not vehicle	3.8
25	Struck against stationary object	5.7
1	Caught under fallen materials	0.2
2	Caught between moving objects	0.5
7	Caught in running machine	1.6
36	Caught between a moving and idle object	8.1
1	Vehicle collision with stopped vehicle in road	0.2
7	Vehicle collision (moving)	1.6
2	Vehicle non-collision	0.5

23	Overexertion (general)	5.2
9	Overexertion from pulling	2.0
31	Overexertion from lifting	7.0
3	Bodily injury from voluntary motions	0.7
23	Bodily injury from involuntary motions	5.2
10	Contact with hot substance	2.3
2	Contact with cold substance	0.5
4	Contact with caustic	0.9
3	Contact with electric current	0.7
5	Contact with acids	1.1
7	Burned from welding flash	1.6
4	Inhalation of fumes	0.9
4	Bitten/stung by insect	0.9
5	Splinters	1.1
18	Unknown	4.1

TABLE 2
SPECIFIC INJURIES RESULTING FROM ACCIDENTS

Number of Occurrences	Body Part Injured	% of all Injuries
	Head:	
11	Injured	2.4
1	Brain concussion	0.2
3	Face injured	0.6
2	Face rash	0.4
7	Neck and ears injured	1.5
4	Nose injured	0.9
1	Mouth cut	0.2
1	Jaw broken	0.2
3	Teeth broken	0.6
	Eyes:	
13	Injured	2.8
10	Burned (heat)	2.2
12	Burned (chemical)	2.6
13	Abrasions	2.8
27	Foreign matter	5.8
2	Glass, wood, metal splinters	0.4
	Shoulder:	
9	Broken	1.9
5	Strained	1.1
	Chest:	
2	Injured	0.4
1	Muscle pulled	0.2
1	Lacerations	0.2
	Ribs:	
3	Bruised	0.6
3	Broken	0.6
	Back:	
20	Lacerated	4.3
27	Sprained	5.8
5	Muscle pulled	1.1
1	Side lacerated	0.2
1	Lungs burned	0.2
8	Multiple body bruises	1.7
8	Hernia	1.7
	Hips:	
1	Injured	0.2
1	Sprained	0.2
	Arms:	
13	Lacerated	2.8
1	Nerve damage	0.2
3	Burned	0.6
1	Elbow broken	0.2
3	Wrists broken	0.6
	Hands:	
17	Bruised	3.7
3	Broken	0.6
7	Lacerated	1.5
2	Punctured	0.4
1	Mutilated	0.2
1	Burned	0.2
	Fingers:	
29	Bruised	6.2
35	Lacerated	7.5
4	Crushed	0.9
9	Broken	1.9
2	Punctured	0.4
17	Mashed	3.7
	Legs:	
3	Broken	0.6
8	Lacerated	1.7
2	Bruised	0.4
	Knees:	
13	Injured kneecap	2.8
1	Muscles pulled	0.2
2	Bruised	0.4
	Foot:	
17	Cut/Punctured	3.7
2	Broken	0.4
5	Bruised	1.1
	Ankle:	
10	Broken	2.2
2	Contusions	0.4
6	Twisted	1.3
6	Toes, broken	1.0
27	Injuries, unclassified	5.8
4	Overcome/fumes	0.9
3	Death	0.6

TABLE 3

Struck by falling or flying objects
25 percent of all employee injuries are attributable to being "struck by falling or flying objects."
These involve:

- Raising/lowering/rigging of bits and casing pipe
- Loading/unloading of casing and bits
- Lack of proper foot protection

Strains/over exertion
14 percent of all employee injuries and 39 percent of the loss time injuries are attributable to this cause.
These involve:

- Lack of pre-employment considerations (already have a disability when hired)
- Muddy conditions in work areas causing slips
- Poor housekeeping causing storage resulting in unnecessary manual handling

Caught between objects
10 percent of all employee injuries are attributable to this cause.
These involve:

- Loading/unloading and setting of pumps
- Improper breaking and blocking of rigs and vehicles

Eye injuries
12 percent of all employee injuries were to the eyes. While only a few of these involve loss time, the loss potential is too great to ignore.
These involve:

- Lack of eye protection when holes are being cut through masonry walls for pump/well liners

Severe injuries
There are several areas for potentially fatal or seriously disabling injuries which always need to be considered.
These involve:

- Electrical contact with overhead lines or underground line cables
- Trenching/cave-ins for waterlines

Equipment loss accidents
In addition, equipment losses have become a major area of concern.
The major areas of these losses are:

- Improper blocking of drilling rigs
- Improper or lack of use of the outriggers
- Unstable or adverse conditions in area for set-up
- Fires from hydraulic lines, improper storage of fuel, poor area housekeeping and welding repairs
- Poor housekeeping in cabs causing improper use of brakes and gas pedals
- Theft and vandalism

The information contained in Tables 1 and 2 outlines the occurrence of accidents as they are happening in the water well industry today.

It must be noted that the insurance documents from which the statistics of Tables 1 and 2 were taken represent a total of approximately 400 drilling and pump installation firms. A conservative estimate of the total number of water well and pump contracting firms in the U.S. today is 11,000, approximately 27 times the number represented in the survey. Consequently, to gain an understanding of the potential toll that water well construction related accidents could assume, multiply the number of occurrences in Tables 1 and 2 by the factor of 27.

This data is a warning to all of us who work on pump installation and drilling rigs, in the front office, in the shop and in the storage yard. We are in constant danger: danger from the types of accidents that are listed here, some more than others.

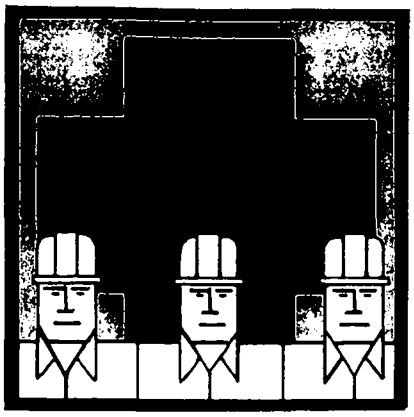
Armed with this information, as well as the various causes of accidents and available preventative measures, we should be able to substantially decrease the number and severity of accidents by simply applying the information contained in this manual.

In reality, however, most contractors will not heed this warning. They will continue to incur needless financial and personnel losses due to work-related accidents.

It is only you, the individual, who can make the decision whether or not to adopt the proven formula given here for the benefit of yourself and your company.

Your involvement may save your life.

CHAPTER III



CREW SAFETY

Safety Responsibilities of Drilling Team Members

Because of the widely varying size of water well drilling companies and variables in drilling jobs, the number of crew members ranges from one to as many as six. The drilling contractor (owner of the drilling company) may perform every job necessary for the installation of a well if he works alone. On the other hand, the owner of a large drilling contracting firm may work almost entirely in his office, relying on a drilling superintendent for field organization and management of rigs and crews. Under this scheme, a driller would actually run the rig assisted by any number of driller helpers depending on the size and complexity of the job. Regardless of the size of the drilling team, there are specific safety responsibilities each team member must assume. In the case of a large drilling team, the safety responsibilities are as follows:

The Drilling Contractor

The drilling contractor, as head of a drilling operation, sets the policies of the drilling firm as well as "sets the example" to indicate how the safety program should be handled by the various supervisors in the shop and on the drilling site. Success of the program largely depends on the contractor's active and personal interest. Striving to improve his company's safety record should be his daily concern, along with matters of operation cost, drilling speed and general efficiency.

The contractor's safety responsibility includes:

- Providing safe drilling equipment and tools, including mechanical safeguards and safe working conditions.
- Developing safe operating practices and procedures.
- Maintaining a regular system of rig, equipment and tool inspection maintenance.
- Providing proper safety instruction, education and training for rig and shop personnel.
- Offering proper supervision through drilling superintendents and drillers to carry out the requirements of the safety program.
- Investigating each accident and reporting injuries to the proper authorities.
- Enlisting the interest and support of all personnel to improve the company's safety record and preventing as many accidents as possible.

Drilling firm management often includes two or more owners or partners who share the responsibility of executive and administrative leadership. Occasionally, one of these men is a geologist or has engineering qualifications.

This management team is usually concerned with overall supervision and operation of all the firm's drilling rigs, no matter where they are located or what their operating status might be. All members of this management team must be involved to insure the success of the company's safety program.

The Drilling Superintendent

The drilling superintendent represents drilling management in the field. He may supervise the operations of several rigs, overseeing the performance of the drillers, drilling crews, and other field personnel. His responsibilities often include warehouse and yard operations and the work of sub-contractors engaged by the drilling firm. Among other things, the superintendent must see that safety functions are carried out by the personnel under them and that accident prevention is a routine practice.

Safety responsibilities of the managing contractor or his drilling superintendent include:

- Setting an example for the drillers and crew by practicing what management preaches in the safety program. This includes wearing a safety hat when on the rig, participating in on the job safety meetings and attending industry meetings where he can learn from the experience of others and return with valuable information that will improve his company's safety program and record.
- Informing the drillers under him of the safety features and protective care of various rig components and necessary safety practices involved.

• Maintaining a monthly safety inspection of shop and yard areas so potential hazards can be spotted and eliminated.

• Confirming that safety standards are met whenever drilling sites are changed or there are changes in equipment and procedures.

• Training drilling crews, including necessary safety instruction.

• Insuring drillers know what doctor to contact in case of accident and that good physical examinations are obtained when new men are hired.

• Knowing insurance companies, and their representatives, that cover the company and reporting by telephone any accident requiring immediate attention.

• Investigating and discussing all accidents and injuries with the crew member(s) involved to determine the cause and then taking the required corrective measures.

• Seeing that all safety equipment is in proper condition, is properly used, and that prescribed safety practices are followed.

• Hiring good men who are physically fit and introducing them fully to the company and the safety program.

• Maintaining a neat and interesting shop bulletin board with up-to-date safety posters and notices as well as posting safety reminder stickers or placards on the drilling rig.

The Driller

The driller is an important part of your safety program because of his close, direct supervision of the drilling crew on the rig. He is responsible to the drilling superintendent for every detail of the drilling operation. This includes the safety precautions required for all personnel on the rig and safe working condition of the equipment. The driller must set a good example, and must coordinate the safety effort so that every crew member receives the maximum instruction, training and benefit from the program. If he supervises more than one rig, his responsibility is the same for each rig.

The driller's safety duties include:

• Making necessary arrangements for safety meetings and conducting them.

• Seeing that all practical recommendations are carried out.

• Giving credit to individual workers who report unsafe conditions or practices.

• Investigating and discussing all accidents and injuries with the crew involved to determine what caused the accidents and taking the corrective measures required.

• Making a monthly report on a rig inspection check list for the superintendent.

• Studying the driller's manual in order to keep rig equipment and operations up to company standards.

• Seeing that all safety equipment is in proper condition, is properly used, and that prescribed safety practices are followed.

• Hiring good workers who are physically fit and introducing them properly to the company and the safety program.

• Making sure all new crew members are trained in safe operating practices as prescribed by the company.

The Driller's Helper

Each member of the drilling crew works directly under the driller and is responsible for his own work. He may perform a specific duty on the drilling rig such as mechanic, welder, pipe handler, etc., but usually he is able to perform any number of drilling tasks. From a safety standpoint it is obvious how important the individual worker is to the safety program since he is most directly involved with the drilling process and its hazards. A good worker has every reason to be safety conscious, not only as an individual, but as a member of the drilling team. His safety responsibility includes the following:

• Maintaining an alert, aggressive and ambitious attitude toward his job and safe practices while doing his job.

• Taking full advantage of company training in operating procedures and safety.

• Making sure that he knows what his duties are before going on the job.

• Following all instructions given by the driller in charge.

• Taking the steps necessary to correct hazardous conditions when he sees them.

• Making every effort to avoid unsafe acts on his part and cautioning fellow crew members when they commit an unsafe act.

• Taking an active part in shop or tailgate safety meetings.

• Striving to work in an orderly and organized manner.

• Not accepting a hazardous job which he does not have sufficient experience to handle.

• Keeping his own safety and the safety of his fellow crew members in mind. Wearing a safety hat, hard-toed shoes and proper clothing while on the job.

• Making certain that he uses all safety equipment properly and that all machine guards are left in place and functioning.

The New Crew Member

The new crewman quickly becomes part of the company's "safety program" whether he realizes it or not. Safety is usually organized within a company in the form of a "program" of some kind. No matter how formal a program it is, the fact remains that everybody is involved in it, from the top on down.

Management is responsible for the way a safety program is organized and how it operates. If it includes a safety director or supervisor that individual has a responsible position and "speaks with authority." All field supervisors are, in effect, safety supervisors since they are responsible for the performance of the men under them.

Management does not want anyone to get hurt. This is true from a humanitarian standpoint and because an outstanding company safety record means reduced insurance rates and a healthy competitive reputation for the company. Few lost time accidents also help to keep the rigs busy, thus insuring steady employment and improved chances for advancement. But the fact remains that all personnel are responsible for accident prevention.

Thus, it actually pays off to get a good start as a new crewman with the proper "safety" frame of mind. By complying with the safety rules and learning to practice safe rig operating procedures from the beginning, the crewman will develop automatic safety habits that will protect and benefit himself, his fellow workers and his company.

Most of the "red tape" involved in putting a new man to work on a drilling or pump installation rig concerns the man's own personal welfare and his personal safety record. Before a man is hired, the driller is expected to check his background, his previous employment and accident record. From this information the supervisor driller is generally able to determine if a new crewman will work well with others and make a good member of his "team" or if he is likely to be careless, indifferent, accident-prone or possibly "claim conscious." If a new man passes this inspection he probably will be hired, provided he passes a physical examination. Of course, he should be in good physical and mental condition before going to work on a rig.

It is very important that a new man receive proper supervision of his new duties and that he receive instructions on proper procedure and safety measures. The new man should learn these rules and instructions and inquire about his duties if he does not understand them.

In addition to making certain that the new man understands his job, frequent and timely reminders should be given concerning overall safe procedures. People remember something they hear over and over, especially if the repetition is a bit irritating.

The Four Steps in Training a New Crew Member

A successful safety and accident prevention program depends largely on the safety conscious supervisor who knows how to train his crew members continuously, especially new crew members. Safety must be stressed as much as job skills.

The following four steps in training a new employee follow proven common sense methodology for training a green recruit into a seasoned veteran in the shortest possible period:

• Tell the worker how to do it safely.

• Show the worker the safe way to do it.

• Encourage him to ask questions.

• Have him show you that he knows how to do the job safely.

Initial instructions for new crew members is just the beginning of the safety training task. Constant watch must be kept on all crew members to be sure they are following the rules and continue to develop safe work habits.

Hints About Safety for the New Crew Member

Like driving a car, working safely on a rig is a two part affair: (1) You watch what you are doing. (2) You watch what the other fellow may do to you.

Among the things the new crew member needs to learn to avoid hurting himself are the following:

• Setting or dropping a heavy object on a foot.

• Spraining his back by wrong stance in lifting something heavy.

• Falling as a result of a skid on a slippery surface or by tripping over a piece of equipment.

• Splashing acid or caustic material in an eye.

• Hitting a thumb or finger with a hammer.

• Chipping a metal fragment into an eye.

• Hanging loose fitting garments on a moving piece of equipment.

• Getting an infection in a neglected "little scratch."

• Mashing a hand or foot while lubricating moving machinery.

• Being injured while "daydreaming" at which time most people are prone to do stupid things. In short, be constantly aware that this is a drilling site.

What the "other fellow" can do to you:

• If another crew member is "daydreaming" as mentioned above, something unfortunate may happen.

• Objects—mostly heavy ones—are always swinging across the drill site. Pipe tongs, drill pipe, lengths of casing and almost anything picked up on a catline that is not snubbed or held back is capable of breaking a rib as it swings. Don't stand in their path.

• Wire rope, chains and catlines don't always stand the strain placed on them. Beware of the big pull. It is usually too late to run after the break occurs.

• You have to assume that every idle machine will start up as soon as you get in a position where it can injure you. Don't depend on it to remain still for you unless it is positively controlled. If you are in doubt, ask.

• Watch out for the man who is rolling casing or drill pipe. This goes for rolling onto or off of trucks as well as on the pipe racks. Anyone may start the big roll—you don't want to be the block that stops it.

• Keep an eye on the man who throws things. He may use a pipe wrench—and throw it. He is especially suspect when taking off metal thread protectors. If he drops them, they'll bounce and roll like crazy.

• In short, don't depend on the other man to watch out for you all by himself. Do some watching out on your own.

The foregoing hints are only a few of the many things to learn about safe conduct on the rig. They may serve as a starter and keep you all in one piece as you begin to get the feel of working on a rig.

For All Crew Members

It is very important that all crew members, regardless of their various duties, work safely together as a team. As concerns the practice of safety and accident prevention, each crew member has the following responsibilities:

• Know your job and the various duties connected with it. This makes you efficient, confident and able to work safely.

• Be constantly alert to what is going on. Keep your mind on your job.

• Use the safety devices provided for your protection—hard hat, goggles, safety belts, and the tools provided for each operation.

• Avoid worn or defective tools—they should be reported to the driller or supervisor.

• Practice safety consciousness. Conduct your work to avoid injury and learn to anticipate how anyone around you might be injured on the job so you can act to prevent as many accidents as possible.

• Act as a safety inspector and report any unsafe condition or practice you observe. (A crew member is likely to be the first person to note anything going wrong.)

• Learn first aid—it can be applied on the job, in the home, or anywhere else.

• Apply grease, or oil the machinery **only** through properly placed grease or oil inlets and **only** when machinery is **not moving.**

• Use ladders and stairs as intended—do not jump off the rig, pipe racks, trucks, etc.

• Avoid walking under drill pipe or casing when it is being hoisted overhead or laid down on racks.

• Remember that practical jokes are out of place on a drilling rig.

• Keep physically fit by obtaining sufficient rest, proper diet, and maintaining good health, physically and mentally.

• Wear proper clothing for the job, including a safety helmet at all times. Several layers of thin clothing are better than thick or heavy clothes. Do not wear loose or floppy clothing that may hang or be caught in moving machinery. Wear the safety shoes required and wear gloves without gauntlets or large open cuffs. Do not work in wet clothing.

• Practice good housekeeping. Keep everything orderly. Before leaving the job see that tools are placed in the tool rack and scrap and debris cleaned up.

• Encourage new crewmen to adopt safe working practices. Point out any hazards around the rig that should be especially watched. Be certain a new crew member has received instructions, and understands them, before he starts work.

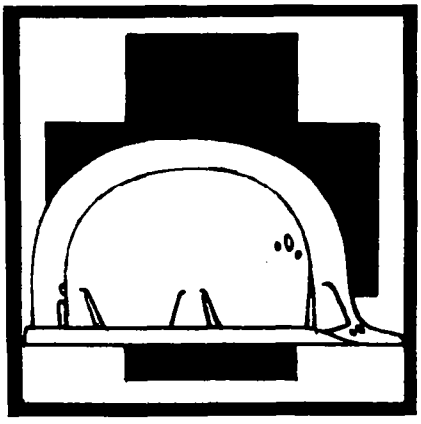
• Report all injuries immediately.

General Safety Practices

The following instructions usually apply to rig personnel as general precautions to prevent accidents:

- Each crew member should inspect the premises where he is to work when he goes on duty to insure that everything is in safe condition.
- See that all tools and equipment are in proper places.
- See that guards and safety devices are in place and in working order.
- Keep floors, stairs and work benches free of grease, mud and trash.
- Inspect machinery and tools for defects and make necessary repairs or replacements before using them.
- Dispose of all rubbish or unnecessary material from the working area.
- See that all flammable gas and oils are in proper containers and in their proper place.
- See that proper lighting at night is provided for the working areas.
- Check all heating devices and open flames to see that they are properly attended.
- Check each other to see if anyone's clothing, physical or mental condition, would endanger him or other crew members. Corrections should be made, if necessary, and an individual replaced if he cannot perform his duties normally.

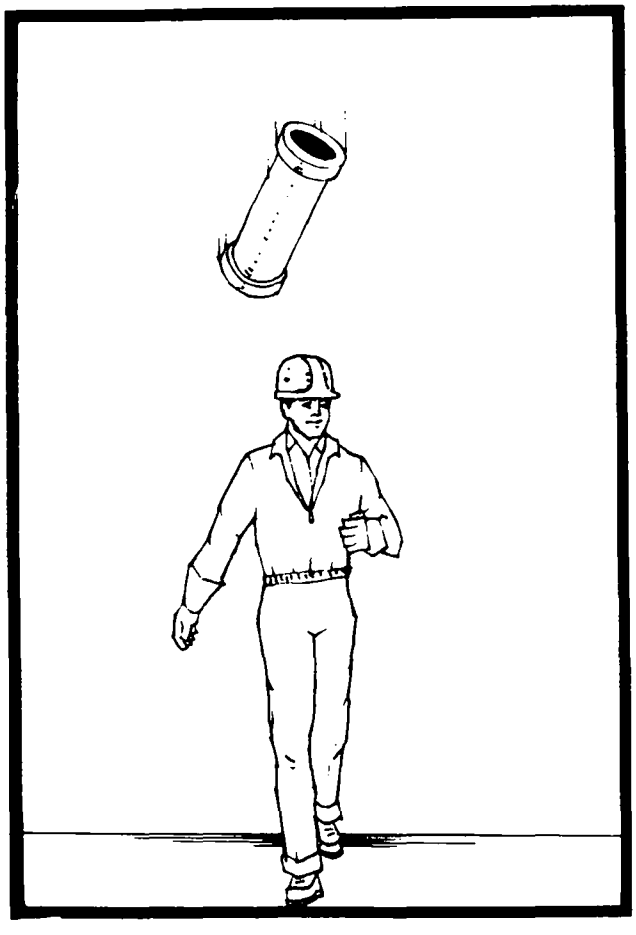
CHAPTER IV



SAFETY EQUIPMENT FOR CREW MEMBERS

Safety Hat

A new member of a drilling rig is usually provided with a safety hat by the drilling firm. One of the "must" requirements is that the safety hat be worn while working on or around the rig. The hard hat is needed for protection from falling objects. Wearing a safety hat can mean the difference between life and death. This role also applies to visitors to the job site.



The hard hat is the number one item of safety equipment. The driller usually sees that his men know how to secure their own hats. It doesn't take long for a new man to observe or to experience danger from a falling bolt, wrench, piece of pipe or wood that can suddenly fall from the area above the rig at considerable height. There is no doubt a man's head needs to be protected by a safety hat at all times during drilling rig operations.

Nearly 11 percent of all accidents resulting in death or permanent physical or mental disability involve head injuries. Permanent mental disability is an important factor here because head injuries often cause permanent brain damage. Where a physical disability may be dealt with in time, the loss of mental functions or control of body parts is rarely recoverable.

The modern hard hat, weighing less than a pound, is designed according to government specifications and subjected to test to improve resistance. The hat must withstand the shock of 40 foot-pounds, the equivalent of a five-pound hammer falling eight feet.

Why are hard hats good head protection? A good hard hat can reduce a 4,000 pound force that would easily break your neck to an 800 pound force which most of us can withstand without injury. It shields your head from falling and flying objects that might otherwise cut or crack your skull.

Due to design and construction, a hard hat has a certain amount of "give." When an object hits the outer shell, the hat dents, cracks or gives, absorbing much of the impact. This impact is further absorbed through the hat suspension. The remaining impact force is distributed over the entire area of the head by the suspension system. If it weren't for this built-in give, you would feel the full impact of the blow.

The safety hat is the individual's last line of defense after all accident prevention measures have failed and the accident is taking place.

Safety Shoes

Along with the safety hat, a good pair of safety shoes is considered a "must" item for each crew member. The driller can advise a new crewman on the best kind of shoes to buy. It is obvious that proper shoes are a necessity to protect the feet from serious injuries. The use of safety shoes has greatly reduced serious foot injuries on drilling rigs.

Safety shoes as well as the safety hat are mandatory if drill site accidents are to be prevented. While the safety hat protects the driller's head with a deflection shield and shock absorber, the safety shoe protects his feet and toes with steel armor.

Safety shoes also help to make the individual more "sure footed" in wet or muddy conditions which often exist around an active drilling site.

The difference in weight between a safety shoe and a good work shoe is little, if any. Likewise the difference in cost is negligible. The major difference between the two is the safety shoe offers many features not found in a regular work shoe. These features include:

- Steel toe protection.
- Protection against puncture wounds from nails, etc., by means of a steel insert between the inner and outer soles of the shoe.
- Slip resistant sole materials available to meet practically all slip conditions.
- Firm arch support construction assuring comfort.
- Specially treated exteriors to withstand hard use and give long service.

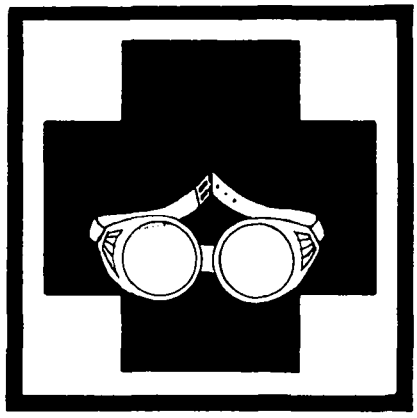
Under the "professional" status assumed by today's water well driller there is no room for employees wearing sandals and sneakers in the shop or on the drill site. Individuals who insist on wearing shoes of this type greatly endanger themselves as well as threaten the company with lost man hours and higher insurance rates.

Use of Goggles

There are numerous examples of eye injuries that could have been prevented if safety glasses had been worn. The slightest eye injury can be painful. The injured usually require first aid treatment and often medical care. The victim may cause an infection by rubbing his eyes before he receives proper treatment. At any rate, the injury and the work stoppage and lost time on the job probably could have been avoided.

Most drilling firms have a policy of furnishing goggles to those who need them. They are usually worn when using a chisel causing chips to fly up, when hammering on metal, handling caustics, or when dust conditions are such that particles continue to get in the eyes. Welding operations should not be performed or watched without proper shade lenses. The following conditions require the use of suitable goggles or eye shields:

- Driving pins in or out of drive chains.
- Replacing keys in tongs.
- Handling hazardous chemicals such as caustic.
- Renewing or tightening gauge glasses.
- Breaking concrete, brick, or cast iron.
- Cleaning material with chemical solutions.
- Hammering or sledging on chisels, cold cuts or bars.



- Cutting wire lines.
- Grinding on abrasive wheels.
- Handling materials in powdered or semi-powdered form where a dust hazard exists.
- Scraping metal surfaces.
- Sledging rock bits or core heads to loosen or tighten them.
- Hammering fittings and connections.
- Driving and holding rivets.
- When involved in any other operations where there may be danger of flying particles striking or entering the eyes or where judgment deems necessary.
- When using acetylene torches for welding or cutting, use No. 5 or No. 6 shade lenses. Helpers should also wear proper shade lenses.

• Employees should exercise caution when working near arc welding as the rays given off are injurious to the eyes. Use No. 10 or No. 12 shade lenses in helmets or goggles in arc welding.

• Anyone near other persons who are doing work which requires the use of goggles should wear them also.

• Goggles should be kept clean and left in their regular places so that they will always be available for instant use when needed. Cleaning goggles with glycerine soap will help prevent fogging.

Gloves

Your hands are the most important tools you'll ever own; protect them with gloves. Wearing a good pair of gloves is necessary for protecting the hands while working on a drilling rig. Be sure the gloves you are wearing are the right type for the job you're doing. Make certain they are the right fit: not too loose (could have tendency to catch on things...poor handling ability); not too tight (could cause hand fatigue as well as wear out quickly); and allow for quick removal. Do not wear gauntlet type gloves because the cuffs can easily get caught in things. If gloves fit closely to the wrist, they protect the hands from metal or wood splinters. Gloves can also help to cushion some blows on the hand that would cause more serious injury.

Gloves should be in good condition. Always check for cracks and holes, flexibility and grip. Keep them clean and in good condition.

There's a Glove For Every Job!

Cloth—protects in general shopwear from dirt, chafing, abrasions, wood slivers and low heat.

Leather—protects from sparks, chips, rough material and moderate heat.

Rubber—protects against acids and some chemical burns.

Neoprene and Cork-Dipped—gives better grip on slippery or oily jobs.

Asbestos or Aluminized—is heat-resistant to protect against sparks, flames and heat.

Metal Mesh—protects from cuts, rough materials and blows from edge tools.

Plastic—protects from chemicals and corrosives.

"Invisible Glove" (Barrier Creme)—protects from excessive water contact and from substances which dissolve in skin oil.

There is no doubt that gloves are a necessary safety item for crew members. They are usually provided by the drilling firm. Other special purpose equipment for protecting the area of the hands are arm and wrist guards, tapes, finger shields, hand pads and mitts.

Safety Belts and Lifelines

The derrickman is the primary crew member to use a safety belt and lifeline since he works at the top of the derrick or mast. However, this equipment should be used by any member of the crew when working from an elevated derrick beam a considerable height from the rig floor. Crew members should become familiar with the safety belt assembly used by their drilling firm.

Every safety belt and lifeline should be strong enough to withstand the strain caused by a weight of 200 pounds dropping a distance of eight feet. This should be tested with proper supervision from time to time. When safety belts develop worn-out stitching, material or have other defects they should be replaced.

A safety belt's lifeline should be secured at a position where the derrickman is working so that he cannot drop more than eight feet. The portion of the safety belt that contacts the wearer should be not less than four inches in width.

A "belly band" or "belly buster" is used when the derrickman works from the platform and handles drilling pipe or casing. This is a strong piece of belting or equivalent, at least four inches in width and at least four feet long, suspended horizontally above the working edge of the platform and readily adjusted by the user to waist height.

