TECHNICAL MANUAL

SWIMMING POOL OPERATION AND MAINTENANCE

HEADQUARTERS, DEPARTMENT OF THE ARMY

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REPAIRS AND UTILITIES
SWIMMING POOL
OPERATION AND MAINTENANCE
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[1]This manual supersedes TM 5-662 dated 1966.

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CHAPTER 1

INTRODUCTION

1-1. PURPOSE.

This manual provides guidance for the effective operation and maintenance of swimming pools and associated equipment at Army Installations by personnel assigned to the Directorate of Engineering and Housing organization. It may be used as a general reference source in related training programs. This manual does not replace nor modify manufacturers' instructions on specific equipment. Objectives are to achieve sanitary and efficient operation and maintenance of swimming pools and to eliminate hazards to life and property.

1-2. REFERENCES.

Appendix A contains a list of references used in this document.

1-3. APPLICATIONS.

This manual describes, and provides guidance relating to,

a. The various type of swimming, wading, and spray pools at Army installations.

b. The operation and maintenance of:
   (1)Swimming and wading pools.
   (2)Water treatment facilities.
   (3)Piping system components.
   (4)Water heating equipment.
   (5)Ventilation and dehumidifying equipment.
   (6)Safety equipment.
   (7)Electrical wiring, lights, and equipment.

c. Management of Pools and Equipment.

d. Observance of water quality standards and tests in accordance with TB MED 575.

1-4. MORALE.

Swimming is one of the best forms of exercise for improving muscle tone and body coordination, and it is also an excellent means of recreation. For these reasons and the fact that the lives of military personnel may sometimes depend on their ability to swim, swimming is strongly encouraged.

1-5. HEALTH.

Although there is little evidence that swimming pools present a significant health hazard, disease can be spread by contaminated swimming pool water or by contact with contaminated objects or persons in the pool or pool area. Some of the illnesses known to be spread by contaminated water are: colds and respiratory infections, typhoid fever, amoebic and bacilary dysentery, cholera, diarrhea, hookworm, tapeworm, infectious hepatitis, intestinal disorders, and miscellaneous eye, ear, nose, throat, and skin infections. Therefore, it is highly important to eliminate organisms which cause these diseases from swimming pool water.

1-6. ENERGY CONSERVATION POLICY.

All military swimming pool installations should have a management improvement program that includes policies and guidelines relating to the efficient use and conservation of utilities. Such programs are offered by the National Swimming Pool Institute and various swimming pool manufacturers. Conservation measures should be implemented by supervisory, operating, and maintenance personnel. The importance of using, adjusting, and maintaining equipment properly can- not be overemphasized.

CHAPTER 2

SAFETY

2-1. GENERAL.

Most military installations have swimming pools. The benefits derived from swimming and the safety associated with it depend on how these pools are operated.

2-2. OPERATING SUGGESTIONS.

A swimming pool can be both safe and enjoyable if proper supervision of bathers and proper maintenance of the pool facilities are accomplished. Safe operation suggestions, such as the following, can provide the responsible swimming pool operator a basis for preventing serious injury or for treating accidents rapidly:

a. Keep crystal clear water in the pool.

b. Employ well trained and alert guards to prevent minor injuries and drownings.

c. Maintain rescue equipment such as hook poles and life preservers at all times.

d. Have a telephone installed in a prominent location, along with a list of telephone numbers of emergency medical and or rescue facilities available at the installation. The list should be protected adequately against defacement from weathering, vandalism, and other normal causes.

e. Limit number of bathers using pool to that prescribed in paragraph 3-8, TB MED 575.

2-3. DANGEROUS PRACTICES.

a Signs prohibiting the following dangerous practices should be posted in the pool area:

(1)Swimming alone or without supervision.

(2)Entering pool soon after eating (the larger the meal, the longer interval before safe swimming).

(3)Overexposure to sun or water.

(4)Boisterous conduct such as running, shoving, throwing others into pool, or attempting feats beyond skill or endurance.

(5)Diving in shallow water or bounding on diving board.

(6)Tag and follow-the leader games.

(7)Swimming during thunderstorms (lightning danger).

b. Swimming pool operators can eliminate many of the above dangerous practices through alert supervision of the pool area. (Suggestion: Provide instruction periods and organized aquatic programs.) Other dangerous practices, such as inexperienced persons tampering with equipment and lifeguards engaging in unnecessary conversation, should also be closely supervised. (Suggestion: Many pools would benefit by giving the lifeguards more responsibility and authority to control bathers.)

2-4. POOL DESIGN.

For pool design parameters see TB MED 575.

2-5. POOL DEPTH.

The water depth should be marked plainly at or above the water surface on the vertical pool wall and on the edge of the deck next to the pool. The points of maximum and minimum depth, the points of break between the deep and shallow ends, and intermediate 1-foot increments of depth should be marked. Intervals between depth markings should not be more than 25 feet; numerals should be 4 inches minimum height and of a contrasting color. The outlet of the pool should also be marked plainly in an appropriate contrasting color.

2-6. POOL ACCESSORIES.

