2025 Pool Operator Training Manual

Presented by:

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Pool Operator Training Certificate and Public Bathing Place Licenses (State and City) must be posted on-site, along with copies of inspection reports and operation records.

State License – A current valid **Public Bathing Place license issued by the Oklahoma State Department of Health** is required for each Public Bathing Place (pool, spa, wading pool, water attraction, etc.). As of July 5, 2023 the state license fees are as follows:

- New Owner- $125
- Renewal-$75
- >30 Days Late-$112.50
- >90 Days Late-$125

Contact 271-5243 for more information.

Oklahoma City/County Licenses – **Oklahoma City** and **Edmond** require current licenses issued by the Oklahoma City-County Health Department. These are $50 per year per Public Bathing Place. They expire on June 30 of each year. For questions please contact the OKC-County Health Department, pools@occhd.org; or check out occhd.org/pools.

PLEASE RETURN A COPY OF THE INVOICE WITH PAYMENT

Each facility/address must be overseen by a properly trained/certified operator. Pool/Spa Operator Certificates issued by the OKC-County Health Department are valid for 3 years. A person can only be the certified operator for **ONE** facility/address.
Operator responsibilities include:

- Maintaining Water Quality
- Keeping Accurate/Complete Records
- General Operation of Facility
- Maintaining Facility and Equipment
- Enforcing Rules
- Closing Facility When Required
- Notifying the Department of Reportable Incidents and Changes in Equipment
- **IMMEDIATE CLOSURE** IS REQUIRED IF:
  The **chlorine/bromine** OR **pH are out of range**
  The **main drain is not clearly visible from all parts of the deck** (TURBIDITY)
  The **main drain cover is broken, missing or does not have all the screws**

*Any alteration to the facility, including replacement of the filter, pool structure or piping will need prior approval from the Health Department.

RECORDS

Records must be completed daily, and kept on file for at least 3 years, longer if there is any pending legal action against the facility. These operation records and incident reports are legal documents that will be subpoenaed in the event of any legal action. Having missing/incomplete records will only hurt your case. Make sure all reports have correct dates/times, and have been reviewed and signed off by the certified operator. In the event of an incident or accident that occurs at the pool, be sure to fill out the attached incident report (or similar, if your organization chooses to use its own version) and keep on file for 3-5 years. If possible, interview anyone involved, or any to witness the event, to create as complete and accurate an account of the incident as possible. The incident may have occurred in your absence, so you want to get as much information as possible in case you are called upon to testify or give an account of actions taken during and since the incident. Pool owners can be held liable for accidents or injuries, as can operators, in cases of gross negligence.

BATHING PLACE OPERATION RECORD

Week of:_____

1. Facility Name / Tank Designation

2. Gallons in tank	Required Flow Minimum			gpm	Maximum Allowed		gpm
3. Bathing Load Maximum							
	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
4. Safety Equipment Checked / Observed							
5. Tank Cleaned/Vacuumed/Baskets emptied							
6. Decks Disinfected / Bathhouse Cleaned							
7. Number of Patrons (daily)							
8. Number of Accidents (daily)							
9. Number of Lifeguards/Attendants (daily)							
10. Pool Hours (Open / Closed)	/	/	/	/	/	/	/
FILTER TYPE:_____Size: _____sq. ft.							
11. Backwashed (min./gal.)/Cleaned							
12. Gauge Readings (influent / effluent)	/	/	/	/	/	/	/
13. Gallons Makeup Water Added							
14. Strainer Gauge Reading							
15. Flowmeter Reading (gpm) / temp (F)	/	/	/	/	/	/	/
CHEMICALS ADDED - Amount (16-22)		Brand/Model Feeder			Sanitizer Type		
16. Chlorine _____ Bromine_____							
17. Soda Ash (pounds, ounces)							
18. Muriatic Acid (ounces, quarts, gallons)							
19. Sodium Bicarbonate (pounds, ounces)							
20. Calcium Chloride (pounds, ounces)							
21. Cyanuric Acid Stabilizer (pounds, ounces)							
22. Other - Specify kind and amount							
REQUIRED TESTS - DAILY	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
23. Combined Chlorine (ppm)							
24. Cyanuric Acid Stabilizer (ppm)							
Enter: time/ sanitizer reading/ pH	T S pH	T S pH	T S pH	T S pH	T S pH	T S pH	T S pH
25. First Test Series	/ /	/ /	/ /	/ /	/ /	/ /	/ /
26. Second Test Series	/ /	/ /	/ /	/ /	/ /	/ /	/ /
27. Third Test Series	/ /	/ /	/ /	/ /	/ /	/ /	/ /
28. Fourth Test Series	/ /	/ /	/ /	/ /	/ /	/ /	/ /
Enter:time/ turbidity/ drain cover on	T Tu DC	T Tu DC	T Tu DC	T Tu DC	T Tu DC	T Tu DC	T Tu DC
29. First Observation Series	/ /	/ /	/ /	/ /	/ /	/ /	/ /
31. Second Observation Series	/ /	/ /	/ /	/ /	/ /	/ /	/ /
32. Third Observation Series	/ /	/ /	/ /	/ /	/ /	/ /	/ /
33. Fourth Observation Series	/ /	/ /	/ /	/ /	/ /	/ /	/ /
REQUIRED TESTS - WEEKLY (minimum - recommended daily)							
34. Total Alkalinity			37. Copper				
35. Calcium Hardness			38. Iron				
36. Water Blance pH			39. Total Dissolved Solids				
40. Comments							

41. Certified Operator In Charge	Operator Number
42. Pool Manager/Owner	Operator Number
Signed: **Must be CPO**	Date:

RETAIN COPY THREE YEARS **OKLAHOMA CITY-COUNTY HEALTH DEPARTMENT 425-4393 occhd.org/pools**

INSTRUCTIONS FOR FILLING OUT A PBP RECORD FORM

This form is filled out <u>daily</u> for <u>each</u> tank.

Keep one blank form. Make a form for each tank to make copies from after filling in the information that does not change. Keep a copy on hand and one in the file for three years. If closed put "closed" under that day in sections 7/8/9 and record tests and maintenance done (4/day not required if closed).

BOLD ITEMS ARE CRITICAL VIOLATIONS – CLOSE OR CORRECT IMMEDIATELY
YOU MUST HAVE PERMISSION TO CHANGE FILTERS, FEEDERS and/or SANITIZERS

Line 1: Facility Name/Tank Designation – facility name and which tank it is
Example: conan's Health Club – Men's Spa
Line 2: Gallons in tank / minimum flow (posted); maximum flow (for filter, main drain)
Line 3: Maximum bathing load – posted at tank (see formula)
Line 4: Safety equipment checked – ie, repair – rope/hook/lifeline attached, etc.
Presence is checked when tests are taken – 4 X / day
Line 5: Tank cleaned and vacuumed, baskets emptied
Line 6: Deck cleaned and disinfected & bathhouse cleaned (if any).
Line 7: Total number of persons using the tank that day – estimate if necessary
Line 8: Number of accidents. For accidents involving serious injury, death, or drowning call the health department ASAP and send a written report within 7 days.
Line 9: Number of certified lifeguards on duty. (1, 4-10, etc.) (NA if not req.)
Line 10: Time tank is opened and closed for use. Example 10a/8p (Set by facility)
Filter Type/Size – Type: Sand, DE, Cart; Size: total square feet of filter area (from tank plate)
Line 11: Filter backwashed/cleaned – minutes backwashed / total gallons discharged
Line 12: Influent/effluent gauge readings (prior to backwash)
Line 13: Gallons of make-up water added (daily/after backwash)
Line 14: Strainer (compound) gauge reading (before cleaning)
Line 15:Flowmeter reading and temperature of water if tank heated
CHEMICAL ADDED: Amount-Lines 16-22; Brand Feeder / Kind of Sanitizer in use
Line 16: Check kind and fill out amount in boxes – estimate lbs., oz., etc.
Line 17-22: Amount of chemical added to the tank – estimate lbs., oz., etc.
REQUIRED TESTS – DAILY
Line 23: Combined chlorine: treat if CC above 0.2ppm – breakpoint, superchlorinate
Line 24: Cyanuric Acid (Stabilizer) ppm: drain/dilute (backwash) if over 50ppm
Line 25-28: Take tests 4 times per day & enter readings under appropriate heading
T=Time, S=Sanitizer in ppm, pH= pH reading
Line 29-32: Make observations 4 times per day & enter readings under appropriate headings
Tu=Turbidity (S-can see main drain clearly from all parts of deck; U-cannot clearly see drain)
DC = Main drain cover on and secured (Y/N)
REQUIRED TESTS – WEEKLY
Line 33-35: Test for TA, CH and record Water Balance pH weekly or as needed
Line 36-37: Spas only. Drain or treat if>0.2ppm/0.3ppm. Treatment may cause staining.
Line 38: TDS. Spas: weekly. Pools: In – every three months; Out - begin/end of season.
Line 39: Comments – Additional tests or information recorded here.
Line 40:CPOIC – Certified Operator In Charge name and CPO number.
Line 41: Name of manager/owner in charge and number if acting as CPO
Line 42:Signature of persons on Line 38 or 39. Date of signature.
Record other CPO name(s) and number(s) below.