A safety line should be stretched across the derrick above the working edge of each stabbing board in use waist high for the derrickman standing there. The safety line should be at least one inch, new three-strand manila rope.

Safety Clothing

The best attitude when selecting clothing to be worn while working on a water well drilling rig is to "dress for danger." Clothing can either protect the individual from hazard itself or increase the chance of accident and/or injury to the wearer.

Overalls and pants should not have cuffs. The cuff forms a "catchall" as well as presenting a serious trip hazard. The trouser leg should be close fitting, ankle length, and not frayed; there should be

no loose belt straps, pocket flaps or other attachments that could catch as a man climbs or moves among projecting structures.

Shirts should preferably have **long** sleeves with snug fitting cuffs. If of the short sleeve style, this sleeve should fit snugly as it otherwise will form a loop to catch on projections with potentially serious results.

Shirts should be worn at all times. They afford protection against (1) sun and weather (2) contact scratches and minor burns from flying sparks.

No tie should be worn. Pocket materials should be kept at a minimum and inside the pocket if at all possible.

Special jobs on the drilling site require special clothing. A welder is constantly exposed to flying sparks and droplets of molten metal. A welder's apron and hood will protect vulnerable parts of the body from this hazard. When muratic acid is used in well rehabilitation jobs, persons handling the acid should wear acid resistant coveralls over normal work clothes to prevent spilled or splashing acid from burning their skin through normal clothing.

Clothing safety also extends to include dressing for extreme weather conditions. In cold seasons, several layers of light but warm clothing are more comfortable and easier to work in than a thick, heavy, single layer. Helmet liners are mandatory for drilling in extreme cold to protect the ears from frostbite.

Conversely, light colored, lightweight clothing serves better than abbreviated attire in hot weather. Short pants and no shirt exposes large areas of the body to the intense rays and heat of the sun as well as hazardous conditions that exist on the job site. If a crew member wants a suntan he must be told to get it on the beach and not on the job. Hot weather and intense sun also demands the wearing of light caps by crew members not working near hazardous overhead conditions.

On the whole, the way of dressing for work on the job site and in the shop is common sense for experienced crew members. Generally, it is new men who must be shown how to dress for safety on the job.

Other Special Protective Gear

While the items referred to in the preceding pages are basic equipment any drilling crew member could be expected to own or have access to, there are other items of common use around a drill site that are usually supplied by the contractor for specific jobs. This is particularly true where large or unusual jobs are involved. Other special protective gear may include:

- Hazardous materials handling gloves (and apron) protection.
- Welders and welder helpers hoods, goggles, gloves and jackets.
- Goggles for dusty areas (with side shields when necessary).
- Overshoes—short and long boots for work in wet areas, concreting operations and similar "abnormal exposure" operations.
- Respirators, dust masks and supplied air breathing equipment for work in hazardous areas.
- Special coveralls, flameproofed when required, static-free if needed, insulated against heat, cold and for various other specific needs.
- Raincoats, hats, gloves and boots for washing down exteriors after erection and similar wet exposures.
- Electrical protective covers and tools for workers in areas where shock potentials may exist.
- Self-contained breathing apparatus for use where hazardous gases may be present.

CHAPTER V

FIRST AID

The whole subject of first aid is far too important to be completely handled in this manual. Both the Red Cross and The National Water Well Association, through the Red Cross, can make first aid training available to your crew. Companies seriously interested in safety must have at least one person trained in first aid on the rig and in the shop and yard anytime work is being done. As well as an employee trained in first aid, there must also be a complete American Red Cross approved first aid kit immediately available at every job site. Usually a kit is kept at a permanent location in the rig, doghouse, office and yard shelter. Replenishment of first aid kit supplies is as important as originally having the kit; incomplete kits or disorderly storage of first aid supplies diminishes the value of the kit.

Treating the "Serious 3"

There are three serious, recurring accidents which take place in the drilling industry that are the result of both ill health and unsafe conditions. These are:

- Heart Attack
- Stroke
- Crushed or broken limbs (arms, legs, ankles, wrists).

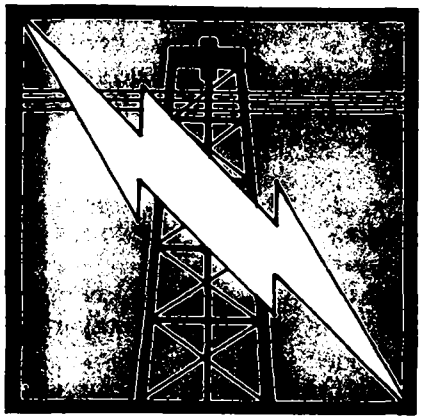
Because these accidents and health conditions are common in the drilling industry, first aid treatment for each is listed in the Appendix. Every employee should be familiar with these first aid procedures.

First Aid Equipment

As stated previously, it is important that all personnel have a knowledge of first aid and emergency procedures. When this knowledge must be put into practice, first aid equipment supplied by the drilling contractor must be available. It should be checked, kept well stocked and ready to use as needed.

The first aid kit on the rig includes antiseptic swabs, burn ointment, adhesive compress, bandage compresses, triangular bandage, eye dressing packet, tourniquet, forceps, scissors, ammonia inhalants, aspirin and probably a snakebite kit. Each crew member should know how to use this first aid material, which is also usually provided in kits on vehicles used by field personnel.

CHAPTER VI



ELECTROCUTION ON THE DRILLING RIG

Caution

Any dealings with overhead power lines constitutes a hazardous act of the most serious nature.

It is beyond the scope of this manual to describe every situation in which a vehicle involved with the water well construction or pump installation process comes into direct contact with electrified overhead power lines. Consequently, any actions taken by individuals to avoid contact with overhead power lines or subsequent actions taken by individuals to extract themselves and/or affected equipment and/or injured persons from the hazard of contact with electrified overhead power lines must be the legal responsibility of the individual acting on the situation.

The role of this manual is strictly advisory in nature, especially those concerning extraction of individuals injured due to direct or indirect contact with electrified overhead power lines.

The methods and techniques mentioned herein are a compilation of methods and techniques which, according to existing publications and manuals, have previously proved successful in the avoidance of overhead power lines with heavy construction equipment and/or the rescue of injured individuals who came into direct or indirect contact with electrified overhead power lines in connection with heavy construction equipment.

Overhead Power Lines

The most frequent cause of job-related death in the water well drilling industry is electrocution caused by contacting overhead power lines while raising a portable drilling rig's derrick.

Water well drilling can be done safely in the vicinity of overhead power lines as long as job planning and job management includes stringent safety precautions.

The problem of working near power lines is an old one. There is a pattern to the types of accidents which occur with power lines, and the following usually are true:

- Almost everyone on the drill site knew the power lines were there.
- Almost everyone involved in the accident admitted they recognized the consequences of contacting the power lines.
- There were laws governing the clearance distance to remain away from these power lines and, in effect, this distance was violated.
- The rig derricks were 40-60 feet tall.
- There was usually no designated signal man.
- The power company or owner of the lines was not contacted for help or advice.

In some instances, industrial installations have storage yards for materials which are immediately adjacent to high voltage overhead power lines.

Another situation common to city drilling involves the close proximity of roads or streets and the adjacent power lines to the location of the job site. Examples of this would be jobs involving service stations, restaurants and other commercial establishments which are often located on corner lots where electric overhead lines often exist on two or three sides of the drilling site.

Operating drilling rigs close to power lines is sometimes an absolute necessity; more often than not, however, a change in location can be made.

The hazards of electric wires have ended successful drilling careers in an instant. It is important to understand these hazards to avoid accidents and personal injury or death.

Under normal conditions, electric circuits and wires are safe. But when a rig is moved into the vicinity of overhead electric wires, abnormal conditions result.

For the safety of yourself and your crew, follow these instructions in such cases:

- Always consider all electric wires to be alive and dangerous. Electric current always flows to ground when a suitable path is provided. When the derrick of a drilling rig touches an overhead wire, the rig becomes completely electrified.

Although it may appear safe because it is insulated from the ground by rubber tires, anyone touching it while standing on the ground furnishes a path to ground for the deadly current.

• Always maintain at least 20 feet of clearance from electric wires. Distances aloft are hard to estimate and wires swing in the wind and sag. Allow at least 20 feet of clearance from your rig to the wires for safe operation.

• Never locate a well under or near overhead wires. With proper location, electric wire hazards can be eliminated. It is up to the driller to advise the property owner of this consideration.

• Your power company can be called upon for free assistance. Call your local power company if you are drilling near overhead wires. They will usually be happy to send an expert to advise you—at no cost.

• Insulate all of the handles that are used to operate the rig. Do this with rubber grips or with heavy wrapping of electrical tape. This reduces the severity of the accident when gripping the controls.

• The rig driver should make it a habit to jump clear and not swing from the cab whenever getting out of the truck cab. When a high line is touched, the operator in the cab is generally not aware of it. Jumping clear will prevent him from grounding on the rig. It must be realized, if all the above suggestions are followed, human error can still create an accident.

If your rig does come into contact with overhead electric wires, following these safety tips could prevent injury or death:

• Do not touch any part of the equipment or attempt to enter or leave it. Keep others away from the rig.

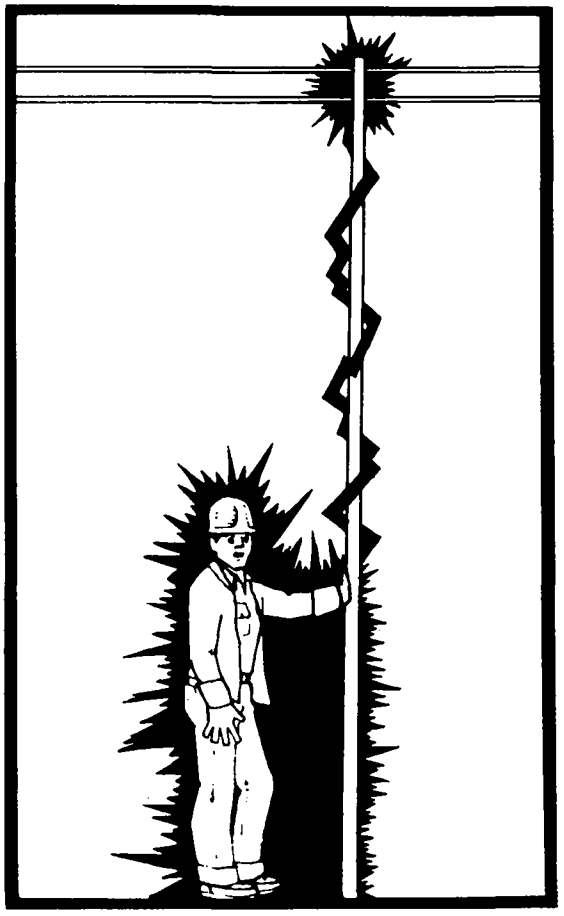
• Have someone call the local power company and local fire rescue squad immediately for their assistance.

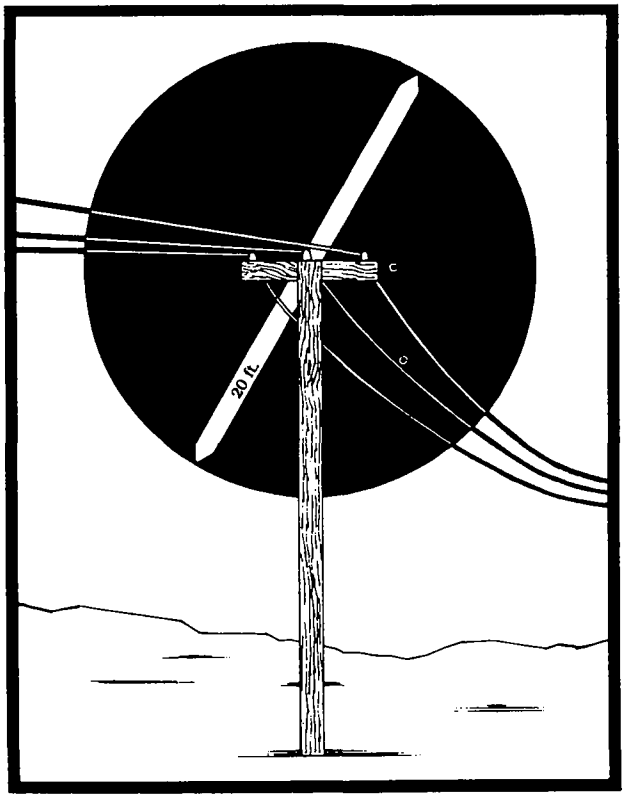
• Do not touch any person who may be in contact with the electrical current. Only when life is at stake should a rescue be attempted—some drillers have lost their lives attempting improper rescues.

• If a rescue is attempted, use a dry, clean rope or a dry, unpainted wood pole to remove the victim. Keep as far away as possible. Do not touch the victim until he is fully removed.

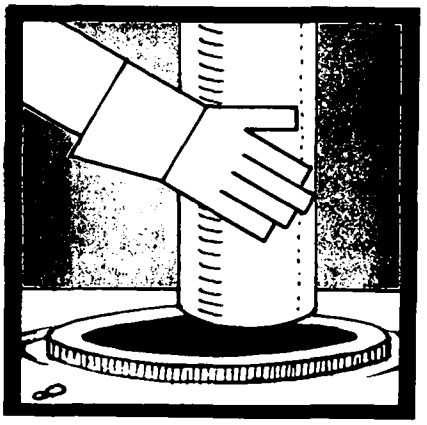
• If the victim is unconscious when released, begin CPR immediately.

• Before setting up the rig mast, stop and survey the entire area—up, down, left and right. Be aware of where you are and exactly what you are doing.





CHAPTER VII



PUMP INSTALLATION AND TESTING

Electrical Safety

The primary hazard in installation and testing of electrical pumps is electrical shock. Care and common sense can minimize this danger, as well as reduce the chance of fire and other hazards which can result from electrical faults.

• Work only on electrical parts which you know are disconnected from power. Never splice, connect, or handle live circuits.

• Use only materials and methods approved by the National Electrical Code and meeting the pump manufacturer's specifications.

• Connect the frames of all accessible electrical components together and to the power supply grounding conductor with copper wire at least as large as the pump supply conductors, or with rigid metal conduit. This includes a submersible pump if it is used or tested outside a drilled well.

• Before connecting power to the completed pump and control circuit, ground check all circuits to the grounding conductor using a 500 or 1000 volt megger. If the cirucit tests less than two megohms to ground, or higher if specified by the manufacturer, find and correct the fault before connecting power.

• Make sure that test flow or possible leaks will not spray water into any electrical enclosures such as starters, control boxes, or connection boxes during testing.

• Do not substitute improper heaters, cable, or other electrical parts to avoid getting the right material. It can be costly and dangerous.

Physical Safety

Care must be taken to avoid physical injury while installing and testing a pump.

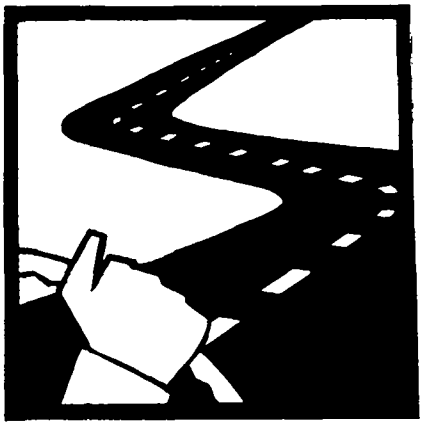
• Use only proper hoists, slings, clamps and techniques for lifting and lowering pumps—and stay out from under them.

• When testing a pump before or after installation, stay clear of the discharge. Stones, dirt and the water itself can cause serious injury.

• Make sure all plumbing, fittings and tanks are suitable for the pressure which the pump can develop.

• Do not use shutoff or check valves above ground on submersible pumps without a check valve also no more than 20 feet above the well pumping level. Vacuum in the delivery pipe when shut off can cause severe water hammer on starting which can break pipe or fittings and possibly cause injury.

CHAPTER VIII



MOTOR VEHICLE SAFETY

The motor vehicle is indispensable to the water well drilling industry. Its uses range from transporting the drilling machine to transporting crew and materials to and from the drilling site. Motor vehicles also represent the company's major investment. A one or two rig operation with a water truck, a pump installation truck and several pickup trucks can easily have $500,000 invested in vehicles. This fact should motivate a contractor to be very concerned with who drives his vehicles and how safely they do it. Not only does the company's success or failure depend on this, but the lives and livelihood of the company's employees also depend on how safely they operate the motor vehicles with which they are entrusted. All vehicle operations in a water well drilling company require constant attention by the company management for control of vehicle loss through either unsafe acts or unsafe vehicle conditions.

Motor Vehicle Safety Program Essentials

There are four parts to any motor vehicle safety program. These are common sense considerations which most contractors recognize; however, enumerating and describing their importance may illustrate it more clearly. The four basics are:

- Driver Selection
- Driver Training
- Vehicular Preventive Maintenance
- Accident Investigation and Reporting Procedures.

Driver Selection

Selection of crew members who will drive the company's motor vehicles from job to job is probably the most important consideration in any motor vehicle safety program. Selection of the person for the job should be based on the following criteria:

- Driving Records—Any person considered for a driver position should be subjected to a search of their Official Driving Record kept by the state which issued their drivers license. Past driving history is a very good indication of how an individual will perform when driving a company vehicle.

The Motor Vehicle Safety section of the appendix gives detailed instructions as well as the addresses to write in each state to get driving record information.

- Personal Character—Much can be learned from observing a person's behavior. "Showoffs" can be detected immediately as well as those who tend to be lazy. Drinking, drug or psychological problems can be recognized. A complete physical examination both prior to and following every two years during employment will also help identify potential problems (See Motor Vehicle Safety Appendix). Some personal characteristics such as aggressiveness behind the wheel can be seen by simply watching the way a person leaves a parking lot or enters a busy highway.

Watch any candidate carefully—especially new crew members—before allowing them to drive a company vehicle.

- Experience—Driving a heavy vehicle such as a rig or water truck requires some experience. A person with a perfect driving record and a good character may be totally incapable of driving the company's portable drilling rig. If possible, use a driver with these qualities plus experience in manuevering heavy motor vehicles.

Driver Training

Before any person is allowed to drive a company drilling/pump installation rig or other heavy vehicle he should be "checked out" by someone who is experienced in driving it. Every car, truck or tractor in existence has its own handling characteristics and it is best to have an experienced driver with the new driver when he discovers these. (See the Motor Vehicle Safety Appendix for Driver Training Methods.)

Vehicular Preventive Maintenance

A preventive maintenance program helps to anticipate vehicle problems before they occur. It usually consists of a set of records, one file for each vehicle, listing each system components which require periodical maintenance or replacement. The records are updated regularly when maintenance is necessary or when a scheduled parts change is done. Often these records are kept on a large chart or blackboard in the office or shop where they are more visible and act as reminders.

Vehicle repair check list pads are also used to supplement the preventive maintenance program. The check list sheet is usually turned in weekly (or as needed) to document mechanical problems which have come up during the past week. The check list can also be used as a maintenance order which is signed when work is completed, then filed in the vehicle record file. (See the Motor Vehicle Safety Appendix for an example of a Vehicle Repair Check List.)

Accident Investigation and Reporting Procedures

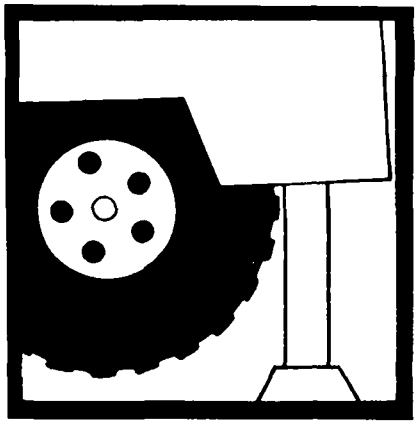
Every accident in a motor vehicle, minor or major, should be investigated. When the cause is found, be it human error or mechanical breakdown, similar occurrences can be prevented by removing the cause.

Investigation of small accidents may point out problems that could cause serious loss or injury in other circumstances. For this reason all accidents must be investigated.

Accident records play an important part in accident investigation. They provide documentation of each accident and the circumstances under which it occured. This documentation can be used in both driver evaluation and in reports to insurance companies and other authorities involved. (See Motor Vehicle Safety Appendix for accident reporting procedure and form.)

Prompt reporting of personal injury and vehicle damage is essential to the recovery of losses and payment of medical expenses as well as disability insurance resulting from a motor vehicle accident. Motor vehicle accidents involving death or serious personal injury should be reported at once by telephone to the insuring company. Notification of lesser accidents may be made by mail. All accidents should be documented in an accident report for examination by the insurance investigator. Prompt reporting and documentation of accidents helps both the claimant and insurance company to settle the accident claim in as little time as possible.

CHAPTER IX



BLOCKING THE RIG

The stability of the portable drilling rig and pump hoist is critical. Improper rig blocking is a major cause of drilling rig losses as well as an extremely hazardous condition which can and does lead to serious injury.

Essentially, blocking provides a more stable drilling structure by distributing the weight of the rig evenly. To accomplish this, jacks and/or outriggers are extended from the rig to the ground, raising the rig partially or entirely off the ground. Blocking is placed between the jack swivel and the ground to provide more support area under the pad. Proper blocking insures that differential settling does not occur. Settling of one or two jack shafts could result in toppling of the entire rig sideways, entailing rig damage or loss and possible serious personal injury or death to crew members.

The following is a list of "do's" and "don'ts" concerning set-up and blocking of portable drilling rigs.

• Do choose a level and reasonably smooth drilling site. If this is impossible, build up solid, compacted earth areas under the places that the jacks or outriggers will contact the ground.

• Do carefully consider the drilling site when it is located on water saturated, partially frozen or loose, caving soil—especially on hillsides.

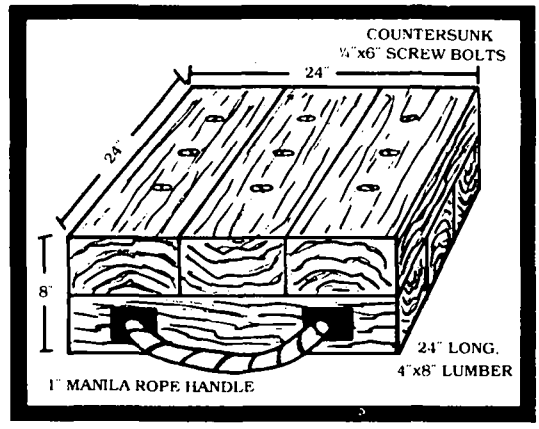
• Do use adequate blocking materials—blocking should be at least 24 inches by 24 inches and of sufficient strength to support the load; this varies with the size (area) of the pad. An adequate pad can be constructed by securely fastening two layers of 4-inch by 8-inch lumber, three 24-inch long boards per layer, at a 90 degree orientation. (See Figure 9-1)

• Do engage emergency brake and chock heels of the rig that remain on the ground.

• Don't attempt to use thin scrap lumber or plywood lying around the construction site as blocking. Keep a set of permanent blocking devices on the rig at all times.

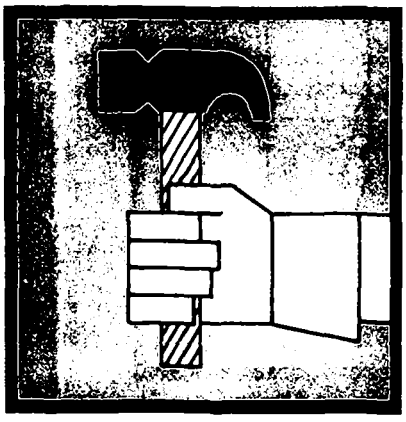
• Don't remove jack pads from the swivel.

Where a drilling site must be located on wet, partially frozen or loose, caving soil or when the site is subject to high gusty winds, guy wires should be attached to the derrick to insure rig stability.



BLOCKING PAD

CHAPTER X



THE SAFE USE OF HAND TOOLS

A variety of hand tools is required by the drilling operation. A crew member should know the proper way to use different kinds of chisels, wrenches, hammers, screwdrivers, pliers, punches and files.

Always use the right size, type and weight of tool for the job. Crew members should not substitute one tool for another in the event that the proper tool for the job is not readily at hand. A screwdriver should not be used as a chisel, a wrench as a hammer, or a pipe or stillson wrench as a monkeywrench. Individual hand tools must be used with care. Hand tools should be made of good quality materials appropriate for the use to which they will be put.

Keep tools clean. Check their condition before you use them. If heads of striking tools become mushroomed or burred, have them dressed. If handles are splintered, broken or loose, have them replaced before you use the tool.

Each tool should have its own storage place. Tools must be returned to their proper places and not be allowed to lie around where they could fall on or trip another crew member.

Carrying tools in pockets is dangerous, especially if they are sharp or pointed. Use a kit or tool belt.

Do not use excessive pressure or force on any hand tool.

When chipping, or doing other work that may cause particles to fly, protect eyes by wearing eye protection.

Here are rules for specific tools.

Hammers

Use a hammer only if it is in good condition, with head firmly attached. Be certain both the hammer and your hands are clean. Hammers with damaged heads or loose or broken handles should be repaired or replaced. Apply glue before you drive a wedge into a handle. Never use nails for wedges.

Grip handle close to the end. "Choking" it is awkward, increases chances for a smashed finger and makes for a less effective blow.

Whenever possible, wear safety goggles while using a hammer. This includes driving nails. A flying nail or other flying material can cause the loss of an eye.

Always keep your mind on your work or you may hit your fingers. Start driving nails by holding them near the head and hitting the nail a light blow. This will minimize the possibility of finger injuries and flying nails. Use a flat-faced hammer to drive nails—never a machinist's hammer.

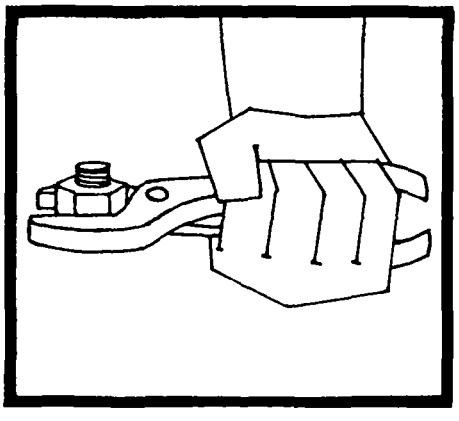
The Use of Hammers

Hammer handles are meant for gripping only. Don't tap objects with them or use them as pry bars.

Don't use a wrench, rod, bolt or other piece of equipment to do a hammer's job. Never strike hardened objects, such as a wrench or another hammer, with anything except a rawhide or soft-metal hammer.

Be sure you have an unobstructed swing when using a hammer. Watch out particularly for overhead obstructions.

Have a helper use tongs or some other proper holding device when holding work to be hit with a sledge hammer. Be sure no one is standing within range of your swing when using a sledge. Both should wear goggles.

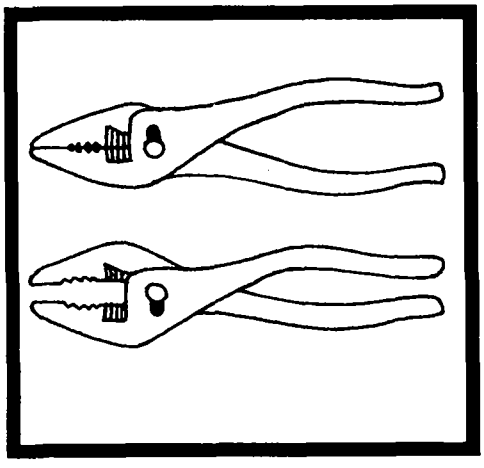


DON'T USE PLIERS ON NUTS

Pliers

There are many types of pliers. The most commonly used are 6-inch combination slip-joint pliers, which permit the jaws to be opened wider at the hinge pin for gripping large diameters. Some combination pliers are made with a side cutter arrangement for cutting wire.

Pliers are often misused as general purpose tools. Their use should be limited to operations for which they were designed: gripping and cutting. Never use a plier for loosening or tightening nuts—use a wrench. In fact, don't use pliers when any other tool will do.



THE SLIP JOINT PERMITS JAWS TO OPEN WIDER

Pliers should not be used for bolt turning work for two reasons: (1) their jaws are flexible, and (2) they leave tool marks on the nut or bolthead, often rounding the corner so much that it becomes extremely difficult to service the fittings in the future.

The inside of cutting jaws should point away from the users face to prevent injury from flying cuttings.

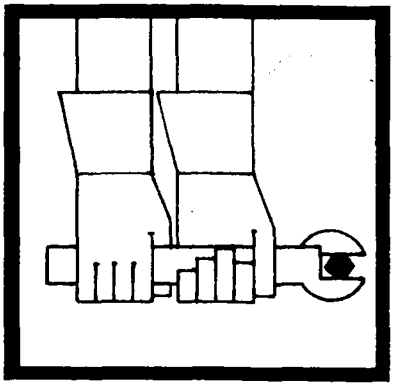
For a firm grip with minimum of effort, plier jaws should be as nearly parallel as possible. Using the right size pliers and proper positioning make this possible.

To avoid overloading cutting pliers, the user should select the pliers with which he can cut a wire with only one hand.

Pliers, like all other tools, should be kept clean. Give them an occasional bath to wash off the dirt and grit. Put a drop of oil on the joint pin. These precautions cut down wear and prevent rusting which is the enemy of all tools.

Wrenches

The first principal of wrench safety is to get rid of the idea that only fools get hurt using wrenches. Use the proper type of wrench for the job—crescent, pipe wrench, ratchet, box-end, etc.