Diving boards, diving platforms, and ladders to slides should be rigidly constructed, should have nonslip surfaces, and should be properly anchored to insure stability under the greatest possible load. At least 15 feet of unobstructed headroom should be provided above all diving boards and platforms. A horizontal separation of at least 10 feet should be provided between diving boards and sidewalls (this may be reduced to 8 feet for surface boards). The maximum safe elevation of diving boards and platforms above the surface of the water in relation to the depth of the water is given in the following table:

Height of board or platform (feet)	Minimum water depth at end of board and 12 feet beyond (feet)	Minimum pool width at end of board and 12 feet beyond (feet)
0-6	8.5	20
6-9	10.0	30
>9	11.5	30

2-7. WATER CLARITY.

Clarity of water should be maintained at all times during the pool season, not only for attractiveness, but also as an indication of proper equipment functioning and as an accident prevention means. A black disk 6 inches in diameter on a white field, when placed on the

bottom in the deepest point of the pool, should be clearly visible from-the sidewalks of the pool at all distances up to 10 yards, measured from a line across the pool through the disk. This minimum standard should easily be met by modern filtration systems.

2-8. POOL COLORS.

One of the outstanding assets of any pool is its clear, sparkling water and this is displayed best by having the pool walls and bottom of a light color. Light colors also improve visibility. White, light blue, and aqua blue are frequently used with excellent results. Alternately, dark colors absorb light, restrict vision, obscure dirt deposits, and tend to make maintenance personnel lax in removing sediment.

2-9. POOL LININGS.

For design information on pool linings refer to TB MED 575.

2-10. POOL LIGHTING.

Proper pool lighting not only enhances the appearance of the pool area, but also provides necessary illumination for safety. Arrangement and design of lighting should be such that all surface and bottom areas of the pool, springboards, towers, floors, and other appurtenances are clearly visible to the lifeguards. Lights within sidewalks must be protected and recessed to prevent tampering or breakage. Underwater lights must be grounded and installed so as to prevent hazards to bathers. Electrical safety requirements are stated in article 680 of the 1981 National Electrical Code and have been made more stringent than previous requirements. Therefore, pool facilities constructed prior to this may not meet minimum electrical safety standards. Underwater lighting and electrical out- lets in the pool area should be examined to insure that they comply with current requirements for ground fault protection and distance (clearance). In general, it is good practice to remove all unnecessary electrical equipment in the pool area and maintain the essential equipment in accordance with the National Electrical Code.

2-11. ACCIDENT PREVENTION.

Accidents and drowning deaths are the most serious problems in the control of swimming pools. Lack of effective bather supervision, poor construction, and improper operation and maintenance of equipment are prime causes of such casualties. A regular routine should be established for daily inspection of the pool area and all pool equipment. The cracking or flaking of concrete can be hazardous to bathers and should be re- paired as soon as possible. Pool ladders, diving board supports, diving towers, and lifeguard chairs should be Ladders and diving equipment should be inspected for the presence of any foreign matter which would render them slippery. After maintenance of moving parts or electrical connections in the equipment room, a safety check should be made to assure that all safety guards and electrical box covers are replaced and valves are properly tagged and positioned. Electrical circuits should be deenergized before working on any equipment. Where wet, slick, or other conditions contribute to slippery walking surfaces and consequent hazards to personnel, nonslip surface treatments should be applied.

2-12. DANGEROUS CONDITIONS.

The following dangerous conditions should be eliminated:

a. Poorly drained, slippery floors and walks.

b. Shower-valve arrangement capable of scalding (central automatic mixing valve is best).

c. Caking soap or leaking soap dispenser.

d. Abrupt changes in the slope of the pool floor or underwater steps.

e. Insufficient depth or area for diving.

f. Excessively high, shakey, or slippery diving equipment.

g. Lack of water depth markings.

h. Turbid water (the bottom at the deepest point should be easily visible from the pool edge).

i. Pool drains, outlets, or other fixtures which could hold a person underwater.

j. Electrical equipment capable of shocking (e.g., underwater light fixtures must be grounded).

k. Water slides poorly located, causing "traffic" congestion.

l. Projecting or ungrated pipes.

m. Improperly vented chlorinators.

n. Use of glass containers of any type in the pool area.

2-13. LIFESAVING FACILITIES.

Equally as important as preventing accidents is being prepared to quickly and effectively respond to an accident. Preparedness includes the following items:

a Lifeguards: A qualified lifeguard having a valid American Red Cross Senior Certificate or equivalent should always be on duty when the pool is in use and should be positioned to observe the entire swimming area.

b Lifesaving Equipment: Swimming pools should be furnished with the following lifesaving equip- ment: (a) a pole, greater in length than one-half the swimming pool width, capable of extension to all sec- tions of the floor of the pool, constructed of suitable lightweight material and having a life hook (shepherd’s crook) at the end with an aperture of at least 18

inches between the tip of the hook and the tip of the pole; (b) a-"flutter board," approximately 1 foot by 3 feet by 3 inches, capable of supporting in water a weight of not less than 20 pounds; with 3/16-inch lines attached at least equal in length to the maximum width of the pool; and (d) a separate throwing rope with a length not less than one-half the maximum width of the pool. These items should be furnished on the basis of one each for every 2,000 square feet of pool surface area (see figure 2.1). Elevated lifeguard platforms or chairs should also be furnished on the basis of one per 2,000 square feet of pool area.

c. Location of Equipment: Lifesaving equipment should be conspicuously displayed and strategically located around the pool deck or at lifeguard chairs. The equipment must be readily accessible, kept in good repair, and the function of each item marked. Bathers or other unauthorized personnel must not be permitted to tamper with or use the equipment for any purpose other than its intended use.