OKC-County Health Department

Oklahoma City-County Health Department
Consumer Protection
2401 NW 23rd ST, Ste 70
OKC, OK 73107
Telephone: (405) 425-4393
Email: pools@occhd.org

PUBLIC BATHING PLACE - INCIDENT REPORT FORM

Please check the type of incident (mark all that apply): ☐ **Injury** ☐ **Contamination**

Fatal/Non-Fatal Drowning, Injury, Entrapment, Illness, Contamination, Chemical, Etc. This report should be filled out as soon as possible after the event. Notify your local health department and send them a copy of this report, along with operator report forms from the two previous weeks.

INJURY INCIDENT

Injury Type: ☐ Drowning Resulting in Death ☐ Recovered Drowning ☐ Hospitalization ☐ Other:_____

Name of Person Injured:_____ Age:_____

Was the Injured Person a: ☐ Bather ☐ Observer

Parent/Guardian Name:_____

Contact Number:_____ &/or Email:_____

Address:_____

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Actions Taken (mark all that apply):

☐ Contacted 911 or other ER #:_____ Who Called:_____ Time of Call:_____

☐ CPR Performed; Who Performed:_____ Time Started:_____

☐ Time of Emergency Medical Services Arrival:_____ or ☐ Patient Refused Assistance

Attach a Brief Summary of Incident (person(s) on duty/location/other witnesses and contact information; type of injury/reasons injury may have resulted).

CONTAMINATION INCIDENT

Contamination Type (mark all that apply): ☐ Fecal-Solid ☐ Fecal-Watery ☐ Vomit ☐ Blood ☐ Other:_____

Area(s) Contaminated (mark all that apply): ☐ Water* ☐ Deck ☐ Bathhouse ☐ Other:_____

*If separate pump systems, list pool contaminated:_____

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Actions Taken (mark all that apply):

☐ Closed Facility: Time Closed:_____ Sanitizer levels at time of incident:_____

☐ Pool/Spa Treated: ☐ Chemical (type/amount):_____ ☐ Filter Cleaned

☐ Area Cleaned ☐ # of Complete Turnovers before Opening: #_____

☐ Measurements: pH:_____ CYA:_____ Temp:_____ Chlorine (ppm):_____

☐ Water Drained ☐ Facility Reopened: Time:_____ Date:_____

Attach a Brief Summary of Incident (person(s) on duty/location/other witnesses and contact information; etc.).

Certified Pool Operator Name:_____ Phone#: _____

CPO Signature: _____ Date: _____

Mail a copy of final report to local county health department within seven (7) days of incident.

WATER SOURCE & WASTEWATER DISPOSAL

- Water used to fill the pool must be potable water from an approved source, normally city water. If well water, must be tested annually to ensure against contamination. Requires either an air gap or an RPZ backflow prevention device before connecting to the pool.
- Wastewater disposal method must be approved, normally required to drain into a sanitary sewer. A point discharge or other method must have written approval from the Oklahoma Water Resource Board, ODEQ, and the local municipality.
- All hose bibs must have a backflow preventer.

SAFETY

According to the CDC the leading contributing factors in drownings include:
TURBIDITY- Water clarity. There have been cases of bathers drowning in busy pools and not being discovered for several days due to turbid water, despite the facility being in constant use during this time.
NO EFFECTIVE BARRIER- see requirements below.
NO ADULT SUPERVISION- being present does not guarantee adequate supervision. Should remain alert, and monitor children from a close distance, as recommended by CDC. **Children under 12** years must be accompanied by an adult (over 18 years). Lifeguards are not considered adequate adult supervision for minors.
In adults **alcohol** is often involved. Persons under the influence of alcohol or drugs must be excluded from the pool area (drugs and alcohol are prohibited at spas).

BARRIER

An approved **fence or barrier (building)** is required around all public bathing places. For apartments and hotels the fence must be 4' tall, for organizations and those open to the general public (YMCA, City) the fence must be 6' tall. **Gates and doors** must be self-closing, self-latching. Gates/doors to the pool area must be locked when the pool is closed, and a "Closed" sign posted at the entrance(s). No openings larger than a 4" sphere are allowed (from the outside). Barrier and nearby features must not form a ladder, or otherwise aid in climbing over the barrier.

INGRESS/EGRESS

Ladders must be maintained in good condition (Do Not Remove!). Stairs must be recessed, and have a 2" stripe of contrasting color on the edge of both the tread and riser (similar requirement for underwater benches and ledges). For questions regarding required ADA accessibility, contact the Justice Department. Any modifications to bring the facility into compliance with ADA requirements must be approved by the health department to ensure this will not violate state/city requirements. Underwater benches must have a barrier along them on the deck to discourage entry via the benches.

SAFETY EQUIPMENT

Minimum Safety Equipment for a pool is **1 hook, 2 ring buoys with heaving lines, phone, and first AID kit**. If the pool is more than 1600sf of water area, then minimum hook and ring buoy requirements are doubled. Facilities with lifeguards can substitute rescue tubes for up to half of the ring buoys required, but must still have a hook and 1 ring buoy at each guard station. An emergency phone must be made available during all hours of operation. Facilities with a break-point must also have a lifeline at the change-in-slope.

SIGNS

The following **signage** is required: Bathing Load; No Diving (where applicable); NO Lifeguard on Duty (if not guarded); 911 with Address of Facility posted near emergency phone; Pool Rules*; Pool Chemicals with appropriate diamond hazard sign (on door to storage area).

*RULES AND PRECAUTIONS FOR PATRONS

Rules for Pools. Rules governing the use of public bathing places shall be displayed on signs large enough for easy reading, which are posted at the entrance to the pool, dressing rooms or other appropriate places. Owners and operators are responsible for enforcing the Rules. Signs shall provide, in similar language that:

- A cleansing bath, using warm water and soap must be taken before entering the water.
- Persons with open wounds, bandages, or any symptom of a communicable disease shall be prevented from entering the water.
- Swimming alone is prohibited.
- At facilities, which do not have lifeguards on duty, children under 12 years of age must be accompanied by an adult responsible for the supervision of that child at the pool side.
- Running and rough play are prohibited in and around the water.
- Bathing load limit_____persons.
- "Cut-offs" should be hemmed.
- Excess body lotions should be removed prior to entering the water.
- "NO LIFEGUARD ON DUTY" where appropriate.
  (The following, are operator responsibilities recommended to be included on the signage.)
- *No glass containers or food allowed in the area. Put trash in waste containers.*
- *Do not enter water if the main drain cover is missing or not securely attached.*
- *NO swimming, diving, playing or snorkeling near the main drain.*
- *All persons who are under the influence of an intoxicating liquor or drug are excluded from the shower rooms and pool area.*
- *Persons that have had diarrhea in the past two weeks are prohibited in the water.*
- *Animals are not allowed inside the pool enclosure.*
- *Safety equipment is not to be used for play or tampered with.*

Additional Rules for Spas – Spas must have all of the above plus the following posted on a sign which provides, in similar language, that:

- Persons who are pregnant, taking medication, diabetic or have any history of cardiovascular disease should consult a physician before entering hot water.
- Drugs and alcohol are prohibited.

Additional Rules for Wading and Spray Pools – Add the following to the pool rules sign:

- Supervisor (parent or guardian) must be present at all times the pool is in use.
- Children over age <u>12</u> years are prohibited in the water.

DEPTH MARKERS

Depth markers reading in feet & inches must be 4" tall on a contrasting back ground. They must be present on the deck and on the inside wall of the pool, visible from the deck and in the water at required intervals. Depth markers are required at the maximum and minimum depths, and at the breakpoint; also at every 1' of depth change in the shallow end and 2' of depth change in the deep end (diving area). Can be spaced no more than 25' apart around the perimeter of the deck. Tanning ledges should be marked with actual depth (typically 4-8"). Depth markers at a set of steps should indicate the depth at the bottom of the steps.

