NAVSHIPS 900171

ELECTRONIC INSTALLATION PRACTICES MANUAL

CHAPTER 1

SAFETY AND FIRST AID

TOBE DEUTSCHMANN
CORPORATION
NORWOOD, MASS.

BUREAU OF SHIPS

NAVY DF

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ELECTRONIC INSTALLATION PRACTICES MANUAL

This manual is intended for the use of the electronic installation worker. It may be used as a reference book on installation practices or in training beginners in Naval electronic installation work.

Subject matter in this text is intended as supplementary to, but not superseding existing and applicable specifications.

Appreciation is extended to the various Naval Shipyards, Commercial Firms, Service Representatives and Manufacturers who were contacted and without whose cooperation this manual would not be possible.

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SAFETY PRECAUTIONS

1. INTRODUCTION.

The safety precautions outlined in this chapter are not intended to supersede information given in instruction books or other applicable instructions for the installation of electronic equipment. They are intended to doubly impress upon personnel, the hazards involved in working with or around high-voltage electronic equipment and the precautions to observe in the performance of such duties.

Special precautions are required for electronic equipment because power supply voltages up to 40,000 volts and even higher radio frequency voltages are used. Special precautions are also necessary because of the effect of electrical fields existing in the vicinity of antennas and antenna leads which may introduce fire hazards, especially where explosive vapors are present.

Additional precautions are needed for personnel working aloft to prevent injuries due to falls, often complicated by possible presence of stack gases and by possible shock.

2. DANGEROUS VOLTAGES.

The actual voltages involved in the installation of electronic equipment are given in the equipment instruction books, but all voltages in electronic equipment are dangerous. Even 110 volts, under certain conditions, can be fatal. The precautions given in the following paragraphs should be observed. Voltages of 300 volts or over are considered High Voltage.

3. WARNING SIGNS.

"DANGER" signs and suitable guards are required wherever necessary to prevent personnel from coming in accidental contact with high voltages, for warning against the possible presence of explosive vapors, and against the effects of smoke pipe gases while servicing electronic equipment aloft. Look for warning signs and heed their warning. Workers should immediately notify a supervisor if a dangerous condition exists without a warning sign.

4. ELECTRICAL SHOCK.

All personnel should familiarize themselves with the safe methods of removing victims from electrical contact and know how to apply artificial respiration as explained and illustrated in Section 1-2.

Intentionally touching an energized circuit is strictly forbidden. Whenever it becomes necessary to check a circuit to see if it is alive, a test lamp, voltmeter, or other indicating device should be used. In the case of live circuits, never trust insulating material that has not been tested. Insulating material has failed before, and may fail again.

5. TAGGING OPEN SWITCHES AND GROUNDS.

When electronic equipment is being installed, the main supply switches or cutout switches in each circuit from which power could possibly be fed should be secured in the open (or safety) position and tagged. The tag should read "This circuit was ordered open and shall not be closed except by direct order of ---" (usually the person in charge of installation). After the work has been completed, the tag or tags should be removed by the same person.

When more than one party is engaged in the work, a tag for each party should be placed on the supply switch. Each party should remove only its own tag upon completion of the work.

Where switch-locking facilities are available, the switch should be locked in the open (SAFETY) position and the key

retained by the person doing the work so that only that person can remove the lock and restore the circuit.

When circuits are grounded for protection of personnel engaged in installation work, such grounds should be located in the vicinity of the working party and should be properly secured to prevent accidental removal. If the location of the grounding point is not near to the working party, the tagging procedure indicated above should be followed with the wording of the tags changed.

6. OPERATING SWITCHES.

a. POWER AND LIGHTING CIRCUITS. As a general rule, use only one hand for switching. Keep the other hand clear. Only one switch should be touched at one time by one person. Before closing a switch make sure of the following:

(1) The provisions of tagging described above have been met.

(2) The circuit is ready and all parts are free.

(3) Personnel near moving parts are notified that the circuit is to be energized. This is particularly important in cases where rotating antennas are energized.

(4) Proper fuses are installed for protection of the circuit.

(5) Circuit breaker is closed. Ease the switch to a position of safe and quick action and then make the final motion positive and rapid. When opening switches carrying current, the break should also be positive and rapid. Be sure hands are dry and therefore not likely to slip off a switch handle and make contact with high voltage. Dry hands also offer better resistance in case the switch handle should be slippery.

b. RADIO FREQUENCY CIRCUITS.—

Avoid breaking energized high-voltage RF output circuits. When other transmitting equipment is in use at the same installation or close by, personnel should be on the alert to prevent shock, burn or other injury due to energy picked up from nearby antennas or equipment.

7. FUSES.

Fuses should be removed and replaced only after the circuit has been completely de-energized. Do not use bare hands. When a fuse blows, it should be replaced with a fuse of the proper capacity of the non-replaceable link type and suitable for use at the circuit current and potentials involved. When practicable, a circuit should be checked before replacing a burned-out fuse as such trouble usually indicates a circuit fault. Use approved fuse pullers when installing fuses. These pullers, as shown in Figure 1-1, are made of either laminated bakelite or fibre and will handle a range of fuses from 0 to 60 amperes. Grasp fuse firmly with puller (using the end that best fits fuse size) and pull straight out from fuse cabinet.

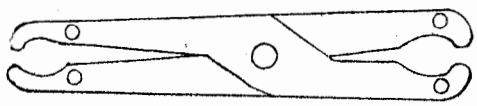

Figure 1-1. Medium Size Fuse Puller

8. CIRCUIT BREAKERS.

a. PRECAUTIONS.— Except for operating handles, all parts of circuit breakers are normally conductors. In opening and closing circuit breakers, observe the following precautions:

(1) Use only one hand.

(2) Keep the hands clear of parts other than operating handles.

(3) Touch only one breaker handle at a time.

(4) Positive and negative breakers with two handles should not be closed at one time.