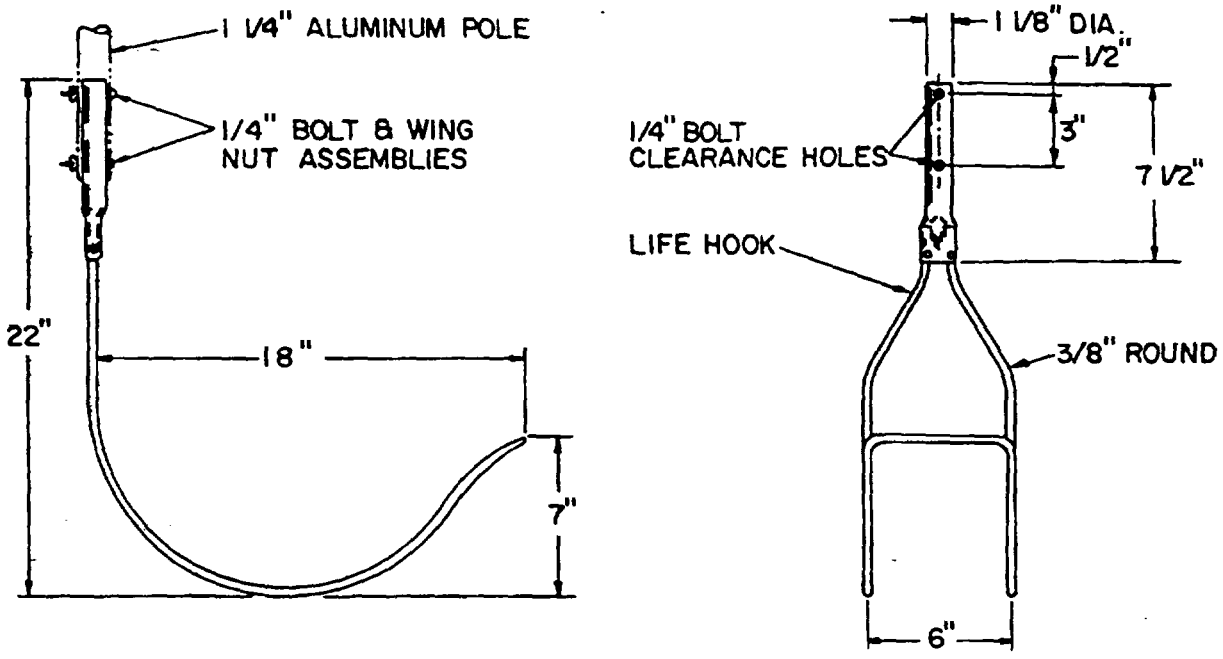
2-14. FIRST AID.

The following first aid techniques are most often used to revive drowning victims:

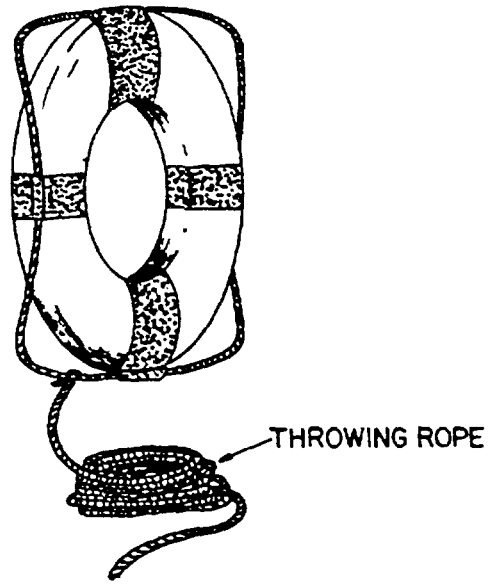
a. Mouth-to-Mouth Resuscitation: Mouth-to-Mouth resuscitation is the most effective and easily administered form of artificial respiration with which all pool operating personnel should be familiar. Procedures for administering mouth-to-mouth resuscitation are explained in detail and illustrated in TM 5-682.

b. Artificial Respiration: Artificial respiration by mechanical means (oxygen inhalers) is authorized only if properly trained operators are available to use the equipment.

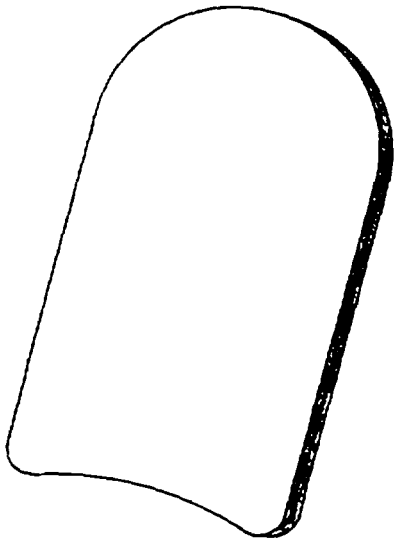
c. CPR (Cardio-Pulmonary Resuscitation): Cardio-pulmonary resuscitation is a lifesaving technique that combines mouth-to-mouth resuscitation with external cardiac compression to restore breathing and heartbeat. This technique should not be attempted unless administering personnel have been properly trained. Proper training requires annual certification.



