

LOS ANGELES COUNTY - DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENT HEALTH
RECREATIONAL WATERS PROGRAM

**SWIMMING POOL SERVICE TECHNICIAN'S APPRENTICE
STUDY GUIDE**

DISINFECTION

Swimmers bring into a pool every kind of contaminate existing on and in their bodies. Some common contaminates are urine, feces, sputum, bacteria, viruses, fungus, and other organisms, cosmetics and toiletries. Sometimes contaminates in pool water can cause illness in susceptible people. Diseases such as Hepatitis A, Norwalk Virus, and a variety of skin infections can be transmitted through pool water. Also, parasites such as Giardia and Cryptosporidium can be easily transmitted through pool water. Disinfection destroys many of these contaminates and helps keep the pool safe for swimmers. The most common disinfectant added to swimming pools is chlorine. Chlorine for pools can be used as a solid, liquid or gas. Chlorine is an active disinfectant when it is available as free chlorine in the pool water. Free chlorine combines with contaminates to form chloramines or combined chlorine. Combined chlorine is a weak disinfectant but has a strong chlorine odor and can irritate eyes. Therefore it is desirable to have as little combined chlorine in the pool as possible. The California Code of Regulations, Title 22 requires maintaining the maximum combined chlorine concentrations at 0.4 ppm or less in a public swimming pool. When the combined chlorine level becomes too high, the pool should be super-chlorinated (shocked). In general, shocking to reach breakpoint is achieved by adding to the pool water an amount of free chlorine equal to 10 times the combined chlorine level present in the pool. The combined chlorine is destroyed (breakpoint) leaving essentially free chlorine in the pool. Pools that have been super-chlorinated should be allowed to return to normal chlorine levels before being used. Title 22 requires that the free- chlorine residual in a public swimming pool be kept at 1.0 ppm to 10.0 ppm in pools not using stabilizer, and 2.0 ppm to 10.0 ppm in pools using stabilizer.

Sunlight can cause chlorine in pool water to disintegrate rapidly. Often a stabilizer called cyanuric acid is added to prevent disintegration of the chlorine disinfectant. Stabilizer is slightly acidic and very slow to dissolve. Cyanuric acid attaches to the chlorine and holds it in reserve until it is needed for disinfection. Frequent use of stabilized chlorine can lead to excessive levels of stabilizer. High levels of stabilizer can cause increased algae growth which can lead to cloudiness in the pool. High levels of stabilizer can also interfere with disinfection properties of chlorine. Title 22 requires that stabilizer be kept below 100 ppm at all times in public pools. The level of stabilizer in a pool should be ideally maintained between 40 - 60 ppm. The only way to reduce the level of stabilizer is to partially drain the pool and refill with clean water.

All public pools are required to have an automatic disinfection device. Most pools utilize an automatic chlorinator as the disinfection device. Automatic chlorinators are mechanical devices used to dispense a small amount of chlorine into the recirculation system over a period of time. This is usually accomplished by pumping from a reservoir or through an erosion type feeder. It is important to remember that floating type chlorinators are not permitted in public pools. Also, placing chlorine tablets in skimmers is not allowed at public pools.

COMMON FORMS OF CHLORINE AVAILABLE FOR USE IN SWIMMING POOLS

<u>TYPE</u>	<u>% CHLORINE</u>	<u>pH</u>
liquid chlorine (sodium hypochlorite)	10%	raises
Trichlor	90%	lowers
Dichlor	65%	lowers
lithium hypochlorite	35%	raises
gas chlorine	100%	lowers

Another type of disinfectant that can be used in swimming pools is bromine. Bromine is a more effective disinfectant compared to chlorine but it is also more expensive. Bromine is dispensed from a device called a brominator. Title 22 requires bromine levels should be kept at a minimum of 2.0 ppm in public swimming pools and 4.0 ppm in public spas, wading pools and spray grounds.

Title 22 requires daily testing for the level of disinfectant in public pool water. There are many types of test kits available on the market, but only DPD test kits or a test kit that is capable of testing free-halogen residual may be used in public pools.