(5) Close breaker first and then close switches.

(6) Trip circuit breakers before opening switches.

(7) Never disable a circuit breaker.

(8) Keep the face turned away while closing circuit breakers.

(9) Never stand over a circuit breaker while power is on.

9. POWER LINE GROUNDS.

Keep all electrical circuits free from grounds, except where required as a normal operating condition. Power should be removed from electronic equipment when the power line shows a ground. Do not return power to the equipment until it has been determined that the ground is not in the equipment.

10. MEASURING VOLTAGES.

a. GENERAL. – Every care and precaution must be taken when measuring voltages. Voltages over 300 volts are considered high voltage, but even 110 volts can prove fatal under certain conditions. Observe the following precautions:

(1) Make sure you are not grounded whenever you are adjusting equipment or using measuring equipment.

(2) In general, use one hand only when servicing line equipment.

(3) If test meter must be held or adjusted while voltage is applied, ground the case of the meter before starting measurement and DO NOT touch the line equipment or personnel working on line equipment while you are holding the meter. Some moving-vane type meters should not be grounded. These should not be held during measurements.

(4) Do not forget that high voltages may be present across terminals that are normally low voltage, due to equipment breakdown. Be careful even when measuring low voltages.

(5) Do not use test equipment known to be in poor condition.

(6) High-voltage, high-capacity capacitors should be discharged with a grounding stick and approx. ten thousand ohms in series with the grounded line. Where neither terminal of a capacitor is grounded, short capacitor terminals to each other. See Figure 1-2.

b. HIGH VOLTAGE CIRCUITS. – When measuring voltages over 300 volts, the precautions listed above and the following procedures must be observed.

WARNING

Never measure potentials in excess of 1000 volts by means of flexible test leads or probes.

(1) Determine the correct voltage of the circuit to be tested.

(2) De-energize the equipment. Ground terminals to be measured to discharge any capacitors connected to these terminals.

(3) Connect meter to terminals to be measured, using a range higher than the expected voltage.

(4) WITHOUT TOUCHING METER OR TEST LEADS, energize the equipment and read the meter.

(5) De-energize the equipment. Ground the terminals connected to the meter before disconnecting meter.

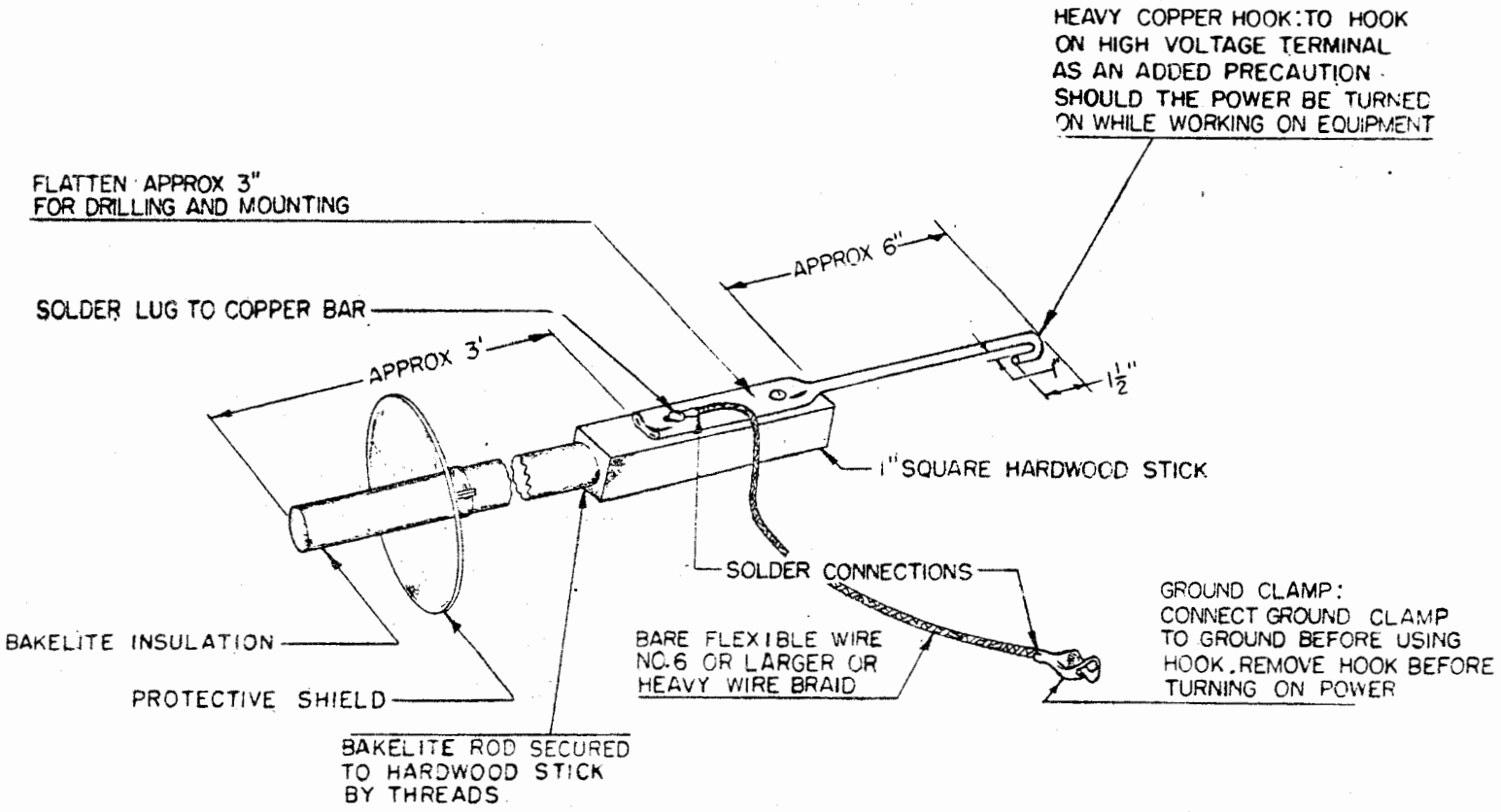

Figure 1-2. Diagram of Shorting Stick

(6) If additional measurements are required the above steps should be repeated for each one.