LIFE HOOK



THROWING-RING BUOY



FLUTTER BOARD

Figure 2-1. Lifesaving Equipment

CHAPTER 3

TYPES OF POOLS

3-1. GENERAL.

The location, terrain, climate, source of water, and intended use determine the type of pool constructed.

3-2. FILL-AND-DRAW AND FLOW-THROUGH POOLS.

Fill-and-draw and flow-through pools which do not filter and recirculate the water are not approved for use at military installations.

3-3. RECIRCULATING POOLS.

a. Recirculating pools are pools in which the water is constantly pumped from the pool, filtered, disinfected, and pumped back into the pool. Water is added as needed to make up for losses due to evaporation, leakage, and water discharged to waste through overflow troughs. This is the most sanitary and economical type of pool and is the type approved for use at military installations. (See figures 3-1 and 3-2.)

b. The basic differences in recirculating pools, other than sizes and shapes, are in the perimeter overflow systems. The primary purpose of a pool overflow system is to provide a continuous skimming of the water surface. Overflow occurs as filtered water is added and as water is displaced by swimmers. This displaced water, containing much of the debris and other wastes, is usually returned through gutter drains to the filters; however, in some pools, the water is wasted. In some pools all the water recirculated through the filters is taken from the overflow system. In other pools, some or all of the recirculated water is taken from the main drain at the bottom of the pool. Pool overflow systems can be separated into the following three general categories:

3-4. TROUGH OR GUTTER TYPE.

Continuous gutters or troughs are constructed around the inside walls of the pool, either fully or partially recessed, or at the top of the wall in an open position (often called roll-out type gutters). (See figure 3-3.).

3-5. RIM FLOW TYPE.

This type of perimeter overflow system maintains the water at the level of the surrounding deck. No overflow troughs are used. Trenches are constructed in the deck surrounding the pool and adjacent to the pool wall. The trenches are covered with metal gratings or tile with drain openings. The deck and the pool edge are sloped toward the perimeter drains. The deck can be easily cleaned, but care should be taken that any cleaning detergents used do not cause problems such as foaming in the recirculation system. (See figure 3-3.).

3-6. SURFACE SKIMMERS.

Surface skimmers are slots constructed in the wall of the pool at regular intervals of 15 to 25 feet. Within each wall opening there are floating weirs that control the water overflow. Surface skimmers allow about 6 inches between the water level and the deck level. Each overflow weir usually discharges into a cylindrical opening that has an access cover at the deck level and a pipe at the bottom to drain the pool overflow to the recirculation system. A removable leaf-strainer basket fits in the bottom of this overflow receiver. (See figure 3-3.) .

3-7. WADING POOLS.

A wading pool is a shallow pool (usually 6 to 24 inches in depth) intended for use by children. Health hazards due to contamination are much greater in children's pools than in adult pools because of the unavoidable habits of small children. Because the quantity of water is small and a considerable amount of debris is often carried into the pool, wading pools require frequent draining and cleaning. Wading pools should have a continuous flow of treated water providing a complete change of water every two hours.

3-8. TYPES OF WADING POOLS.

Wading pools, like regular swimming pools, can be classified as flow-through, fill-and-draw, or recirculation type. The newest and most sanitary type of children's pool is the spray pool. Fresh or treated water is sprayed through a nearly vertical nozzle atop a 3 to 5 foot high pipe positioned near the center of the pool. By regulating the water pressure, all the sprayed water falls into the pool. A drain at the low point of the pool continuously discharges water to waste; therefore, no water accumulates in the wading pools. The conversion of wading pools to spray pools, which is comparatively easy, is highly recommended. (See figure 3-4.)