BATHHOUSE

Must have hot and cold running water for both handwash sinks and showers. Must also be provided with soap and a means for hand drying. Surfaces must be cleaned daily with a bleach solution. Minimum 1 water-flush toilet for each sex must be provided. Showers must be separated by gender, to encourage thorough nude showers so as to remove excess makeup, body lotion, sweat, **residual fecal matter**, etc. before entering the pool. This helps to minimize the chlorine demand, saving your chemicals, reducing the amount of combined chlorine compounds produced, and reducing the chance for the spread of waterborne pathogens.

VENTILATION

For indoor pools, air temperature must be no more than 2^{o}F below the pool water temperature no more than 8^{o}F above pool water temperature (does not apply to spas). Relative Humidity must be maintained below 60% per Mechanical Code. Decks must be regularly scrubbed with bleach water, along with any other surfaces prone to moisture buildup or mold growth.

WINTERIZED or NOT IN USE

All PBP must be properly secured and maintained in **at least one** of the following ways:

- Maintained-filtration system running and chemicals maintained so that water is clear, circulating, and sanitized.
- Drained-and kept drained. Be sure to remove all water from the filtration piping and equipment to prevent damage from freezing. Sweep out leaves and other debris that collect in the pool over the winter-this will make it much easier to get it ready in the spring.
- Covered-with approved cover (NSF) securely anchored to deck, with min capacity of 1000 lbs. If choosing to cover the pool, you may consult a professional. Typically the water level is drained below the skimmers, and the skimmer lines are emptied and plugged to prevent damage from freezing. Remove any water or debris that collects on top of the cover, as the added weight will damage the cover.

FILTRATION SYSTEM

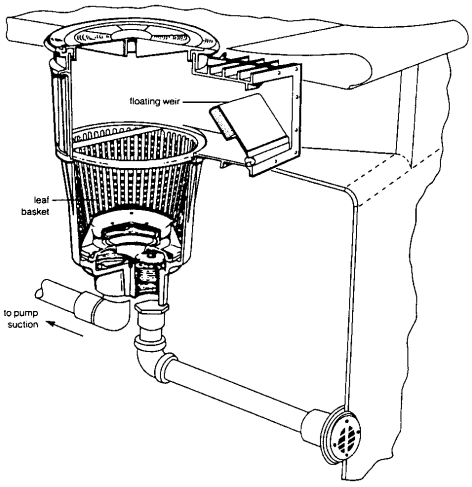
CONTACT THE HEALTH DEPARTMENT BEFORE CHANGING OUT ANY EQUIPMENT

Filtration systems- typical components include outlets, pumps, filters, chemical feeders, flow meters, pressure/vacuum gauges, valves, and possibly a heater and backwash site glass. The water flows from the pool into the outlets, through the system where it is filtered and treated, before returning to the pool via the inlets, clear and sanitized.

OUTLETS

SKIMMER- skims oils and debris from the pool surface; only functional at correct water levels-half-way up the skimmer opening, or at constant overflow if using gutters. General parts include:

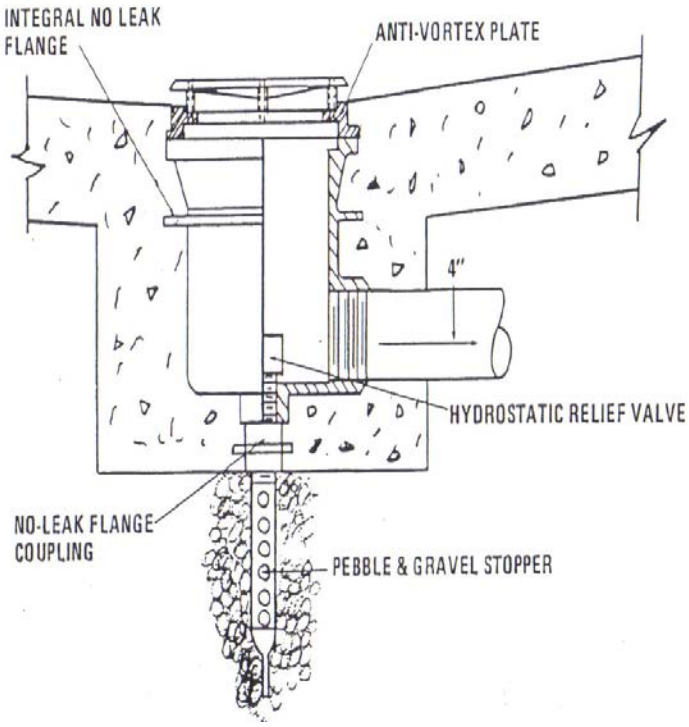
- Weir-floating flapper that increases surface velocity (increases skimming action).
- Equalizer-prevents skimmer from sucking air when water level is low.
- Strainer Basket-collects large debris to protect the pump.
- Float Valve-works with equalizer to prevent air suction.
- Equalizer Valve-ensures equalizer stays shut until needed if water level drops.



Main Drain Sump & Hydrostatic Relief Valves

MAIN DRAIN- pulls water from lowest point in pool to ensure proper circulation of water, and removal of heavy debris. General parts include:

- Drain Cover-prevents entrapment; must meet VGB requirements.
- Sump-cavity beneath drain cover; must be sized correctly to evenly distribute suction, to prevent entrapment.
- Hydrostatic Relief Valve-relieves pressure from the surrounding groundwater, to prevent the pool from floating.



GUTTER SYSTEM- same concept as a skimmer, but different design; for larger pools (required if over 2400ft^2). Requires continuous overflow for effective operation.

- Dropout Box-low spots in the gutter where the water enters the pipes leading to the surge tank.
- Surge Tank-holds excess water to maintain a constant water level, accounting for changes in bather load.

VIRGINIA GRAHAME BAKER (VGB) ACT

Federal Act, applying to all public/semi-public bathing places. Addresses the 5 major types of entrapment, and required steps for prevention (major elements have also been adopted into the OK State Code):

- Mechanical Entrapment-when clothing, jewelry, etc. gets caught/tangled in something under the water, such as a ladder, drain cover, etc.
- Body Entrapment-when the body, or part of the body, is stuck on an outlet.
- Evisceration-intestines and/or genitals are sucked out due to suction created by blocking an outlet with a person's bottom.
- Hair Entrapment-when a person's hair is stuck/tangled on an underwater feature/device.
- Limb Entrapment-a limb is stuck in a pipe/crevice.

Means of prevention include:

- All openings (main drains, equalizer lines, inlets etc.) must have covers that are NSF/ANSI 50 approved.
  - -Certified maximum flow rates
  - -Anti-vortex covers
  - -Adequately designed/sized sump
  - -Properly installed, and replaced every *x* years per manufacturer's recommendation
  - -Required regardless of whether or not there is any suction from the opening
- All main drains must meet at least one of the following criteria:
  - -Dual drain system, with drains spaced no less than 3 feet apart from centers, connecting at a point equidistant from both drains (some pools may use more than 3)
  - -Safety vacuum release system (SVRS) that will automatically shut off the pump in the event of entrapment
  - -Suction-limiting atmospheric vent system
  - -Gravity drainage system with collector/surge tank
  - -Unblockable drain (large drain covers and channel drain systems)

*The Consumer Product Safety Commission is tasked with enforcement of the VGB Act at the federal level. Non-compliance can result in substantial fines from the federal government, in addition to any enforcement/fines at the state and local levels. As part of the VGB Act, facilities are required to keep records regarding their outlet covers, including date of purchase/installation, manufacturer's installation manual, etc.