11. ADJUSTMENT OF TRANSMITTING EQUIPMENT.

Transmitter adjustments should not be made while motor generators are running or rectifiers are energized unless they can be accomplished by the use of the exterior controls normally provided for this purpose.

12. INTERLOCKS AND SAFETY DEVICES.

Safety devices such as interlocks, overload relays and fuses should not be altered or disconnected except for replacement, nor should safeguard circuits be modified without specific authority of the Bureau of Ships in each case.

Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any manner.

13. GENERAL PRECAUTIONS.

a. KEEP ENCLOSURES CLOSED AND MAINTAIN GROUNDS.- All fuse boxes, junction boxes, lever-type boxes, and wiring accessories should always be kept closed except when servicing is necessary. Care should be exercised to ground effectively and to maintain these protective grounds on all metal enclosures of electronic equipment.

b. LOOSE METAL PARTS OR LIQUIDS.- Personnel should never take loose metal parts or liquids near or above a starter box or above open electronic equipment. Do not stow articles in or near switch-gear, control appliances, panels, etc.

c. DISCHARGE AND GROUND CIRCUITS.- High-voltage circuits should never be approached or worked upon until it has been determined that the circuit is de-energized and grounded. Even with the current off, machinery sometimes retain enough electrical charge to cause a severe shock. Be safe. Discharge to ground all machinery and power tools before starting work.

Inspect extension cords on lights, drills, soldering irons, etc., before plugging into a circuit. Electrical hand tools, extension cords and such are designed for low voltage but, under certain conditions, these circuits can prove fatal. Examine the outer insulation of the equipment being used, including terminal points where cords enter plugs, lights, or tools. Most extension cords connected with electrical hand tools contain a third wire. This wire is not there by accident, but to prevent one. It is a ground wire and should be connected with a grounded structure before starting work.

d. DISCHARGING CAPACITORS.- Before touching a capacitor, short circuit the terminals using an insulated lead, shorting or ground bar for this purpose. (Figure 1-2).

e. USE OF PORTABLE CABLE OR LEADS.- Portable cables should be selected carefully. Spliced portable cables are extremely dangerous and should not be used. The cable selected should be adequately insulated and of proper length and cross-sectional area.

14. WORK ON TRANSMITTING ANTENNAS.

Personnel should not be permitted to go aloft while antennas are energized by electronic transmitting equipment unless it is definitely determined in advance by suitable tests that no danger exists. Even then, ladders and landings made safe by grounded hand rails or similar structures should be used. This safety measure will prevent an accident due to involuntary relaxation of the hands which might occur if a small spark is drawn from a charged piece of metal or section of rigging. Personnel of the deck force or others working on rigging should be warned of the hazards which may exist

and the precautions to be observed. Safety belts should be used when working aloft to guard against falls.

The above precautions should also be observed when other antennas in the immediate vicinity are energized by electronic transmitters unless it is definitely known that no danger exists. Other antennas may be interpreted to mean any antenna on board another ship moored alongside or across a pier, or at a nearby shore station.

There is always serious danger to personnel aloft due to radar or other antennas which rotate or swing through horizontal or vertical arcs. Motor safety switches controlling the motion of radar antennas should be tagged and locked open before anyone is allowed aloft close to such antennas.

15. PRECAUTIONS IN DRYDOCK.

While a ship is in drydock the electronic equipment may be energized only with the permission of the docking officer. The hull must be adequately grounded. Excitation should not be applied to sonar transducers unless properly immersed. Hoist mechanisms are to be operated only after it has been definitely assured that sufficient clearance exists for the moving elements within their full limit of travel and that no mechanical damage can occur through such operation. This should be determined as soon as possible after the dock is drained and, if sufficient clearance does not exist, positive steps should be taken to prevent lowering of the transducer by gravity, manual or power operation.

16. PRECAUTIONS WHEN CLEANING.

All electronic equipment should be clean to insure good performance. The following precautions should be observed when cleaning.

a. USE OF SOLVENTS.— Alcohol or other inflammable solvents should not be used on energized equipment or on equipment near other electronic units from which a spark is possible. If a solvent must be exposed, it should be in the smallest possible quantity and only in well-ventilated compartments. Except in locations in the open, alcohol should be limited in quantity to one pint.

b. USE OF VOLATILE LIQUIDS.—

When working with volatile liquids such as insulating varnish, paint, lacquer, turpentine, kerosene, and carbon tetrachloride, ample ventilation should be provided to prevent accumulation of inflammable or noxious vapors. Careless use of carbon tetrachloride may result in headache, dizziness, nausea, loss of consciousness, and even death. It should never be used in a small, poorly-ventilated compartment. Avoid direct contact of the liquid with the skin or breathing the vapors.

17. ELECTRICAL FIRES.

In case of electrical fire, de-energize the circuit for the equipment involved. When this has been done - STOP! LOOK! THINK! The use of a CO_2 (carbon dioxide) fire extinguisher directed at the base of the flame is always best for all electrical fires. For a complete discussion, refer to Chapter 2, EXTINGUISHING ELECTRICAL FIRES.

18. HIGH FREQUENCY OPERATING HAZARDS.

The use of electronic equipment in the frequency range of 30 megacycles and below may, under certain conditions, cause dangerous voltages to be induced in the standing rigging and other portions of a ship's structure. These voltages may cause shock to personnel or produce open sparks when contact is made or broken, the circuit opened, or when momentarily in contact with other metallic objects. For example:

Excessive radio-frequency pickup from ship antennas has been noted on smokestack guys, davit head spans, and the like. A similar high radio-frequency pickup has been observed on board ship, particularly carriers, when reeling in or paying out wire cable and wire hawsers

when the length involved becomes resonant to the emitted frequency.