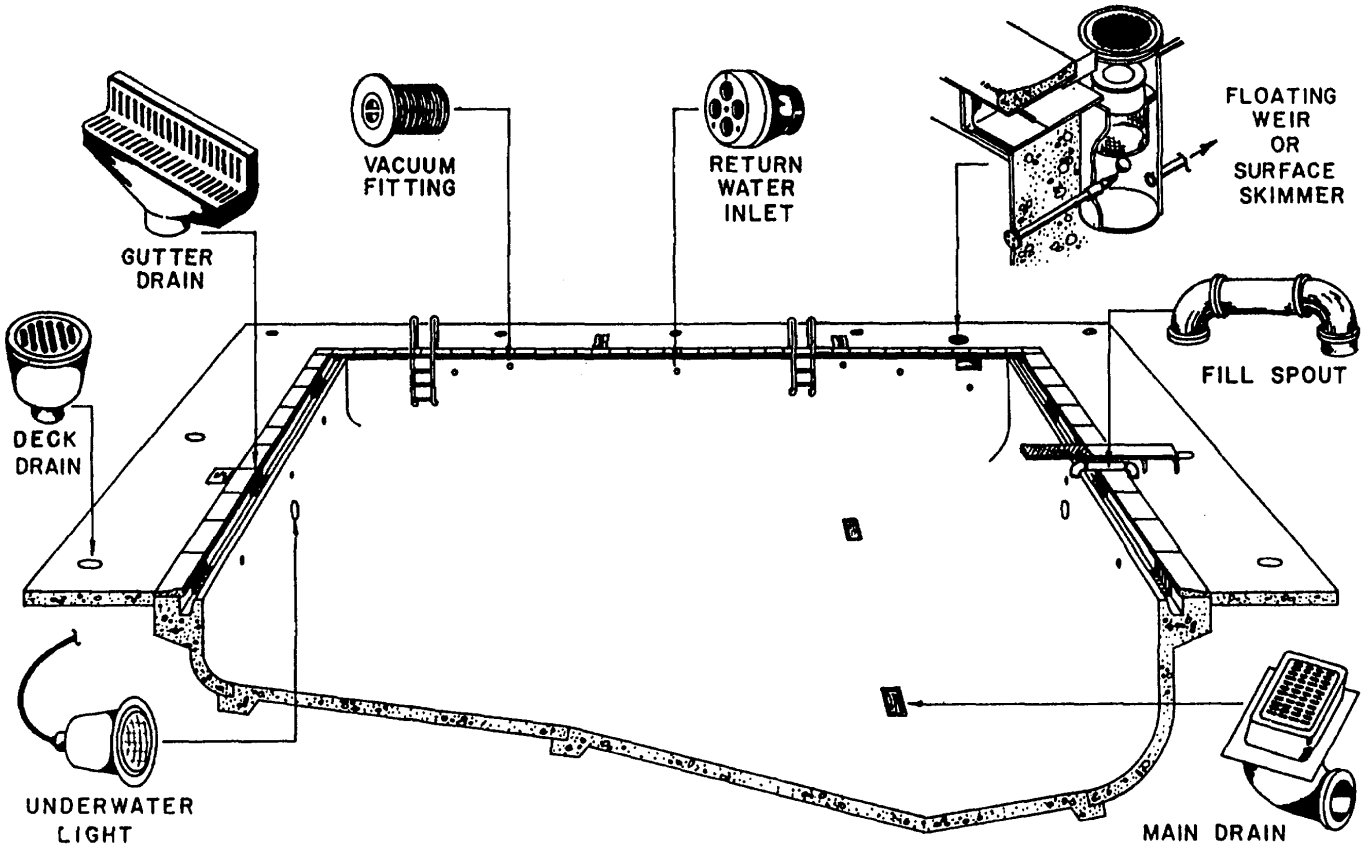


Figure 3-1. Longitudinal section through pool, showing fittings.