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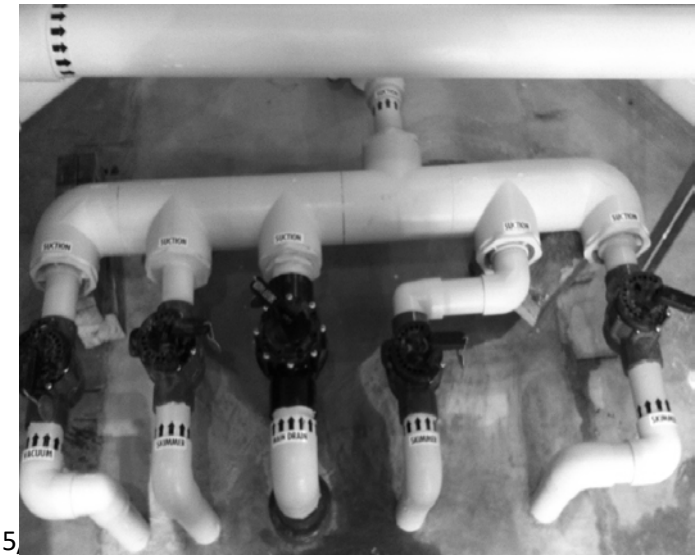
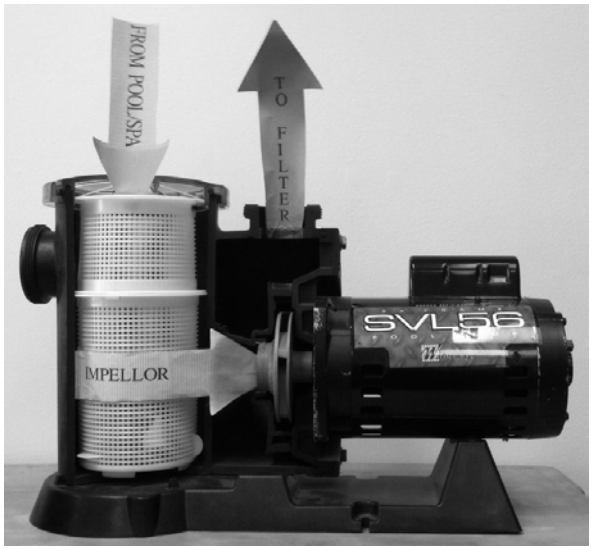


PIPING- piping from each skimmer and main drain/group of main drains must enter the pump room as a separate pipe, with its own valve for flow control. Each must be properly labeled, and will combine to a manifold after the valves. 30% of the overall flow should be through the main drain, with the rest evenly divided among the skimmers (~30gpm at each skimmer). Make sure all piping is thoroughly labeled, including arrows indicating the direction of flow. Must be NSF-labeled piping.

PUMP-the pump pulls the combined water from the manifold or surge tank, and pushes it through the filter and the rest of the system, back to the pool. General parts consist of:



•Strainer-catches large debris, preventing damage to the pump, or excess buildup in filter; must have an extra strainer basket

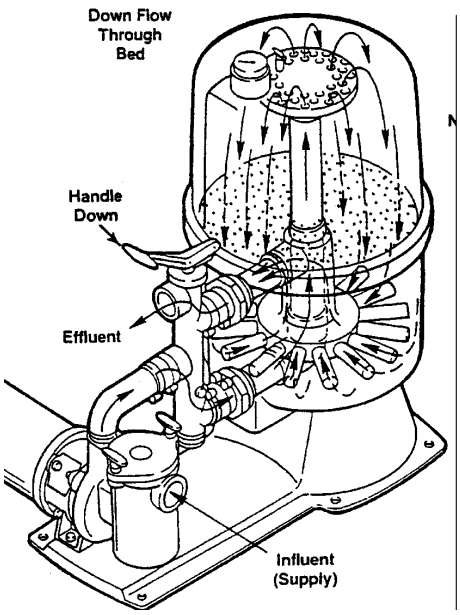
•Vacuum Gauge-measures vacuum suction, indicating whether something is clogging the line between the pool outlets and the pump impeller; installed between the strainer basket and the impeller

•Impeller-a paddle-wheel-like device, which drives the water through the system; usually either brass or a plastic

•Pump size (hp) is specified by the engineer; impeller is sized according to the hp

Filters

Remove dirt and suspended particles of sufficient size. Must have both an inlet and outlet pressure gauge. 3 Main types:



HIGH RATE SAND FILTER-

•Graded Sand Bed-sand grains are uniform in size

•15gpm maximum flow per ft^2 of surface area (cross section of filter is filtration surface area)

•Elements-lateral pipes along bottom of filter with razor slots that the water flows through, but too small for sand to flow through (sand can be forced through under high pressure)

•Scum Layer-as particles are filtered out, they form a scum layer in the upper part of the sand, which helps to filter out smaller and smaller particles

•Backwash-scum layer eventually collects too much debris, and the flow will decrease, and/or the pressure difference from the filter inlet and outlet will increase enough that the filter will need to be cleaned (generally pressure difference of 8-12 psi from normal); flow is reversed through the filter, ejecting most of the scum buildup to the wastewater disposal system; **Turn pump off before adjusting the backwash valves!**

•If flow is too high through filter, can cause channeling, where the water forms channels in the sand, forcing particles through that would normally be filtered out. It can also force sand through the razor slots in the laterals, causing sand to deposit in your pool (can also be an indication of a broken/cracked lateral).

•If sand remains discolored after sufficient backwashing, it may need to be replaced. Calcium deposits can build up on the sand, eventually hardening parts of the sand into a concrete-like substance. Biofilms can build up in the sand as well, causing it to appear as a blackish (or possibly other colored) sludge. If this happens, thoroughly empty, clean, and sanitize the filter, and replace with fresh sand of appropriate grade.

CARTRIDGE FILTER-

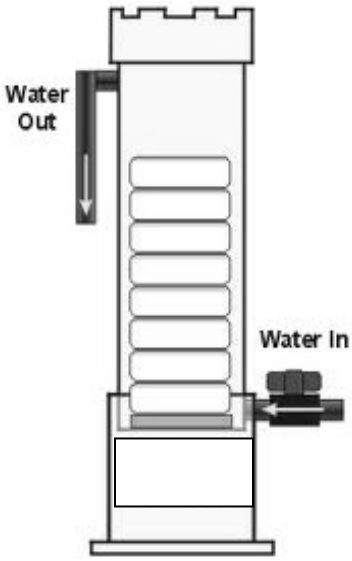
- Filter pleats make up total filtration surface area, making them more compact
- Maximum flow of 0.375gpm per ft^2 of filter surface area
- Must have extra set of cartridges
- Must be removed for cleaning, cannot be backwashed
  - -remove cartridges and soak overnight in a cleaner/degreaser (TSP)
  - -add bleach toward the end of the soak
  - -rinse off the filter, particularly between each of the pleats, with a garden hose (do not use high pressure hose, it can tear the filter)
  - -can be acid washed if necessary (degrease first!); after first cleaning step, soak in slightly acidic solution
  - -allow to dry completely before replacing
- If flow is too high, can tear the filter and/or force particles into or through the filter

DIATOMACEOUS EARTH (DE) FILTER-

- Similar to a cartridge filter, but with a coating of very fine DE powder
- Can filter out some of the larger pathogens
- Maximum flow of 2.5gpm per ft^2 of filter surface area
- Filter panels or cartridges are either pre-coated, or slurry fed
- Cleaned by backwashing
- Must have a separation tank for removal of DE, as it cannot be discharged into the sewer (it will clog the lines)

__ALL FILTERS-__ There should be a bleed valve on top of the filter. If air begins to build up in the filter, open the bleed valve until all the air is gone. Significant air buildup in the filter, pump basket, or coming out of the inlets in the pool will generally indicate either the water level is too low or there is a leak in the piping on the suction side (from the outlets leading into the pump). Air buildup in the filter will prevent proper filtration. From time to time, or if you can see that there is air in the filter, open the bleed valve until all the air is expelled, and water begins to spray out. Then close the valve to prevent any more leakage. If there is a multiport valve, for changing the system between the filter, backwash, and drain modes, be sure to turn the valve in only one direction. Turning it back and forth can cause the valve to fail, and destroy or displace the gasket (o-ring). If this valve begins to leak, turn off the pump, and take the valve apart. Reset or replace the o-ring as needed. If using a series of valves in lieu of a multiport valve, be certain you know which valves to open/close to operate the different modes, and be sure those valves are labeled accordingly. Never change operation from one mode to another (filtration to backwash, etc.) without first turning off the pump!

CHEMICAL FEEDERS



EROSION CHLORINE/BROMINE FEEDERS- Feeders where tablets or granules are eroded and dissolved by the recirculation water flowing through the feeder

GAS CHLORINE FEEDERS- Compressed Cl_2 gas is fed into the system via a non-mechanical venturi system

LIQUID CHLORINE FEEDERS- Large drums of concentrated bleach, with a mechanical pump to feed solution into recirculation piping

IN-LINE SALT CHLORINE GENERATOR- Utilizes sodium chloride (table salt) dissolved in the water, to produce hypochlorous acid (pool chlorine)

- Salt must be maintained at proper range according to operation manual for specific unit being used
- Must use only pool salt (pure sodium chloride)
- Produces NaOH as a byproduct, a strong base which will raise the pH of the pool
- Must have a controller, with indicator lights for diagnostics
- Only operable at certain temperatures (varies by model)
- Electrolytic cells must be removed and cleaned according to manufacturer's specifications, and replaced accordingly
- Units must be calibrated to assure correct readings of salt and other readings, otherwise unit will not operate correctly/efficiently

BRINE TANK CHLORINE GENERATOR- Uses a tank of concentrated salt water to produce hypochlorous acid as needed, that is then injected into the recirculation system headed back to the pool. Similar to an in-line salt chlorine generator, except that the pool water itself is not salted, only the brine tank.