During the handling of ammunition, volatile liquids, or gases (particularly during fueling operations involving delivery of gasoline from hoses, spouts, cans, or any place where gasoline vapors are present), the following precautions to eliminate the hazards should be observed:

a. Call attention of the deck force or others to the hazards involved.

b. Use an insulated steering hook for guiding boom or crane cables.

c. Insulate loading hook from burtoning wire, crane or boom cables by use of manila rope or strain insulators.

19. PRECAUTIONS FOR HANDLING CATHODE RAY TUBES.

When handling cathode ray tubes, wear goggles to protect eyes from flying glass particles in event of envelope fracture which might cause implosion due to high vacuum within the tube. Goggles which provide side and front protection and have clear lenses which will withstand a fairly rigid impact test, are recommended. Remove tube from packing box with caution, taking care not to strike or scratch the envelope. Insert into equipment socket cautiously,, using only moderate pressure. Do not jiggle the tube. These precautions also apply when removing tube from equipment socket. Do not stand directly in front of the tube face. If the tube should explode, the tube base often is propelled directly forward with a force sufficient to cause severe injury.

20. PRECAUTIONS TO OBSERVE WHEN PAINTING ELECTRONIC EQUIPMENT.

The following safety precautions should be observed when painting electronic equipment on shipboard:

a. Provide adequate ventilation for all inclosed compartments in which painting is to be done. Exhaust ventilators as well as power blowers should be used. Blowers should be so arranged as to insure rapid and complete removal of all explosive, combustible, and/or toxic vapors which may be present. Vapors should be exhausted in such a way that they will not be sucked into any of the ship's supply vents which may be running or in any way contaminate other areas.

b. Where paint vapors or fumes are known to be explosive, any electrical portable equipment used in the vicinity of the painting operations in inclosed compartments should be of the explosion-proof type. Do not permit smoking or allow any type of work which may produce flames or sparks to be performed within the danger area.

c. Maintain good housekeeping practices and keep all unnecessary objects and materials picked up and out of the way. Particular attention should be given to rags, sweepings, waste, etc., which may be paint saturated or contaminated. These materials should be placed in covered metal containers or buckets containing water.

d. The exits to the compartment in which painting is being done should not be blocked in any manner. Provide adequate fire-fighting equipment in easily accessible positions.

e. No eating, drinking, or storing of food should be allowed in any compartment where painting is being done.

f. When spray guns are used there is normally a large amount of flashback and, in inclosed compartments, the painter should be equipped with an air respirator or hose mask.

21. CONNECTING AND SOLDERING CABLES AND WIRES.

The soldering iron is always a potential fire hazard, therefore, when connecting and soldering cables or wires keep the iron holder in the open where the danger is minimized. Always dis-

connect the iron when leaving work for even short periods and observe the following precautions:

a. Place the ends of wire and cables in such a position that they do not provide a potential source of injury to the face or eyes.

b. Keep the head in such a position that the face or eyes will not be injured by wire ends, molten solder or tools.

c. Do not flip the soldering iron to dispose of molten solder accumulated on the tip; serious eye injury may result or equipment damaged.

22. THINGS TO REMEMBER.

It is the duty of all personnel engaged in the installation of high-voltage electronic equipment, or engaged in the training of other personnel on this equipment to become familiar with the safety precautions given in this section and the safety precautions given in applicable instruction books for specific equipment. Always remember the following:

a. Do not rely on safety devices such as interlocks and high-voltage relays.

b. Don't work alone.

c. Observe all warning signs.

d. Don't intentionally come in contact with an energized circuit.

e. Avoid working on energized circuits.

f. Don't eat or drink while painting.

g. Use a shorting stick such as the one shown in Figure 1-2 for discharging capacitors.

h. Use approved fuse pullers.

i. The appearance of the work is a measurement of the worker's ability.

j. Remember that personnel may be killed or injured by high-voltage equipment which is assumed to be off. Take nothing for granted. Make certain that the power is off by securing the power-line switch in the OFF position.

SECTION 1-2

FIRST AID

NOTICE

A Department of Defense Press Release, dated December 6, 1951 announced the adoption of the "Back-Pressure Arm-Lift" (Holger Nielsen) method of manual artificial respiration as the preferred method of resuscitation, replacing the Schafer Prone-Pressure method. This was a joint release issued by the Department of Defense, American National Red Cross, National Research Council, and Public Health Service. Immediate plans were made for teaching and publicizing the newly advocated method. Instruction manuals were ordered printed, instructors indoctrinated, and the Back-Pressure Arm-Lift method ordered taught on a large scale.

The following paragraphs on Artificial Respiration explain the reasons for this change and provides illustrated instructions on how to apply the new method.

1. ARTIFICIAL RESPIRATION.

Artificial respiration is used to induce breathing in persons whose respiration has stopped. The common causes of respiratory failure (where artificial respiration can be of value), are electric shock, drowning, suffocation, poisoning by illuminating gas or carbon monoxide, poison gases and nerve gases used in warfare which may cause respiration to cease. Artificial respiration is also used occasionally in certain illnesses, such as poliomyelitis.

Attempts to start respiration after breathing has stopped are made either by mechanical or manual methods. Mechanical methods require the use of machines (pullmotor) which usually are not available when most needed. Manual artificial respirations, which can be conducted by personnel familiar with the methods, can be started immediately and can be continued until breathing has started or until mechanical respirators become available.

a. MANUAL METHODS. – The manual method used most extensively in the United States in the past was known as the Schafer prone-pressure method. It consisted of placing the victim face downward and then having an operator compress the victim's chest by pressure on the lower ribs of the back. This pushed air out of the chest and was called a "push" method. The method depended upon the elastic recoil of the chest and internal organs for air to be drawn into the lungs. Since this latter process is not given assistance by the operator, there is no "pull" maneuver in the Schafer method.