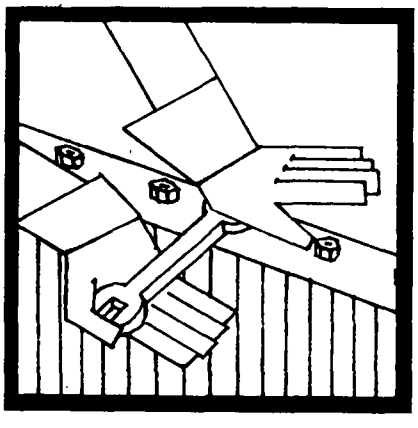


CORRECT PULL

Use wrench of adequate size for the job to be done. A heavier wrench is always better than adding leverage with a "cheater pipe."

Inspect wrenches frequently for worn or sprung jaws, broken cages, springs, faces or bent handles. Repair or replace damaged wrenches at once.

It is much safer to pull on a wrench with your arm muscles than to push. The fixed jaw is stronger than the movable jaw.



CORRECT HOLD

Don't try to work with a wrench in a cocked position—use angle connections so that the wrench will fit flat and square on the nut or bolt head.

When pulling on a wrench, brace against a backward fall by placing one foot behind the other.

Never use a wrench as a hammer.

Don't pound on any wrench to loosen a frozen nut—use penetrating oil, a heavier wrench or one designed for impact work.

Never apply a wrench to moving machinery.

See that pipe wrench jaws are sharp and clean.

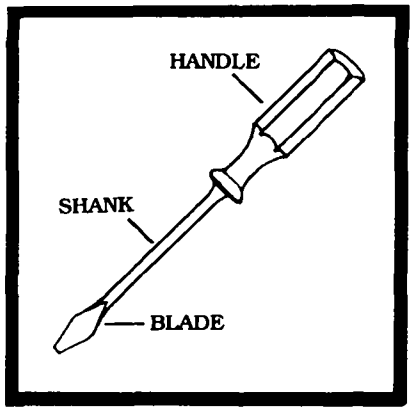
Take a proper stance and do not place your hand or body in a position that may cause you to be injured if the tool should slip.

Probably the chief reason people are hurt using wrenches is that they don't take them seriously enough.

Screwdrivers

The condition of a screwdriver is important. The handle should be smooth and undamaged but not slippery. It should be shaped to give a good grip. It should be tight on the shank with no play. The shank should be true and straight. The sides of the blade should be exactly parallel to fit the slot in the screw head. The end of the blade should be exactly at a right angle with the shank and neither blunted nor nicked.

All information except the bit details also applies to the cross-slot type of driver. The accuracy of fit between bit and screw is very important with both



types. Failure to make sure of a close fit is the chief cause of accidents with screwdrivers.

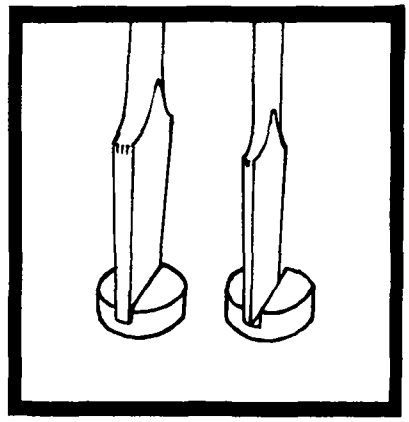
With the ordinary single-slot type of screw, there should be practically no play. A driver set into the slot of a screw held vertically should stand alone.

Use the largest size screwdriver of proper length that will fit snugly into the screw slot.

Don't use a screwdriver with a worn, chipped or broken tip. Keep the blade filed square and follow original line of taper in filing. If part of the blade is broken, file immediately or discard.

Do not improvise with a screwdriver when a chisel or pry bar is needed.

Never hammer on a screwdriver as it may chip or break.



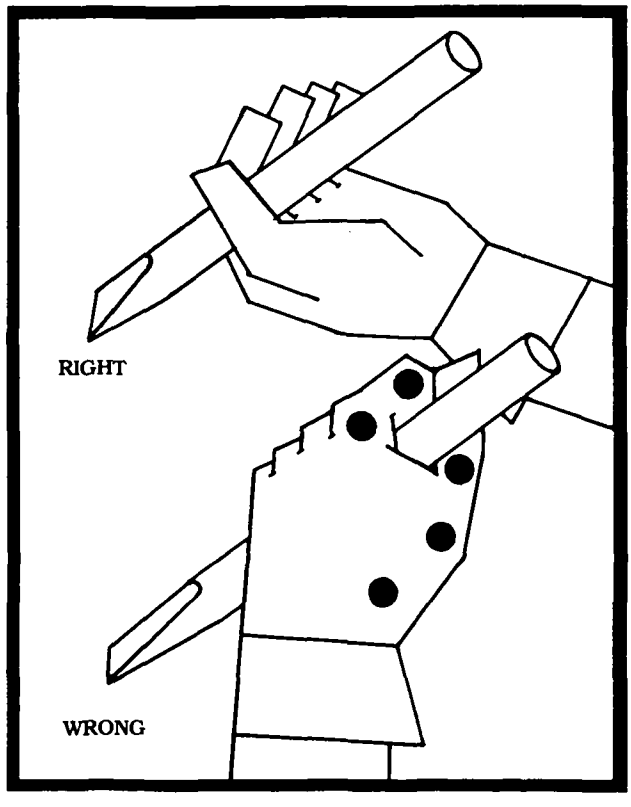
SHOWS HOW A SCREWDRIVER SHOULD FIT THE SCREW SLOT. A POOR FIT DAMAGES SCREWDRIVER AND SCREW SLOT.

Don't hold a small part in your hand while working on it with a screwdriver—put it into a vise.

For electrical work, use a screwdriver with an insulated handle.

Chisels

The chisel must be big enough for the job and your hammer must be big enough for the chisel. Whenever possible, use a mallet instead of a hammer.



Hold a chisel close to its upper end—then if the mallet misses (but see that it doesn't!) your hand won't get the full force of the blow.

Whenever possible, hold the chisel with thumb and forefinger, palm up, keeping knuckles out of range. (Black spots show where hammers that miss can do serious damage.)

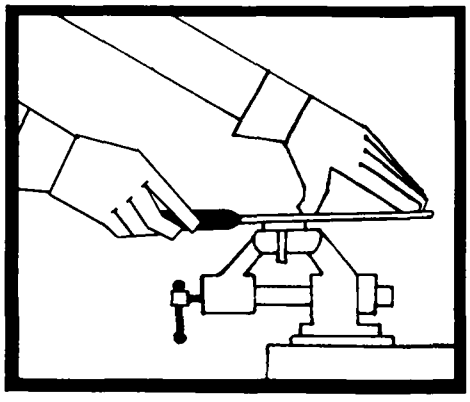
Use a chisel with a cutting edge of the same width as the width to be cut.

Do not attempt to hold a cold chisel if your hands are numb with cold—especially if another person is wielding the hammer or sledge.

Use no more force than is necessary for making the cut. Always chip in a direction away from yourself.

The cutting edge of the chisel must be kept sharp. Chisels with mushroomed heads spell **danger** because of the possibility of flying chips. Heads should be dressed as soon as they start to crack. A 3/16-inch radius ground on the head will allow chisels to stand more pounding. When using chisels for chipping, always wear eye protection. The eyes of men working close by should also be protected—either by goggles or by erecting a screen or shield.

Never use a wood chisel without a handle.



HOLD PROPERLY

Files

All files should be equipped with a tight-fitting handle. It is dangerous to use a file without a handle because the end of the tang is often quite sharp. If you are using a file without a handle and the file meets an obstruction, the pressure of your hand against the end of the tang may result in a bad cut.

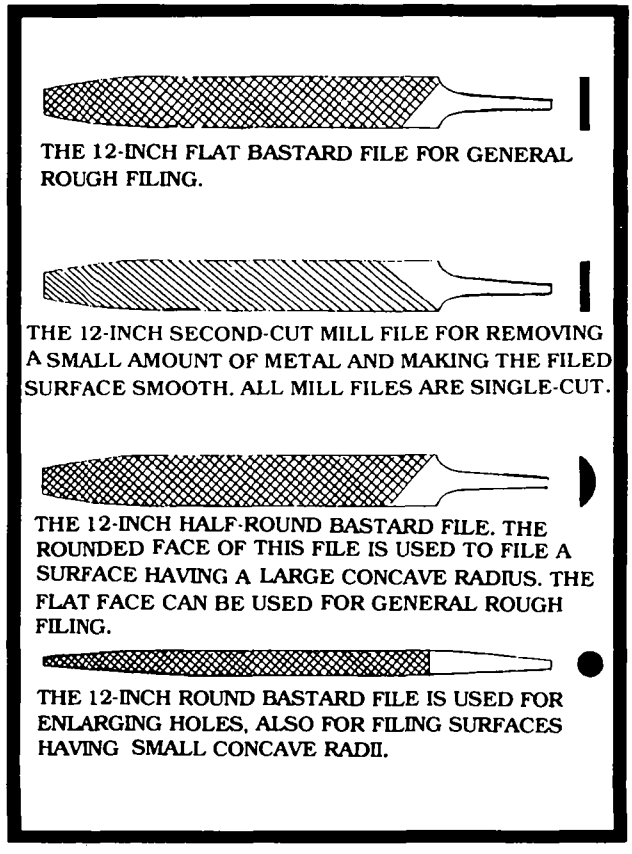
Whenever possible, the object to be filed should be clamped rigidly in a vise. To prevent rough vise jaws from damaging finished surfaces, use copper caps or other soft material.

When using a file, remember that the teeth are made to cut in only one direction—when the file is being pushed forward. All pressure of the file against the work should be relieved on the back stroke. Holding a file against the work on the back stroke serves only to help dull the cutting edges of the teeth.

The preferred method of using a file is to raise it off the work before drawing it back. Files stay sharper longer when used that way.

Never use a file for prying. The tang end is soft and bends easily. The body of the file is hard and very brittle. A light bending force will snap it in two.

A final and very important precaution—never hammer on a file. This is positively dangerous because it may shatter and send chips flying in every direction.



THE 12-INCH FLAT BASTARD FILE FOR GENERAL ROUGH FILING.

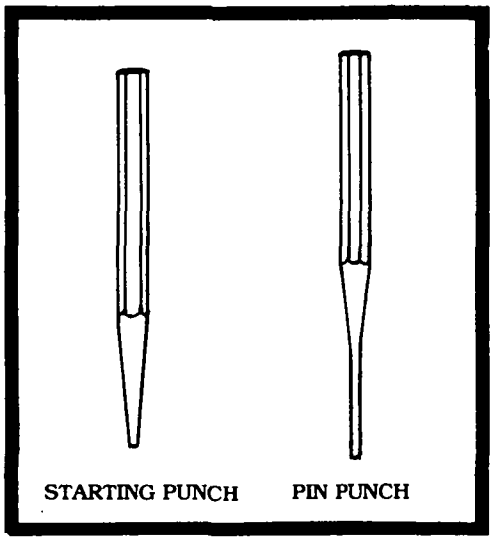
THE 12-INCH SECOND-CUT MILL FILE FOR REMOVING A SMALL AMOUNT OF METAL AND MAKING THE FILED SURFACE SMOOTH. ALL MILL FILES ARE SINGLE-CUT.

THE 12-INCH HALF-ROUND BASTARD FILE. THE ROUNDED FACE OF THIS FILE IS USED TO FILE A SURFACE HAVING A LARGE CONCAVE RADIUS. THE FLAT FACE CAN BE USED FOR GENERAL ROUGH FILING.

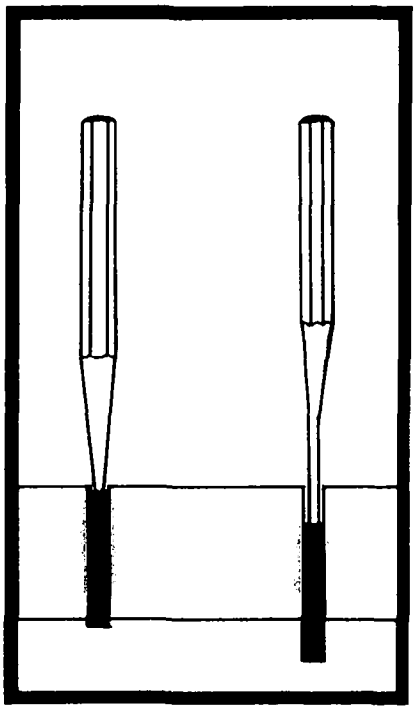
THE 12-INCH ROUND BASTARD FILE IS USED FOR ENLARGING HOLES, ALSO FOR FILING SURFACES HAVING SMALL CONCAVE RADII.

Punches

Starting punches, sometimes called drifts, are made with a long, gentle taper which extends from the tip of the body of the punch. They are made that way to withstand heavy shock blows. This type of punch is used to knock out rivets after the heads have been cut off. It also is used to start driving out straight or tapered pins because it can withstand the heavy hammer blows required to break loose the pin and start it moving.



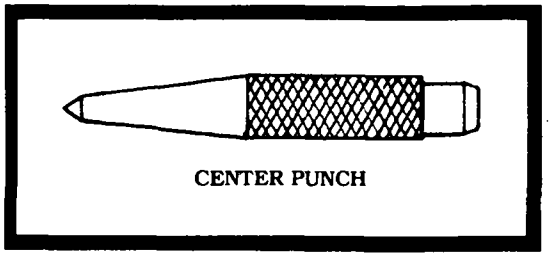
After the pin has been driven partially out of the hole, the starting punch can no longer be used. The increasing taper on the punch becomes too large for the hole. Then the punch to use is a "pin punch." The pin punch is made with a straight shank—no taper—so that it fits into the hole. Always use the largest size of starting and pin punches that will fit the hole.



USE STARTING PUNCH FIRST THEN PIN PUNCH.

Never use a pin punch to start a pin because, since it has a slim shank, a hard blow on the punch may cause it to bend or break. Starting and pin punches usually come in sets of various sizes with three to five punches in a set.

The point on a center punch is accurately ground to a true taper point which is central with the shank. The included angle is usually 60 degrees.



CENTER PUNCH

It requires considerable experience to grind a center punch point by hand with any degree of accuracy. For this reason, you should take good care of your center punch. Don't use a center punch on metal hard enough to dull the point.

Tool Storage

Tools should be stored in appropriate tool boxes and care taken to protect cutting edges and prevent rust and other corrosion. When being used on the job, tools should be placed in a tool belt or bag and not in your pocket or pants belt. Tools should be put back in their proper place after use. They should not be placed on benches, tables, or work platforms where they may roll off and cause an accident or be lost. Such precautions will help prevent ripping or falling hazards.

Tool Maintenance

Some common defects in hand tools are: splintered tool handles, chipped hammer heads, mushroomed heads, cracked or chipped points of screwdrivers or cold chisels, loose heads on hammers or axes, and worn or spread wrench jaws. Dull cutting tools (chisels, drill bits, etc.) are a frequent cause of injury because employees try to make up for a deficiency of the tool.

Damaged tools should be promptly repaired by qualified personnel. Temporary or makeshift repairs should be avoided. Tools should be kept free of grease and dirt by periodic use of cleaning fluids or solvents to prevent injuries. When sharpening tools, dip them in water to avoid overheating. Sharp tools require less pressure and improve accuracy.

Handles of tools should fit tightly and wedges should be used where necessary. Insulated or non-conducting tools should be tested frequently to assure that they are safe.

On most drilling or shop jobs the hand tools are provided by the drilling firm, although individual workers may use their own tools for special jobs out of preference. The contractor is urged to encourage employees to check and maintain the company tools as well as their own tools in safe condition.

Remember, discard all defective tools that cannot be repaired.

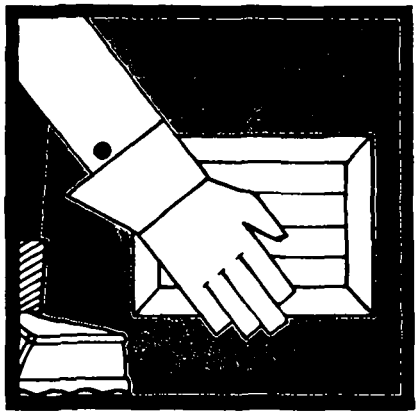
Tool Related Hand Injuries

Excessive pressure or force on hand tools should not be used. Too much pressure means that the right tool is not being used for the job. When possible, pull on a tool rather than push. Cuts, scraped knuckles and other injuries should be treated immediately by simple first-aid measures. An untreated small cut can become infected overnight, so treat all small cuts, scrapes and abrasions immediately.

Power Hand Tools

When working with power tools the individual must work at using them safely. Rules for working safely with power tools have been compiled by the Power Tool Institute, an association of major power tool manufacturers, in cooperation with the National Safety Council and the U.S. Department of Health, Education and Welfare. They are as follows:

- Know the power tool. Read the operation manual carefully. Learn its applications and limitations as well as the potential hazards peculiar to the tool.
- Ground all tools—unless double-insulated. If a tool is equipped with a three-prong plug, it should be plugged into a three-hole electrical receptacle. If an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground. Never remove the third prong from a plug.
- Keep blade guards in place and in working order.
- Keep children away. All visitors should be kept a safe distance from the work area.
- Avoid a dangerous environment. Don't use power tools in damp or wet locations. Keep your work area well lighted.
- Don't force a tool. It will do the job better and safer at the rate for which it was designed.
- Store idle tools. When not in use, tools should be stored high and dry.
- Use the right tool. Don't force a small tool or attachment to do the job of a heavy tool.
- Use safety glasses with most tools. Use a face or dust mask if the operation is dusty.
- Don't abuse the cord. Never carry a tool by its cord; never yank to disconnect the cord from the receptacle. Keep the cord away from heat, oil and sharp edges.
- Secure work. Use clamps or a vise to hold the work. It's safer than using your hand, and it frees both hands to operate the tool.
- Remove adjusting keys and wrenches. Form the habit of checking to see that adjusting keys and adjusting wrenches are removed from a power tool before turning it on.
- Keep the work area clean. Cluttered benches invite accidents.
- Maintain tools with care. Keep tools sharp and clean for best performance. Follow instructions for lubricating and changing accessories.
- Wear proper apparel—no loose clothing or jewelry that might get caught in moving parts. Rubber gloves and/or footwear are recommended outdoors.
- Don't over-reach. Be sure to keep your footing and maintain good balance when operating a hand power tool.
- Avoid accidental starting. Don't carry plugged-in tools with your finger on the switch.
- Disconnect all power tools when not in use, before servicing or when changing accessories such as blades, bits, cutters, etc.



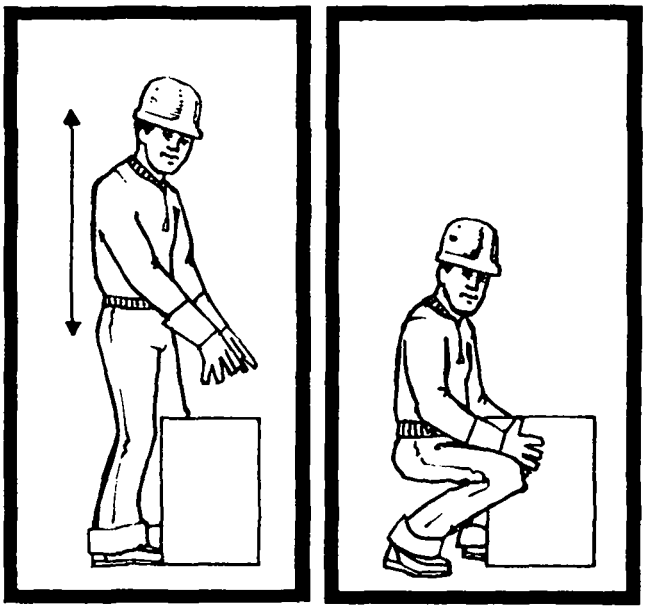
SAFE LIFTING TECHNIQUES

Lower back pain resulting from improper lifting techniques affects approximately 65 percent of American workers at some time during their working careers. Back injury is the most prevalent cause of Worker's Compensation claims. Most lower back pain is intermittent in nature: the annoying to disabling attacks typically last from three to ten days, and then the worker recovers and remains free of symptoms for one to three years. This intermittent pattern is common in 85 percent of all lower back injuries. The middle-aged worker is most affected. Attacks usually begin in the late 20s or early 30s, peak at age 40, become less frequent and less severe in the late 50s and are somewhat uncommon in the 60s. Most workers recover in a few weeks—with or without medical treatment. However, about 25 percent of the cases linger on and account for 87 percent of the total cost of back injuries. These lingering cases are usually accompanied by psychological overtones.

Lifting is a complex subject; age, height, weight, posture, muscular development and fatigue may have an effect on any one employee. Therefore, it is the drilling contractor's responsibility to motivate and educate employees toward safer work habits—including proper lifting techniques.

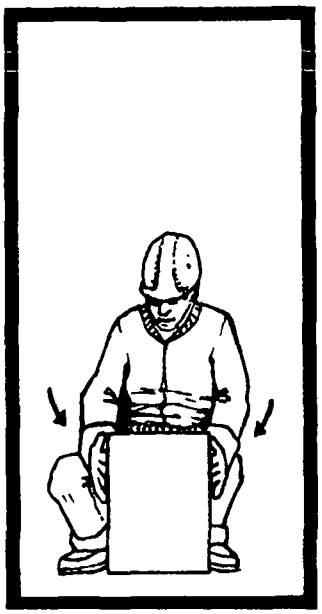
The following procedures are designed to take the hazard out of lifting heavy objects. Be sure your employees learn these procedures and follow them. Before lifting:

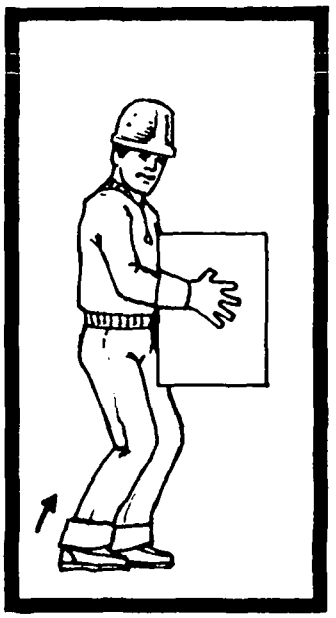
- Make certain that the load can be lifted safely by one person.
- If available, use a mechanical lifting device.
- Inspect the route to be traveled, making sure that there are sufficient clearances and no obstructions or spills on the floor.
- Inspect the object to decide how it should be grasped. Look for sharp edges, slivers or other things that might cause injury.

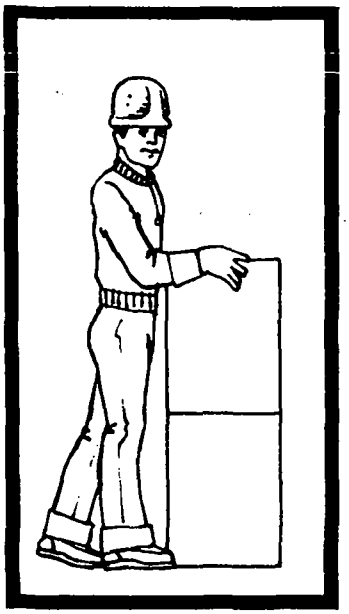


Proper Lifting Techniques

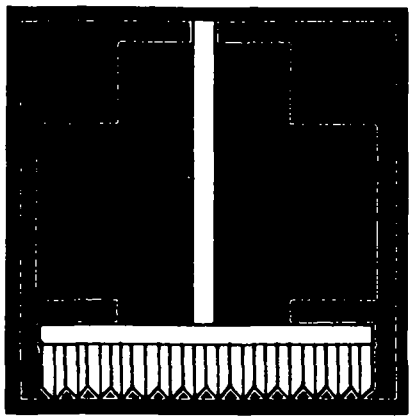
- Keep feet parted—one along side, one behind the object.
- Keep back straight, nearly vertical, with the spine, back muscles and organs of the body in correct alignment.
- Tuck your chin in.
- Bend knees.
- Assume squatting position.
- Grip the object with your whole hand.
- Tuck elbows and arms in.
- Keep body weight directly over feet.
- Start the lift with a thrust of the rear foot.
- When setting the object down, never twist your body. Stand as close to the unloading point as possible.







CHAPTER XII



SAFETY THROUGH GOOD HOUSEKEEPING

Housekeeping Around the Job Site and Shop

Good housekeeping is an indication of efficiency and pride in workmanship. It provides for good public relations and improved worker morale, both of which improve safety performance and accident control.

A fundamental rule of good housekeeping on the well site and in the shop is that cleanup should be considered a part of the operation rather than a separate, periodic activity. The proper time to clean up is as soon as possible after the mess has been created.

Poor housekeeping increases accident potential, the possibility of personal injury and reduces the speed and efficiency of the operation. The policy of integrating good job housekeeping into all operations does not eliminate the need for periodic inspection and regular cleanup, such as an end-of-the-day cleanup or weekly checkup.

Examples of Poor Housekeeping that can Contribute to Accidents in the Shop:

- Loose objects on floors or ground—tripping hazards
- Slippery material on floor—slips and falls
- Loose objects overhead—may fall on workers below
- Large objects out of place—can be bumped against
- Collections of rubbish—provides fuel for fire
- Oil soaked cloth, wood and metal shavings, straw, etc.—may result in spontaneous ignition
- Insecurely piled materials—may fall on workers
- Projecting nails—may puncture or scratch
- Disorder, overcrowding, etc.—may block access to fire extinguishing equipment

Planning for Good Shop Housekeeping Includes:

- Orderly arrangement of processes and equipment.
- Adequate space for materials, tools, and portable equipment.
- Adequate noncombustible receptacles for waste and scrap.
- Provisions for systematic disposal of debris.
- Provide adequate working space.

Planning for Good Drill Site Housekeeping Includes:

- Knowing where the rig will be located before arriving on the job.
- Unloading all supplies and equipment required for the day's work immediately adjacent to the drill site.
- Designating and maintaining an open and dry materials fabrication area adjacent to the drilling site.
- Providing grated walk-ways in the immediate vicinity of the bore hole which is certain to be wetted or muddied by drilling fluid or water from the well.
- Keeping noncombustible receptacle for waste and scrap on the drilling site.
- Making sure at least one drilling crew member is responsible for well site cleanup operations at the end of the day and at the end of the job.

Examples of Poor Housekeeping that can Contribute to Accidents on the Drilling Site:

- Deep indentations in the earth made by rig and/or water truck when moving onto drilling site—tripping hazard
- Unorganized off-loading and piling of well construction supplies and equipment—tripping hazard, may shift and trap workers, may block emergency exit or entry routes

• Wet, muddy, slippery areas immediately around borehole—slips and falls

• Empty cement or drilling mud bags lying scattered and loose around drill site—slips and falls when wet—may blow across drill site and hit and distract driller or helper while he is doing a hazardous job.

• Jagged cut pieces and sections of metal well casing on ground around well site—tripping hazard—worker may fall onto these, may puncture or scratch

• Loose unstable boards or temporary walkways in muddy drill site area—slips and falls, tripping hazard

Good Rules for Job-Site Housekeeping

• Keep the immediate area near the rig and borehole free at all times from materials, supplies and obstructions.

• Secure loose or light material stored on the ground that is not enclosed.

• Remove empty bags or other containers which have held drilling mud, cement, or other dust-producing material from work areas.

• Pick up tools, materials or debris which may cause tripping or other hazards.

• Put a tool back in the rack when through with it.

• Sweep up or wash off any dirt or mud as soon as possible.

• Keep catline coiled when not in use.

• Keep excess pipe, connections, etc., in a pipe rack—*not lying around the rig or immediate* drilling area.

• Keep water hose clean and coiled when not in use.

• See that fire extinguishing equipment is in good order and that first aid equipment is ready for use.

• Check condition of personal safety equipment—goggles, gloves, gas masks, etc.

Good housekeeping essentially concerns cleaning. A clean rig and clean, well lubricated tools are not only more pleasing to look at and work with, they work better and are safer. Cleaning is not only an important part of good housekeeping, it is also an integral part of any safety program.

The Meaning of Clean

Innumerable things need to be **cleaned** around a rig in any given day, week or month. When there is nothing more pressing to be done, something should always be cleaned.

It is generally taken for granted that a man so new on the job as to lack the necessary skills for more complex jobs can always be given a cleanup assignment.

This should naturally give rise to three questions:

1. What is to be cleaned?
2. How is it to be cleaned?
3. How clean is clean?

Too many times this last question has not been answered correctly and fully. Each of the questions requires brief consideration here.

What Is To Be Cleaned?

At one time or another, just about everything has to be cleaned. A few examples:

• The rig floor has to be cleaned at almost any time, but especially:

after a round trip—use the wash-up hose.

after maintenance work has been finished, put the tools away.

after a spillage of oil, skidproof by scrubbing with sand or by other suitable procedures.

• With grease fitting and other points of lubrication, remove the surplus lubrication after every greasing job.

• Clean mud and other foreign matter from pipe threads of every sort. This is usually followed by applying lubricant, rust inhibitor or thread protectors.

• *Wash grease and dirt from all machinery* when it is safe to do so.

• Wash parts of pumps and other equipmment in a suitable cleaning fluid (gas, oil) before the parts are reassembled.

• Wash casing threads (after removing protectors), lubricate the threads and replace the protectors at any time when a casing job is coming up and the casing is on the rack.

• Ditch around the rig to drain off water from rain, washing the rig, etc.

• The storage place for spare parts requires frequent policing. The spares should be kept in the original containers or wrapping to avoid damage from careless handling, dirt, dampness, etc.