OTHER CHEMICAL FEEDERS- Most common is a pH feeder, that feeds acid (muriatic or carbonic), for constant automated control of pH levels, by means of a mechanical pump (not a flow through feeder). Also includes secondary sanitizers, such as UV and Ozone, which are only approved as secondary treatment, and not as stand-alone sanitizers.

Chemical feeders should always feed downstream of any other equipment, to prevent damage to the system. If using multiple chemical feeders of the same or different type, no feeder should feed directly into another chemical feeder. Feeders must be NSF listed, and of adequate sizing according to the NSF listed output, and the minimum output requirements of the OK State Code. Feeders may only be installed according to the manufacturer's instructions. Feeders may only use chemical types intended for that unit. All units must have an adjustable feed rate, from 0 to maximum output and have an automatic shut-off feature in the event that the recirculation pump is not running.

HEATER

If using a heater, should be spec'd by the engineer during the build process. Must be installed according to the manufacturer's specifications. Usually requires bypass valve so that water can still be circulated when heater is off/needing repair, as well maximum achievable flow through the heater may be lower than required minimum flow for the system. Must have temperature gauges on both the inlet and outlet. If gas, combustion air cannot be drawn from area where chemicals are stored, and combusted air must be exhausted direct to outside the building, to prevent the buildup of noxious/poisonous fumes.

FLOW METER

Measures flow through the piping, measured in gallons per minute (gpm). Flowmeter is sized according to the pipe diameter. The wrong sized flowmeter will not give an accurate flow reading. Recommend NSF approved when available (again, be sure of correct sizing). Must be installed according to the manufacturer's specifications, otherwise will not give accurate flow. Must be maintained in working order to verify correct flow through system. Maximum flow is set by filter type and size.

MINIMUM FLOW is determined by the following two methods (the method resulting in the higher required minimum flow rate is chosen):

- Minimum Turnover- flow is set such that a volume equivalent to the volume of the pool/spa is recirculated within a given time frame, expressed in gpm

-Pool	every 8 hours
-Wading Pool	every 4 hours
-Wave Pool	every 4 hours
-Tube Ride	every 4 hours
-Water Slide	every 1 hour
-Spa	every 0.5 hour
-Lagoon	every 0.5 hour

- # of Skimmers Required- required number of skimmers is determined by the surface area of the pool; required total flow is 43gpm per skimmer (30gpm through each skimmer, with 30% of total flow through the main drain). 1 skimmer is required for each:

-Pool	600 ft^2 surface area
-Wading Pool	400 ft^2 surface area
-Spa	50 ft^2 surface area

Pool Volume and Required Minimum & Maximum Flow Rates Must Be Posted in the Pump Room. Typically the operator just uses a marker and writes these figures on the wall or the filter(s).

INLETS

Pool inlets are where the water reenters the main part of the pool. Inlets must be adjustable, and should be pointed down and to the right (counter-clockwise) to assist with proper turnover/mixing of treated and untreated water. This will also help to flush particles toward the main drain so it can be removed by the filter.

TOTAL DYNAMIC HEAD

TDH is a calculation to determine the resistance to flow (friction) through the piping. Longer piping, and smaller pipe diameters will lower the maximum achievable flow rate, as will increasing the number of bends in the piping. Pipe lengths and diameters are spec'd by the engineer, who calculates the TDH during the plan review process. Do not change the piping without first consulting your local health department, as this may cause your flow to drop below what is required.

WATER CHEMISTRY

GENERAL

When Chlorine and Water mix the reaction creates **Hypochlorous Acid (Free Chlorine).** This product treats the water in 3 ways:

- Sanitation- process of destroying harmful organisms
- Oxidation- process of chemically removing organic debris from the water
- Algaecide- controls the growth of algae in the water

COMBINED CHLORINE- chlorine combined with organic molecules (urine, sweat, bacteria, etc.), that have only been partially oxidized.

- Respiratory and Eye irritant, foul smelling (chlorine smell)
- Must be removed, generally by increasing the free chlorine levels by one of the following methods:
  - **Superchlorination** (>5ppm)
  - **Shock** (>20ppm)
  - **Breakpoint Chlorination** (adding just enough free chlorine to remove the combined chlorine, without raising the free chlorine residual)
- Indoor pools must have proper ventilation to prevent buildup of combined chlorines in the air
- Removal of Combined Chlorine from water facilitated by adequate air flow over water surface

pH- logarithmic scale for measuring the acidity of a solution

- pH 6 is 10x more acidic than pH 7
- Effectiveness of sanitizer is pH dependent (more so for chlorine), being more active at lower pH
- pH is vital part of maintaining water balance
- pH outside the required range can cause bather discomfort, skin and eye irritation

TOTAL ALKILINITY- buffers pH

- High Total Alkalinity will resist changes in pH, whether intentional (adding acid to adjust pH), or unintentional (rain affecting pH levels)
- Low Total Alkalinity can cause “pH bounce” where the pH level is unstable and easily changed
- Affects water balance

CALCIUM HARDNESS- calcium compounds in the water that build up over time, which can deposit on the pool surfaces (scale)

- Can decrease effectiveness of other chemicals when high
- Affects water balance
- Can cause scale regardless of water balance, if levels are high enough
- Must drain and dilute to lower

CYANURIC ACID- a chlorine stabilizer, used to protect chlorine from dissipation and UV degradation in outdoor pools

- Not for use in indoor pools or spas
- Can significantly decrease sanitizer activity
- Affects pH in large amounts (is an acid)
- Must drain and dilute to lower; if very high (over 100 ppm) will need to power wash or scrub it off the plaster after draining, before refilling

TOTAL DISSOLVED SOLIDS (TDS)- everything dissolved in the water that the filter doesn't catch

- High TDS can:
  - -decrease sanitizer activity
  - -cause cloudy water
  - -affect chemistry tests
- Will increase quickest in spas, from sweat and other sources

CHEMICAL CONTAMINANTS- chemicals that may find their way into your pool, that you're better off without; these chemicals can disrupt your chemical tests, giving inaccurate results; if you suspect any of these may be the problem, take a water sample to your local pool supply store to be analyzed (usually at no cost); they can usually diagnose the problem and suggest possible corrective measures.

- **Copper**-from heating coils, brass fixtures, pump impeller
  - -stains water a blue-green color
  - -can stain plaster
  - -can affect chlorine activity
- **Iron**-usually from rusting steel fixtures
  - -stains water a rusty reddish-brown color
  - -can stain plaster
  - -can affect chlorine activity
- **Phosphate**-found in cleaning compounds that might be used around the pool, also a major ingredient in fertilizer
  - -can affect chlorine activity
  - -algae food
- **Nitrate**-major ingredient of fertilizer; can come from contaminated source water
  - -can affect chlorine activity
  - -algae food

*****Any landscaping or plants near the pool can be a source of contamination or of fertilizer overspray that can make its way into the pool. Also improper deck slope or drainage of the surrounding area can cause runoff to enter the pool, carrying whatever chemicals and critters from those areas into the pool. It is good to know what cleaning chemicals are used near the pool, as this may help determine the cause of problems later.*

TEST KITS

Must have accurate test kit (not test strips) able to test for all required chemicals mentioned above (except the 4 chemical contaminants listed). Must be able to accurately test water temp to determine water balance, and must be able to test for salt concentration, if using a salt chlorine generator, to verify controller is reading accurately. Kits should be stored in a cool, dry area, and checked/replaced annually for expiration dates. Be sure to completely read and understand all instructions with your specific kit. If your kit has a booklet, it is strongly recommended that you read it when you have the chance. Booklet will have a wealth of information regarding general pool care, trouble shooting pool problems, and determining problems with your chemical testing. Common problems encountered with testing include, but are not limited to the following:

•Chlorine test flashes pink, then goes clear, without adding any other reagents- your free chlorine is high enough that it is bleaching out the reagent; add more DPD powder, or dilute the sample with distilled water (if you dilute your sample with half pool water, half distilled water, you will multiply your chlorine reading by 2); correct the chlorine before doing any other tests, as a high level will affect your other readings
•pH out of range- will affect other tests; correct the pH before doing the alkalinity and calcium hardness tests
•Alkalinity- should observe a color change of green to red; high chlorine and high/low pH may change those colors to blue/yellow. Can add extra drop of R-007 at start of test (3 total) to neutralize extra chlorine up to a certain point; better to adjust chlorine/pH before doing this test; high cyanuric acid levels may affect the alkalinity reading; do not stop adding drops until a complete color change is observed
•Calcium Hardness- have seen readings as high as 2000 ppm, so do not be surprised if you get a high reading; calcium hardness is found in the source water at various ranges, depending on where you are; it builds up over time, from replacement of evaporated water, and added chemicals such as calcium hypochlorite (shock); do not stop adding drops until a complete color change is observed (from pink to blue)

Chemical Testing Parameters and Required Ranges

Items in **BOLD** are critical, requiring closure if outside these ranges.