Other methods of manual artificial respiration, widely used in Europe and by skilled anesthetists in the United States, but which have never been taught in first aid classes, all follow the principle of pushing the air from the chest,

but in addition add a second step which pulls air into the chest. These methods are:

(1) The back-pressure arm-lift method, in which the patient is placed face down with the hands under the cheek and the operator rhythmically presses on the back of the chest and then pulls upward on the arms.

(2) The back-pressure hip-lift method, in which the patient is placed face down and the operator rhythmically presses on the back and then raises the hips or rolls the hips upward on the operator's thigh.

(3) The modified Silvester method, in which the patient is placed face upward and the operator rhythmically presses on the abdomen and then manipulates the arms upward. (To be used only if patient cannot be placed face down.)

o. COMPARISON OF METHODS. - Although the Schafer prone-pressure method has been used almost exclusively in the United States for many years, recent research activities in which all methods were tested extensively, led to the following conclusions:

(1) The back-pressure arm-lift method of artificial respiration is the best method.

(2) The back-pressure hip-lift method should be used, when indicated, on victims with injuries to the arms.

(3) The Silvester method, with the victim lying on his back, should only be used when the victim cannot be placed face down.

(4) The Schafer method, which is less effective, should be replaced by the back-pressure arm-lift method

In addition to the many studies and experiments which brought about the above conclusions, the ease and effectiveness of teaching the various methods, and the ease or difficulty in administering the methods were also tested. The results fell into three main classes: (a) Experiments to determine which method gave the greatest exchange of air; (b) which method was the easiest to learn; (c) which method was the easiest to perform. These were as follows:

When measurements were taken to determine how much air was exchanged through the mouth in the various methods, it was determined that when the Schafer prone-pressure method was used, only 485 cc's, or approximately one pint, of air was exchanged with each application of pressure. Compared to this, the push-pull methods, such as the back-pressure arm-lift or hip-lift, or the Silvester method with the victim lying on his back, provided an exchange of over 1,000 cc's, or over one quart, of air with such application of pressure combined with arm or hip manipulation. Inasmuch as the number of cycles of manipulation per minute (12) are essentially the same in all methods, this revealed that the Schafer method was less than one-half as effective as the other methods in the exchange of air.

Experiments also revealed that the effectiveness of the Schafer method depended upon the natural tone and elasticity of the victim's muscles. This is due to the fact that the pressure on the small of the back, used in this method, expels air from lungs and it is only when the ribs spring back into place that air is sucked back in. However, when a victim is deeply asphyxiated and near death, there is a loss of natural muscle tone, less elasticity of the chest, and less tendency for air to be sucked in. This makes the Schafer method least effective when most needed.

Many deaths in the asphyxiated, and especially in electrocution, are due to heart failure and sometimes this cannot be avoided. However, it is less likely to happen if there is sufficient oxygen in the blood. The exchange of a large volume of air in manual artificial respiration helps keep the blood oxygen level high.

Experiments with ease of teaching the various methods indicated that the back-pressure arm-lift and hip-lift methods were only slightly more difficult to teach than the Schafer prone-pressure method and can be taught to most personnel in a period of approximately ten minutes.

Experiments relating to the ease of operation, revealed that both the back-pressure arm-lift and the Schafer methods could be performed by a half-grown child or a woman upon a heavy adult victim without undue fatigue. The back pressure hip-lift method, however was very fatiguing and probably could not be performed by a light individual upon a heavy adult. Experiments with the modified Silvester method, where the victim is placed on his back, revealed that it had one serious drawback. That was the inability to keep the throat clear. Although the method could be used by skilled anesthetists, it could not be used extensively by lay personnel due to the fact that the victim's tongue, or water and debris might stop up the air passages.

It has been determined, therefore, that the back-pressure arm-lift method of manual artificial respiration provides for sufficient exchange of air, can be taught quickly, and is easy to perform. The only potential drawback to the use of this method would be in cases where the victim had severely injured arms which could not be raised. In this case, results indicate that the back-pressure hip-lift method should be used. Finally, results indicate that the modified Silvester method should only be used when the victim cannot be placed on his stomach, i.e., in case of severe frontal burns.

c. NEW METHOD ADOPTED. - As a result of this research and experimental work on manual methods of artificial respiration, the back-pressure arm-lift method has been adopted by the Armed Forces, the American National Red Cross, the Federal Civil Defense Administration, the Council on Physical Medicine and Rehabilitation of the American Medical Association, and others.

It should be remembered, however, that although the back-pressure arm-lift method of artificial respiration is considered superior and replaces the Schafer method, the Schafer method has saved many lives and should not be abandoned until the new method has been learned.

2. GENERAL INSTRUCTIONS FOR MANUAL ARTIFICIAL RESPIRATION.

Certain general principles must always be kept in mind in performing any method of artificial respiration.

a. TIME IS OF PRIME IMPORTANCE, SECONDS COUNT. – Do not take time to move the victim to a more satisfactory place; begin at once. Do not delay resuscitation to loosen clothes, warm the victim, apply stimulants, etc. These are secondary to the main purpose of getting air into the victim's lungs.