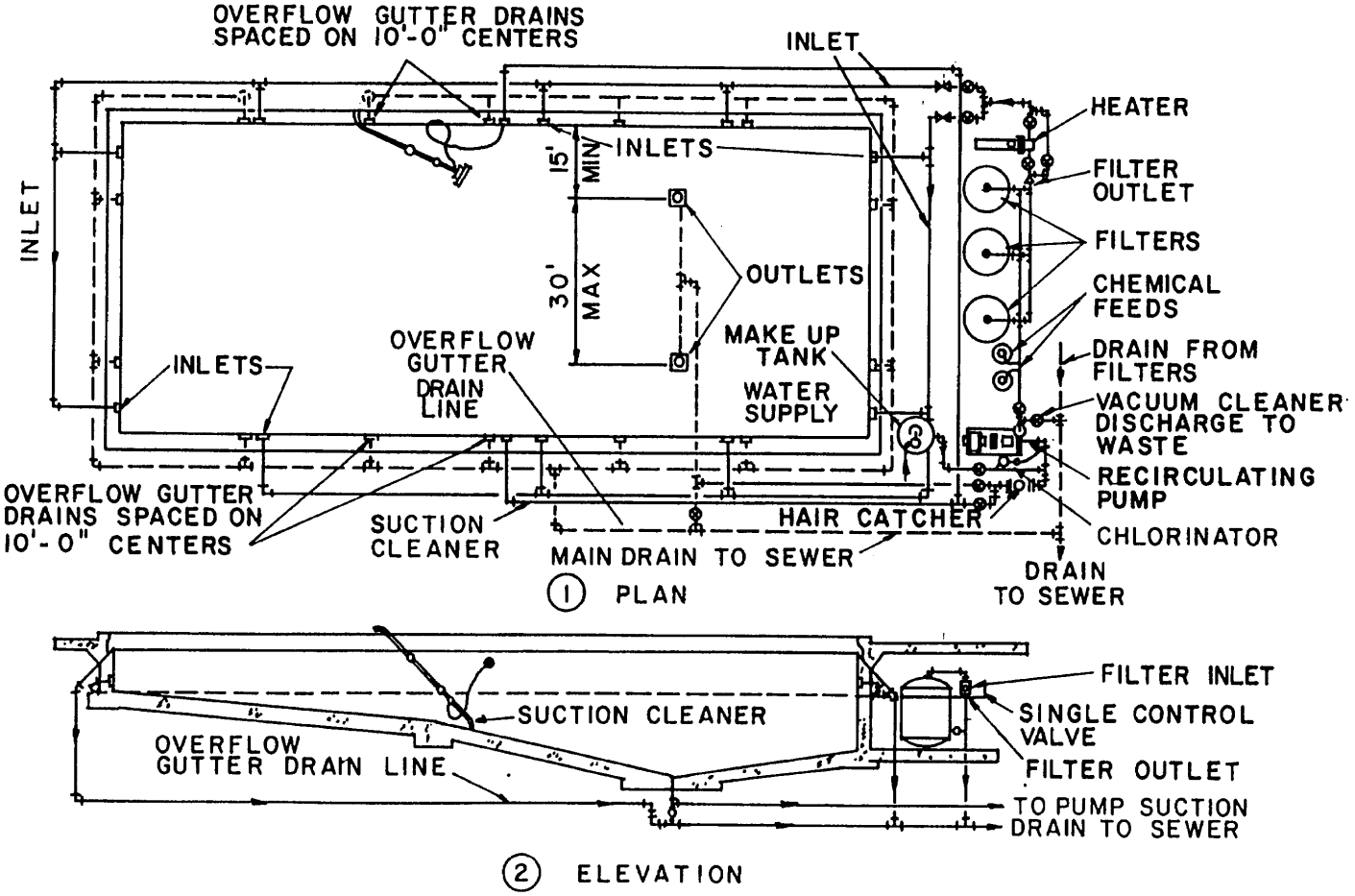


Figure 3-2. Typical recirculation pool and equipment.

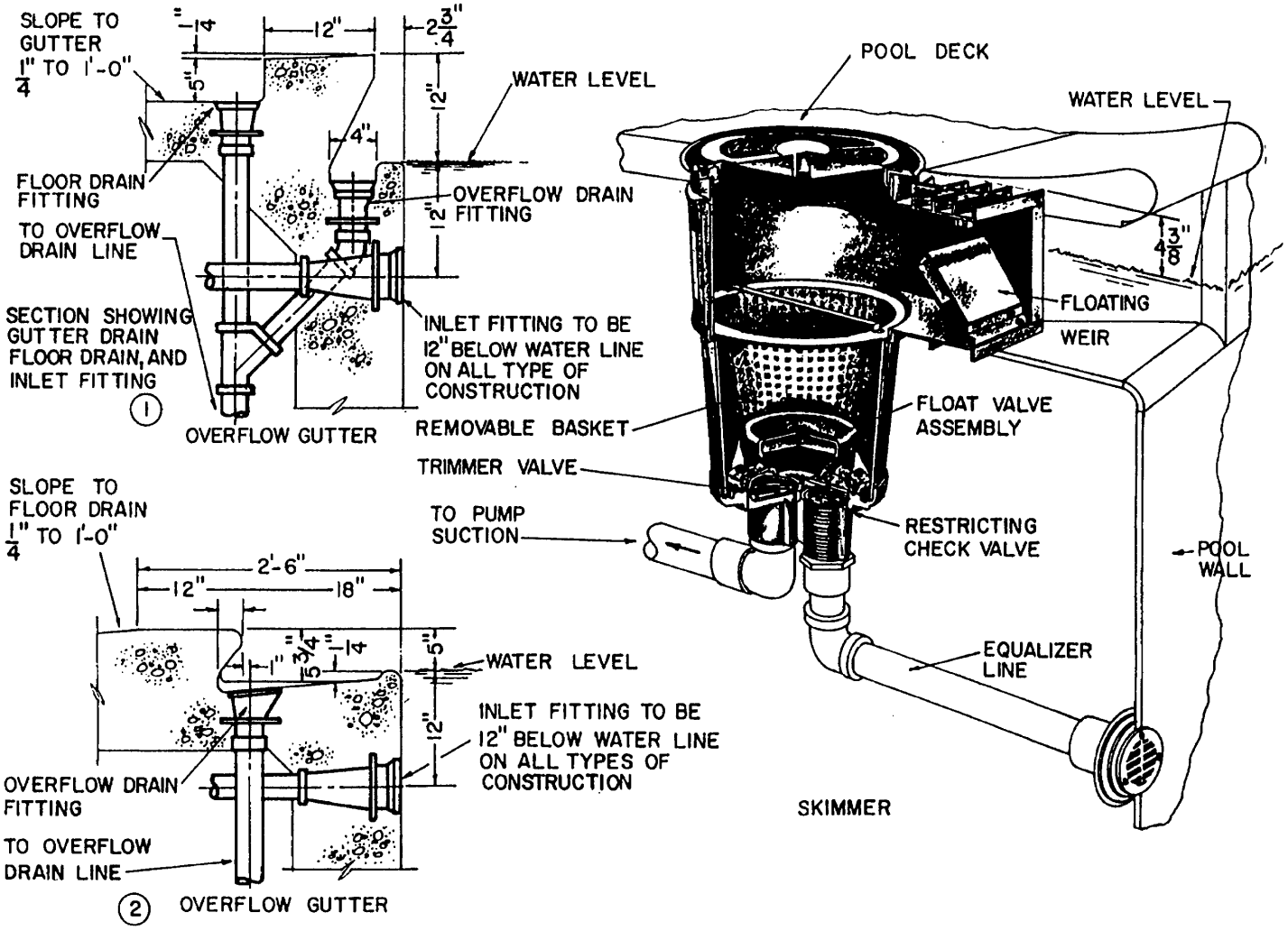


Figure 3-3. Overflow and skimmer.