Chemical	Minimum	Maximum
DISINFECTION:		
Chlorine, free available (FAC)	**1.0 ppm**	**5.0 ppm**
Chlorine, combined (CC)	N/A	0.2 ppm
Bromine	**2.0 ppm**	**4.0 ppm**
pH	**7.2**	**7.8**
WATER BALANCE:		
Saturation Index	N/A	±0.5
Total Alkalinity	80 ppm	200 ppm
Calcium Hardness	50 ppm	500 ppm
Total Dissolved Solids	N/A	1500 ppm
Temperature-Pool Temperature-Spa	75°F	90°F 105°F
Temperature-Air (Indoors)	Pool Temp - 2°F	Pool Temp + 8°F
OTHER PERAMETERS:		
Turbidity (water clarity)	**MD clearly visible from deck**	**MD clearly visible from deck**
Relative Humidity (indoors)		<60%
Copper/Iron	N/A	0.3 ppm
Cyanuric Acid – Stabilizer[1]	Not required	100 ppm

1 The water is stabilized at 10ppm. The maximum benefit occurs at 30ppm.
Values over 30 ppm do not add to the effectiveness and will inhibit the chlorine, increasing the chance of spreading a RWI.
Drain and replace water as needed to keep cyanuric levels well below 50ppm.
Currently, the only approved method for lowering Calcium Hardness, Cyanuric Acid, and TDS levels is to dilute with fresh water.

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WATER BALANCE

Water balance involves the relationship between pH, Total Alkalinity (TA), Calcium Hardness (CH), Water Temperature (F^O) and Total Dissolved Solids (TDS- all the particles that are too small to be removed by the filter).
Corrosive water will eat metals, heater cores, plaster and tile grout and lead to chlorine loss.
Scaling water will put a white scale on walls, steps and turn sand to cement, and can also build up in the plumbing lines (similar to plaque buildup in an artery).
The **Langelier Saturation Index** tells the operator if the water is CORROSIVE or SCALING.
Water is always balanced to the pH to be used.

WATER BALANCE

TARGET VALUES: pH 7.5	**TA 100ppm**	**CH 250ppm (hot water CH 150ppm)**
Total Dissolved Solids	1500ppm	

- **Langelier Saturation Index**

This formula was developed by Dr. Langelier.
Test for your pool's pH, Total Alkalinity (TA), Calcium Hardness (CH), Water temperature (F^O). In the equation, the actual pH is used. The three factors below are added to the pH. Find the closest value or the next highest to the reading. To adjust for Total Dissolved Solids (TDS) 12.1 is subtracted from the total. Saturation Index refers to the point at which the Calcium comes out of the water and scales on the walls, etc.

pH + Temperature (^0F) Factor + Calcium Hardness Factor + Total Alkalinity Factor – 12.1 =S.I.

Temperature (^0F) = Factor	Calcium Hardness = Facter	Total Alkalinity = Factor
32 . . . . . 0.0	5ppm 0.3	5ppm 0.7
37 . . . . . 0.1	25ppm 1.0	25ppm 1.4
46 . . . . . 0.2	50ppm 1.3	50ppm 1.7
53 . . . . . 0.3	75ppm 1.5	75ppm 1.9
60 . . . . . 0.4	100ppm 1.6	100ppm 2.0
66 . . . . . 0.5	150ppm 1.8	150ppm 2.2
76 . . . . . 0.6	200ppm 1.9	200ppm 2.3
84 . . . . . 0.7	250ppm 2.0	250ppm 2.4
94 . . . . . 0.8	300ppm 2.1	300ppm 2.5
105 . . . . . 0.9	400ppm 2.2	400ppm 2.6
128 . . . . . 1.0	800ppm 2.5	800ppm 2.9
	1000ppm 2.6	1000ppm 3.0

Calculation Results	Water IS:
+0.5 to -0.5 =	**BALANCED**
Greater than +0.5 =	SCALING
Less than -0.5 =	CORROSIVE

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CHEMICAL HANDLING AND STORAGE

Store chemicals in the original, labeled container in a cool, dry place. Read and follow all label directions. Keep Material Data Sheets on all chemicals. Keep the lids on. **DO NOT store/mix with paint, cleaning products, organics, strong acids or bases. Do not add chemicals in the skimmer. Do not add chemicals when patrons are present. Always add chemicals to the water – never water to the chemicals.** Add chemicals one at a time TO THE POOL. DO NOT put them in the skimmer. **If calcium hypochlorite is used to raise the chlorine level, breakpoint or shock, mix into a bucket of water and let the residue settle out before putting the liquid in the pool. Always use a separate clean scoop for each chemical to prevent contamination and possible accident.**

DETERMINING THE AMOUNT OF CHEMICALS TO ADD

The **10K FORMULA** is used to find out how much chemical is needed to make a change in the chlorine reading or raise and lower pH, TA, CH. The **Taylor Kit** has a booklet with tables that give the chemical amounts to use. **Always refer to the actual dosage instructions on your specific product label**.

THE 10K FORMULA

The formula below is similar to that found on product labels. The 10K FORMULA uses 10,000 gallons of water to determine the amount of chemical needed to adjust the chemical levels of Chlorine, Alkalinity, Calcium Hardness, etc. by a certain amount. Manufacturers may use other amounts such as 3000 or 5000 gallons, etc.- **see label directions**. The label for the calcium hypochlorite (65%) listed below would list dosage instructions similar to: "Add 2oz per 10,000 gallons, to increase the free chlorine residual by 1ppm." If your pool is not exactly 10,000 gallons, or you wish to raise your chlorine by one more than 1ppm, you would need to do a series of calculations summarized by the 10K formula. **Always use the actual numbers from your own chemical label, as they may be different from what is in our chart!**

Chemical Amount*	**X**	**Pool Volume 10,000 gal.**	**X**	**Needed Change Increment to Change 10,000gal****	**=**	**AMOUNT of CHEMICAL to TREAT WATER**

Chemical Amount is in ounces (oz.), pounds (lbs.), or fluid ounces (fl.oz.). the unit of measure in "CHEMICAL AMOUNT" will be the same unit of measure for your final answer. Use the **table on the next page** (or chemical label, if available) to determine values for **"Chemical Amount"** (3rd column) and **"Increments to change"** (2nd column). **"Needed Change"** is the change to be made from the actual test reading to the desired reading – i.e. Total Alkalinity is 30ppm and desired reading is 100ppm. Needed Change = 70ppm.
To Breakpoint chlorinate: TC – FAC = CC; (CC x 10) - FAC = Needed Change (from formula above).

CHEMICALS USED TO TREAT WATER

Chemical to Use↓	Increments To Change 10,000gal.**	Chemical Amount*	pH Effect
Chlorine (Free Available)	1ppm		
Calcium Hypochlorite (65%)		2 oz	UP
Sodium Hypochlorite (10%)		13 fl oz	UP
Lithium Hypochlorite (35%)		10.5 oz	NA
Dichloro-s-triazinetrione (99%)*		2.5 oz	DOWN
Trichloro-s-triazanine trione (86-99%)*		1.5 oz	DOWN
Gas (100%)		1.3 oz	DOWN
Stabilizer – Raise (Increase)	5ppm		
Cyanuric Acid – granular		6.5 oz	DOWN
Dichloro-s-triazinetrione		13.0 oz	DOWN
Neutralize Free Chlorine	1ppm		
Sodium Thiosulfate		1 oz	UP
pH – Raise (Increase)	in 0.2increments		
Soda Ash		6 oz	UP
pH – Lower (Decrease)	in 0.2increments		
Muriatic Acid		12 fl oz	DOWN
Sodium Bisulfite		1.5 lbs	DOWN
Total Alkalinity – Raise (Increase)	10ppm		
Sodium Bicarbonate		1.5 lbs	UP
Total Alkalinity – Lower (Decrease)	10ppm		
Muriatic Acid		24 fl oz	DOWN
Sodium Bisulfate		1.5 lbs	DOWN
Calcium Hardness – Raise (Increase)*	10ppm		
Calcium Chloride (100%)		1.0 lbs	UP
Calcium Chloride (77%)		1.25 lbs	UP

*The only way to Lower Calcium Hardness, Cyanuric Acid or Total Dissolved Solids is to drain water and replace with tap water.