CAUTION

In many cases of electrical shock the victim remains in contact with the circuit because of inability to let go, or due to unconsciousness. If this occurs, do the following quickly and efficiently: Open the electrical circuit, if possible, before removing the victim; use dry insulating material and BREAK THE CIRCUIT or pull the victim free of the live conductor. DON'T TOUCH THE VICTIM WITH BARE HANDS UNTIL CIRCUIT IS BROKEN.

b. QUICKLY place the victim in the prone position, that is, on his abdomen with the face turned to one side, the elbows bent, and the cheek resting on the back of the hand.

c. QUICKLY sweep your fingers into the victim's mouth, removing froth and debris and drawing the tongue forward.

d. Begin artificial respiration and continue it rhythmically (12 times per minute) and uninterrupted until spontaneous breathing starts or the patient is pronounced dead.

e. As soon as the patient is breathing for himself, or when additional help is available, see that the clothing is loosened (or removed if wet) and the patient is kept warm. However, do not interrupt the rhythmical artificial respiration to accomplish these measures.

f. If the victim begins to breathe on his own, adjust your timing to assist him. Do not fight the victim's attempts to breathe. Synchronize your efforts with his.

g. DO NOT WAIT FOR A MECHANICAL RESUSCITATOR, but when an approved model is available, use it. A well-performed "push-pull" type manual artificial respiration is immediately available and effective, and accomplishes adequate ventilation. The mechanical resuscitator is no more effective than a properly performed "push-pull" manual technique. The most important advantage of good mechanical resuscitators are that they require less skill to operate, are not fatiguing, and can furnish 100% oxygen. There are other advantages. Since the resuscitators need only be applied to a patient's face, it can be employed when physical manipulation of the body is impossible or would be harmful, as during surgical procedures, in accident cases with extensive burns, broken vertebrae, ribs, arms, etc., for victims trapped under debris of excavations, overturned vehicles, etc., and during transportation of the victim. Furthermore, some resuscitators signal when the airway is obstructed, and provide an aspirator.

3. APPLICATION OF BACK-PRESSURE ARM-LIFT METHOD OF ARTIFICIAL RESPIRATION. (PREFERRED METHOD)

a. POSITION OF VICTIM. – Place the victim in the face down, prone position. Bend his elbows and place the hands one upon the other. Turn face to one side, placing the cheek upon his hand. (See Figure 1-3.)

b. POSITION OF THE OPERATOR. – Kneel on either the right or left knee, at the head of the victim, facing him. Place the knee at side of the victim's head, close to the forearm. Place the opposite foot near the elbow. If it is more comfortable, kneel on both knees, one on either side of the victim's head. Place your hands upon the flat of the victim's back in such a way that the heels of the hands lie just below a line running between the arm pits. With the tips of the thumbs just touching, spread the fingers downward and outward. (See Figure 1-3.)

c. COMPRESSION PHASE. – Rock forward until the arms are approximately vertical and allow the weight of the upper part of your body to exert slow, steady, even pressure downward upon the hands. This forces air out of the lungs. Your elbows should be kept straight and the pressure exerted almost directly downward on the back. (See Figure 1-4.)

d. EXPANSION PHASE. – Release the pressure, avoiding a final thrust, by commencing to rock slowly backward.

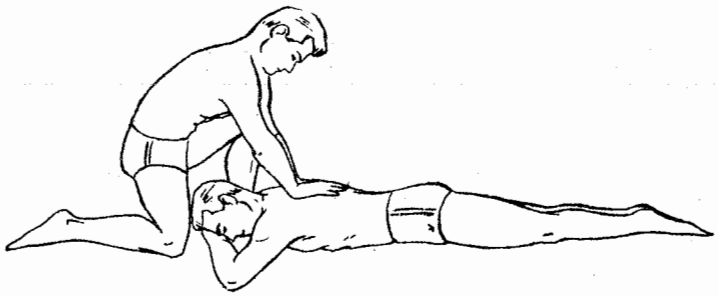

Figure 1-3. Correct Position for Back-Pressure Arm-Lift Method

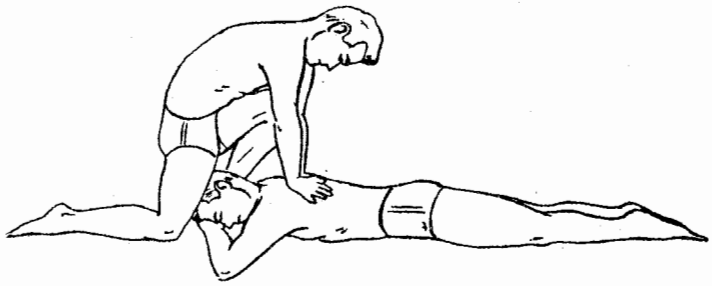

Figure 1-4. Compression Phase

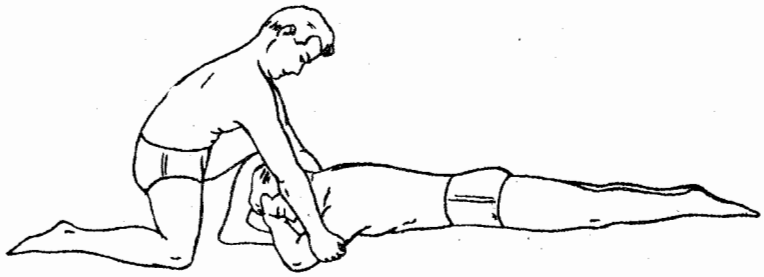

Figure 1-5. Expansion Phase

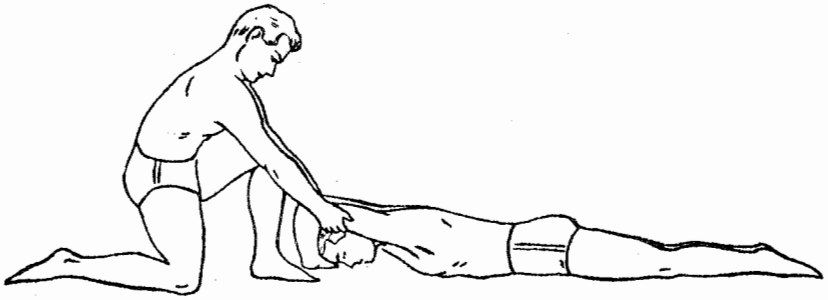

Figure 1-6. Expansion Phase Continued

Place your hands upon the victim's arms just above his elbows, and draw his arms upward and toward you. (See Figures 1-5 and 1-6.) Apply just enough lift to feel resistance and tension at the victim's shoulders. Do not bend your elbows, and as you rock backward the victim's arms will be drawn toward you. Then drop the arms gently to the ground. This completes the full cycle. The arm-lift expands the chest by pulling on the chest muscles, arching the back, and relieving the weight on the chest.