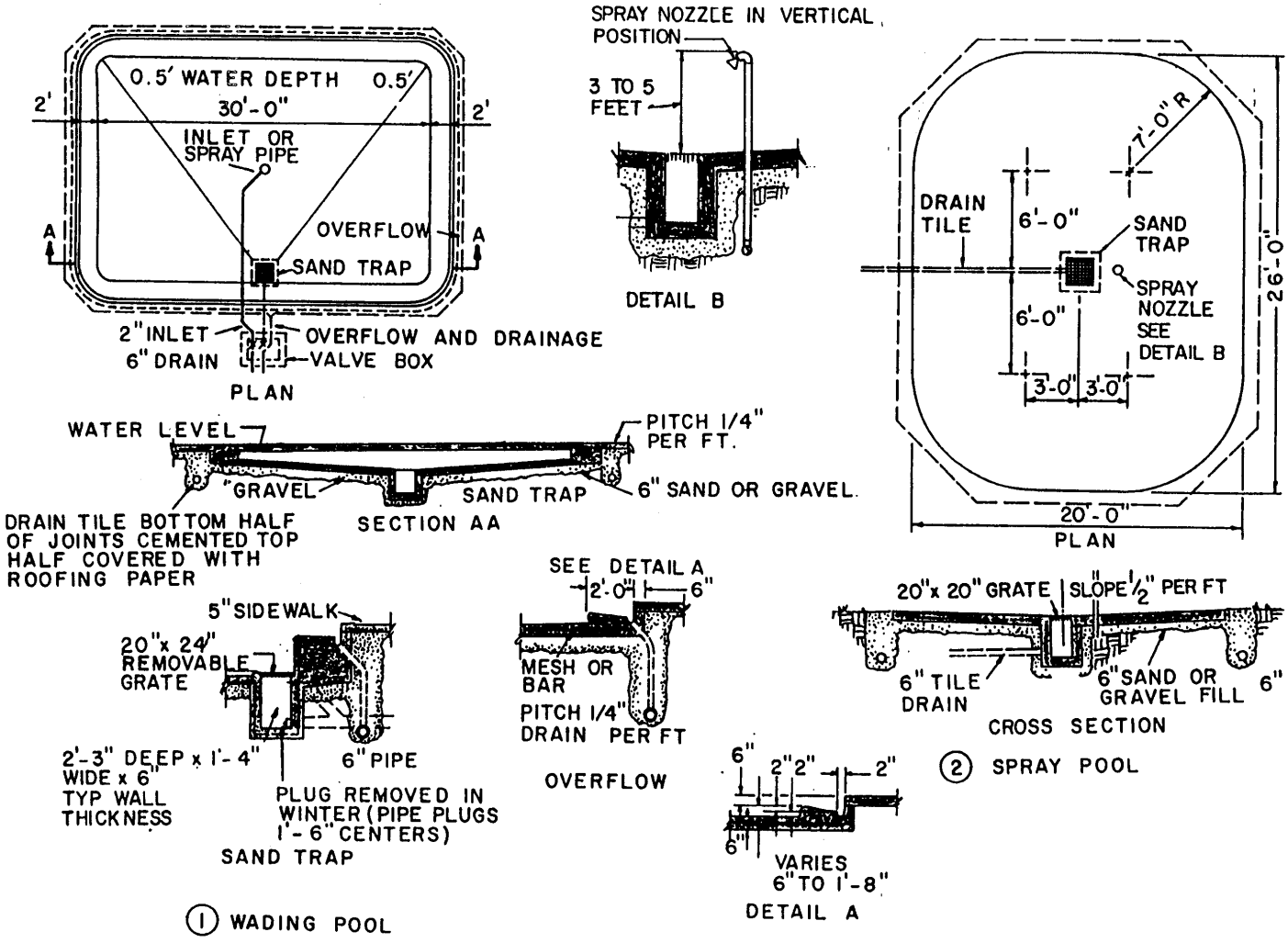


Figure 3-4. Typical children's pools

CHAPTER 4

STANDARDS

4-1. PERSONNEL.

Personnel hired to perform the various types of pool maintenance, operation, and lifeguard duties must have evidence of proper training or qualifications.

4-2. QUALITY OF SWIMMING POOL WATER.