It is important to carefully follow the manufacturer's directions supplied with the kit. The pool water sample should be taken between 12 to 18 inches below the surface of the water. After testing, don't return the test sample back into the pool. To calculate the combined chlorine, subtract the free chlorine reading from the total chlorine reading. For example, if a pool had 3.0 ppm of total chlorine and 2.0 ppm free chlorine, the amount of combined chlorine would be 1.0 ppm.

WATER BALANCE

Water balance is the relationship of pool chemicals in the water. The ideal pool water provides a comfortable environment for the swimmer while resisting the growth of pathogens, algae and other organisms. The components of water balance are temperature, pH, total alkalinity, total hardness, and total dissolved solids (TDS). The pH scale means "the potential for hydrogen", and is a measurement of acidity or alkalinity in any substance. PH is measured on a scale numbered from 0 to 14. As the pH of swimming pool water is lowered from 7 to 0, the more acidic it becomes. As the pH is raised from 7 to 14, the more alkaline it becomes. At pH 7 swimming pool water is neutral, neither acidic nor alkaline (basic). Title 22 requires that the pH in a public pool be kept between 7.2 and 7.8. Chlorine disinfects more efficiently at this range of pH. For optimum disinfection, the pH of pool water should be kept between 7.4 and 7.6. The acidity and alkalinity of swimming pool water can also affect the growth of algae and other organisms. Chemicals may be used to adjust the pH of pool water when it becomes too acidic or alkaline. Soda ash (sodium carbonate) is used to raise the pH of pool water. It comes in a powdered form and is broadcast into the pool. Caustic soda (sodium hydroxide) is a highly corrosive liquid which is often used to raise the pH in larger pools. This chemical is pumped into the recirculation system at a controlled rate. Baking soda (sodium bicarbonate) can be used to raise the total alkalinity without significantly changing the pH. Total alkalinity is a measure of all alkaline substances in the pool water. Total alkalinity should be maintained between 80 and 150 ppm.

Muriatic acid (hydrochloric acid) and dry acid (sodium bisulfate) are used to lower the pH of pool water. No more than one half quart of liquid acid per 10,000 gallons should be added at one time to a pool. One hour should be allowed between half quart doses. Acid should be poured into the deep end of the pool and not into the skimmer or shallow end. Excessive acid in a pool can cause blue staining by leaching copper from the recirculation piping and heat exchanger. When pool water has been in an acidic state for an extended period of time, the water should be checked for copper levels over 0.2 ppm before adjusting the pH as blue staining from the formation of copper carbonate can occur. The only solution to lower high copper levels is to drain or partially drain the pool and refill with clean water.

The saturation index of pool water indicates the pool water's scaling or etching properties. The factors used to calculate saturation index are pH, water temperature, alkalinity, and calcium hardness. These factors are totaled and the total dissolved solids (TDS) value is subtracted to obtain the final result. A saturation index of 0 indicates the water is balanced. A negative number greater than -0.5 indicates the water can be corrosive to metals in the pool and etch the pool plaster. A number greater than +0.5 indicates the water can form calcium deposits which clog recirculation pipes and filter grids, and can stain pool plaster.

The calcium hardness level in pool water should be kept between 175 and 300 ppm. If the calcium hardness is high, the pool should be partially drained and refilled with clean water to reduce the level.

It is important to closely follow the manufacturer's label on each chemical. Misuse of chemicals can injure the operator and swimmers. Mixing together some pool chemicals can cause dangerous gases to form, explosion, or fire. Mixing Trichlor with calcium hypochlorite or lithium hypochlorite will likely cause a violent explosion. As a rule, it is safer to add chemicals to water than to add water to chemicals.

FILTERS

A swimming pool filter removes organisms, hair, skin, and other particles from the water. The following filters are presented in order of effectiveness. The requirements for all types of filters can be found in Title 24 of the California Code of Regulations.