e. TIME CYCLE. – The cycle should be repeated twelve times per minute at a steady, uniform rate. The compression and expansion phase should occupy about equal time, the release periods being of minimum duration.

f. ADDITIONAL RELATED DIRECTIONS. – It is all important that artificial respiration, when needed, be started quickly. There should be a slight inclination of the body in such a way that fluid drains better from the respiratory passage. The head of the subject should be extended, not flexed forward, and the chin should not sag lest obstruction of the respiratory passages occur. A check should be made to ascertain that the tongue or foreign objects are not obstructing the passages. These aspects can be cared for when placing the subject into position or shortly thereafter, between cycles. A smooth rhythm in performing artificial respiration is desirable, but split-second timing is not essential. Shock should receive adequate attention, and the victim should remain lying down after resuscitation until seen by a physician.

4. APPLICATION OF BACK-PRESSURE HIP-LIFT OR HIP-ROLL METHOD OF ARTIFICIAL RESPIRATION.

a. POSITION OF VICTIM. – Place the victim in the face down, prone position, with the arms stretched outward and the face turned to rest upon one cheek between the outstretched arms. (See Figure 1-7.)

b. POSITION OF THE OPERATOR. – Kneel on either the right or left knee, straddling the victim, and facing the same direction. Place the palms of the hands on the small of the victim's back with fingers resting on the ribs, the little finger just touching the lowest rib. (See Figure 1-8.)

c. COMPRESSION PHASE. – Rock forward until the arms are approximately vertical and allow the weight of the upper part of your body to exert slow, steady, even pressure downward upon the hands. This forces air out of the lungs. (See Figure 1-8.)

d. EXPANSION PHASE. – Release the pressure and place the hands or fists under the victim's hips and lift upward approximately four inches, and release. This pulls air into the lungs. (See Figure 1-9.) The hip-lift can be altered by grasping the distant hip of the victim and rolling it onto your knee. (See Figure 1-10.)

e. TIME CYCLE. – The cycle should be repeated twelve times per minute at a steady, uniform rate.

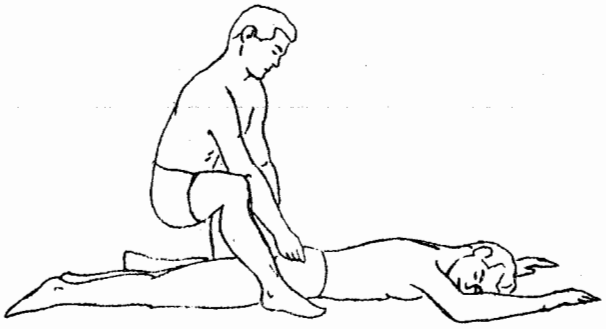

Figure 1-7. Correct Position for Back-Pressure Hip-Lift Method

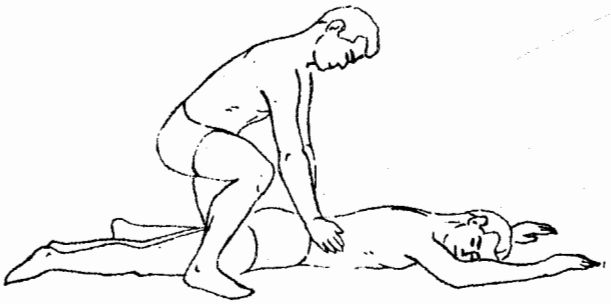

Figure 1-8. Compression Phase

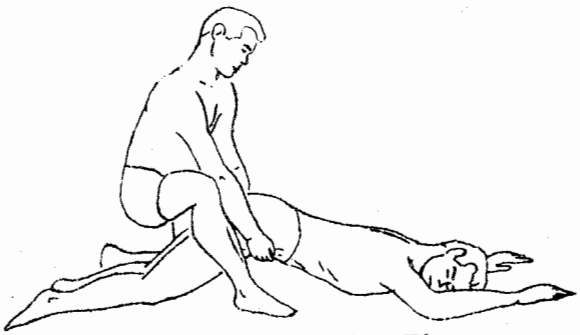

Figure 1-9. Expansion Phase

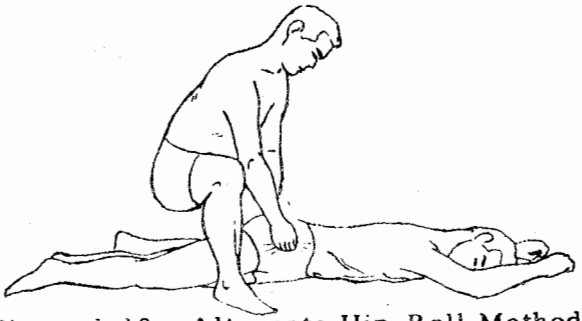

Figure 1-10. Alternate Hip-Roll Method

5. APPLICATION OF MODIFIED SILVESTER METHOD OF ARTIFICIAL RESPIRATION.

a. POSITION OF VICTIM. – Place the victim in a face up position with the elbows bent and hands on the chest. (See Figure 1-11.)

b. POSITION OF THE OPERATOR. – Kneel on both knees, with the head of the victim between the knees. Place your hands on the victim's arms, between the elbows and wrists. (See Figure 1-11.)

c. COMPRESSION PHASE. – With your arms stiff, rock forward until the arms are approximately vertical and allow the weight of the upper part of your body to exert slow, steady, even pressure downward upon the hands. (Figure 1-11.)

d. EXPANSION PHASE. – Remove the pressure and grasp the victim's arms between the wrists and elbows and lift upward and toward you as you rock backward. (See Figure 1-12.) Apply just enough lift to feel resistance and tension at the victim's shoulders. Place the arms gently back upon the chest for the next compression phase.

e. TIME CYCLE. – The cycle should be repeated twelve times per minute at a steady, uniform rate.