UNIT CONVERSION CHART

The Amount of Chemical to USE often requires conversion from smaller measures to larger ones. Here is a handy conversion chart.

1 pound (lb)	=	16 dry ounces (oz)
1 gallon (gal)	=	128 fluid ounces (fl oz)
8 fl oz	=	1 cup
1 cubic foot (ft^3)	=	7.5 gal of water

*If converting Left to Right, Multiply. If converting Right to Left, Divide

Ex. 3 lb → ? oz; 3 x 16 = 48 oz

Ex. 500 fl oz → ? gal; 500 ÷ 128 = 3.9 gal

EXAMPLES:

You have a 64,000 gallon pool with a pH reading of 8.4, which you want to lower to 7.4 using muriatic acid:

$$12 \text{ fl oz} \times \frac{64{,}000 \text{ gal}}{10{,}000 \text{ gal}} \times \frac{1}{0.2} = 12 \times 6.4 \times 5 = 384 \text{ fl oz} \qquad 384 \text{ fl oz} \times \frac{1 \text{ gal}}{128 \text{ fl oz}} = 3 \text{ gal of muriatic acid}$$

You have a 28,000 gallon pool with a free chlorine reading of 24 ppm, which you want to lower to 3 ppm using Sodium Thiosulfate (chlorine neutralizer):

$$1 \text{ oz} \times \frac{28{,}000 \text{ gal}}{10{,}000 \text{ gal}} \times \frac{21 \text{ ppm}}{1 \text{ ppm}} = 1 \times 2.8 \times 21 = 58.8 \text{ oz} \qquad 58.8 \text{ oz} \times \frac{1 \text{ lb}}{16 \text{ oz}} = 3.7 \text{ lb of Sodium Thiosulfate}$$

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RECREATIONAL WATERBORNE ILLNESS (RWI)

Disease is transmitted in water from one person to another by pathogens. They can be transmitted by **Ingestion (drinking), Inhalation (breathing) or Contact** with the pathogen on the skin. Pathogens generally include bacteria, virus, protozoa, and algae that make people sick. Bacteria and viruses are killed by sanitizers (Chlorine, Bromine, Ozone, and Ultraviolet Light). Protozoans are much harder to kill with conventional chlorine/bromine. According to the CDC, the average adult is estimated to carry approximately 0.14 grams of fecal matter on their bottom, which can hold more than enough pathogens to transmit disease. Approximately 85% of RWI are transmitted by the fecal-oral route, indicating the importance of thoroughly showering before entering the pool, to remove all of this residual fecal matter. **In the event of a fecal incident, close the pool and advise patrons to shower thoroughly. Remove any solid particles, and treat or drain the pool according to CDC recommendations for remediation. Pathogens can be shed from the gut for several weeks (as many as 6 weeks for certain pathogens) after symptoms have disappeared.**

Steps should be taken to prevent fecal matter from entering the pool:

- Require all patrons to shower before entering the pool
- Do not allow diapers to be changed near the pool- should be done either in the locker room or outside the pool area
- Encourage frequent potty breaks, especially for young children ("safety breaks"), encouraging them to use the bathroom rather as needed rather than try to hold it
- Exclude any bathers who have had diarrhea within the last (2) weeks- add this to your pool rules so that bathers can see and police themselves when the pool is not guarded

BIOFILMS- colonies of microorganisms that grow in or near the pool, on wet or damp surfaces (underside of skimmer lid), they secrete a slimy coating that chlorine and bromine cannot penetrate. They can harbor other organism and pathogens, protecting them from the chlorine, and secreting them into the pool over time. The best way to remove them is to dry them out completely, scrape them off, and then scrub the surface with a concentrated bleach solution. Check the underside of your skimmer lid, and any other crevices where they are likely to grow.

ALGAE- single celled plants. Can cause turbid water, eat plaster, form biofilms, stain plaster, and secrete harmful toxins into the water. Shock affected areas, scrub any surfaces where they have colonized, filter out and backwash. Repeat as needed. In extreme cases, the filtration media may need special cleaning/treatment-consult a professional.

BACTERIA- most are easily killed by chlorine and bromine. *Legionella*, associated with moist, humid environments (not necessarily in the pool water itself, but the atmosphere) causes legionnaire's disease, a deadly type of pneumonia, and Pontiac fever. *Pseudomonas*, causes a very painful "hot tub rash," with puss filled blisters and follicles. Staph infections may be spread by items in the pool area- lounge chairs, towels, etc.- if not properly cleaned and disinfected.

PROTOZOA (Parasites)- can be extremely chlorine resistant. If suspected, further steps must be taken to assure proper remediation/removal of viable pathogens. *Giardia*, causes severe diarrhea and gastrointestinal distress. *Cryptosporidium*, the most chlorine resistant pathogen for RWI's, can survive in a properly chlorinated pool for several days. Causes severe diarrhea and gastrointestinal distress, very dangerous for children and the elderly. Very easily spread- outbreaks sometimes involve several thousand people infected from one person/incident, and incredibly small infectious dose- as little as (1) organism.

Fecal Incident Response Recommendations for Aquatic Staff

What do you do when you find poop in the water?

Check for existing guidelines from your local or state regulatory agency before use. CDC recommendations do not replace existing state or local regulations or guidelines.

These recommendations are for responding to fecal incidents in chlorinated aquatic venues (for example, pools and water playgrounds).

Improper handling of chlorine-based disinfectants can cause injury. Follow proper occupational safety and health requirements when following these recommendations. For more pool chemical safety information, visit www.cdc.gov/healthywater/swimming/aquatics-professionals/preventing-pool-chemical-events.html.

CLOSURES: Fecal incidents are a concern and an inconvenience to both aquatic staff and patrons. Aquatic staff should carefully explain to patrons why the aquatic venue needs to be closed in response to a fecal incident. Explaining the reasons for closing the venue (for proper disinfection and protection of swimmer health) is likely to promote patron understanding and minimize their frustration. Closures allow chlorine to do its job—kill germs and help prevent recreational water illnesses (RWIs).

Hot tubs/spas, and some water playgrounds, can have much smaller amounts of water. In response to formed or diarrheal fecal incidents in small-volume venues, it might be more efficient to completely drain as much water as possible from the venue and associated plumbing; scrub and clean all accessible surfaces in contact with contaminated water; replace or clean filter media when appropriate, and refill with uncontaminated water from an approved source (for example, municipal water system).

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

What do I do about...

formed fecal matter (poop) in the water?

Formed fecal incidents pose a risk for spreading germs, including moderately chlorine tolerant *Giardia*. To disinfect the water following a formed fecal incident, aquatic staff should follow the steps below, which are based on killing or inactivating *Giardia*.

Step 1: Close the aquatic venue to swimmers. If you have multiple venues that use the same filtration system—all of the venues will have to be closed to swimmers. Do not allow anyone to enter the venue(s) until the disinfection process is completed.

Step 2: Remove as much of the fecal matter as possible (for example, using a net or bucket) and dispose of the fecal matter in a sanitary manner. Clean and disinfect the item used to remove the fecal matter (for example, after cleaning, leave the net or bucket immersed in the water during disinfection). **VACUUMING FECAL MATTER FROM THE WATER IS NOT RECOMMENDED.**

Step 3: Raise the water's free chlorine concentration to 2 parts per million (ppm), if less than 2 ppm. Maintain free chlorine concentration at 2 ppm and water at pH 7.5 or less for 25–30 minutes.[1] Other concentrations or closure times can be used (see table). State or local regulators may require higher free chlorine concentration in the presence of chlorine stabilizers,[2] which are known to slow the rate at which free chlorine inactivates or kills germs.

Step 4: Confirm that the filtration system is operating while the water reaches and is maintained at the proper free chlorine concentration and pH for disinfection.

Step 5: Allow swimmers back into the water only after the disinfection process has been completed and the free chlorine concentration and pH are within the operating range allowed by the state or local regulatory authority.