• Dispose of empty drilling mud and cement sacks, acid drums, empty bit boxes, etc., in a methodical way.

• Discarded spare parts have a way of accumulating about the rig. Pump liners, pistons and rods, swivel wash barrels, casing thread protectors, solvent cans, etc., need to be stored in a safe place until they are permanently disposed of or sent to the shop for reconditioning.

How Is It To Be Cleaned?

Here is where the learning takes place. The method to be used in the cleaning described in the previous section will depend on **what** is to be cleaned, and also on the thinking of the contractor and the driller.

Here, for example, are some suggestions which will indicate the nature of the cleaning method:

• To clean up the rig you have to have a place to put the tools you pick up.

• To clean up trash around the rig you have to have a place to put the trash.

• To clean up tools and rig equipment you generally need liquid solvent, a container for it and some wiping rags.

• To wash up mud you need a hose with suitable pressure.

• To dispose of pipe protectors you have to have a place to put them. Drill pipe protectors have to be kept around future use. Casing protectors will be hauled away.

The only way to learn these things is to ask and to observe experienced individuals on the rig.

How Clean is Clean?

It is usually safe to say that nothing is too clean. This statement applies especially to machine parts which have to fit together. Pump parts, gaskets, ring-joint flanges and valve parts are choice examples of where everything literally needs to be as clean as the plate from which you eat.

An ordinary grain of sand on the face of a high-pressure flange can readily cause a leak and washout when the pump goes into operation. Casing threads will not be leakproof unless the foreign material is completely eliminated. In this very critical area of a rig it behooves all hands to guard against foreign matter of all kinds in pipe threads and on flange faces.

The problem on the rig is not to convince everyone that certain surfaces must be kept clean. The problem is that most don't appreciate just how clean it really needs to be. Halfhearted cleaning is not the answer.

Keeping things clean will save a lot of work in cleaning next time.

You can protect your equipment from blowing sand on most land locations and corroding salt on the coast. Sand requires that you keep small items in containers (such as tool boxes and storage bins inside). The latter suggests coating with lubricant against corrosion or keeping paint on painted surfaces.

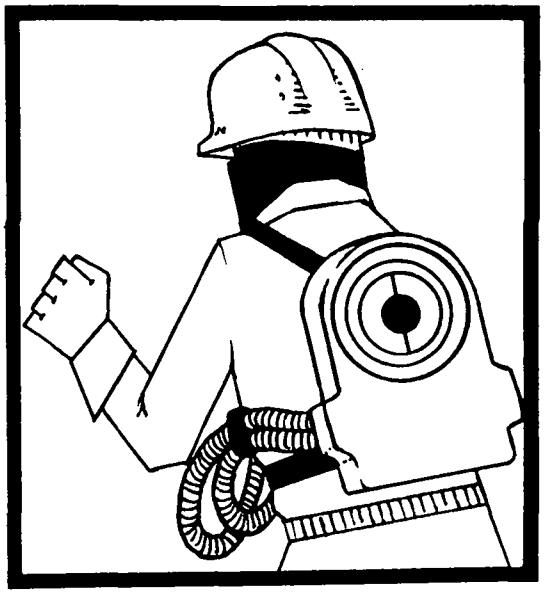
Not only is all of this related to safety on the rig, it also conserves the contractor's property and reduces waste.

CHAPTER XIII

HAZARDOUS GASES

Safety Precautions When Working in the Presence of Hazardous Gases

Whenever a water well is large enough to permit a worker to enter the borehole, the danger of hazardous gases existing in that borehole must be considered. The gases which are of greatest concern are carbon dioxide, hydrogen sulfide and methane. All occur naturally in the subsurface and can fill a borehole and remain there because they are heavier than air. Carbon monoxide is also heavier than air and can settle into unventilated pits or boreholes; this gas is not usually produced in most subsurface environments but by man's activities.



Carbon Dioxide (CO_2)

Carbon dioxide is neither toxic nor explosive. However, breathed in large volumes, it can cause asphyxiation and unconsciousness.

Because CO_2 is heavier than air, in very calm weather it tends to settle in low areas such as large diameter wells under construction, pits and trenches. When workers enter these depressions they will suffer several symptoms:

- Headaches
- Dizziness
- Unconsciousness

The unconscious person(s) must be immediately removed from the depression by persons with individual, self-contained air-packs, and then given oxygen.

Simple ventilation of the well, ditch or pit will remove the CO_2 threat.

Methane (CH_4)

Methane is a natural gas formed by the decompositon of organic material. It is a by-product of the same process that forms coal and oil, and is often associated with coal seams, oil reservoirs and shale deposits. Methane is trapped by certain types and sequences of rock underground. When a water well penetrates these rock layers, the methane will enter and fill the well.

Methane alone is **not** detectable by smell. It sometimes is combined with small amounts of hydrogen sulfide which gives it a faint to strong rotten egg smell. Often it is completely odorless, and detection can only be made by a methane monitor.

Unlike carbon dioxide, methane presents a two-fold threat: danger of asphyxiation and danger of explosion.

Where methane gas seepage into wells has been a problem in the past or where methane is suspected of being present several steps must be taken immediately:

- Smoking, welding or other activities using open flames or sparks must immediately be halted.
- Positive ventilation devices must be installed in the borehole and run continuously.
- Methane detection meters should be kept on the job site at all times to measure the gas concentration at regular intervals.
- Any workers entering the wellbore must be equipped with self-contained airpacks and clothed with static-free garments.

Symptoms of Methane Poisoning Include:

- Headache
- Dizziness
- Nausea
- Unconsciousness

If unconsciousness occurs, the worker should be removed from the excavation by persons equipped with self-contained individual air-packs and given oxygen if still breathing. If not breathing, begin CPR immediately.

Hydrogen Sulfide (H_2S)

Hydrogen sulfide is formed when there is a decomposition of organic sulphur containing materials under reducing conditions. It is highly toxic and has no lasting odor in very high concentrations due to olfactory fatigue. A 30-second exposure at 1000 ppm can cause death.

H_2S gas is colorless, has an initial odor of rotten eggs, but will arrest respiration completely and makes rapid artificial respiration necessary for life. Slower poisoning will cause nausea, stomach distress, belching, coughing, headaches, dizziness, eye irritation and blistering of the lips. The gas is heavier than air and burns with a blue flame producing sulphur dioxide. It forms an explosive mixture with air from 5.9 to 77.2 percent by volume.

In deep shale wells and petroleum production areas, hydrogen sulfide gas is a hazard because of the extremely toxic effect on humans from relatively small concentrations. Testing equipment should be available and used before entering any area where doubt exists as to the presence of hydrogen sulfide gas. Unless tests indicate it is safe to do so, no one should enter any area suspected of containing hydrogen sulfide gas unless he is equipped with suitable,

EFFECTS OF HYDROGEN SULFIDE INHALATION ON HUMANS

Number of Subjects	Concentration parts per million	Duration of Exposure	Effects
1	12,000		Death
1	2,000-4,000	20 min.	Death
10	1,000	1 min.	Death 1/10, unconsciousness, abnormal EKG
342	1,000-2,000	20 min.	Hospitalization of 320, death of 22 including 13 in hospital, residual nervous system damage in 4
5	1,000	Instant	Unconsciousness, death
1	1,000	25 min.	Unconsciousness, low blood pressure, pulmonary edema, convulsions, hematuria
4	290-550		Unconsciousness
1	230	20 min.	Unconsciousness, arm cramps, low blood pressure
78	15-25		Burning eyes in 25, loss of appetite in 31, headache in 32, weight loss in 20, dizziness in more than 19
6500	11-14	4-7 hrs.	Conjunctivitis
City of Terre Haute	.002-8	Intermittent air pollution episodes over a 2-month period	Numerous complaints of nausea (13), headache, shortness of breath (4), sleep disturbance (5), eye and throat irritation (5)

From National Institute for Occupational Safety and Health Criteria Document on Hydrogen Sulfide—DHEW (NIOSH) Publication No. 77-158, May, 1977.

approved respiratory equipment and a safety belt and lifeline. Such equipment as tanks and wells which are known to contain hydrogen sulfide gas should have warning signs posted to warn all employees and other persons of the dangers.

The precautions that should be taken when H_2S is suspected are:

- Inform each crew member of H_2S characteristics, dangers, safety procedures and first aid procedures.
- Instruct all drilling crews in the use of personal protective equipment.
- Tests should be made for presence and concentration.
- Personnel should work in pairs; more personnel might need to be hired.
- Warning signals should be posted.
- Adequate ventilation should be maintained.
- Always wear the proper respiratory protection, self contained or supplied air breathing apparatus, and a life-line when working in a suspected atmosphere.

When drilling in a known hydrogen sulfide area, these precautions should be taken:

- Situate the drilling rig so prevailing winds blow from the rig to the mud pits.
- Allow enough room for all jobs to be accomplished safely.
- Three wind streamers, located at tree top, at draw works and at least eight feet from the ground should be illuminated at night.
- Power generators should be located over 150 feet from the well to reduce explosion hazards.
- All electrical fixtures should be vaporproof and all heaters, even though flameproof, must be turned off when H_2S is encountered.
- All wind breakers and curtains should be removed when H_2S is encountered.
- Communication—telephone or radio—should be available at the drilling site.
- A fan should be installed to evacuate the borehole area toward the mud pit.
- A map of the area within a 3-mile radius of the well site should be available showing the number and names of people in each building. The dangers and procedures to be followed in case of an emergency should be explained to the people in this area.
- Civic authorities, ambulances, hospitals and doctors should be warned of possible H_2S encounters.
- Persons with punctured eardrums should not depend on a mask for protection.

Carbon Monoxide (CO)

Like hydrogen sulfide, carbon monoxide is a highly toxic gas and explosive if ignited. It is produced from internal combustion engines as exhaust, and sometimes can be formed underground by slow oxidization of organic material such as peat, lignite or coal.

In large diameter wells or pits where gasoline-powered motors are running and surface air movements do not ventilate the working area, carbon monoxide is a serious threat. The presence of carbon monoxide cannot be detected by sight, smell or taste. It is a colorless, odorless, tasteless gas. Its presence may be suspected, however, where the smell of exhaust fumes is detectable.

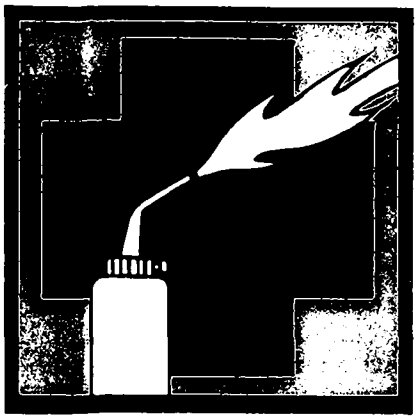
The symptoms of carbon monoxide poisoning are:

- Headache
- Dizziness
- Nausea
- Distinctive "cherry-red" flushed face
- Unconsciousness

When these symptoms are evident, the victim should be removed immediately by persons wearing respirators and non-static clothing.

The same precautions and planning involved in working with hydrogen sulfide should be used when carbon monoxide is present.

CHAPTER XIV



WELDING AND CUTTING TORCH SAFETY

Welders and cutters should be protected by wearing flame resistant gauntlet gloves, leather or asbestos aprons, oil-free clothing, and safety shoes.

Clothing should be without cuffs and unbuttoned pockets.

High quality welding helmets should be worn by arc welders. Hand shields, using the same shade glass as the helmets, may be used for light work.

An adequate supply of proper shade welding glasses should be available for arc welders.

Gas welders and cutters and their helpers should wear goggles.

Arc Welding

Use only standard electric arc welding equipment complying with the National Electrical Manufacturers Association, Electric Arc Welding Machine Standards, and Underwriters Laboratories Inc., Standards for Transformer Type Arc Welding Machines.

Frames of all electric welding machines should be effectively grounded. Special protective coverings should be provided for machines exposed to weather or unusual environmental conditions.

Electrode and ground cables should be supported so they do not create obstructions to the safe passage of workers. Insulated connectors should be used on both ground and electrode holder lines if occasional coupling is necessary. Soldered, taped splices may be used to operate welding machines in enclosed spaces.

Electrode stubs should be disposed of in a fire-resistant container. Careless disposal of hot stubs may result in a fire. The adjoining work should be shielded with asbestos or sheet metal to minimize this hazard.

Welding operators should be properly instructed how to avoid shock. Damp clothing and wet working conditions should be avoided.

Gas Welding and Cutting

Only standard oxyacetylene welding and cutting equipmment in first class operating condition should be used. Equipment approved and listed by Underwriters Laboratories or Factory Mutual laboratories is acceptable.

Cylinders should be:

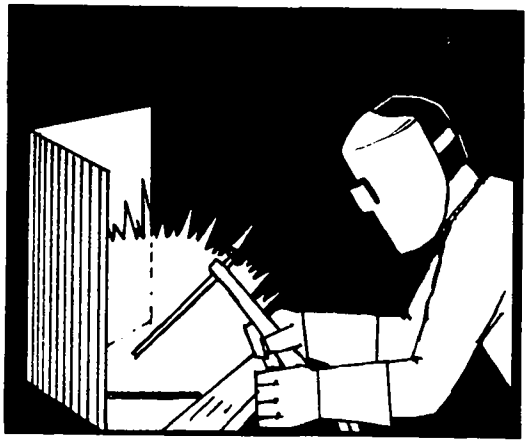
- Stored away from sources of heat.
- Stored securely to prevent tipping.
- Protected from ice and snow.
- Protected from contact with electric wires and shielded from sparks.
- Stored in an upright position.
- Moved on the job by hand, truck or other safe means.
- Secured, when free standing, to prevent tipping.

The protective cap should be in place over the valves and closed when the cylinder is being moved, when work is completed or the cylinder is empty.

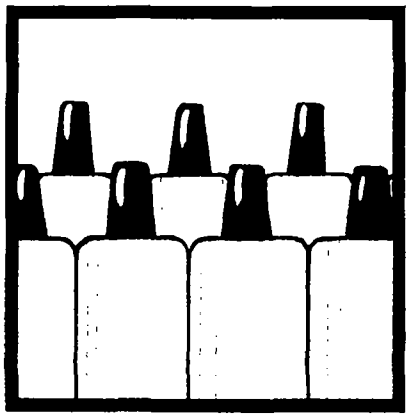
Hose for oxyacetylene service should comply with the specifications for rubber welding hose of the International Acetylene Association and Rubber Manufacturers' Association. The generally recognized colors are red for acetylene and other gas-fuel hose, green for oxygen hose, and black for inert gas and air hose.

Hose connections should comply with the Standard Hose Connection Specifications of the International Acetylene Association.

Hose should be inspected frequently for burns, leaks, worn places or other defects. Defective lengths should be discarded.



CHAPTER XV



OXYGEN AND ACETYLENE CYLINDERS

In recent years there has been increased use of compressed gas in cylinders—oxygen, acetylene, hydrogen and other gases. These cylinders, full or empty, are harmless if handled properly. Each crew member should be told how to handle gas cylinders. This training should include the following rules.

Cylinders should be prevented from dropping or striking together. When moving them by crane, use a cradle or platform, never a chain or rope sling. Keep protective caps on valves except when the cylinder is in use. Do not tamper with safety devices in either valves or cylinders. Never use cylinders for rollers, supports or any other purpose other than gas containers. Valves should be opened slowly with only those tools approved by the manufacturer. Never attempt to repair or alter cylinders or valves. Be sure the threads on regulators or other auxiliary equipment are the same as those on cylinder valve outlets. Never force a connection. Never attempt to repair or alter cylinders or valves. Protect cylinders against excessive temperature rises. They should be stored in the open but should be protected against extremes of weather and from the ground to prevent rusting. Protect them also from snow or ice and from direct rays of the sun. Do not allow any part of a cylinder to be subjected to a temperature above 125 degrees Fahrenheit. Do not permit a direct flame to contact any part.

Some "do's and don'ts":

Oxygen Cylinders

- Do not lubricate or allow oil or grease to get on oxygen connections, blowpipe or other oxygen equipment.
- Never use oxygen for compressed air or as a source of pressure.
- Never use oxygen from a cylinder except through an oxygen regulator.
- Never use valve protection caps for listing oxygen cylinders.
- Do not use a hammer or wrench to open oxygen cylinder valves.
- Open an oxygen cylinder valve slightly at first, when a regulator is attached, so that the high pressure gauge hand climbs slowly. Then open it all the way.
- Oxygen, or air rich in oxygen, should never be allowed to saturate any part of the clothing since a spark might quickly start a fire.
- Do not drop cylinders.
- Keep cylinders from being knocked over while in use.
- Never use cylinders as rollers or supports even if they are considered to be empty.
- Keep cylinders far enough away from the welding or cutting work so that sparks, hot slag or flame will not reach them.

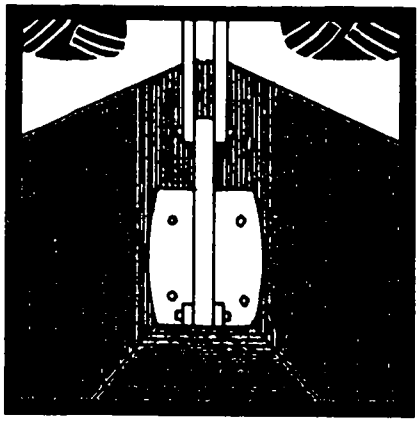
Acetylene Cylinders

- Do not permit acetylene to escape into a room or any enclosed space.
- Always use the special T-wrench or key for opening or closing the cylinder valve.
- Never tamper with fuse plugs.
- Do not use the recessed top of a cylinder as a place for tools.
- Never turn an acetylene cylinder valve more than one and one-half turns.
- Always close cylinder valves when work is finished, or when stopping work for even a short time—especially in an enclosed place.

When gas cylinders are stored, fasten them so they cannot be tipped or knocked over.

Acetylene cylinders should **never** be stored horizontally due to the possibility of the acetone in the cylinder leaking out leaving only acetylene gas which is unstable (explosive) above 15 psi pressure unless dissolved in acetone.

CHAPTER XVI



TRENCHING SAFETY

Trench excavation is normally accomplished by use of mechanical equipment, although explosives are sometimes used to remove hard material such as rock. These operations, together with moving equipment to the job, positioning and removal, can result in deaths, injuries and property damage. Types of losses involved include:

• Hundreds of workmen are killed or injured each year from trench cave-ins.

• Extensive property damage is sustained from blasting in shallow trenches.

• Sidewalks, roads and adjacent structures are often undermined by trenching operations.

• Many underground conduits are damaged from excavation activities. These include telephone and television conduits, electric transmission cables, and gas and water mains.

What Should Be Done

• A careful study should be made to determine the the following:

Relative location of highways, sidewalks and adjacent buildings—underpinning and shoring required.

Existence of overhead and underground service utilities.

Soil conditions and seismicity of area.

• Have the needed material immediately available to facilitate the fast and easy handling and placing of pipe.

• Able-bodied and experienced workers and equipment operators should be selected. Proper protective equipment such as hard hats and safety shoes should be used.

• Notify **all** utility companies or the Public Utility Protection Service in the area in which you will be working and request their assistance in locating and protecting underground utilities. Call before you dig.

• Where there is danger to adjacent buildings, a pre-job survey should be made to determine existing damage.

• Plan public protection with barricades and warning devices if the excavation will be open overnight or an extended period.

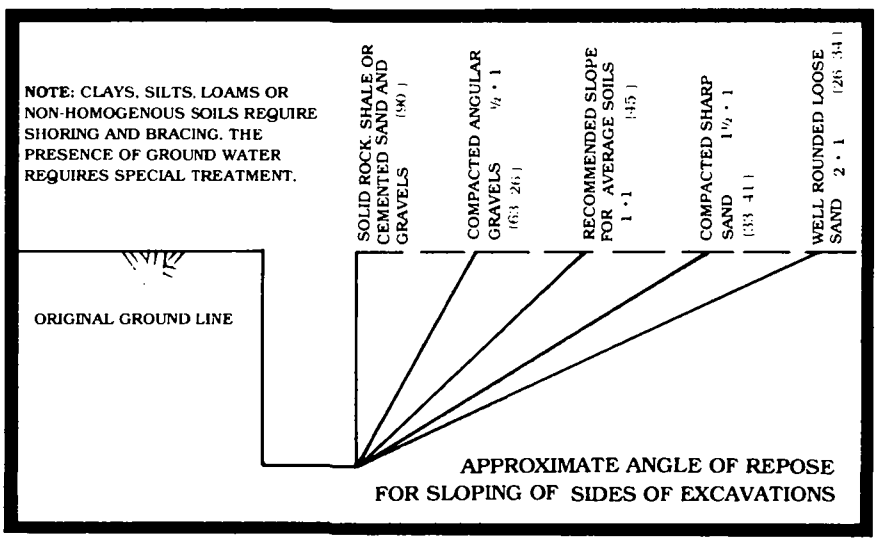
• Walk the excavation line with underground detection equipment prior to breaking ground.

How Should Trenching be Accomplished?

Trenches four feet or more in depth should be provided with ladders or steps spaced so that an employee will not have to move laterally more than 25 feet to a safe means of exit. Ladders should extend from the bottom of the trench to at least 36 inches above ground and be secured at the top.

All loose material should be kept back at least two feet from the edge of the cut.

Excavation around existing utilities should be done by hand.



When is Bracing and Shoring Required?

If it is not economically feasible, or there are space restrictions to prevent cutting the trench walls back to the safe angle of repose of the soil, all trenches 5 feet or more deep should be shored.

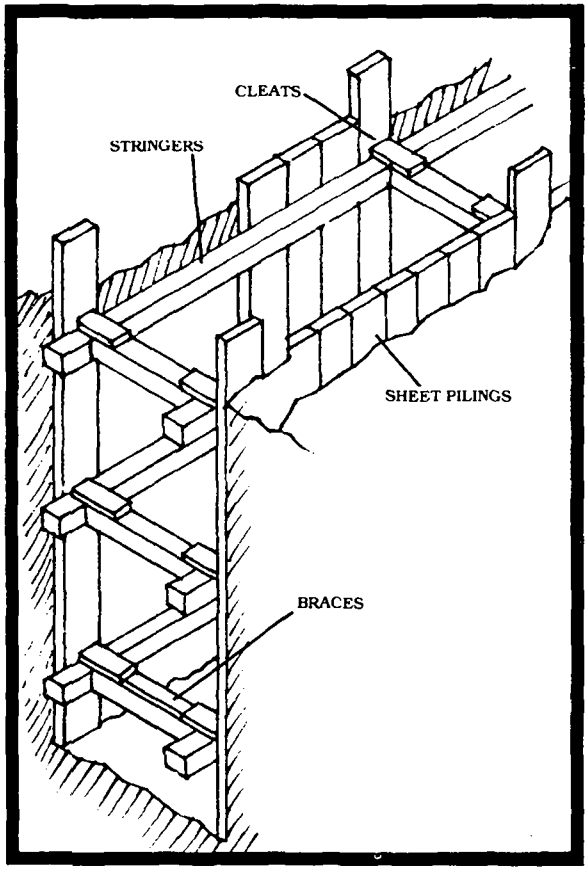
Shoring should be carried along as excavation progresses and should follow as closely as possible to the end of the bottom of the mechanical excavator.

What Type of Shoring Should be Used?

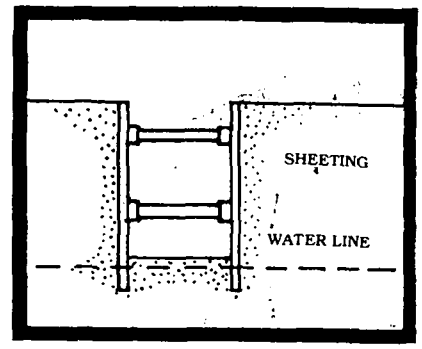
There are various methods and types of materials which may be used for bracing:

• The size, shape and design pattern for timber sheeting depends on the nature of the soil and the depth and width of the trench.

• In certain soils, and under unusual conditions such as presence of water, interlocking steel sheeting is often recommended.

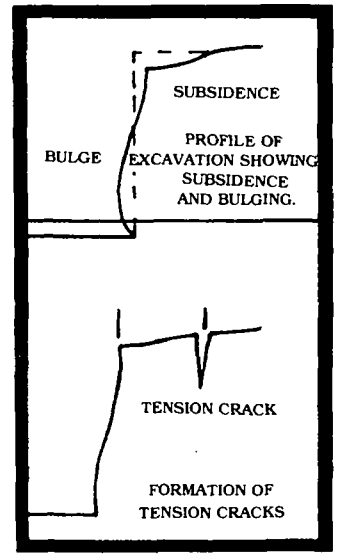


ONE EXAMPLE OF SEVERAL TYPES OF SHEETING.



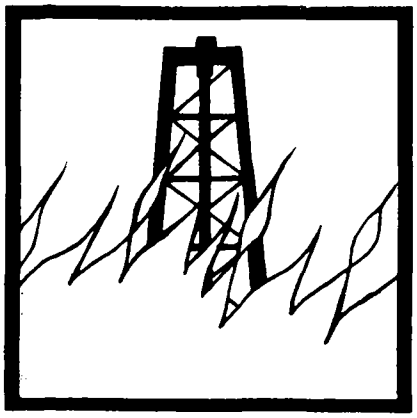
EXCAVATION BOTTOM BELOW WATER LINE.
SHEETING SHOULD BE DRIVEN BELOW BOTTOM.

• Trench shields are becoming more common, especially when ordinary bracing is not practical due to unstable ground. Shields should be constructed of steel flat sides, welded to a heavy steel framework of structural shapes and/or pipe. Shields may be moved along by the mechanical excavator as the excavation proceeds.



WHEN SUBSIDENCE OR TENSION CRACKS ARE APPARENT STOP ALL WORK AND CORRECT THE PROBLEM.

CHAPTER XVII



FIRE ON THE RIG

A large fire can totally destroy a drilling rig. Injury to employees, injury to a third party, property damage or a loss of business can be even more costly than equipment loss.

Since the nature of your business requires that equipment often be left at a job site some distance from the immediate help of professional fire fighters and equipment, the driller must assume some responsibility for safety from fire.

The following are some suggestions which will help to lessen the exposure to fire.

Preventive maintenance is the first line of defense against job site fire hazards. This maintenance should include at a minimum:

- Repair of worn or leaky fuel and hydraulic lines.
- Ignition wiring check.
- Battery cable and contact check for possible shorts.
- Doing welding and cutting at the yard to reduce the need for "emergency" welding in the field.

Set-up and security of equipment should include the following minimum considerations:

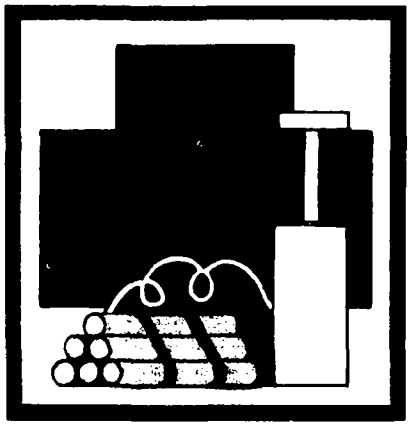
- Clear area of combustibles such as tall, dry grass, trash, construction material, etc.
- Portable flammable liquid containers (drip pans) should not be left where they may be used by vandals or arsonists. A can of gas on a rig is an invitation for a fire to be started.

Refueling of pumps, compressors and other portable equipment requires each workman's attention if this fire hazard is to be controlled:

- No smoking should be allowed within 25 feet of any refueling area.
- Proper funnels and pour spouts should be available to reduce the spill hazard.
- Always turn the equipment off and allow it to cool before refueling.
- Keep a Class B or multipurpose fire extinguisher in the immediate refueling area.
- Do not overfill; leave space for expansion of the fuel in the tank.
- Use only approved (such as Underwriters Laboratories) containers for fuels.

Since drillers and drillers helpers are often the only people near the rig, they must know how to use the fire extinguishers. The carbon tetrachloride and chlorobromomethane type extinguishers should **not** be used on hot metals. An all-purpose (Class ABC) extinguisher is probably the most suitable for installation on a drilling or pump installation rig; job site equipment fires might involve ordinary combustibles, flammable liquids or electrical exposures. The ABC multi-purpose extinguisher is designed for such uses.

CHAPTER XVIII



EXPLOSIVE SAFETY

Safe handling is of the utmost importance to any well drilling firm that uses, stores or transports explosives. If proper procedures are used, explosives are no more dangerous than a sack of sand; however, if **one** mistake is made in their use, storage or transportation, explosives can literally wipe out your place of business, your means of transportation and several, if not all, of your employees.

Only the most reliable drilling personnel can be allowed to handle and use explosives. A two-man team is usually the best system.

General Storage Precautions for Explosives

• Periodic inventories and inspections of magazines should be conducted at intervals not exceeding three days to determine if there has been unauthorized entry. Records should be kept of all magazine transactions and inspections.

• Explosives should always be stored in an approved storage facility.

• Only explosives should be stored in magazines.

• Explosives should not be stored in a damp place, near sources of heat, or near oil, gasoline, cleaning solutions or solvents.

Safe Handling and Use of Explosives

This section is **not** a "how to" blasting guide, but a compilation of the major hazards and safety precautions. All Dept. of Transportation , Dept. of Treasury, Dept. of Labor and state and local regulations **must** be followed. In case of conflict between regulations, the most stringent regulation must be followed.

Pre-Blast Procedures

• All circuits to charged holes should be tested; only galvanometers designed for this purpose should be used.

• A warning system consistent with current regulations should be in effect and posted to protect both employees and the public.

• The blast should not be fired until it is absolutely certain that every person is in a safe location.