6. TREATMENT OF SHOCK.

It is probable that many delayed deaths in electrical accidents are due to the direct effects of shock rather than to the direct effects of electric current. Shock may come on immediately or be delayed, developing several hours later. If it is at all severe, prompt treatment must be given. Shock is frequently the cause of death, and immediate treatment may save a life and permit the victim to recover from other injuries. The patient should be treated for shock in the same way that a patient would be treated after a severe surgical operation.

There are only four measures of value in the first aid treatment of shock. These are heat, position, quiet, and stimulants.

Heat is the most important. A person suffering from shock looses heat very rapidly due to poor circulation of the blood. To make the situation worse, the more heat lost and the more exposure to cold, the worse the shock becomes. THE PATIENT MUST BE KEPT WARM. This may be done by wrapping blankets, coats, etc., around the victim, and by using heaters, hot water bottles, heated bricks or stones, etc. Take care not to burn the victim, especially if unconscious.

The patient must be kept quiet and lying down, preferably with the head slightly down hill. Do not let the patient stand, sit up, or exert himself in any way. Keep onlookers away.

Never give a stimulant by mouth when the patient is unconscious. After consciousness has returned, give the patient a teaspoonful of aromatic spirits of ammonia in a small glass of water, or a cup of hot coffee, tea, etc. The amount usually given is one cupful, which can be repeated every thirty minutes.

These measures must be considered strictly first-aid. Do not neglect the care of the patient, but make every effort to summon medical aid as soon as possible.

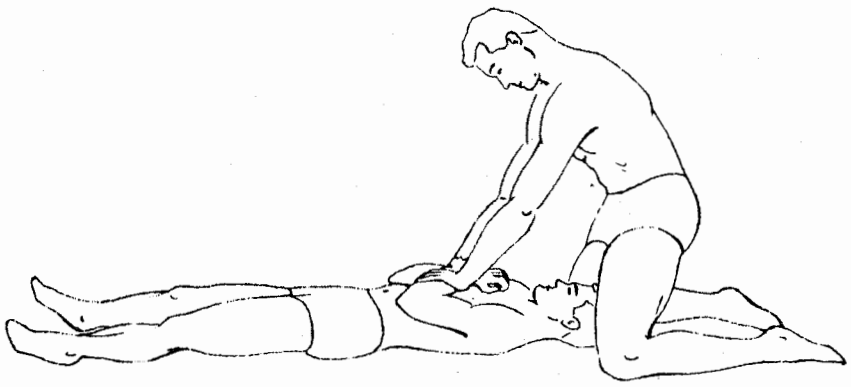

Figure 1-11. Position and Compression Phase of Silvester Method

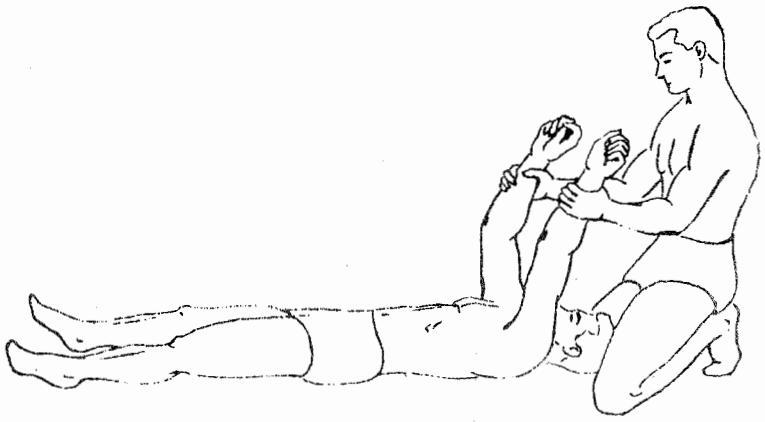

Figure 1-12. Expansion Phase of Silvester Method

7. EMERGENCY FIRST AID FOR VICTIMS OF BURNS AND FUMES.

a. BURNS FROM ELECTRICAL OR PAINT FIRES. –Ignorance of safety precautions when working with high-voltage electronic equipment may cause explosions resulting in fires and serious burns to personnel.

Painting is a job that requires foresight and planning to avoid the difficulties which may happen to personnel wielding a paint brush or holding a spray gun. Often the explosive nature and fire hazard of paint vapors are ignored during painting operations in confined areas.

In case personnel receive serious burns due to explosion fires, the victim should be taken to a hospital as soon as possible. However, the following emergency first aid can be given if a first aid kit is available:

(1) Pour a sterile oil, such as castor oil, mineral oil, etc., over the victim's eyes and face.

(2) Protect victim from air. Cut clothing away from burns.

(3) Place sterile dressing over burned area.

(4) Wrap and keep victim warm.

(5) Give blood plasma as soon as possible.

b. FUMES FROM PAINTS AND SOLVENTS. –It is very important that personnel working with volatile liquids, such as insulating varnish, paint lacquer, and carbon tetrachloride, should be instructed to report promptly any feeling of discomfort, dizziness, headache, eye difficulties, weakness, insomnia, or sudden upset.

Many of these characteristics may be due to other causes, but they can also result from inhaling solvent vapors or poisoning from one of the paint ingredients. Neglect of such warnings may lead to serious illness. Prompt medical attention usually leads to complete recovery.

The first signs of headache or dizziness are warnings to go outside for fresh air. In severe cases the victim, or victims, should lie flat on their back and breathe heavily to rid the system of inhaled fumes. Milk may be given during this period. In case of unconsciousness, call a doctor or take patient to the hospital.

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