Establish a fecal incident log.
Document each fecal incident by recording date and time of the event, whether it involved formed fecal matter or diarrhea and the free chlorine concentration and pH at the time or observation of the event. Before reopening the aquatic venue, record the procedures followed in response to the fecal incident (including the process used to adjust chlorine concentration and pH [if necessary], the free chlorine concentration and pH, and the disinfection time). You can download a Water Contamination Response Log at **http://www.cdc.gov/healthywater/swimming/aquatics-professionals/fecalresponse.html**

***Giardia* Kill or Inactivation Time for a Formed Fecal Incident**	
Free Chlorine Concentration (ppm)	**Disinfection Time[3]**
1.0	45 minutes
2.0	25–30 minutes
3.0	19 minutes

1. Ideally, the water temperature should be 77°F (25°C) or higher during the disinfection process.
2. Chlorine stabilizers include compounds such as cyanuric acid, dichlor, and trichlor.
3. These closure times are based on 99.9% kill or inactivation of *Giardia* cysts by chlorine at pH 7.5 or less and temperature of 77°F (25°C) or higher. The closure times were derived from the U.S. Environmental Protection Agency (EPA) Disinfection Profiling and Benchmarking Guidance Manual. These closure times do not take into account "dead spots" and other areas of poor pool water mixing.

What do I do about...

diarrhea in the water when chlorine stabilizer[1] is NOT in the water?

A diarrheal incident is a high-risk event for contamination caused by *Cryptosporidium* (or "Crypto"), an extremely chlorine-tolerant parasite. Therefore, it is important that aquatic staff educate patrons not to swim when ill with diarrhea. To disinfect the water following a diarrheal incident, aquatic staff should hyperchlorinate, or raise the free chlorine concentration to a high concentration for a long period of time. If necessary, before attempting to hyperchlorinate, consult an aquatic professional to determine the feasibility, the most optimal and practical methods, and needed safety considerations.

Step 1: Close the aquatic venue to swimmers. If you have multiple venues that use the same filtration system—all of the venues will have to be closed to swimmers. Do not allow anyone to enter the venue(s) until the hyperchlorination process is completed.

Step 2: Remove as much of the fecal matter as possible (for example, using a net or bucket) and dispose of the fecal matter in a sanitary manner. Clean and disinfect the item used to remove the fecal matter (for example, after cleaning, leave the net or bucket immersed in the water during hyperchlorination).

VACUUMING FECAL MATTER FROM THE WATER IS NOT RECOMMENDED.

Step 3: Raise the water's free chlorine concentration (see Table below) and maintain water at pH 7.5 or less.[2]

Step 4: Achieve a concentration × time (CT) inactivation value of 15,300[3] to inactivate or kill Crypto. The CT inactivation value refers to the concentration of free chlorine in parts per million (ppm) multiplied by time in minutes at a specific pH and temperature.

Step 5: Confirm that the filtration system is operating while the water reaches and is maintained at the proper free chlorine concentration and pH for hyperchlorination.

Step 6: Backwash the filter thoroughly after reaching the CT inactivation value. Be sure to discharge directly to waste and according to state or local regulations. Do not return the backwash through the filter. Where appropriate, replace the filter media.

Step 7[4]: Allow swimmers back into the water only after the required CT inactivation value has been achieved and the free chlorine concentration and pH are within the operating range allowed by the state or local regulatory authority.

Establish a fecal incident log.
Document each fecal incident by recording date and time of the event, whether it involved formed fecal matter or diarrhea and the free chlorine concentration and pH at the time or observation of the event. Before reopening the aquatic venue, record the procedures followed in response to the fecal incident (including the process used to adjust chlorine concentration and pH [if necessary], the free chlorine concentration and pH, and the hyperchlorination time). You can download a Water Contamination Response Log at **http://www.cdc.gov/healthywater/swimming/aquatics-professionals/fecalresponse.html**

Use the formula below to calculate the time required to inactivate or kill Crypto[5]

Concentration × time (CT) inactivation value	÷	Free chlorine concentration (parts per million [ppm])	Time (in minutes)
15,300	÷	20*	= 765 (or 12.75 hours)
15,300	÷	10	= 1,530 (or 25.5 hours)

1. Chlorine stabilizers include compounds such as cyanuric acid, dichlor, and trichlor.
2. Ideally, the water temperature should be 77°F (25°C) or higher during the hyperchlorination process.
3. Alternative options could include circulating the water through a secondary disinfection system (for example, ultraviolet light or ozone) to theoretically reduce the number of Crypto oocysts in the aquatic venue(s) below one oocyst/100 mL as outlined in the Model Aquatic Health Code (MAHC) standard 4.7.3.3.2.4 (current edition of the MAHC is available at www.cdc.gov/mahc/currentedition/index.html) or draining the aquatic venue(s).
4. CDC does not recommend testing the water for Crypto after hyperchlorination is completed. Although hyperchlorination destroys Crypto's infectivity, it does not necessarily destroy the structure of the parasite.
5. Shields JM, Hill VR, Arrowood MJ, Beach MJ. Inactivation of *Cryptosporidium parvum* under chlorinated recreational water conditions. J Water Health. 2008;6(4):513–20.

* Many conventional test kits cannot measure free chlorine concentrations this high. Use chlorine test strips that can measure free chlorine in a range that includes 20–40 ppm (such as those used in the food industry) or make dilutions for use in a standard DPD test kit using chlorine-free water.

What do I do about...

diarrhea in the water when chlorine stabilizer[1] is in the water?

A diarrheal incident is a high-risk event for contamination caused by Cryptosporidium (or "Crypto"), an extremely chlorine-tolerant parasite. Therefore, it is important that aquatic staff educate patrons not to swim when ill with diarrhea. To disinfect the water following a diarrheal incident, aquatic staff should hyperchlorinate, or raise the free chlorine concentration to a high concentration for a long period of time. If necessary, before attempting to hyperchlorinate, consult an aquatic professional to determine the feasibility, the most optimal and practical methods, and needed safety considerations.

Step 1: Close the aquatic venue to swimmers. If you have multiple venues that use the same filtration system—all of the venues will have to be closed to swimmers. Do not allow anyone to enter the venue(s) until the hyperchlorination process is completed.

Step 2: Remove as much of the fecal matter as possible (for example, using a net or bucket) and dispose of the fecal matter in a sanitary manner. Clean and disinfect the item used to remove the fecal matter (for example, after cleaning, leave the net or bucket immersed in the water during hyperchlorination).

VACUUMING FECAL MATTER FROM THE WATER IS NOT RECOMMENDED.

Step 3: Raise the water's free chlorine concentration (see bullets below) and maintain water at pH 7.5 or less.[2]

Step 4: Hyperchlorinate.[3] Chlorine stabilizer slows the rate at which free chlorine inactivates or kills Crypto, and the more stabilizer there is in the water the longer it takes to kill Crypto.

If the cyanuric acid concentration is 1–15 parts per million (ppm)[4]

- Raise the free chlorine concentration to 20 ppm[5] and maintain it for 28 hours or
- Raise the free chlorine concentration to 30 ppm[5] and maintain it for 18 hours or
- Raise the free chlorine concentration to 40 ppm[5] and maintain it for 8.5 hours

If the cyanuric acid concentration is more than 15 ppm, lower the concentration to 1–15 ppm by draining partially and adding fresh water without chlorine stabilizer before attempting to hyperchlorinate.

Step 5: Confirm that the filtration system is operating while the water reaches and is maintained at the proper free chlorine concentration and pH for hyperchlorination.

Step 6: Backwash the filter thoroughly after hyperchlorination has been completed. Be sure to discharge directly to waste and according to state or local regulations. Do not return the backwash through the filter. Where appropriate, replace the filter media.

Step 7[6]: Allow swimmers back into the water only after hyperchlorination has been completed and the free chlorine concentration and pH are within the operating range allowed by the state or local regulatory authority.

Establish a fecal incident log.
Document each fecal incident by recording date and time of the event, whether it involved formed fecal matter or diarrhea and the free chlorine concentration and pH at the time or observation of the event. Before reopening the aquatic venue, record the procedures followed in response to the fecal incident (including the process used to adjust chlorine concentration and pH [if necessary], the free chlorine concentration and pH, and the hyperchlorination time). You can download a Water Contamination Response Log at **http://www.cdc.gov/healthywater/swimming/aquatics-professionals/fecalresponse.html**

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2. Ideally, the water temperature should be 77°F (25°C) or higher during the hyperchlorination process.
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4. Murphy JL, Haas CN, Arrowood MJ, Hlavsa MC, Beach MJ, Hill VR. Efficacy of chlorine dioxide tablets on inactivation of *Cryptosporidium* oocysts. Environ Sci Technol. 2014;48(10):5849–56.
5. Many conventional test kits cannot measure free chlorine concentrations this high. Use chlorine test strips that can measure free chlorine in a range that includes 20–40 ppm (such as those used in the food industry) or make dilutions for use in a standard DPD test kit using chlorine-free water.
6. CDC does not recommend testing the water for Crypto after hyperchlorination is completed. Although hyperchlorination destroys Crypto's infectivity, it does not necessarily destroy the structure of the parasite.