DIATOMACEOUS EARTH (DE) - This filter consists of a plastic frame covered with a cloth element. Diatomaceous earth is a white powder which is added to coat these cloth elements. This substance filters the pool water, not the cloth elements. A DE filter should never be run without diatomaceous earth. The usual amount of earth added to DE filters is about one half pound per 5 square feet of filter area. A one pound coffee can filled with DE is equal to approximately one half pound of DE. Filter size is measured in square feet (sq. ft.) of filter area. When the pressure gauge reading indicates that the pressure has increased approximately 10 pounds per square inch over the starting pressure, it is time to backwash the filter. This is accomplished by reversing the flow of water through the filter with a series of valves or a multiport valve, and flushing the DE along with accumulated dirt to a waste container. A sight glass is used to observe the backwash water. When the water is clear the backwashing is complete. Backwash water shall never be returned to the pool. From time to time, the filters should be disassembled for a more thorough cleaning. Oils and grease can be removed from filter elements with a non-foaming type detergent. Scale can be removed by a weak dilution of acid. When diluting acid, you should always add the acid to the water. DE filters are sized at 2 gallons per minute per square foot. This means that a 60 sq. ft. filter can have a maximum of 120 gallons per minute flowing through it. A slightly oversized filter will give you a longer filter run between backwashes.

RAPID SAND AND HIGH RATE SAND - These types of filters use varying grades of sand for filtering. As water passes through the layers of sand, contaminants are removed. Most of the filtration occurs on the surface of the sand. Like DE filters, water is flushed backwards through the sand filter to a waste container. Backwash water shall never be returned to the pool. Rapid sand filters are used on large municipal pools and are much larger than high rate sand filters. The flow through high rate sand filters is much faster than rapid sand filters and consequently these filters are much smaller in size.

CARTRIDGE - Cartridge filters are made of a pleated cloth element. Dirt is trapped on the elements as the water is forced through the filter. When dirty, cartridge filters are taken out of the filter holder and hosed down, scrubbed and disinfected in a chlorine solution. They should be allowed to completely dry before being put back into service. Title 24 of the California Code of Regulations requires that "an additional set of filter elements shall be available for installation while the existing filter elements are cleaned." Cartridge filters are sized at 0.375 gallons per minute per square foot.

RECIRCULATION

The recirculation system of a pool consists of several mechanisms. Pool water, dirt and other debris is removed from the pool through the main drain and skimmer(s). Pool water is drawn to a pump which forces the water through a filter and returns the cleaned water back to the pool through the return lines. The amount of water being filtered is expressed in gallons per minute (gpm). The length of time required to filter a volume of water equivalent to the volume of water in the pool is called the turnover time. The minimum required turnover time for a public pool is 6 hours. Public spas shall have a minimum turnover time of one half hour. Public wading pools shall have a minimum turnover time of 1 hour. To calculate the gallons per minute required for a 36,000 gallon swimming pool, divide the total volume of the pool by the minimum required turnover time multiplied by 60 minutes ($36,000 / 60 \times 6$). In this example, the recirculation system must run at 100 gpm to filter the entire 36,000 gallons of water in 6 hours. Title 22 requires that pumps, filters, and all related parts of a

public pool recirculation system shall operate whenever the pool or spa is available for use and as long as necessary to maintain the water in a clean and clear condition. Pools shall never be used if the water becomes so cloudy that the bottom of the pool at the maximum depth is not clearly visible from the deck. A public pool shall be closed by the Health Department when the bottom of the pool at all depths is not clearly visible.

MAINTENANCE

The Los Angeles County Code, Title 11 requires that public and private pools in Los Angeles County shall be serviced by a certified Swimming Pool Service Technician or Technician's Apprentice.

The applicant should be familiar with all of the requirements regarding pool maintenance in The Los Angeles County Code, Title 11 and The California Code of Regulations, Title 22 and Title 24.

DISCLAIMER

This study guide comprises a general outline of public swimming pool function, equipment and maintenance but does not supersede the requirements of law. The most current Federal and State Laws and the County Codes, are the authority regarding construction and maintenance of public swimming pools.