• Blasting mats should be used when in congested areas, in close proximity to structures, highways, etc.

• Utility companies should be notified well in advance of the actual shot if there is any possibility of the shot affecting their service.

• Only the person making firing line connections should fire the shot.

• All connections should be made from the hole to the firing source.

• No holes should be loaded except those to be fired in the next round of blasting. No holes should be left loaded overnight.

• The blaster should survey the blasting area for possible sources of extraneous current.

• Whenever there is a possibility of vibration damage claims, vibration consultants should be retained by the contractor to provide pre-blast surveys and seismic analyses as required.

Loading

• All drill holes should be large enough to freely admit explosives.

• Drilling should not be restarted until the borehole has been examined for unexploded charges and these charges refired.

• After loading, all excess explosives should be returned to the magazine.

• If an electrical or severe dust storm is approaching the area, all blasting operations should be suspended and all persons removed from the area.

• All blasting operations should occur during daylight hours.

• No smoking, open lights, flames, etc., should be permitted near explosives.

• No person handling explosives should be under the influence of alcohol, narcotics or other dangerous drugs.

• Deteriorated or damaged explosives and blasting equipment should not be used.

• The carrying of blasting caps or explosives in pockets of clothing should not be permitted.

• All roads in or near the blasting area should be posted against usage of mobile radio transmitters in the area of blasting operations. Signs shall have 4-inch white letters on a red background with the words, "Blasting Area—Radio Transmitting Prohibited."

• Do not mix blasting caps from different manufacturers in the same circuit.

• The smallest number of persons possible should be involved in the loading of holes under the supervision of an authorized and qualified blaster.

Post Blast Procedures

• Lead wires from the power source should be disconnected and short-circuited immediately after the blast.

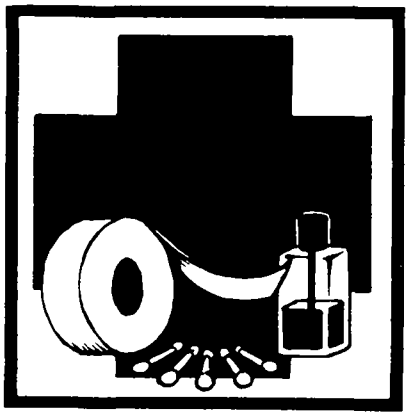
• After a shot underground or in an enclosed space, ventilation should be completed before proceeding with work.

• An inspection (after smoke, dust and fumes clear) should be made for misfires, loose rock, etc., prior to proceeding with work. After the inspection is complete an "all clear" should be sounded.

• Explosives should not be extracted from a hole unless it is impossible to detonate a charge by a fresh primer. Extractions should be done by an experienced person, preferably the one who loaded the hole.

(See Appendix D for explosive storage procedures.)

APPENDIX A—FIRST AID



The first aid procedure descriptions mentioned in this appendix are based on the most recent first aid publications available. The descriptions are included in this manual only to familiarize the individual with the kinds of first aid procedures which may be applicable to the well site in the event that an accident occurs. They are not designed as a substitute for formal first aid training.

The National Water Well Association strongly recommends that every individual who is employed in the water well industry successfully complete the first aid and cardiopulmonary resuscitation (CPR) courses made available by the American Red Cross.

CPR—Cardiopulmonary Resuscitation

Some day you may have the opportunity to save a person from death by cardiac arrest, drowning, suffocation or electrocution. Your action can save life if immediately and properly applied.

This life-saving method, called cardiopulmonary resuscitation, is a combination of artificial respiration and artificial circulation. It should be started immediately as an emergency procedure when cardiac arrest occurs, but only by those properly trained. It has been widely and successfully used by doctors and nurses and paramedical personnel for some time. It is recommended that the general public be trained in this technique.

All tissues of the body require oxygen, but the brain requires more than any other tissue. If the brain is deprived of oxygenated blood for four to six minutes or more, permanent brain damage or death will usually occur.

Respiratory arrest occurs when breathing stops, although pulse and circulation may continue for some time. Common causes of respiratory arrest are drowning, electrical shock and suffocation. Artificial respiration is required since the heart action continues to circulate blood to the brain and the rest of the body.

When circulation stops, the pulse disappears and breathing stops soon thereafter. This is called cardiac arrest. Both artificial respiration and artificial circulation are required to oxygenate the blood and circulate it to the brain. Common causes of cardiac arrest are heart attack, electrical shock, hemorrhage, drowning and suffocation.

Life Support

The maintenance of life is obviously the goal of cardiopulmonary resuscitation. Life support measures must be started as quickly as possible and continued until the victim's respiration and pulse are restored. Other reasons to discontinue CPR are: when the rescuer is completely exhausted and cannot continue; when care of the victim is relinquished to medical personnel; or when the victim is pronounced dead.

Life support can be divided into these basic steps:

1. Airway opened (head tilt method)
2. Breathing restored (mouth to mouth breathing)
3. Circulation restored (external cardiac compression).

A victim requiring cardiopulmonary resuscitation should be moved to a life support unit or hospital as quickly as possible. You should still start basic life support at the scene, stabilize the victim before moving him and continue life support during transportation.

Artificial Respiration

The basic steps of artificial respiration are (a) opening the airway, and (b) restoring breathing. They can be performed quickly without help from another person. They constitute emergency first aid for respiratory inadequacy or respiratory failure.

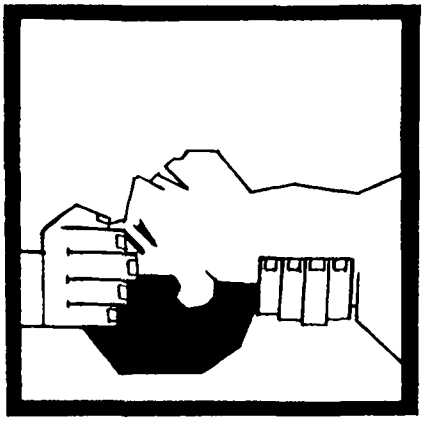
An obstructed airway is sometimes difficult to recognize until the airway is opened. A partially obstructed airway can be recognized by labored breathing.

Respiratory failure is characterized by failure of the chest or upper abdomen to move and absence of air movement through the nose or mouth.

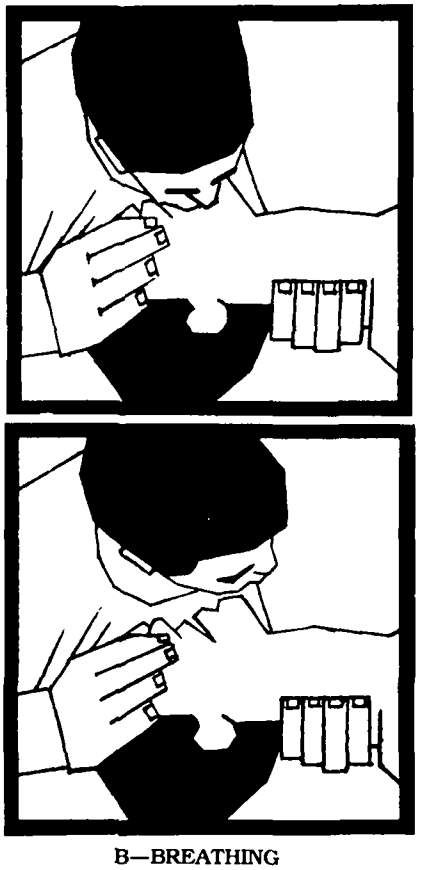
Airway

Immediate opening of the airway is most important. In the unconscious victim lying on his back, the relaxed muscles allow the lower jaw to drop backward. The tongue is also carried back and obstructs the back of the throat. Tongue obstruction can be relieved quickly by tilting the head backward as far as possible. Sometimes this is all that is required for breathing to resume spontaneously.

A-B-C of C.P.R.



A—AIRWAY



B—BREATHING

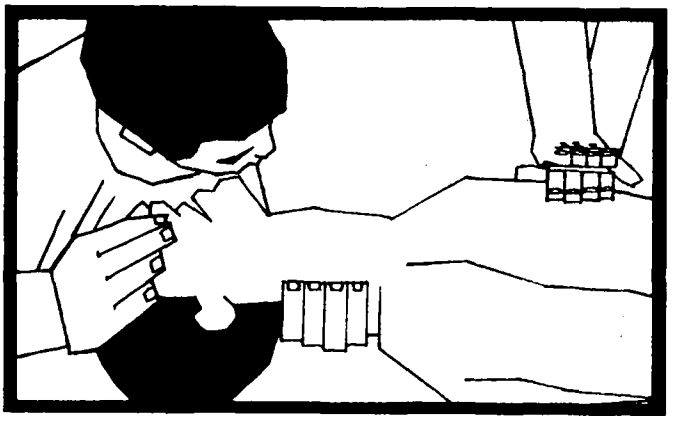
To perform the head tilt, position the victim on his back. Place one hand beneath the victim's neck and the other hand on his forehead. Then lift the neck with one hand, and tilt the head backward by pressure with your other hand on the forehead. The head must be maintained in this position at all times.

When the victim's head is tilted back, you should look, listen and feel to determine if there is any respiratory arrest or if spontaneous respirations are present. Place your cheek close to the victim's mouth and nose. Look at the chest and upper abdomen to see if they rise and fall while you listen and feel for the exhaling of air. If there is no evidence of spontaneous respiration, begin artificial respiration.

To perform mouth-to-mouth resuscitation, use your hand behind the victim's neck to keep the head in a position of maximum tilt (Figure 2). Continue exerting pressure on the victim's forehead with your other hand, thumb and index finger. Then open your mouth wide, take a deep breath, make a tight seal with your mouth around the victim's mouth, and blow. Remove your mouth and allow the victim to exhale passively, while you watch if his chest falls. Repeat this cycle once every five seconds as long as respiratory inadequacy persists.

The rescuer is providing adequate ventilation if he:

- Sees the chest rise and fall.
- Feels in his own airway the resistance and compliance of the victim's lungs as they expand.
- Hears and feels the air escape during exhalation.



C—CIRCULATION

Artificial Circulation

When sudden, unexpected cardiac arrest occurs, the ABCs of basic life support are required in rapid succession. No pulse, no breathing, and a deathlike appearance are characteristics of cardiac arrest. The carotid artery pulse should be checked as quickly as possible when cardiac arrest is suspected. In an unwitnessed cardiac arrest, first open the airway and quickly ventilate the lungs four times. Then maintain the head tilt with one hand on the forehead, and use the tips of your index and middle fingers of the other hand to locate the victim's larynx (adam's apple). Slide your fingers laterally into the groove between the trachea and the muscles at the side of the neck where the carotid pulse can be felt. The pulse area must be felt gently, not compressed.

There are several reasons for palpation of the carotid pulse. First, you are already at the victim's head to perform artificial respiration. Second, the neck area is accessible without removing any clothing. Third, pulses in the carotid arteries will persist when more peripheral pulses are no longer evident.

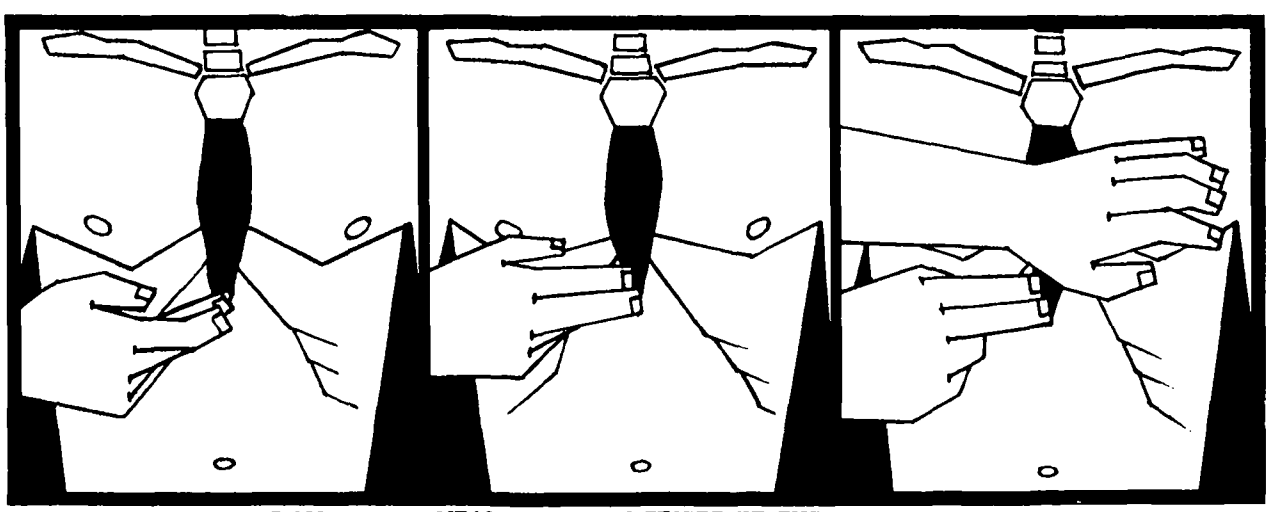
External cardiac compression must always be accompanied by artificial respiration. Compression of the sternum (breastbone) produces some movement of air, but in an insufficient volume to provide adequate oxygenation of the blood.

First, the patient must always be in the horizontal position. During cardiac arrest there is no blood flow to the brain when the body is in the vertical position, even during properly performed external cardiac compression.

Position yourself close to the side of the victim's chest and place the long axis of the heel of one hand over the long axis of the lower half of the sternum. Do not place your hand over the lower tip of the sternum which extends down over the upper abdomen—avoid it. Feel the tip of the xiphoid (Figure 3). Measure two finger-widths up from this point, place the heel of your other hand on the lower half of the sternum about one to 1½-inches away from the tip of the xiphoid and toward the victim's head. Place the other hand on top of the first one, bring your shoulders directly over the victim's sternum, keep your arms straight, rock back and forth slightly from the hip joints, and exert pressure almost vertically downward to depress the lower sternum 1½ to two inches. You may want to interlock your fingers during this procedure to assist in keeping the fingers off the chest wall. Relaxation must immediately follow compression and be of equal duration. Do not remove your hand from the chest during relaxation, but completely release pressure on the sternum so that it returns to its normal resting position between compressions.

Since artificial circulation must always be combined with artificial respiration, CPR is best performed by two rescuers. One rescuer positions himself at the victim's side and performs external cardiac compression while the other remains at the victim's head, keeping it tilted back, and continues artificial respiration. The compression rate for two rescuers is 60 per minute. When performed without interruption, this rate can maintain adequate blood flow and pressure and will allow cardiac refill. Be sure to quickly interpose one inflation after each five chest compressions without any pause. This is important since any interruption in cardiac compression will stop blood flow.

If you are the only rescuer, you must perform both artificial respiration and artificial circulation using a 15:2 ratio (two very quick, long inflations



LOCATE TIP OF XIPHOID. MEASURE UP TWO FINGER-WIDTHS FROM TIP OF XIPHOID. PLACE HEEL OF OTHER HAND OVER LOWER HALF OF STERNUM ABOVE BASE OF XIPHOID.

after each 15 chest compressions) at the faster rate of 80 compressions per minute, to achieve an actual compression rate of 60 per minute. The two full lung inflations must be delivered in rapid succession, within a period of five seconds, without allowing full lung exhalation between breaths. If time for full exhalation is allowed, this reduces the number of compressions and ventilations achieved in one minute.

Checking Effectiveness of CPR

The reaction of the pupils should be checked periodically during cardiopulmonary resuscitation, since this provides the best indication that oxygenated blood is being delivered to the victim's brain. Pupils that constrict when exposed to light indicate adequate oxygenation and blood flow to the brain. If the pupils remain widely dilated and do not react to light, serious brain damage is imminent or has already occurred. Dilated, but reactive pupils are less ominous.

The pupils should be checked as frequently as possible during resuscitation. This can be accomplished without any interruption in CPR, either by the rescuer who is performing ventilation or by others. The rescuer should not try to check the pupils before initiating CPR. This often leads to uncertainty and delay in starting effective treatment. Absence of the carotid pulse should be the criterion of cardiac arrest.

The carotid pulse should be felt periodically during CPR in order to check the effectiveness of external cardiac compression, or the return of a spontaneous heartbeat. When other rescuers are present and interruptions can be minimized, the pulse should be checked after the first minute of CPR and every few minutes thereafter. The pulse should be checked particularly at the time when rescuers are changed.

Proper CPR Sequence for Unwitnessed Cardiac Arrest

Here is a review of the steps you should take for CPR:

- Tilt the head back to open the airway.
- Look, listen and feel for breathing in order to recognize respiratory arrest.
- If breathing is absent, give four quick, full breaths, without allowing time for the lungs to deflate completely between breaths.
- Check the carotid pulse to recognize cardiac arrest. If pulse is absent, begin CPR.

Two-Rescuer CPR

- Compressions—rate of 60 per minute—regular, smooth, uninterrupted;
- Ventilations—after each five compressions, interposed with no pause in compressions;
- Ratio of compressions to ventilations—5:1.

One-Rescuer CPR

- Compressions—rate of 80 per minute, series of 15 compressions;
- Ventilations—two quick, full lung inflations, delivered within five seconds;
- Ratio of compressions to ventilations—15:2;
- Check carotid pulse and pupils frequently during resuscitation to determine the effectiveness of CPR, or the return of a spontaneous heartbeat.

Time is of the essence. Never waste time for prolonged examination of the patient, seeking assistance, removing clothing, moving the patient, probing the air passages, or checking the pupils. Do not procrastinate. Begin at once.

Some cases of cardiac arrest cannot be resuscitated even if you start immediately and perform CPR correctly, adequately, and without interruption. A massive heart attack, severe depression from drugs or carbon monoxide, prolonged submersion, serious electrical shock, or profound asphyxia, may prevent recovery despite your efforts. Recognize this fact and do not blame yourself or become discouraged if you fail.

Any patient who requires CPR also requires follow-up care in the hospital. When only artificial respiration is required, minimal care may be indicated. Every CPR case must be brought to a hospital as quickly as possible so that therapy (diagnosis, drugs, defibrillation) can be given. Many cases cannot be restored without definitive therapy.

Start CPR at once—but don't delay moving the patient to a hospital.

Special Resuscitation Situations

Electric Shock

The effects of electrical shock are varied. The outcome depends largely upon the amplitude of the current and how long the victim was exposed to it. In addition to burns, emergency symptoms are as follows:

- Spasm of the muscles used in breathing. This condition is usually confined to the duration of the shock, but it may produce cardiac arrest if the shock is prolonged.

• Prolonged paralysis of respiration. This may follow a massive convulsive-like reaction and last four minutes after the shock has ended.

• Ventricular fibrillation or other serious alterations of the cardiac rhythm produced by low voltage currents (110v-220v) sustained for several seconds.

After safely clearing a victim from an energized object, the rescuer should immediately determine his cardiopulmonary status. If spontaneous respiration or circulation is absent, cardiopulmonary resuscitation should be initiated.

If electrical shock is witnessed on public utility poles, a precordial thump should be delivered and mouth-to-mouth ventilation started at once. The victim must be lowered to the ground as quickly as possible.

Precordial Chest Thump

The precordium is the area of the chest over the heart; it includes the midsternum and the area just to the left of it. In some cases a blow or thump over this area can be effective in restarting a heart. Follow these rules for administering precordial thump:

• Restrict it to cases of witnessed cardiac arrest.

• Administer the blow within the first minute following arrest.

• Deliver a single blow only.

If it is not immediately effective, start CPR. The precordial thump is performed by placing your clenched fist 8 to 12 inches above the chest and delivering a quick, firm blow over the midsternum with the fleshy portion of the fist.

If a witnessed cardiac arrest occurs, the following steps should be taken:

• Tilt the head to open the airway, and simultaneously feel the carotid pulse.

• If the pulse is absent, give a precordial thump.

• If the victim is not breathing, give four quick, full lung inflations.

• If pulse and breathing are not immediately restored, begin CPR.

This discussion of cardiopulmonary resuscitation is intended to help our readers understand the process. When read thoroughly and carefully, it can help you save a life. For complete confidence in your ability to administer the procedures outlined in this section you should attend a formal training session on CPR methods.

Heart Attack

Heart attack usually involves a clot in one of the blood vessels that supplies the heart. The attack is sometimes called a coronary since there is a loss of blood supply to a portion of the heart muscle (by blockage of the coronary arteries). A heart attack may or may not be accompanied by loss of consciousness. If the attack is severe, the victim may die suddenly. The victim may have a history of heart disease, or the attack may come with little or no warning. Attacks with mild pain sometimes occur. The degree of pain is not a good indication of the seriousness of the disease.

Symptoms

• Persistent chest pain is usually under the sternum (breastbone). The pain frequently radiates to one or both shoulders or arms, the neck, jaw or both.

• Gasping and shortness of breath.

• Extreme pallor or bluish discoloration of the lips, skin and fingernail beds.

• Extreme prostration.

• Shock.

• Swelling of the ankles, which may be an indication of heart disease.

The two principal symptoms of an acute heart attack are pain (in the chest, upper abdomen, or down the left arm and shoulder) and extreme shortness of breath. The symptoms can occur together, but usually one or the other is stronger. Indigestion, nausea and vomiting are often associated with a heart attack.

First Aid

Place the victim in a comfortable position, usually sitting up, particularly if there is shortness of breath—although his comfort is a good guide. Use as many pillows as needed.

Provide ventilation and guard against drafts and cold.

If the victim is not breathing, begin artificial respiration.

Have someone call for an ambulance equipped with oxygen, and have the victim's own doctor notified.

If the victim has been under medical care, help him with his prescribed medicine. (Look for some form of emergency medical identification.) If in doubt, confer with a physician by telephone.

Do not give liquids to an unconscious victim.

Since transportation causes added strain upon the victim, do not attempt to transport him until you get medical advice—if available within a reasonable time.

Stroke

A stroke is caused by a spontaneous rupture of a blood vessel in the brain or formation of a clot that interferes with circulation.

Major Stroke Symptoms

- Unconsciousness
- Paralysis or weakness on one side of the body
- Difficulty in breathing and in swallowing
- Loss of bladder and bowel control
- Pupils of the eyes unequal in size
- Lack of ability to talk or slurring of speech

First Aid For Major Stroke

- Provide moderate covering.
- Maintain an open airway.
- Give artificial respiration if indicated.
- Position the victim on his side so the secretions will drain from the side of the mouth.
- Call a doctor for medical advice as quickly as possible.

Do not give fluids unless the victim is fully conscious and able to swallow or unless medical care will be delayed a long time.

Minor Stroke

In a minor stroke, small blood vessels in the brain are involved. These usually do not produce unconsciousness. The symptoms depend upon the location of the hemorrhage and the amount of brain damage.

Minor Stroke Symptoms

The minor stroke may occur during sleep and be accompanied by:

- Headache
- Confusion
- Slight dizziness; ringing in the ears
- Other minor complaints

Later, there may be:

- Minor difficulties in speech
- Memory changes
- Weakness in an arm or leg
- Some disturbance in the normal pattern of the personality

First Aid For Minor Stroke

- Protect the victim against accident or physical exertion
- Suggest medical attention

Fractures

A fracture is a break or crack in a bone. Fractures can be either simple or compound.

Simple fractures are those not related to open wounds on the surface of the body.

Compound fractures are those associated directly with open wounds.

The most common cases of fractures are motor vehicle accidents, or accidents related to falls or crushed limbs. Some fractures result from very slight injuries, particularly in older people, because of brittle or abnormal bones.

Symptoms

If an accident victim is conscious he will usually be able to provide clues to possible fractures. He may recall his position before the injury and relate what happened as he fell or struck some object. In addition:

- He may have heard or felt a bone snap
- He may indicate the location of pain and tenderness and difficulty in moving the injured part
- He may also report a grating sensation of broken bones rubbing together
- He may report abnormal or false motion in an area of the body
- Differences in the shape and length of corresponding bones on the two sides of the body
- Swelling
- Discoloration
- Pain or tenderness to touch

Simple Fractures

Simple fractures are much more common than compound fractures. As a rule, accurate diagnosis can be made only by a physician with the assistance of X-ray examination. The first aid worker should suspect that a bone is broken when any of the signs are present. Even if there is a doubt, to prevent aggravation of existing injuries, he should carry out first aid measures for a fracture.

Compound Fractures

In a compound fracture, the wound usually is caused by a broken bone end that tears through the skin and, in most cases, slips back again. Sometimes the wound is caused by machinery or by a flying object that penetrates the skin and breaks the bone. Compound fractures are much more serious because of tissue damage, bleeding, and the danger of infection because of contamination in the fracture area.

First Aid for Fractures

- Call for an ambulance or medical assistance.
- Prevent movement on the injured parts and the adjacent joints.
- Elevate involved extremities, if possible, without disturbing the suspected fracture.
- Apply splints, if ambulance service is not available, if there is a delay in transportation, or in less serious injuries before seeking medical assistance for diagnosis and treatment.
- Do not attempt to set (or reduce) a fracture or try to push a protruding bone end back.
- If splinting and transportation are necessary, the bone end may slip back when the limb is straightened for splinting.
- If an ambulance or rescue squad can arrive within a short period after an accident, when an injured peron obviously requires hospitalization, do not attempt to move the victim unless there is danger of fire, carbon monoxide poisoning, explosion, or other life-threatening emergencies.

Above all, unless in extreme emergency in attempting rescue, do not drag victims out of vehicles, from under wreckage, or throw them on the ground in your haste to save their lives.

If possible, even in the midst of a crowded street or highway, take the time to tie a victim's injured leg to his uninjured one, or bind his injured arm to his chest or side.

Lift and move an unconscious victim as though there is injury to his neck or spine.

Wait for help—at least three and preferably four persons—and obtain a rigid support for the victim's back, if possible.

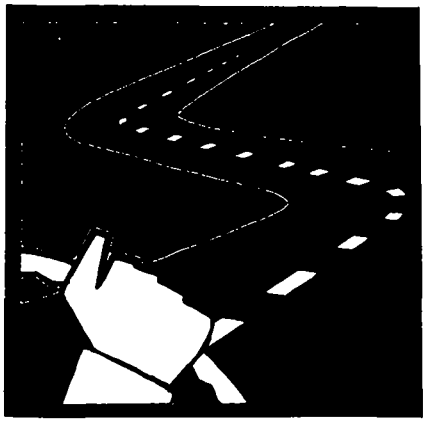
Delegate others to telephone for an ambulance and the police, if necessary, and to assist in maintaining order in the area of the accident.

If a compound fracture is evident or suspected, treat the wound as outlined previously, then:

- Remove or cut away the victim's clothing.
- Control hemorrhage by applying pressure through a large sterile (or clean) dressing over the wound.
- Do not wash the wound, do not probe it, and do not insert your fingers into it.
- If a fragment of bone is protruding, cover the entire wound with a large sterile bandage compress or pads; if these are not available, use freshly laundered sheets or towels.
- Do not replace bone fragments.

Apply splints according to the location of the fracture. Then elevate the limb slightly to reduce hemorrhaging and swelling. Open fractures should have priority over closed fractures for transportation and medical treatment, unless associated injuries dictate otherwise.

APPENDIX B



MOTOR VEHICLE SAFETY

Driving Records

The folowing pages provide a compilation of the availability and procedures for obtaining information on driving records from the different states. Through the active development of more adequate performance records of their licensed drivers, the various states have provided the motor carrier with both a tool for driver supervision and an added means of determining the desirability of a new driver. For the most part, these driver records provide information on involvement in accidents, convictions for traffic violations, and violations of certain other laws. Motor carriers who are subject to the Federal Motor Carrier Safety Regulations are required to review the driving record of each driver they employ at least once every 12 months.

A review of a driver's official driving record should be made in each state in which they hold a license and, if possible, in each one in which they drive regularly. When requesting information, list the full name of each individual, their complete address, full date of birth and the number of the license(s) held by them in that state. When two or more individuals are being checked at the same time, they should be listed in alphabetical order by last names. Follow all special instructions applicable to the state concerned. Full remittance of fees covering the names to be checked should accompany each request along with stamped, self-addressed envelopes.

Alabama

Contact: Driver License Division, Certification Section, P. O. Box 1471, Montgomery, Alabama 36102.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $2.00 per person. Make checks payable to Department of Public Safety.

Note: Request must include the full name (no nicknames or abbreviations), date of birth and driver license number. Prescribed request forms required. Contact above address for sample form for reproduction. Each request must be on a separate sheet.

Alaska

Contact: Department of Public Safety, Driver's License Section, Pouch N, Juneau, Alaska 99801.

Information Supplied: Accident involvement; accidents at fault; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic. Information covers three years; five years for serious offenses.

Fee: $1.00 per person. Payment in cash or by check must accompany the request. Make checks payable to the Department of Public Safety.

Note: Requests must include full name, date of birth, Alaska driver's license number and fee.

Arizona

Contact: Motor Vehicle Division, 1801 West Jefferson Street, Phoenix, Arizona 85007.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic.

Fee: Make checks payable to Motor Vehicle Division.

Abstracts $2.00
Certified Copies $2.00
Record Check $1.00
Name and Address $1.00

Note: Requests must be made in writing.

Arkansas

Contact: Driver Licensing Section, P. O. Box 1272, Little Rock, Arkansas 72203.

Information Supplied: Traffic violations convictions; suspensions and revocations.

Fee: $2.00 per request, make check or money order payable to Department of Finance and Administration.

Note: Request must include full name, date of birth, current address of subject, and Arkansas driver's license number. Sample request form available from the Department.

California

Contact: Department of Motor Vehicles, Division of Driver's Licenses, P. O. Box 1231, Sacramento, California 95806.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: Driver record search by name and driver license number—$ .50. Driver record search by name and birth date—$ .75. Make checks payable to the California Department of Motor Vehicles.