Disinfection of swimming pool water is achieved by maintaining a bactericidal concentration of chlorine distributed uniformly throughout the pool. Methods of applying disinfectants and tests for determining residual concentrations are outlined in TB MED 575 and TM 5-660. Chlorine residuals and corresponding pH values for optimum bactericidal action and minimum eye irritations are given in Appendix B. Laboratory examinations for determining total bacteria count and numbers of the coliform group are as outlined in "Standard Methods for Examination of Water and Wastewater," latest edition. Not more than 15 percent of the samples examined during any 30-day period may contain more than 200 MPN bacteria per milliliter (ml) or not more than 15 percent of the samples may show positive (confirmed) test for coliform organisms in any of the five 10 ml portions comprising each sample. When the membrane filter procedure is used, not more than 15 percent of the membrane filters may show more than 1.0 coliform organism per 50 ml.

4-3. WORK SCHEDULE.

Work schedules are established contingent on the number of pool users and operation and maintenance duties.

4-4. HOUSEKEEPING.

High maintenance standards will insure the safe and economical operation of an entire pool area. The first step in maintaining a clean pool is to prevent foreign matter from entering the pool. Floating debris is easily disposed of by keeping water levels high enough to maintain a constant overflow into the troughs and weirs. Allowing the water level to drop prevents proper disposal of floating debris and also causes a scum ring to form around the pool. Sediment and debris deposits on the bottom of the pool should be removed daily with suction equipment and discharged to waste.

Normally, it is not necessary to empty a properly operated recirculating pool for cleaning.

4-5. SANITATION.

Sand, grass, leaves, dust, and other foreign matter may be tracked into the pool by bathers or blown in by the wind. To minimize this, direct access to the pool area should be prevented by routine bathers through foot sprays or showers. Also persons wearing shoes should not be allowed on the pool deck. Pool walkways and decks must be kept thoroughly clean to maintain sanitation and prevent accidents. Cracks and low spots in the pool deck should be promptly repaired.

CHAPTER 5

PRINCIPLES OF POOL OPERATION

5-1. PATRON SANITATION.

Pool sanitation begins with bather supervision and discipline. For the most part, the rules governing good conduct and cleanliness are fairly uniform as published in various pool operations publications and as posted on walls and fences of public pools throughout the United States. Unfortunately, however, the seriousness of enforcing the rules is not stressed. Not until the pool operator understands the public health involvement can he/she fully appreciate the importance of enforcing every rule without exception.

5-2. BODILY INFECTION.

An obviously healthy patron wearing a small bandage may appear entirely harmless to an untrained bathhouse attendant. However, the bandage may be covering a common pimple or sore, that has festered with staphylcoccus bacteria. Although the highly localized infection presents no serious problem for the person afflicted, it does pose a significant health hazard if these same bacteria are washed from the infection and conveyed to other bathers.

5-3. SHOWERING AND EATING.

Much more difficult to relate to public health are the rules that require nude showers with warm water and soap and that prevent food, drink, or tobacco in the pool area. Permitting patrons to enter the pool unbathed can impair the efficiency of the disinfection system by as much as 50 percent. As indicated in discussions which follow, organic soil (usually harmless in itself) imposes a serious burden upon the chemical disinfectants and filtration system if allowed to accumulate in the pool.

5-4. WATER TREATMENT TECHNIQUES.

a. Since the contamination of swimming pool water to some extent is inevitable, water treatment techniques must be established to make the water safe for bathers. Such treatment is accomplished by the operation of three interrelated and interacting systems:

(1) A system for the recirculation and distribution of pool water.

(2) A system for feeding chemicals for disinfection and control of pH.

(3) A system for the removal of particles by filtration.

b. In this chapter these systems are discussed together to emphasize the manner in which they work together to accomplish the ultimate goal of safe, clear pool water. In subsequent chapters they are discussed individually to provide the reader with detailed knowledge of how each system performs.

5-5. RECIRCULATION.

a. The function of the swimming pool recirculation system is probably best described as a type of transportation system. Water is transferred from the pool, delivered to a station where it is filtered and chemically treated, and then returned to the pool. The round trip the water takes is described by the term "turnover." Turnover is expressed as the number of hours necessary to circulate a volume of water equal to the volume contained in the pool. Another method of expression is the number of times in 24 hours that the volume of the pool is circulated; i.e., turnover in 8 hours is a turnover of three.

b. Both in theory and practice, it has been determined that the typical public pool should be recirculated continuously at a rate equal to one turnover in each 6to 8-hour period. The Law of Dilution as developed by Gage and Bidwell suggests that such a turnover rate will provide 95 percent to 98 percent dilution of soiled pool water with water that has been filtered and chemically treated. Gage and Bidwell's law has been largely upheld in practice, and the 6to 8-hour turnover rate has generally become a standard for the operation of public pools.

5-6. FILTRATION.

Filtration is of some value for its capacity to remove bacteria and disease producing organisms. However, its primary function is to remove soil particles which, if not removed, would increase the need for chemical treatment and reduce the germ killing and oxidizing power of disinfection chemicals.

5-7. DISINFECTION.

a. The disinfection function is a complicated process involving rather intricate chemistry. Ideally, disinfection is accomplished by introducing a germ-killing chemical to pool water in sufficient strength to rapidly destroy bacteria. Chlorine, one of a group of chemicals referred to as "halogens," is the disinfecting agent most commonly used in public pools and is therefore used as a term of reference henceforth in this manual.