Note: California Driver records have been converted to data processing—replies may be on automated printout or manually produced. Requests must include full name, date of birth, current address, or California license number of subject. Prescribed form required. Contact above address for sample form and instructions for use.

Colorado

Contact: Colorado Department of Revenue, Motor Vehicle Division, Master File Section, 140 West Sixth Avenue, Denver, Colorado 80204.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.25 per person. Make checks payable to Colorado Department of Revenue.

Connecticut

Contact: Department of Motor Vehicles, Copy Record Section, Sixty State Street, Wethersfield, Connecticut 06109.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $4.00 per driving record, $4.00 per accident record. Fee payable with request. Separate checks requested for driving record and accident record. Make check(s) payable to Commissioner of Motor Vehicles.

Note: Request must include full name, date of birth, address, and license number of each subject.

Delaware

Contact: Motor Vehicle Department, P. O. Box 698, Driver's License Section, Dover, Delaware 19901. Attn: Sandra O'Brien or Mary Carter.

Information Supplied: Accident involvement; accidents at fault; suspension and revocation, traffic; traffic convictions; suspension and revocation, other than traffic.

Fee: $2.00 per record. Make checks payable to Motor Vehicle Department.

Note: Request must show full name, date of birth, and license number (if available).

District of Columbia

Contact: D. C. Department of Transportation, Bureau of Motor Vehicle Services, 301 C Street, N.W., Washington, D.C.

Information Supplied: Traffic charges; dispositions; suspensions and revocations in lieu of traffic convictions.

Fee: $ .50 per person. Make checks payable to Treasurer, District of Columbia.

Florida

Contact: 10/18 Merit Rating, Driver's License Division, Department of Highway Safety and Motor Vehicles, Neil Kirkman Building, Tallahassee, Florida 32304.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: Any information of driving record, $1.50. Certified copy of driving record, $3.00, payable to Department of Highway Safety and Motor Vehicles.

Note: Requests must be submitted on prescribed form to be furnished by firm seeking information. For sample form and instructions for use, contact the Driver's License Division.

Georgia

Contact: Department of Public Safety, Driver's Services Section, P. O. Box 1456, Atlanta, Georgia 30301, c/o Merit Rating.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $2.00 for seven-year record; $1.50 for three-year record. Make checks payable to the Department of Public Safety. Personal checks, personal money orders or stamps not accepted. Correct fee must accompany each request.

Note: Requests must be in written form listing subject's full name, date of birth and license number. In order to obtain a record, you must comply with one of the following: insurance, credit, or employment; It is necessary that anyone who requests a driver's record, other than his own, file proof that he has permission (written) from the driver to obtain a copy of his record. This written authorization is valid for a period up to sixty days.

Hawaii

Driver records data is available in Hawaii at the county level for a $1.00 abstract fee at the following locations: District Court of the First Circuit, State of Hawaii, Violations Bureau, 842 Bethel Street, Honolulu, Hawaii 96813; District Court of the Second Circuit, State of Hawaii, Violations Bureau, P. O. Box 922, Wailuku, Maui, Hawaii 96793; District Court of the Third Circuit, State of Hawaii, Violations Bureau, P. O. Box 896, Hilo, Hawaii 96720; District Court of the Fifth Circuit, State of Hawaii, Violations Bureau, P. O. Box 95, Lihue, Kauai, Hawaii 96766.

Idaho

Contact: Department of Law Enforcement, Motor Vehicle Division, Box 34, Boise, Idaho 83731.

Information Supplied: Traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.50 per name. Request information on prescribed form obtainable from above.

Illinois

Contact: Secretary of State, Driver's License Division, Driver Control Section, Centennial Building, Springfield, Illinois 62723.

Information Supplied: Abstract includes all operators holding chauffeur's registrations; license number; class; restrictions; issue and expiration date; traffic law violations and accidents of record. Also listed are the driver's complete name, birthdate and personal description.

Fee: Abstract, $2.00; certification of abstract, $2.00 additional; information on licenses held $2.00. Make checks payable to Secretary of State.

Note: A form is prescribed for requesting each driver's past record. This form is not furnished by the state and must be reproduced by the agency making the request. Copies for reproduction purposes are obtainable from the above. In making requests, show correct Illinois driver's license number and individual's full name: first, middle initial, and last; date of birth and sex.

Indiana

Contact: Bureau of Motor Vehicles, Division of Driver Licensing, Paid Mail Section, Room 315, State Office Building, Indianapolis, Indiana 46209.

Information Supplied: Traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.00 per person. Make check payable to Indiana Bureau of Motor Vehicles. Regular users may open an account with the Paid Mail Department.

Iowa

Contact: Department of Transportation, Records Section, Lucas State Office Building, Des Moines, Iowa 50319.

Information Supplied: Accident involvement; traffic convictions, suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $2.00 per person. Make checks payable to Department of Transportation.

Note: Furnish full name, date of birth and license number.

Kansas

Contact: Division of Vehicles, Driver's License Section, State Office Building, Topeka, Kansas 66626.

Information Supplied: Traffic convictions; suspension and revocation, other than traffic. Licensee's written consent required prior to release of information, or affidavit, if employer, asserting employer/employee relationship and that request is in connection with employment.

Fee: $1.00 per person if inquirer furnishes questionnaire; $2.00 per person if record is certified by Department. Make checks payable to Division of Vehicles. Fee must accompany request.

Kentucky

Contact: Division of Driver Licensing, New State Office Building, Frankfort, Kentucky 40601.

Information Supplied: Accident involvement; traffic convictions (within three years of date of conviction); suspension and revocation, traffic; medical information when available.

Fee: $2.00 per motor vehicle record report when request is submitted on MVR form; otherwise the fee is $3.00. Prescribed form obtainable from above.

Louisiana

Contact: Department of Public Safety, Driver's License Division, P. O. Box 1271, Baton Rouge, Louisiana 70821, Attn: O.D.R. Section.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $2.00 per person. Make checks payable to Driver's License Division.

Maine

Contact: Secretary of State, Motor Vehicle Division, Capital Street, Augusta, Maine 04333.

Information Supplied: Accident involvement; accident of fault; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $2.00. Make checks payable to Secretary of State.

Maryland

Contact: Motor Vehicle Administration, Driver Records Section, 6601 Ritchie Highway, N.E., Glen Burnie, Maryland 21601.

Information Supplied: Traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.00 per person. Make checks payable to Motor Vehicle Administration.

Note: Furnish full name (including full middle name), date of birth and license number, if available.

Massachusetts

Contact: Registry of Motor Vehicles, Court Records Section, 100 Nashua Street, Boston, Massachusetts 02114, Attn: Miss Bette McNiff.

Information Supplied: Limited records available furnishing current status of license only. An individual may obtain a complete copy of his own driving record by submitting a notorized request and said record will be returned to him.

Fee: $3.00. Make checks payable to Registry of Motor Vehicles. Prepaid requests for driving records may be purchased at $30.00 a block, ten requests to each block.

Note: Furnish name, date of birth, address, license number. In accordance with a ruling of the Attorney General, driver license information can be obtained only by the license holder.

Michigan

Contact: Michigan Department of State, Bureau of Driver and Vehicle Services, Commercial Look-Up Unit, Lansing, Michigan 48918.

Information Supplied: Traffic convictions; Suspension and revocation, traffic; Suspension and revocation, other than traffic.

Fee: Driving record information, $4.00 per person. Certified copy of record, $5.00 per person. Make checks payable to State of Michigan.

Note: Requests must be made in writing. Complete name and date of birth and/or Michigan Driver's License number must be included on the request.

Minnesota

Contact: Minnesota Department of Public Safety, Driver's License Office, Room 108, State Highway Building, St. Paul, Minnesota 55155.

Information Supplied: Traffic convictions; suspension and revocation, traffic; Suspension and revocation, other than traffic.

Fee: $2.00 per name. Make checks payable to State Treasurer.

Note: Prescribed form in duplicate available for making inquiries or facsimile may be used. Show Minnesota driver license number, full name and date of birth.

Mississippi

Contact: Mississippi Highway Safety Patrol, Driver's License Issuance Bureau, P. O. Box 958, Jackson, Mississippi 39205.

Information Supplied: Accident involvement; accidents at fault; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $3.50 per person. Make checks payable to Commissioner of Public Safety, Driver Services Division.

Missouri

Contact: Bureau of Driver's License, Department of Revenue, P. O. Box 200, Jefferson City, Missouri 65101.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.00 per person. Make checks payable to Department of Revenue.

Note: Submit request for information in duplicate and furnish full name, month, day and year of birth, sex and driver license number.

Montana

Contact: Montana Highway Patrol, 1014 National, Helena, Montana 59601.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $2.00 per person. Make checks payable to Montana Highway Patrol.

Note: Requests must be made on prescribed form. Copies of this form for reproduction purposes are available from the above. In making requests, show Montana driver's license number, complete name and date of birth.

Nebraska

Contact: Department of Motor Vehicles, Driver License Records, P. O. Box 94780, State Capitol, Lincoln, Nebraska 68509.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: Each abstract $ .75.

Note: Use of prescribed form required. Contact address above for sample of form to be furnished by party making request. Self-addressed return envelope with sufficient postage required.

Nevada

Contact: CBM of Nevada, Box 1964, Carson City, Nevada 89701.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation.

Fee: $1.25 per record search; $ .25 additional per sheet for photocopies. Make checks payable to CBM of Nevada.

New Hampshire

Contact: Division of Motor Vehicles, Driver Record Research Unit, 85 Loudon Road, Concord, New Hampshire 03301.

Information Supplied: Accident involvement, three years to include date and location; traffic conviction, seven years to include date of conviction and court location.

Fee: $2.00 per person. Make checks payable to the State of New Hampshire—DMV.

Note: Request must be made in writing or in person and must contain full name and complete date of birth.

New Jersey

Contact: Driver Record Abstract Section, Division of Motor Vehicles, 25 South Montgomery Street, Trenton, New Jersey 08666.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $5.00 per certified copy of record; $100.00 per book of 100 requests for uncertified copies. Contact above address for further information on these books. Make checks or money orders payable to New Jersey Division of Motor Vehicles.

New Mexico

Contact: Department of Motor Vehicles, Driver's Services Division, Bataan Memorial Building, Santa Fe, New Mexico 87501.

Information Supplied: Accident involvement; accidents at fault; traffic convictions; suspension and revocation, traffic.

Fee: Abstract of driver's license or other driver's record for the preceding three years—$1.00; abstract of driver's license or other driver's record for the preceding five years—$1.50; abstract of vehicle record, per name or vehicle—$1.00; copy of record, per name or vehicle—$3.00; duplicate of microfilm roll limited to vehicle records only and subject to the discretion of the Commissioner as to each request—$10.00; certification of any abstract of copy, per name or vehicle—$1.00. Make checks payable to Department of Motor Vehicles.

New York

Contact: Department of Motor Vehicles, Public Service Bureau, Empire State Plaza, Albany, New York 12228.

Information Supplied: Certified abstract of operating record, including driver's name, address, date of birth, driver's license information and expiration date; accident record and accident case numbers; traffic convictions; suspension and revocation information.

Fee: $2.00 per record, additional $ .50 if certification is required. Make checks payable to Commissioner of Motor Vehicles.

North Carolina

Contact: Department of Transportation, Driver License Division, Raleigh, North Carolina.

Information Supplied: Traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic. Record checks will contain a record of proceedings and orders pertaining to a driver's license granted, refused, suspended, or revoked and convictions or violations as required by G.S. 20-26.

Fee: $1.00 per person for copy of record. Make checks payable to Department of Transportation, Driver License Division. Advise if complete or three-year record is needed.

Note: A form is prescribed for making requests. Form furnished by the state. In making request, show correct North Carolina driver's license number, individual's full name and date of birth.

North Dakota

Contact: Driver's License Division, Capitol Grounds, Bismarck, North Dakota 58505.

Information Supplied: Traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic restrictions, cancellations. Information available for last three years only.

Fee: $2.00 per record. Make checks payable to Driver's License Division. Requests must include full name, date of birth, address, and driver's license number, if available, and may be submitted in the form of a letter.

Ohio

Contact: Bureau of Motor Vehicles, Department 16, P. O. Box 1199, Columbus, Ohio 43216.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic.

Fee: $1.00 per record. Make checks payable to State of Ohio, Bureau of Motor Vehicles.

Note: Contact address above for full information and instructions for obtaining driver records.

Oklahoma

Contact: Driver Records Service, Oklahoma Department of Public Safety, P. O. Box 11415, Oklahoma City, Oklahoma 73111.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $3.00 per record. Certified copy of any document in driver's file obtainable at cost of $2.00 per page or portion thereof. Make checks payable to Department of Public Safety.

Note: Show Oklahoma driver's license number, full name of individual and birth date.

Oregon

Contact: Motor Vehicles Division, 1905 Lana Avenue, Salem, Oregon 97314.

Information Supplied: Accident involvement; traffic convictions (past five years); current suspension and revocation, traffic; current suspension and revocation, other than traffic.

Fee: Employment record—$2.50; non-employment record—$2.50; consolidation of both records—$5.00. Make checks payable to Oregon Motor Vehicles Division.

Note: When requesting a person's driving record, please provide his Oregon driver's license number and complete name and birth date. Request supply of Form 48 for volume use. Employment record does not include convictions for major offenses under 482.430, nor convictions of the energy conservation speed limit. Non-employment driver record also does not include convictions of the energy conservation speed limit. Employment driving record must be specifically requested or only non-employment record will be provided.

Pennsylvania

Contact: Pennsylvania Department of Transportation, Bureau of Accident Analysis Operator Information Section, Room 212, Transportation & Safety Building, Harrisburg, Pennsylvania 17120.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic (for three-year period); suspension and revocation, other than traffic.

Fee: $1.50 per name ($5.00 per name certified). Make checks payable to the Pennsylvania Department of Transportation.

Note: Furnish name, date of birth, address and Pennsylvania Operator's Plate Number; Each request must be accompanied by a prescribed release form in order to comply with state privacy legislation.

Rhode Island

Contact: Registry of Motor Vehicles, Room 101G, State Office Building, Providence, Rhode Island 02903.

Information Supplied: Certificate I—all information pertaining to operator's license data. Certificate II—any and all of the operator's violations, convictions, revocations and suspensions. Certificate III provides a list of the operator's accident involvement.

Fee: $ .50 for each certificate issued; $1.50 for complete record. Make checks payable to Registry of Motor Vehicles.

Note: Furnish name, address, date of birth and license number.

South Carolina

Contact: South Carolina State Highway Department Driver Record Check Section, Columbia, South Carolina 29202.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $2.00 per person. Make checks payable to South Carolina Highway Department. South Carolina driver's license number must be furnished for each subject.

South Dakota

Contact: Department of Public Safety, Driver Improvement Program, 118 West Capitol, Pierre, South Dakota 57501.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic for three-year period.

Fee: $2.00 per record. Make checks payable to the Department of Public Safety. Prescribed form must be used. Sample forms available from Department of Public Safety.

Tennessee

Contact: Department of Safety, Andrew Jackson Building, Nashville, Tennessee 37219.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic.

Fee: $3.00 per person. Make checks payable to Department of Safety.

Note: Request must show full name, date of birth and license number.

Texas

Contact: Texas Department of Public Safety, License Issuance and Driver Records, P. O. Box 4087, NAS: Austin, Texas (Mark envelope "22").

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.00 each; 100 or more at one time on data processing cards $ .75 each. Obtain sample copy of prescribed form and instruction for requesting records from address above. Make checks payable to Texas Department of Public Safety.

Utah

Contact: Driver's License Division, 314 State Office Building, Salt Lake City, Utah 84114.

Information Supplied: Traffic accidents where a conviction has resulted. Traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.00 per person. Make checks payable to Driver License Division.

Note: Give complete name, date of birth, driver's license number and address.

Vermont

Contact: Motor Vehicle Department, Records Section, Montpelier, Vermont 05602.

Information Supplied: Accident involvement; traffic suspension and revocation, other than traffic.

Fee: $3.00 for a three-year record; $5.00 for a complete history. Make checks payable to the Vermont Department of Motor Vehicles.

Virginia

Contact: Division of Motor Vehicles, Driver License and Information Department, P. O. Box 27412, Richmond, Virginia 23269.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, other than traffic.

Fee: $3.00 check or money order payable to Virginia D.M.V. for each search for information. No charge for driving records requested in accordance with Department of Transportation Regulations or for employment.

Note: Request must show full name, date of birth, sex and license number (if available).

Washington

Contact: Division of Driver Licensing, Department of Motor Vehicles, Olympia, Washington 98501.

Information Supplied: Traffic convictions and accident involvement for previous three years.

Fee: $1.50 per abstract.

West Virginia

Contact: Driver Improvement Division, West Virginia Department of Motor Vehicles, 1800 Washington Street E., Charleston, West Virginia 25305.

Information Supplied: Traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.00 per person. Make checks payable to West Virginia Department of Motor Vehicles.

Note: Give complete name, address, date of birth, operator or chauffeur's license number for each subject.

Wisconsin

Contact: Wisconsin Department of Transportation, Driver Record File, P. O. Box 7918, Madison, Wisconsin 53707.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.00 for single or multiple records; $ .75 per record if requestor prepares input for computer search. Make checks payable to Wisconsin Department of Transportation.

Note: Give full name, date of birth and current address of each subject. Obtain sample of prescribed form (MVD-3325-74) from above address.

Wyoming

Contact: Wyoming Department of Revenue, 2200 Carey Avenue, Motor Vehicle Division, Cheyenne, Wyoming 82001.

Information Supplied: Accident involvement; traffic convictions; suspension and revocation, traffic; suspension and revocation, other than traffic.

Fee: $1.00 per person. Make checks payable to Wyoming Department of Revenue.

Note: Provide full name, date of birth and driver's license number, if available.

MOTOR VEHICLE DRIVER SELECTION CRITERIA

The Medical Examination

A pre-employment physical examination is required by most employers. However, where the employee will be asked to drive a motor vehicle, a special form is used and includes medical history on items peculiar to driving commercial vehicles and handling heavy objects.

Where companies come under the jurisdiction of the Bureau of Motor Carrier Safety of the U.S. Department of Transportation, an approved form has to be filled out by the examining physician. The approved form with instructions for the employer, the doctor and driver is shown in Motor Vehicle Bulletin Section 8.00 containing the Motor Carrier Safety Regulations. It can be found under Subpart E. Physical Qualifications and Examinations 391.41 to 391.65. This form is also used by companies that do not come under the control of DOT.

TESTING A NEW DRIVER

The Road Test

The following pages include material developed for the purpose of testing drivers under actual road and operating conditions.

You Can't Afford NOT to Pick... ...The RIGHT Person

Why is it so important to get the right person? Because the wrong one can cost you a lot of money. He takes the responsibility for operating your high-priced equipment. He hauls valuable materials, and takes your legal liability with him wherever he goes. Just one serious accident by the wrong driver can deal your business a severe financial blow.

How do you get the right person? By checking, of course. You run your regular personnel investigation and find out about his background, his references and his health. You check his license, too. But, there's only one way to be sure that he can **really** do the job for you. You've got to get him out onto the highway with a skilled observer by his side.

ROAD COURSE DRIVING EXAMINATION

Situation 1

1. Makes visual check of equipment including lights, tires, hose connections (air or vacuum), horn. ☐
2. Checks for proper operations of parking and service brake systems. ☐
3. Adjusts seat for comfortable driving position. ☐
4. Adjusts rearview mirrors. ☐
5. Familiar with gearing arrangement. ☐
6. Checks traffic conditions before pulling into traffic. ☐

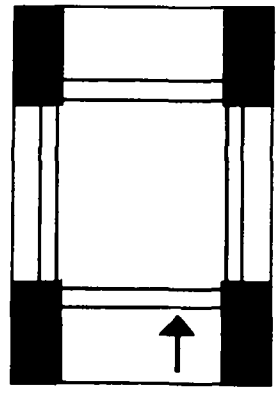
Checking the driver

7. Keeps eyes on road during shifting maneuver. ☐
8. Maintains steering control while shifting. ☐
9. Does not roll backward when starting on an upgrade. ☐
10. Drives with both hands on the wheel. ☐
11. Steers smoothly without erratic motion. ☐
12. Maintains proper speed within posted limits but not too slow. ☐

Remarks: _____

Situation 2

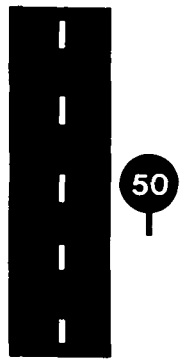
Uncontrolled intersection



1. Approaches intersection at speed where vehicle could stop if necessary. ☐
2. Positions other vehicles—looks in all directions—uses mirrors. ☐
3. Gives right-of-way to vehicles in or entering the intersection. ☐
4. Driving in proper lane not crowding adjacent lane or curb. ☐
5. Allows adequate distance to vehicle ahead. ☐
6. Gives pedestrians a brake. ☐

Remarks: _____

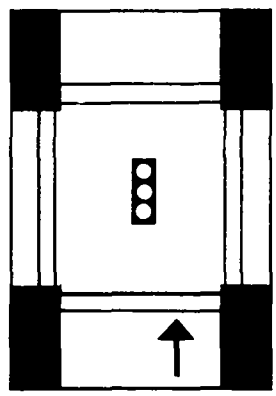
Situation 3
Overtaking and passing



1. Checks ahead and behind to be sure passing room is adequate. ☐
2. Indicates intention by use of hand or directional signals. ☐
3. Picks up speed before moving out into passing lane. ☐
4. Allows ample room before cutting back into regular lane. ☐
5. Uses horn to warn vehicle being passed. ☐
6. Does not attempt to pass when traffic flow is moving at or about posted speed. ☐

Remarks: _____

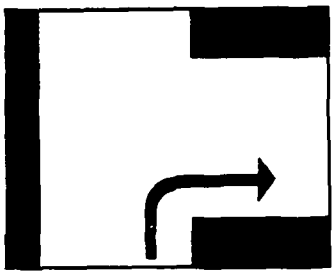
Situation 4
Controlled intersection



1. Brings vehicle to a full stop. ☐
2. Stops soon enough to avoid running over crosswalk. ☐
3. Does not allow vehicle to roll or creep forward while waiting for light. ☐
4. Remains alert to changing traffic situations. ☐
5. Good coordination of clutch, gear shift and accelerator. ☐

Remarks: _____

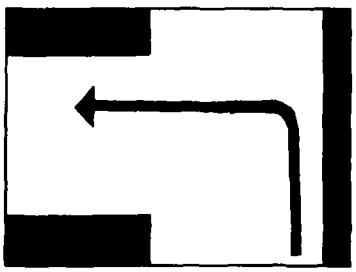
Situation 5
Right turn



1. Approaches intersection in proper lane. ☐
2. Approaches at proper speed—not too fast or too slow. ☐
3. Begins turn signal at least 100 or more feet from corner. ☐
4. Checks position of other vehicles to rear and sides. ☐
5. Maintained proper lane during turn. ☐
6. Completes turn in same lane and maintains original position. ☐
7. Makes allowance for off-track or back end cutting short. ☐

Remarks: _____

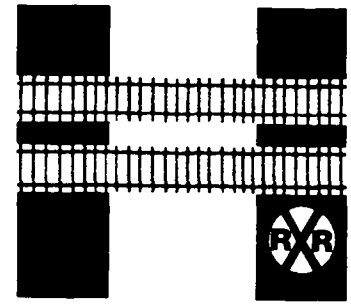
Situation 6
Left turn



1. Checks position of other vehicles well ahead of turn. ☐
2. Begins to slow down in advance—at least 100 feet from turn. ☐
3. Begins turn signal at least 100 feet from corner. ☐
4. Takes proper left lane position in advance of turn. ☐
5. Checks to right and left before starting turn. ☐
6. Enters turn just to right of center. ☐
7. After turn is completed, vehicle is gradually steered back to right lane. ☐

Remarks: _____

Situation 7
Railroad crossing

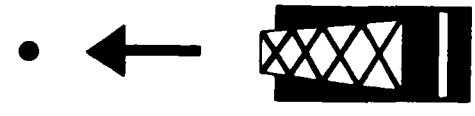


1. Looks in all directions when approaching crossing. ☐
2. Comes to complete stop when necessary. ☐
3. Stop made not more than 50 feet, nor less than 15 feet from the nearest rail. ☐
4. Did not change gears while crossing tracks. ☐

Remarks: _____

Situation 8
Backing

1. Stops in correct position to back. ☐
2. Steps out of cab and inspects line of travel for surface depressions, overhead and side clearance. Also surveys area carefully for overhead power lines near stopping site. (This is a necessity in driving tests taken in pump installation and drilling rigs.) ☐
3. Backs smoothly without excessive use of clutch-brake. ☐
4. Does not zig-zag or oversteer. ☐
5. Makes full use of mirrors. ☐



Remarks: _____

VEHICLE REPAIR CHECK LIST

VEHICLE NO. _____ SEMI-TRAILER NO. _____

DRIVER _____

MILEAGE (present speedometer reading) _____

CHECK DAILY

FUEL ☐ OIL ☐ WATER ☐

CHECK THE PARTS THAT NEED ATTENTION

Steering		Service Engine		Loose Parts	
Clutch-Transmission		Anti-Freeze		Brakes	
Windshield Wipers		Radiator Hoses & Connections		Air Brake Hose & Connections	
Mirrors					
Instruments		Tires-Chains		Air Tank (Drain)	
Fire Extinguisher		Glass		Refrigeration Equipment	
Warning Device		Bumpers-License		Coupling Device	
Lights-Reflectors		Wheels		Battery & Cables	
Stop Lights		Springs-Frame		Noises	
Turn Signals		Oil Leaks			

REMARKS-SEE OVER Date _____

Repairman _____ Job Order No. _____

This report is to be used as a list of maintenance items to be checked before, during and after operation of the vehicle. It is also to be used to report defects. Turn it in daily or weekly as required by your supervisor. Make report in duplicate. Retain one copy and recheck vehicle before leaving the garage. If work is incomplete or unsatisfactory return list to supervisor for instructions before proceeding.

Here's How the Program Works

The Theory

Good drivers are consistent. They are good because they have developed safe habits. Proper driving is second-nature to them. And because they drive better, they have a much better accident record. This means fewer claims on your insurance...and possibly lower rates. It also means that materials get through on time and your equipment stays out of the repair shop...or the junk yard. Again, a saving for you.

Good drivers are also predictable. Safe driving is a matter of habit, so their driving is the same on a road test as it is alone on the open highway. Because of this, a proper test will show which driver can do the job, and which one can't.

The Test

There's more to road testing than just a spin around the block. You don't know how well the driver can handle the equipment until you've seen him in a broad variety of highway situations. This test covers the getting-ready process, controlled and uncontrolled intersections, right and left turns, railroad crossings, superhighways, parking and backing. Ideally, the course should cover 10 to 20 miles and take about 45 minutes to drive. A regular test course should be laid out in advance, using a map of your community as a guide. Once you've established a route where all of these driving situations can be covered, you're ready to establish standards for your test.

The Standards

How tough is the course? Drive it yourself and find out. Then take four or five of your best drivers, men who have top safe-driving records, and have them drive it. Go along with each of them and rate their performance. Their scores will serve as a standard of excellence for new drivers to live up to.

Tips to the Tester

The applicant shouldn't have to take this test completely cold. Show him a map of the test route. And before you actually take the vehicle onto the road, give the applicant a few minutes to familiarize himself with the equipment. Even an experienced driver has to get the feel of an unfamiliar vehicle.

Be familiar enough with the test to check off performance results without hunting. This will allow you to watch the applicant's driving more closely.

Don't forget to start judging Situation One of the test as soon as you reach the truck. Be sure that the applicant makes all necessary checks before he starts to drive.

Don't chat with the applicant during the test. This may distract him. Just answer his questions and give any necessary instructions.

Scoring

This test does not concern itself with overall point totals. It is **not** intended to establish a passing or failing grade. It is aimed, instead, at establishing areas where the driver is competent and pointing out any weaknesses he may have.

If your applicant scores as well or nearly as well as your best drivers, you can safely consider hiring him. A bad performance will probably eliminate him. In other cases, you may decide to hire the applicant and give him extra training in the areas where the test shows him to be below your standards.

Naturally, the more drivers that you test under this program, the surer you become of the standards that you have set. And the tester's judgment should be consistent. This can best be accomplished by using just one tester.

Motor Vehicle Safety Program Formulation

The primary considerations for an effective vehicle loss control program are:

1. Safe Motor Vehicle Equipment
   - A. Selection
   - B. Maintenance
   - C. Inspection
   - D. Storage
2. Safe, Skillful Drivers
   - A. Selection
   - B. Training
   - C. Supervision
3. Planning Job Safety
   - A. Planning
   - B. Operation

To achieve success in the control and reduction of losses, **all** of the following features of these three elements are essential requirements.

Safe Motor Vehicle Equipment

Selection—Although many specialty vehicles are required by the water well construction industry, certain inescapable economic factors are common to all. The units should be adequately powered and properly fitted to the job. Safety should play a large part in the planning of equipment purchasing. Many desirable safety features should be considered in the purchase, such as special lights, mirrors, horns and emergency braking systems.

Maintenance—The most carefully constructed and designed equipment will fail unless carefully maintained. All operators should have a thorough understanding of the equipment they use, including manufacturer recommendations for periodic service. Rigs are relatively complicated machines with numerous moving parts. Engines require periodic attention to avoid failure at a critical time. Equipment in poor condition is both inefficient and a potential hazard to operating crew members. Maintenance is easy and inexpensive insurance.

Inspection—This is the twin of maintenance in providing routine safety assurance. Maintenance obviously requires routine inspection of critical parts, but inspection goes beyond the operating manual. Every time the equipment is to be operated, it should be subjected to a visual once-over to catch safety hazards such as a fuel can in the wrong place, a glove on a sprocket, a strategic loose bolt, a small animal curled up next to a warm engine. Beyond inspecting the vehicle itself, make an inspection of the parking area and job site for potentially dangerous objects to prevent avoidable vehicle damage. Make sure lights work, tires are properly inflated, and that there is sufficient fuel to avoid running out on a busy freeway. Check that necessary parts, lubricants, tools and equipment are on hand, in their proper places.

Storage—Drilling equipment is difficult to store. Any parking area should be spacious to allow for maneuvering, service, and loading and unloading. An unheated, enclosed storage area is the best protection for your equipment, providing shelter from precipitation, reducing rust potential, allowing more comfortable service and increased security. If storage indoors is not feasible, some provision must be made to cover sensitive engines and moving parts. Tools and equipment should be available on the job site, possibly in a mobile unit with a power supply, to drive electrical tools. Compressed air is a good alternative for power tools. A broken hose has less injury potential than a broken, wet extension cord. Some means of keeping out children, vandals and small animals will prevent unnecessary damage to equipment and injury to the ignorant. Rodents chew on anything handy and intricate equipment, tool bins and stacks of pipe provide attractive shelter for animals.

Safe, Skillful Drivers

Selection—The road test is the place to start, once you have identified a potentially responsible, reliable candidate.

Training—A systematic procedure for training and instructing the drivers concerning their assigned equipment is essential. Changes of job site and personnel complicate the problem of training. Drivers must understand the needs of the particular job, special equipment and its capabilities and limitations, access roads, special hazards, and the need for proper inspection and care of their equipment. The training may be informal on-the-job, including five minute tail-gate meetings, or formal class sessions. Retraining of men who have been involved in equipment damaging incidents and/or accidents is critical. Regardless of how it is done, it is essential that good communications exist to permit continued training.

Supervision—The drivers in a drilling or pump installation fleet need a knowledgeable supervisor. He must be experienced, capable of testing and training, and be a person with good, sound, mature judgment.

Planning Job Safety

Planning—Problems vary on each drilling job and require careful planning for safe operation. The contractor and supervisor should coordinate their efforts for that purpose. Access roads should be driven to check turning, grades, traffic and loadbearing capacities of roads, culverts and bridges. Police and highway officials should be contacted and their assistance, cooperation and advice sought where necessary.

Operation—In some cases, the access route should be safeguarded to protect the public as well as the contractor's fleet. When and where to use barricades, signs, lighting and flagmen should conform to the standards set forth by the Manual on Uniform Traffic Control Devices for Streets and Highways (ANSI D6.1-1071). Drivers must receive special instructions to perform as planned, and finally the operation should be constantly supervised to spot hazards quickly and prevent violation of safe operating practices. Personnel should be transported only in vehicles designed for that purpose.

Interstate Operations

Any drilling project which is interstate in scope is subject to specific U.S. Department of Transportation regulations. These regulations cover the following: Qualification of drivers; driving of motor vehicles; parts and accessories necessary for safe operation; notification, reporting and recording of accidents; hours of service of drivers;

inspection and maintenance; transportation of hazardous materials; and driving and parking rules. These are Motor Carrier Safety Regulations, U.S. Dept. of Transportation parts 390-397 inclusive.

Motor Vehicle Accident Investigation

Any motor vehicle accident incurred by a company fleet vehicle is hard to understand from a management point of view. This is especially true where the company has exerted time and money on a vehicular safety program. A second accident similar to the first tempts the drilling contractor to abandon the safety program completely beause it simply doesn't work for him. If he is willing to take the final step in his safety program, however, he may reach an understanding of the real cause of the recurring accident as well as the potential causes of accidents which might occur in the future. Accident investigation records is the final step.

Adequate accident records are an indispensable tool in accident prevention. Both with respect to the fleet vehicles as a whole and the individual driver, these records give direction to and measure the effect of the safety effort. Care must be exercised that all records serve a useful purpose and that their nature and the details incorporated should be consistent with plans for using accumulated information.

Fleet Vehicle Accident Record

A fleet vehicle accident record should serve a threefold purpose as follows:

1. Disclose the driver who is in need of further instruction.

2. Disclosure of the predominant unsafe driving acts to formulate means of preventing repetition.

3. To furnish information on accident prevention for safety meetings, safety letters and bulletins.

The following items should be included in an accident record: driver's name, base of operation, date and time of accident, place and description of accident, plus unsafe driving act involved, responsibility and action taken to prevent repetition. It should contain the same information on any other accident in which the driver has been involved.

In this connection care must be used to distinguish between **cause** and **circumstance**. Thus, a left turn of itself is merely a circumstance, and even though it may be a violation, it is not necessarily a cause of an accident. An icy road is not a cause per se, but a circumstance. Circumstances are the conditions or environment under which an accident occurs, and which may or may not have contributed to it. Causes are driver actions or omissions, vehicle failures or conditions. Another distinction is that causes lend themselves more readily to correction than do circumstances, and this is a good test to apply in certain cases of doubt.

The circumstances of each person involved may be recorded if they differ. The physical environment will be common; most differences will be found in movement or action.

Unsafe driving practices or conditions, as previously defined, may be common to each driver or may differ. Causes, like circumstances, may appear in combination.

The usually accepted unsafe driving practices of traffic accidents, for statistical purposes, are:

- Operating too fast for conditions.
- Contesting, or failing to grant right of way.
- Following too closely.
- Improper turns, or changing direction without consideration for other vehicles (i.e., without signaling).
- Improper passing on hills, curves, where prohibited and/or where risk is involved.
- Cutting in.
- Failing to look in direction of motion.
- Proceeding into unpaved area without first inspecting terrain.
- Driver impaired by drowsiness, intoxication, illness, fatigue or poor vision.
- Insufficient clearance (around parked cars or when passing moving cars).
- Loss of control and skidding—usually concurrent with "too fast for conditions."

Other data desirable to complete the record are the total number of accidents or claims, subdivided into those judged preventable, or not preventable, chargeable or not chargeable, the total mileage, and the accident frequency rate per mile driven.

Accident Preventability

Accident preventability is related to the individual driver's responsibility. It is used as a basis for corrective action and for administration of incentive plans.

The National Safety Council definition of a preventable accident is:

"Any accident which results in property damage and/or personal injury, regardless of who was injured, or what property was damaged, in which the driver failed to exercise every reasonble precaution to prevent the accident."

Severity and accident costs are important considerations, although in pure theory, safety engineers prefer to ignore them on the grounds the severity is unpredictable and that all accidents are serious. It is to be noted that in this philosophy, it is not that they reduce all to the level of the most minor, but they raise all to the level of the most severe.

Severity and costs can be recorded on a bracket basis. If the latter is used it is subject to correction until liability cases are concluded.

The detail in which such records are maintained must be based solely upon the relative value of the information. It is, in a sense, a greater mistake to have too much information than it is to have too little. The gathering and recording of the valueless data takes important time from more productive activities and tends to confuse and obscure the important facts.

The type of information desirable will also vary according to the industry. The National Safety Council, American Trucking Association, American Transit Association and insurance companies are sources of prepared forms for the recording of accident statistics.

Driver's Record

An analytical record should be kept of each driver rather than simply filing accident report copies in the jacket. The former method makes possible the quick detection of trends and a ready and more accurate summation of the driver's performance. In the end it is a time saver. Once analyzed, the accident remains so; kept only in the report form, they must be re-analyzed each time there is occasion to review them.

The individual records will contain all of the information necessary to complete the fleet record, and if desired, additional information not to be transferred to the summary but which is important with respect to the individual.

The analytical record distills the available information concerning the type, circumstances and cause into a highly reduced form, from which the accident can be readily reconstructed. The form must also be designed so that trends, or frequencies of certain patterns, will call attention to themselves.

This means a classification system as described for the fleet record and designed to be transferred readily to the fleet record. Record sheets which rely wholly or in part upon narrative description do not readily reveal patterns. Since the accident has to be classified for the fleet report anyway, it is best to do it at this stage.

Illustrated is an example of an analytical record. This form carries relevant information about the driver, while the other facilitates analysis of a specific accident. Similar sheets are available from various sources and may be adapted to fit specific requirements. It may be found preferable to design a form to fit the needs of an individual motor carrier. The insurance company safety engineer can be of assistance in setting up such a form.

From a sheet such as shown, any accident recorded can be reconstructed in narrative form. For example, the sheet might show that on a specific date "the insured (owner vehicle) struck left front of other parked car with his right rear, while passing." The complete record from the card might then reveal a trend or pattern such as: "this driver has difficulty in traffic, particularly with vehicles in the same stream, and seems to be prone to following too closely, resulting in his striking vehicles which stop ahead or being struck from behind."

Analysis of Accidents

Rarely does the driver's accident report alone enable the analyst to transfer directly from it to the record, particularly in the area of "cause." Even when other evidence is available (i.e., statement of other party involvement, witness statements, examination of scene and vehicles) much of accident analysis depends upon the skill of the interpreter, his own driving experience, his knowledge of human nature and driver psychology, the laws of probability, and in some cases, mathematical possibilities. It must be recognized that some error will exist; but, over an extended period, the skilled and experienced interpreter will strike much more closely to the truth than any of the involved pesons and even disinterested witnesses.

The analyst uses all of the information bearing upon the accident which is available to him and arrives at what is usually a substantially correct cause.

Accident Investigation

Information other than that which appears on the driver's report is secured by investigation, and may consist of any or all of the following, each of which is discussed in a subsection: interview with the driver; examination of Claims Dept. or Insurance Company report or interview with Claims Examiner or Investigator; interview with other persons involved or with witnesses. Since company policies vary, each engineer should proceed with care, consistent with his own responsibilities.

PERATOR ______________________________ BRANCH ______________________________

______________________________ COMPANY ______________________________

	TYPE		PERSONAL INJURY							OTHER PROPERTY						POINT OF CONTACT						COLLISION				DRIVER—CIRCUMSTANCE											PEDESTRIAN CIRCUMSTANCE						CAUSE									DEFECT		TIME	
DATE	PERSONAL INJURY	PROPERTY DAMAGE	NUMBER INJURED	OUR CAR	OTHER CAR	PEDESTRIAN	FATAL	SERIOUS	SLIGHT	PASSENGER VEHICLE	TRUCK	TRACTOR - TRAILER	BUS	FIXED OBJECT	UPSET	FRONT	RIGHT FRONT	LEFT FRONT	REAR	RIGHT REAR	LEFT REAR	MEDIAL	INTERSECTIONAL	MARGINAL	INTERNAL STREAM	CITY	RURAL	STRAIGHTAWAY	CURVE	U TURN	RIGHT TURN	LEFT TURN	SHORT STOP	BACK UP	PARKED OR STOPPED	PASSING	FROM OBSTRUCTION	CONFUSED BY TRAFFIC	CUT OFF	AGAINST TRAFFIC	WITH TRAFFIC	CHILD IN STREET	FOLLOWING TOO CLOSELY	CUT OFF	TOO FAST	INSUFFICIENT CLEARANCE	CUTTING IN	FAILED LOOK DIRECTION M'N	INTOXICATED	ASLEEP	SKIDDING	BRAKES	OTHER	A.M.	P.M.
Y:	X	X	NUMBER INVOLVED							NUMBER OR X						A, O OR B						X				A, O OR B											X						A, O OR B											HR	

structions: Where key is "X," insert "X" in box when appropriate.
Where key is number, insert the number of persons or objects involved; for persons injured, show total in first block. Number of each category in others.
Key "A, O or B" means "assured, other or both;" used to describe circumstances and actions of drivers only.
Insert time of accident to nearest hour, A.M. or P.M.

ERATOR ______________________________

TE EMPLOYED ______________ DATE OF BIRTH ______________ COMPANY NUMBER ______________

ERATOR'S OR CHAUFFEUR'S LICENSES HELD:

STATE	FROM	TO
	19__	19__
	19__	19__
	19__	19__
	19__	19__
	19__	19__

DATE	PREVIOUS ACCIDENT EXPERIENCE

Interview With the Driver

The interview with the driver should take place in a friendly atmosphere; the appearance of a trial or inquisition is to be avoided. The interviewing person is patiently seeking facts to guard against recurrence of similar accidents.

The interview has, of course, another and perhaps more important purpose—subtle corrective counsel to the driver. To accomplish this the interviewer must be astute and experienced enough to penetrate the perfectly natural defensive smoke screen that obscures any facts unfavorable to the driver. When involved in an accident, all of us are inclined to minimize our own contribution and to magnify other's. This tendency leads us to describe the accident as occurring under safe circumstances; we were driving slowly, we stopped, we looked, but in spite of our care and vigilance the accident happened. Meanwhile, of course, the other driver is telling his boss the same thing. So we have two drivers, who both stopped, looked, saw nothing and then violently collided a few feet further.

Of course, accidents and safe circumstances are incompatible; accident reports tell of more careful driving than is ever observed on the streets and highways. The interviewer can usually be sure that the date, time and place are related accurately, and that the directions and relative positions of the vehicles involved prior to and after the accident are fairly accurate. It is the action taking place between the "before" and "after" positions that the interviewer must fill in, and most of it has to be filled in by analysis. Since it has been stated that the accident usually could not have happened exactly as described by the drivers, it is the interviewer's job to determine the ways in which it could happen and which alternative is most probable.

Claims and Insurance Investigators

This is the best, and usually only, available source of detailed information. Claims investigators will usually open their files to the drilling contractor and discuss their findings and opinions with him. However, it should be remembered that while both are fact finders, the goals of the contractor and the claims person are not the same. The contractor is trying to prevent the accident from happening again; the claims person is trying to establish a defense against the consequences and is most interested in the negligence aspect with emphasis on the claimant.

Interview With Other Persons—Witnesses

Without stipulated authority from his claims department or insurance company, the contractor should never undertake the interrogation of other involved persons or witnesses in a liability accident. This is almost always the exclusive province of the insurance company.

If this permission is granted, the approach must be respectful and dignified. Signed statements should not be necessary. The investigator should be prepared so he can obtain all needed information in the shortest time possible. He must **never** become involved in an altercation with a witness.

Conclusion

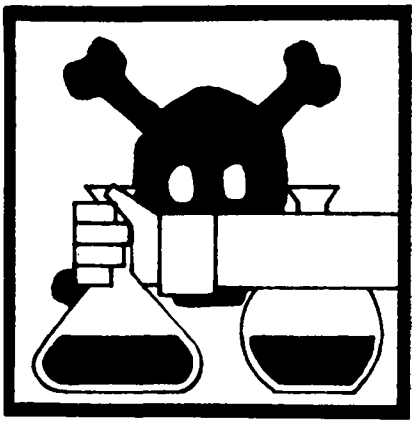
The recording, analysis and investigation of accidents involves the gathering of facts, arranging them in a usable fashion, interpreting them as accurately as possible, and using them intelligently in the prevention of further accidents.

Statistics, no matter how complete or reliable, cannot prevent accidents. Proper analysis of these statistics should accomplish the purpose of accident investigation—to determine the conditions responsible and corrective action necessary to prevent repetition. All unsafe driving practices are merely stepping stones to one or more of the basic areas in which management must take corrective action through:

1. Proper selection of drivers
2. Adequate training and retraining
3. Adequate preventive maintenance
4. Thorough accident investigation and reporting
5. Proper selection of equipment
6. Adequate supervision and leadership

Accident records and investigations which stop short of discovering basic weaknesses in driver, supervisor or organization are missing the mark.

APPENDIX C



HAZARDOUS CHEMICAL HANDLING

Handling and Mixing Hazardous Chemicals

The water well drilling industry uses several notably hazardous chemicals, usually in well maintenance and rehabilitation jobs. These chemicals, liquid and powdered hypochlorite compounds (bactericide), caustic soda (lye), sulfamic, hydroxyacetic and muratic acids (anti-incrustation agents) are extremely corrosive and must not contact any part of the body. Special precautions must be taken by the crew member(s) responsible for preparing and using these materials.

Handling Calcium and Sodium Hypochlorite

The hypochlorites are concentrated bleaching agents used to kill bacteria water wells.

The concentrations of these chemicals is three to five times that of common household bleach. Contact with the skin can cause second and third degree burns. If splashed in the eyes, both calcium and sodium hypochlorite can cause permanent blindness.

Sodium hypochlorite for well treatment is normally sold as a liquid in 55-gallon drums. Safe placement into the well should be accomplished by use of a flexible plastic pipe, through the pump column or drop pipe. The liquid is usually pumped through the pipe by means of a hand-operated, corrosion-resistant pump, connected directly to the drum. A flexible plastic hose connected to the pump and drop pipe by corrosion resistant fittings conducts the liquid hypochlorite from the drum to the well.

Although this method of introduction is a closed system, with no apparent means of spilling the hypochlorite outside the well, **acid resistant coveralls, heavy rubber gloves and close-fitting goggles** should be worn by crew members engaged in this task as a precaution against mechanical or material failure.

Calcium hypochlorite is normally sold as a white powder under several trade names. It must be handled in a manner completely different than liquid hypochlorite. Powdered hypochlorite when used to disinfect drilling mud may be simply mixed with the mud in the mud pit or tank. When used as a bactericide in an already completed well, calcium hypochlorite powder should be mixed with water in a large container. The solution then is treated in the same manner as sodium hypochlorite liquid.

Several companies market calcium hypochlorite in compressed pellets which simplifies its use considerably. Pelleted, it can be simply dropped into the well by a rubber-gloved hand without worries of hazardous, blowing dust.

The powdered form of the compound presents several problems: (1) As a powder it can become suspended in air and accidentally inhaled by crewmen working with it. (2) Also, because it is a powder, it will adhere to and chemically react with moist surfaces such as exposed, sweaty skin. If this occurs, the resultant burns are as serious as those caused by liquid hypochlorite. Handling of powdered hypochlorite must be done with (1) rubber gloves, (2) goggles, (3) long sleeved shirt and (4) a respirator or some form of approved industrial filter mask. The crew member placing the powdered hypochlorite into the well should always position himself upwind of the well opening.

Caustic soda (lye) has adverse effects very similar to those of the powdered hypochlorite. Caustic soda, however, is usually sold in flake or fine granular form. Also, caustic soda is mixed in a well servicing tank with water prior to use. During this mixing process care must be taken not to allow contact between skin and the flakes or granules, as severe burns can result from this contact. The following precautions should be observed while mixing caustic soda:

- Wear goggles provided for this job.
- Wear plastic coated gloves and apron.
- Have sleeves rolled down.
- Stand upwind when dumping.
- Place caustic into empty tank.
- Add water by inlet pipe—not by hose.
- Stir carefully with paddle.
- Dispose of can.

• Do not remove goggles and gloves until the mixing operation has been completed.

• Keep a running water hose and a large jar of diluted vinegar nearby in case of accidental contact while mixing. Caustic soda is a strong base compound; if it is accidentally spilled on the skin, vinegar will chemically change the caustic soda to a harmless liquid.

Safe Handling of Acid on the Job Site

As mentioned previously, several types of acid are used for the maintenance and rehabilitation of water wells. The most commonly used are muratic (hydrochloric), sulfamic and hydroxyacetic acids. Muratic acid is the most hazardous and corrosive, followed by sulfamic and hydroxyacetic acids when used at their maximum concentrations.

Again, these acids are normally used in different forms; muratic and hydroxyacetic acids as liquids and sulfamic acid as a white, crystalline solid. Handling procedures vary according to the form of acid, but there are several procedures that are standard when working with **any** kind of acid:

• Always wear close fitting goggles which provide eye protection from all directions.

• Always wear rubber gloves—elbow length are the best.

• Never add water to acid, always add acid to water.

• When the probability of coming in direct contact with acid solutions is high, a rubber jacket, rubber pants, acid resistant safety shoes and a safety helmet should also be worn.

• Always have a supply of fresh water available for flushing of eyes and skin in case of direct contact with acid.

Muratic acid is the most hazardous and corrosive acid used in well maintenance work, and consequently must be handled with the utmost care. Acid resistant coveralls, cup-type, rubber or soft plastic framed goggles, a plastic safety helmet, and acid resistant rubber boots at least 12 inches high are a must when handling muratic acid. A supply of sodium bicarbonate (baking soda) should be kept near the job site when using muratic or other forms of acid. When acid is accidentally spilled on equipment or splashed on exposed skin, sodium bicarbonate, when spread over the acid in liberal amounts, will chemically neutralize the acid. Solutions of bicarbonate and water can also be used to wash off and neutralize acid on the skin.

Muratic acid is transported to the job site in two ways. Larger well servicing companies transport muratic acid in 500-3000 gallon capacity tank trucks with built in pumps and acid transmission hoses. This method of transportation and placement is probably the safest because when the acid hoses are connected to the well, a closed system (truck to well) is formed which prevents spraying and splashing of acid. Care must be taken, however, to insure that hose connections are tight and the tanks on the truck do not leak.

The second method of transportation of muratic acid is by reusable, structurally reinforced, corrosion resistant 55-gallon drums. These drums are filled at an industrial supply point and transported to the job site. Transmission of the acid to the well is done by a hand pump installed on the drum with plastic, corrosion resistant hose from the pump down the well. Again, care must be taken to insure all connections and pump seals are tight and in good condition to prevent spraying and splashing of acid.

Under no conditions should an attempt be made to dump any liquid acid from drum to the well. The uncontrollable splashing of acid combined with the weight and bulk of the drum make this extremely hazardous.

Sulfamic acid is used either in pellet or powder form. Handling of this acid should be done in the same manner as the handling of powdered calcium hypochlorite.

Sulfamic acid and its solutions can cause eye injury. Cup-type, rubber, or soft plastic framed goggles, equipped with approved impact-resistant glass or plastic lenses, should be worn. Goggles should be carefully fitted to insure maximum protection.

In case of contact, flush the eyes with large amounts of water for 15 minutes and get medical attention.

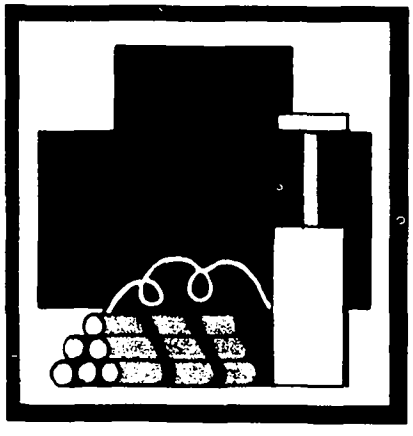
Sulfamic acid and its solutions may also irritate the nose, throat and skin. Avoid breathing its dust. Avoid contact with skin and clothing. Skin exposure can be minimized by wearing rubber gloves when handling sulfamic acid and its solutions. In case of contact, flush the skin with plenty of water.

For ingestion of sulfamic acid, the person should drink large amounts of water immediately and get medical attention. Vomiting should **not** be induced.

Hydroxyacetic acid is a fairly strong organic acid, and the standard technical 70 percent solution may cause burns. Contact of the acid with skin, eyes and clothing should be avoided. Exposure can be minimized by wearing chemical goggles and rubber gloves when handling hydroxyacetic acid solutions. Additional protective clothing, such as rubber pants and jacket, rubber safety shoes, and rubber guantlets may be desirable where probability of contact with hydroxyacetic acid solutions is high.

In case of contact, immediately flush skin or eyes with large amounts of water for at least 15 minutes; for eye contact, get medical attention immediately.

APPENDIX D



EXPLOSIVE STORAGE TABLES AND PROCEDURES

Explosive Storage

As few explosives as possible should be kept on hand at any time. If a company stores explosives, the storage **must** be done in conformance with state and federal regulations.

Before any storage of explosives is contemplated, it is necessary to determine exactly which governmental regulatory agencies have regulations that will affect the site. They may include:

- Bureau of Mines
- OSHA
- Dept. of the Treasury, Internal Revenue Service, Alcohol, Tobacco and Firearms Division
- Coast Guard
- State and local ordinances

Some of these agencies will require on-site inspections prior to approval. In any event, the most stringent applicable regulations must be followed.

The Treasury Department lists five types of storage facilities. It also specifies types of construction and security measures, in addition to types of explosives that are permitted to be stored in each type of magazine. For example, blasting caps, detonators and primers should not be stored in the same magazine with high explosives or blasting agents.

Location

The location of the magazine depends on the amount of explosives that will be stored and its distance from other magazines and surrounding exposures. For specific separation distances, local codes or the American Table of Distances should be consulted. When using the table, make sure that distances are correct because of the factors depending on whether the magazines are barricaded or not.

The table does not apply to indoor facilities. Particular attention should be paid to the footnotes in the table for additional restrictions and instructions. In general, the ground around the magazine should be kept clear of brush and combustible materials for at least 50 feet and should slope away from the magazine for proper drainage. Smoking, matches, open flames, etc., should not be permitted in, or within, 50 feet of an outdoor storage facility.

Construction

Magazines should be constructed to meet all applicable federal, state and local codes. In general, magazines should be theft-, fire- and weather-resistant and well ventilated. The interior should be covered with a suitable non-sparking material and the door should be equipped with two locks. If permitted, when trailers are used as a magazine, the wheels should be removed or the trailer otherwise immobilized by kingpin locking devices or some other approved means.

Indoor storage facilities should be equipped with substantial wheels or casters to facilitate removal from the building in the event of fire.

Marking

Magazine locations and access roads should be posted with signs indicating "Explosives—Keep Off." The signs should be located so that a bullet passing through any sign will not strike the magazine.

General Storage Precautions

- Periodic inventories and inspections of magazines should be conducted at intervals not exceeding three days to determine if there has been unauthorized entry into the magazines. Records should be kept of all magazine transactions and inspections.
- Explosives should always be stored in an approved storage facility.
- Only explosives should be stored in magazines.
- Explosives should not be stored in a damp place, near sources of heat, or near oil, gasoline, cleaning solutions or solvents.
- Primacord should be considered an explosive and not stored with caps.
- Corresponding classes, grades and brands should be stored together within a storage facility in such a manner that class, grade and brand marks are easily visible upon inspection.
- Oxidizers should be adequately separated from readily combustible fuels. The storage requirements for oxidizers are for non-cap sensitive oxidizers only. Cap sensitive oxidizers shall be treated in the same manner as any other cap sensitive explosive.
- Always use the oldest stock first. Adequate controls should be instituted to insure this.
- Cartridges or detonators should be kept in covered boxes, not loose in the magazine.
- The magazine floor should be swept regularly with cleaning utensils having no spark-producing metal parts.
- In the event an explosive has deteriorated to the unstable or dangerous level, or if nitroglycerine leaks from any explosive, this should be reported to the governing authoity. Upon their approval, an experienced person should destroy the explosives.
- If magazines require repairs on the inside of the structure, all explosives should be removed and the floors swept. If repairs are required outside the structure, and there is a possibility of causing sparks or fire, the explosives should be removed. In both cases, the explosives should be removed to an "approved" magazine.
- Shoes with metal plates or nails that could cause sparks should not be worn in magazines or around explosives.
- Explosives cases should not be unpacked or repacked in the magazine, within 50 feet of the magazine, or in close proximity to other explosives. Cases should be opened with a non-sparking tool.
- Smoking, matches, open flames, spark producing devices, firearms, etc., are prohibited within 50 feet of magazines or warehouses.
- A competent person at least 21 years of age should be placed in charge of the magazine or warehouse and held responsible for the enforcement of all safety precautions.
- Caked oxidizers should not be loosened by blasting.

References

1. American Insurance Association—Fire Prevention Code, 1976.
2. National Fire Protection Association No. 492 and No. 495.
3. Part 181 of Title 26 Code of Federal Regulations Commerce in Explosives.
4. IME Publication No. 17, Safety in the Transportation, Storage, Handling and Use of Explosives, April, 1974.
5. OSHA 1926.904—Storage of Explosives and Blasting Agents.
6. U.S. Dept. of Treasury, Bureau of Alcohol, Tobacco and Firearms—Your Guide to Explosive Regulation, 1976.

Vehicles

Explosives and/or blasting agents should not be carried or transported in or upon a public conveyance or vehicle passing through high population concentrations or through areas of heavy traffic congestion. It is preferable that the explosives supplier transport the explosives to the job site or storage area. Detonators and explosives should not be carried in the same vehicle.

EXPLANATORY NOTES ESSENTIAL TO THE APPLICATION OF THE AMERICAN TABLE OF DISTANCES FOR STORAGE OF EXPLOSIVES

Note 1—"Explosive materials" means explosives, blasting agents and detonators.

Note 2—"Explosives" means any chemical compound, mixture or device, the primary or common purpose of which is to function by explosion. A list of explosives determined to be within the coverage of "18 U.S.C. Chapter 40, Importation, Manufacture, Distribution and Storage of Explosive Materials" is issued at least annually by the Director of the Alcohol, Tobacco and Firearms Division of the Internal Revenue Service of the Department of the Treasury.

Note 3—"Blasting agents" means any material or mixture, consisting of fuel and oxidizer, intended for blasting, not otherwise defined as an explosive, provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a number 8 test blasting cap when unconfined.

Note 4—"Detonator" means any device containing a detonating charge that is used for initiating detonation in an explosive; the term includes, but is not limited to, electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses and detonating cord delay connectors.

Note 5—"Magazine" means any building or structure, other than an explosive manufacturing building, used for the permanent storage of explosive materials.

Note 6—"Natural barricade" means natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the magazine when the trees are bare of leaves.

Note 7—"Artificial barricade" means an artificial mound or revolted wall of earth of a minimum thickness of three feet.

Note 8—"Barricaded" means that a building containing explosives is effectually screened from a magazine, building, railway or highway, either by a natural barricade or by an artificial barricade of such height that a straight line from the top of any sidewall of the building containing explosives to the eave line of any magazine, or building, or to a point twelve feet above the center of a railway or highway, will pass through such intervening natural or artificial barricade.

Note 9—"Inhabited building" means a building regularly occupied in whole or in part as a habitation for human beings, or any church, schoolhouse, railroad station, store or other structure where people are accustomed to assemble, except any building or structure occupied in connection with the manufacture, transportation, storage or use of explosives.

Note 10—"Railway" means any steam, electric or other railroad or railway which carries passengers for hire.

Note 11—"Highway" means any street or public road. "Public Highways Class A to D" are highways with average traffic volume of 3,000 or less vehicles per day as specified in "American Civil Engineering Practice" (Abbett, Vol. 1, Table 46, Sec. 3-74, 1956 Edition, John Wiley and Sons).

Note 12—When two or more storage magazines are located on the same property, each magazine must comply with the minimum distances specified from inhabited buildings, railways and highways, and, in addition, they should be separated from each other by not less than the distances shown for "Separation of Magazines," except that the quantity of explosives contained in cap magazines shall govern in regard to the spacing of said cap magazines from magazines containing other explosives. If any two or more magazines are separated from each other by less than the specified "Separation of Magazines" distances, then such two or more magazines, as a group, must be considered as one magazine and the total quantity of explosives stored in such group must be treated as if stored in a single magazine located on the site of any magazine of the group and must comply with the minimum of distances specified from other magazines, inhabited buildings, railways and highways.

Note 13—Storage in excess of 300,000 lbs. of explosives in one magazine is generally not required for commercial enterprises; however, IME will provide recommendations for quantities greater than 300,000 lbs. in one magazine upon inquiry.

Note 14—This table applies only to the manufacture and permanent storage of commercial explosives. It is not applicable to transportation of explosives or any handling or temporary storage necessary or incident thereto. It is not intended to apply in bombs, projectiles or other heavily encased explosives.

For transportation purposes, the Department of Transportation in Title 49 Transportation CFR Parts 1-199 subdivides explosives into three classes:

Class A—Maximum Hazard
Class B—Flammable Hazard
Class C—Minimum Hazard

Note 15—All types of blasting caps in strengths through No. 8 cap should be rated at 1½ lbs. of explosives per 1,000 caps. For strengths higher than No. 8 cap, consult the manufacturer.

Note 16—For quantity and distance purposes, detonating cord of 50 to 60 grains per foot should be calculated as equivalent to 9 lbs. of high explosives per 1,000 feet. Heavier or lighter core loads should be rated proportionately.

TABLE OF RECOMMENDED SEPARATION DISTANCES of AMMONIUM NITRATE and BLASTING AGENTS from EXPLOSIVES or BLASTING AGENTS [1] [6]

References—NFPA No. 492 and NFPA No. 495

Donor Weight		Minimum Separation Distance of Receptor When Barricaded [2] (ft)		Minimum Thickness of Artificial Barricades [5] (in.)
Pounds Over	Pounds Not Over	Ammonium Nitrate [3]	Blasting Agent [4]	
	100	3	11	12
100	300	4	14	12
300	600	5	18	12
600	1,000	6	22	12
1,000	1,600	7	25	12
1,600	2,000	8	29	12
2,000	3,000	9	32	15
3,000	4,000	10	36	15
4,000	6,000	11	40	15
6,000	8,000	12	43	20
8,000	10,000	13	47	20
10,000	12,000	14	50	20
12,000	16,000	15	54	25
16,000	20,000	16	58	25
20,000	25,000	18	65	25
25,000	30,000	19	68	30
30,000	35,000	20	72	30
35,000	40,000	21	76	30
40,000	45,000	22	79	35
45,000	50,000	23	83	35
50,000	55,000	24	86	35
55,000	60,000	25	90	35
60,000	70,000	26	94	40
70,000	80,000	28	101	40
80,000	90,000	30	108	40
90,000	100,000	32	115	40
100,000	120,000	34	122	50
120,000	140,000	37	133	50
140,000	160,000	40	144	50
160,000	180,000	44	158	50
180,000	200,000	48	173	50
200,000	220,000	52	187	60
220,000	250,000	56	202	60
250,000	275,000	60	216	60
275,000	300,000	64	230	60

Notes to Table of Recommended Separation Distances of Ammonium Nitrate and Blasting Agents from Explosives or Blasting Agents

Note 1—Recommended separation distances to prevent explosion of ammonium nitrate and ammonium nitrate-based blasting agents by propagation from nearby stores of high explosives or blasting agents referred to in the table as the "donor." Ammonium nitrate, by itself, is not considered to be a donor when applying this table. Ammonium nitrate, ammonium nitrate fuel oil or combinations thereof are acceptors. If stores of ammonium nitrate are located within the sympathetic detonation distance of explosives or blasting agents, one-half the mass of the ammonium nitrate should be included in the mass of the donor.

These distances apply to the separation of stores only. The American Table of Distances shall be used in determining separation distances from inhabited buildings, passenger railways and public highways.

Note 2—When the ammonium nitrate and/or blasting agent is not barricaded the distances shown in the table shall be multiplied by six. These distances allow for the possibility of high velocity metal fragments from mixers, hoppers, truck bodies, sheet metal structures, metal containers and the like which may enclose the "donor." Where storage is in bullet-resistant magazines* recommended for explosives or where the storage is protected by a bullet-resistant wall, distances and barricade thicknesses in excess of those prescribed in the American Table of Distances are not required.

Note 3—The distances in the table apply to ammonium nitrate that passes the insensitivity test prescribed in the definition of ammonium nitrate fer-tilizer promulgated by the National Plant Food Institute and ammonium nitrate failing to pass said test shall be stored at separation distances determined by competent persons and approved by the authority having jurisdiction.

Note 4—These distances apply to nitro-carbo-nitrates and blasting agents which pass the insensitivity test prescribed in the U.S. Department of Transportation (DOT) regulations.

Note 5—Earth or sand dikes, or enclosures filled with the prescribed minimum thickness of earth or sand are acceptable artificial barricades. Natural barricades, such as hills or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the "donor" when the trees are bare of leaves, are also acceptable.

Note 6—When the ammonium nitrate must be counted in determining the distances to be maintained from inhabited buildings, passenger railways and public highways, it may be counted at one-half its actual weight because its blast effect is lower.

*For construction of bullet-resistant magazines see IME Publication No. 1.

Construction of Vehicles

• The vehicle should be in good mechanical condition and inspected daily to check the proper operation of brakes, lights, horn, windshield wipers and steering mechanism. Tires should be properly inflated and free of defects. Electrical wiring should be completely protected and securely fastened to the vehicle. The motor and chassis should be free of excessive grease and oil.

• The vehicle body should be equipped with tight wooden or non-sparking metal floor and sides.

• If the vehicle is not of closed body construction, the explosives should not be loaded above the sides or ends of the body. The load should be covered with a flame resistant and moisture-proof tarpaulin.

• Explosives should not be transported in any type of trailer except semi-trailer or truck-full trailers used for freight transportation over the public highways.

Markings

Vehicles should be marked in accordance with federal, state and local codes. Vehicles used for transporting explosives should be marked on both sides, front and rear with the word "EXPLOSIVES" in red letters on white background not less than four inches high.

Protection

Each vehicle should be provided with at least one fire extinguisher, having not less than a 10-ABC rating, located near the driver's seat. Adequate chocks and reflectors should be carried.

Operation

• Vehicles transporting explosives should be operated by a person who is not less than 21 years of age, capable, reliable and able to read and write English. He should be in good physical condition with no major disability, not under the influence of intoxicating liquors, narcotics or other dangerous drugs, and possess a valid driver's or chauffeur's license.

• The driver must be familiar with and obey the traffic regulations of all local, state and federal laws governing the transportation of explosives along the routes to be traveled.

• Smoking should not be permitted in or near vehicles transporting explosives.

• Persons other than those necessary for transporting explosives should not be permitted to ride in the vehicles transporting explosives.

• Refueling operations should be kept to a minimum and done only with the ignition off.

• Oil, matches, firearms, acids, drill steel or bits, and any other items not necessary for the transportation of explosives should not be carried in the vehicle body.

• Vehicles transporting explosives must stop before proceeding at all railroad crossings.

• Except in emergencies, vehicles transporting explosives should not be parked, even if attended, near bridges, tunnels, dwellings, buildings or places where persons congregate, work or assemble. When parked, the wheels should be chocked and reflectors put in place.

• Vehicles carrying explosives shall not be serviced or repaired inside buildings.

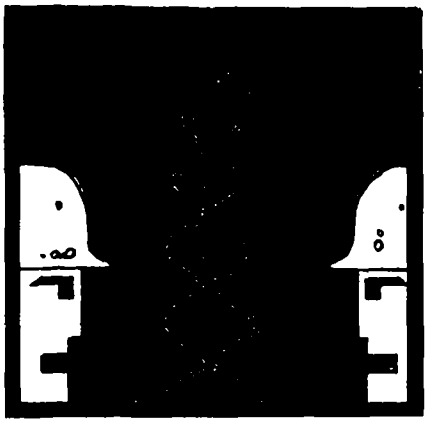
• Explosives should not be transported through or over prohibited vehicular tunnels, subways, bridges, roads or elevated highways. Vehicles should be routed so as to avoid congested traffic and densely populated areas.

• Fire and police departments should be immediately notified when a vehicle transporting explosives is involved in an accident.

• No radio equipment should be allowed on the vehicle.

• Vehicles transporting explosives should never be left unattended.

APPENDIX E



THE TAILGATE SAFETY MEETING

The tailgate safety meeting may be used in both large and small drilling operations.

In small operations, it may be possible to have all employees at the meeting. In large operations, employees may be divided into logical groups.

Here are a few points to remember to make tailgate safety meetings effective:

- Hold a meeting at least once a week. Regular meetings will provide the feeling that they are a usual and valuable part of the job.
- Hold the meeting at the beginning of a shift, right after lunch, or after a break. Perhaps the best time is at the beginning of a shift, when everyone is alert.
- Hold the meeting on the job site, preferably where people can sit down and relax.
- Limit each meeting to between five and 10 minutes. If the discussion gets heated, continue it at the next meeting.
- Discuss only a single point or subject—don't choose too broad a subject. "Hand tool safety," for instance, is much too comprehensive a topic to be covered at a short meeting. "Defective hand tools," "returning hand tools to proper place," or "cold chisel use" might be good and appropriate subjects.
- Do spend some time and thought before the meeting so that you are ready to stimulate discussion if necessary.
- While you may open the meeting by stating the subject and presenting the hazard or problem, try to get the group to develop the discussion and to sum up the solution.
- Use positive approaches and conclusions whenever possible.

Appropriate Topics

There are any number of topics that can be covered at tailgate meetings, but your own group's activities should furnish the source of most topics.

- You can review an unsafe act or procedure that you have observed amoung your own group (without mentioning names) to introduce the topic of safe practices or safe procedures.
- Discuss a recent injury or accident either at your own operation, or one you have learned about from an outside source such as a newspaper, trade journal or neighboring driller.
- Discuss how a piece of new equipment can be safely operated.
- Review a good safe job recently completed in your own organization.
- Review an unsafe condition that was not promptly corrected—a guard removed, an obstructed job site, a defective tool not reported, repaired, or replaced. Emphasize the injury that could have resulted from the unsafe condition.

Let 'em Talk

The supervisor can either lead the group himself or delegate someone to act as the leader.

In the latter case, discuss the subject beforehand, if possible, and give pointers on conducting the meeting.

Whenever possible, however, it is good if the employees themselves are encouraged to speak and to offer recommendations or solutions. They will then take much more interest in seeing that their own recommendations or solutions are carried out.

Records and Reports

As a rule, it is not advisable to take notes or keep any long records or minutes of tailgate meetings. The following are outlines of some topics of general interest.

You will be able to think of many others of value to your own operation.

Example Tailgate Meeting Topic

Guards are placed on machines to prevent a person from contacting moving parts. Many drillers are injured or killed each year because guards are left off tools or the drilling rig itself. Why are guards left off machines? Let the group give reasons for this.

Some reasons often given:

- No time to replace it.
- The boss said, "Let's go."

• Wanted to be sure the machine operated properly before installing the guard, but it was left off indefinitely.

• Guard did not fit a new drive.

• Had to remove guard to adjust or lubricate.

• "Could not do the work with the guard on," or "it slowed me down."

• "Ran these machines without a guard for years, and never got hurt."

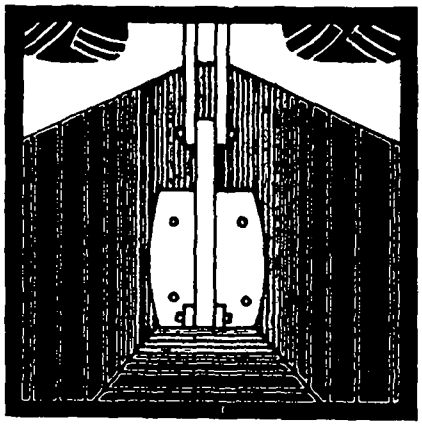
Each of the above alibis, and others, has been stated hundreds of times following serious injuries. After the accident, positive corrections are taken, attitudes are changed and safety measures are revised.

Value Proved

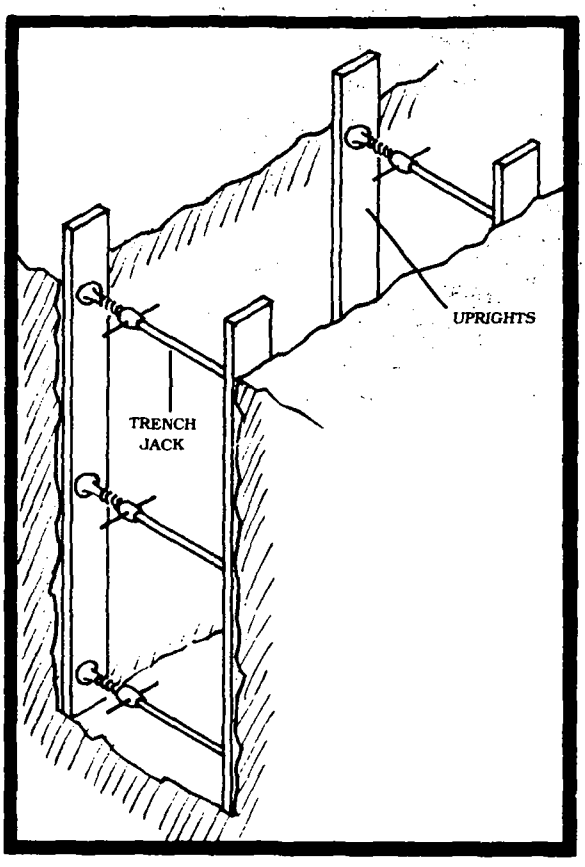
Whenever tailgate safety meetings have been properly and conscientiously conducted, they have their worth.

As a result, the tailgate meeting is growing more and more popular, and is recognized as an essential part of many operations.

APPENDIX F



TRENCH SHORING MINIMUM REQUIREMENTS



TRENCH JACKS IN TRUE HORIZONTAL POSITION AND SPACED VERTICALLY

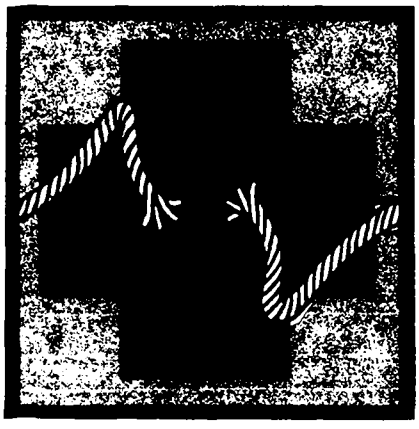
Depth of trench	Kind or condition of earth	Size and spacing of members: Uprights		Stringers		Cross braces*					Maximum spacing	
						Width of trench						
		Minimum dimension	Maximum spacing	Minimum dimension	Maximum spacing	Up to 3 feet	3 to 6 feet	6 to 9 feet	9 to 12 feet	12 to 15 feet	Vertical	Horizontal
Feet		Inches	Feet	Inches	Feet	Inches	Inches	Inches	Inches	Inches	Feet	Feet
5 to 10	Hard, compact	3x4 or 2x6	6			2x6	4x4	4x6	6x6	6x8	4	6
	Likely to crack	3x4 or 2x6	3	4x6	4	2x6	4x4	4x6	6x6	6x8	4	6
	Soft, sandy or filled	3x4 or 2x6	Close sheeting	4x6	4	4x4	4x6	6x6	6x8	8x8	4	6
	Hydrostatic pressure	3x4 or 2x6	Close sheeting	6x8	4	4x4	4x6	6x6	6x8	8x8	4	6
10 to 15	Hard	3x4 or 2x6	4	4x6	4	4x4	4x6	6x6	6x8	8x8	4	6
	Likely to crack	3x4 or 2x6	2	4x6	4	4x4	4x6	6x6	6x8	8x8		6
	Soft, sandy or filled	3x4 or 2x6	Close sheeting	4x6	4	4x6	6x6	6x8	8x8	8x10	4	6
	Hydrostatic pressure	3x6	Close sheeting	8x10	4	4x6	6x6	6x8	8x8	8x10	4	6
15 to 20	All kinds or conditions	3x6	Close sheeting	4x12	4	4x12	6x8	8x8	8x10	10x10	4	6
Over 20	All kinds or conditions	3x6	Close sheeting	6x8	4	4x12	8x8	8x10	10x10	10x12	4	6

*Trench jacks may be used in lieu of, or in combination with, cross braces.

Shoring is not required in solid rock, hard shale, or hard slag.

Where comparable, steel sheet piling and bracing of equal strength may be substituted for wood.

APPENDIX G



WIRE ROPE SAFETY

Worn or misused wire rope is one of the most potentially dangerous pieces of equipment on a rig. When a wire rope breaks it is usually under the stress of a heavy load so it tends to "snap-back" like a rubber band. Men and machinery can be mutilated by the recoil of a broken wire rope.

Unfortunately, overloading and violent jerking are commonplace in the water well industry; often, the ability of wire rope to withstand this punishment is reduced by abrasion. Safety minded contractors are constantly aware of this wearing process and frequently check the wear on their wire ropes to prevent accidents.

Wire rope safety basically involves proper selection, maintenance and handling techniques. Proper selection will insure the wire rope is designed to perform in a safe manner (i.e., the "right" tool for the job). Proper maintenance is practiced so that the rope will not fail due to preventable damage. Proper handling techniques will prevent a crew member from becoming entangled in or struck by coils or loose ends.

The following pages may seem at first to be a wire rope handbook rather than a wire rope safety manual. In the case of wire rope, however, safety consists primarily of understanding how wire rope is made, which type is used, how it behaves during use and how it deteriorates. This knowledge will permit the safety conscious individual to use wire rope within its limits and thereby operate at all times in a safe manner.

The 6x19 wire rope is most commonly used. Nineteen wires are laid in a strand, then six strands around a core or center. Fiber cores are usually made of sisal, java, manila, or a combination of such hard fibers. Wire rope centers are an independent wire rope. The fiber cores are most suitable for lubrication purposes.

Rope Lay—Lay of the rope describes the direction in which it is closed, determined visually.

Right Lay - Regular Lay—The wires are laid lefthanded into a strand and the strands laid righthanded around the center.

Left Lay - Regular Lay—The wires are laid right-handed into a strand and the strands laid left-handed around the center.

Right Lay - Lang Lay—Both the wires in the strands and the strands in the rope are laid right-handed.

Left Lay - Lang Lay—Both the wires in the strands and the strands in the rope are laid left-handed.

Regular lay cables are less likely to kink and untwist. Cable tool drilling cable usually is left lay. Rotary drilling wire rope usually is right lay.

Pre-Formed

For drilling operations, the pre-formed cable is preferred. The wires have been pre-shaped before they are laid together. The rope is easier to handle, spools more evenly, has less tendency to whip when the blocks are empty, and practically eliminates twisting of the blocks.

Rope Diameter

Selection of the wire rope diameter should be made using the efficiency and fast line pull factor to obtain the fast line pull.

Wire Rope Maintenance

A wire rope will spool evenly and smoothly at speeds up to 400 feet per minute. If this rate is exceeded, the line will ball up and overlap on the drum. Long strings of drill pipe should not be run in the hole at high speeds. The bit may strike a ledge or a tight place in the hole and the line will unreel until the drum rotation is stopped. If the pipe then becomes free, it will drop until the slack is taken up. The momentum of such dropping may exceed the breaking strength of the line.

The line passing over the sheave bends to conform to the sheave diameter, and straightens out when it leaves the sheave. At high speeds, the continued flexing of the rope will cause breaks on the inside of the line.

Kinks may be caused by careless handling and unspooling from the reel. The wire rope should be first passed over the crown sheave and unwound from the same side of the reel that it is wound on the drum. Thus, if an underwind type of drum is used, the line should be removed from the underside of the reel.

N = number of lines strung through the blocks

$E = \frac{1}{(1.04)(N-1)}$ = efficiency

F = 1/(NxE) = fast line pull factor

Fast line pull = weight lifted x F

No. of Line—N	4	6	8	10	12
Efficiency E	88.8900	82.1900	75.9900	70.2500	64.9600
Fast Line Pull Factor F	0.2912	0.2027	0.1645	0.1423	0.1283

6x19 CLASSIFICATION WIRE ROPE

	Approximate Weight Lbs/Ft		Minimum Breaking Strength—Tons		
	Independent Wire Rope		Improved Plow Steel		Plow Steel
Rope Diameter	Fiber Core	Center IWRC	Fiber Core	IWRC	Fiber Core
1/4	0.10	0.11	2.74	2.94	2.39
5/16	0.16	0.18	4.26	4.58	3.71
3/8	0.23	0.25	6.10	6.56	5.31
7/16	0.31	0.34	8.27	8.89	7.19
1/2	0.40	0.44	10.70	11.50	9.35
9/16	0.51	0.56	13.50	14.50	11.80
5/8	0.63	0.69	16.70	17.90	14.50
3/4	0.90	0.99	23.80	25.60	20.70
7/8	1.23	1.35	32.20	34.60	28.00
1	1.60	1.76	41.80	44.90	36.40
1-1/8	2.03	2.23	52.60	56.50	45.70
1-1/4	2.50	2.75	64.60	69.40	56.20
1-3/8	3.03	3.33	77.70	83.50	67.50
1-1/2	3.60	3.96	92.00	98.90	80.00

RECOMMENDED SHEAVE GROOVE DIAMETERS

Diameter of Wire Rope	Minimum Diameter	Maximum Diameter
1/4- 3/16	+1/64"	+1/32"
3/8- 3/4	+1/32"	+1/16"
7/8-1-1/8	+3/64"	+3/32"
1-1/4-1-1/2	+1/16"	+1/8"

The drilling line should never be placed around any object having a diameter less than the recommended diameter of the sheave. A short bend has the same effect as a small diameter sheave.

Each strand of a wire rope and its core is lubricated when it is manufactured. The amount of service obtained will depend as much on proper lubrication as on other factors. Oil can be applied with a brush to the line on the drum or the line can be run through oil. The oil should be thin enough to penetrate between the strands. Crude oil and kerosene are not satisfactory.

Twisting of the blocks can be eliminated by back-twisting the line. The blocks should be laid down or the two fast lines clamped together and the dead end loosened. It should then be twisted in the same direction as the blocks are twisting to relieve the strain.

Cable Clips

There is only one correct method of applying the clips and that is with the roddle on the working end only. Then a sufficient number of clips should be used to hold the line without excessive tightening of the clips.

The roddle is grooved to fit the strands in the line. Care should be taken to ensure proper application. Apply the clip farthest from the thimble or loop first, at about four inches from the end of the rope and screw up tightly. Next, put on the clip nearest the thimble or loop and apply the nuts hand-tight. Then put on the intermediate clips hand-tight. Take a strain on the rope, and while the rope is under strain, tighten all clips previously left loose. Take a turn alternately on the two nuts to keep the roddle of the clip square. After the rope has been in operation a short time, again tighten all of the clips.

Rope Wear

Three main points of wear may be observed:

1. At the drum when the traveling block is at its lowest and highest position when:
   a. going in and coming out of the hole, or
   b. adding or pulling a drill pipe.
2. At the crown block when the traveling block is in positions (a) and (b).
3. At the fast sheave of the traveling block when the block is in positions (a) and (b).

Proper inspection of the wire rope should include its entire length. The inspection should include a check for:

- The number of broken wires by rope lays (the distance in which one strand makes one complete revolution around the rope). If the majority of wire breaks are in one or two strands, the rope will be considerably weaker than if they are evenly distributed. A majority of crown breaks indicate normal deterioration. A majority of valley breaks indicate an abnormal condition.
- Rope diameter. A reduction in diameter at any point indicates the hemp core has dried out, the rope has been stretched, or internal corrosion is present.
- Abrasion wear. The length of the wear or the diameter of the individual wires should be determined accurately.
- Signs of rust or pitting in the valleys which may indicate internal corrosion.

Rope Wire Breaks

A check for the type of break will indicate if a more suitable rope should be used or if improvements should be made on the installation.

Rope Diameter—Inches	Number of Crosby Clips	Space Between Clips—Inches
1/4	2	1-1/2
5/16	2	2
3/8	2	2-1/4
7/16	2	2-1/2
1/2	3	3
5/8	3	4
3/4	4	4-1/2
7/8	4	5-1/4
1-	4	6
1-1/8	5	7
1-1/4	5	8

Fatigue Breaks

Transverse; cross-section of broken ends shows granular structure. Rope has been bent around too small a radius, or has been subjected to vibration.

Tension Break

One side of broken wire cones, the other cups. Rope has been subjected to too great a strain. May be caused by suddenly applying a load to a loose rope.

Abrasion Break

Broken ends smooth to knife-edge thinness. Wear concentrated at points rubbed constantly, usually sheave, traveling block and drum grooves. Improper grooves indicated.

Corrosion Break

Wire surface pitted, with break usually showing signs of fatigue, tension or abrasion. Probably caused by improper lubrication.

Cutting Break

Wire pinched and cut at broken ends. Caused by mechanical abuse.

Tension or Twisting Break

Broken ends show evidence of twisting and cork-screw effect. Caused by mechanical abuse.

Mashing Break

Wire flattened and spread at broken ends. Caused by mechanical abuse.

Sheave Wear

The sheaves should have enough clearance to permit normal rotation of the line and yet maintain proper support. A groove that is too large will flatten or distort the rope. A groove that is too small will pinch the rope.
Sheaves should be checked for:

Size

Measure the diameter from cable-bearing surface to cable-bearing surface. It is the bearing surface radius that governs the degree of bending as the rope travels over the sheave. For 6x19 wire rope, the recommended diameter is 45 times the rope diameter. The minimum diameter is 30 times the rope diamater.

Grooves

The diameter of the sheave bearing groove is related to the diameter of the rope. The rope causes the groove to wear deeper and its diameter becomes smaller until it is less than that of the new rope. A new rope placed in the groove will be pinched out of shape and subjected to severe wear. A rope in a groove of too great a diameter will not have proper support and will flatten.

Materials

Too soft a sheave material will be cut by the wire rope and form corrugations which will cut and wear a new rope. The grooves should be remachined or the sheave replaced using harder materials.

Operation

Defective bearings cause the sheave to wobble and set up a whipping action in the rope.

General

An out-of-round sheave or flat spot on the bearing surface causes whipping action in the rope. The grooves should be machined to a true contour.

A broken sheave flange may cause the wire rope to jump from the sheave or come into contact with the sharp edges of the break and cause serious damage to the rope. The sheave should be replaced.

Cable Drums

Sufficient rope should be used that the entire first layer will remain on the drum at all times except when the blocks are laid down. With the elevators just above the rotary cable, there should be at least three complete coils on the second layer.

An inspection of the drum should be made for:

Contour

Diameter and groove tolerances for the drums are the same as for sheaves. Remachining should be performed if necessary.

Face

A low spot will tend to pile up rope at this point. The rope coming on the low spot first will wind in an open wrap and on the other side will wind too tightly, causing rubbing of the adjacent wraps.

Winding

If fleet angles are properly used and the drum is properly grooved for the cable, no winding difficulties may be expected. With non-grooved drums, the wire rope should wind onto the durm in an even, continuous, loosely closed helix with one wrap just touching the adjacent wraps. Tight winding causes scrubbing of adjacent ropes. Too open winding on multiple layer drums will allow upper layers to pull down between bottom layers and cause excessive rubbing.

Fleet Angle

This is the angle between the center line of the first sheave over which the rope passes from the drum and the rope. If the fleet angle exceeds 1.5 degrees, the rope may wind unevenly, and scrape against the flange of the lead sheave. If the fleet angle is less than 0.5 degrees, the rope may pile up in more than one layer on the flanges and will wind unevenly after more than one layer is on the drum.

Guides

Rollers on other devices used to guide or protect the rope from scraping should never be less than eight times the diameter of the rope and should rotate freely. Rollers with imperfect surfaces should be replaced.

Wire Rope Diameter

The diameter of wire rope should be measured with a machinist's caliper. The measurement should be at the widest diameter. This will be from the outside to the outside of diametrically opposite strands in the wire rope. For example, a 6x19 wire rope has six strands. With one strand at 12 o'clock, the other strands would be 2, 4, 6, 8 and 10. The diameter should be measured from the outside of the 12 o'clock strand to the outside of the 6 o'clock strand.