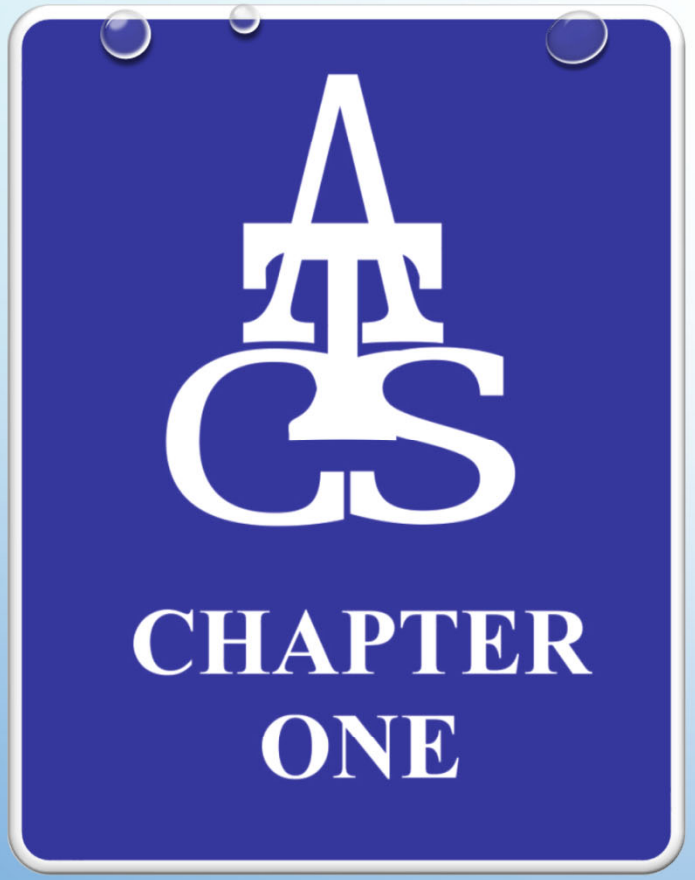


THE JOB OF THE PROFESSIONAL SWIMMING POOL OPERATOR

HOUSEKEEPING

- Introduction of Instructors
- Please mute your microphone
- Questions will be taken at the end of each chapter & during the presentation through the messaging area
- Breaks will happen after each chapter and will last about 10-15 minutes

INTRODUCTION

- OVER THE PAST 30 YEARS AQUATICS HAS BECOME ONE OF AMERICA'S MOST POPULAR RECREATIONAL ACTIVITIES.

- SWIMMING POOLS CAN BE A GREAT SOURCE OF FUN AND EXCITEMENT AND THEY'RE RAPIDLY INCREASING IN NUMBERS. WITH INCREASED USAGE POOLS, IF NOT PROPERLY OPERATED, CAN BECOME A DANGEROUS RISK TO THE HEALTH AND SAFETY OF THE PUBLIC. THE JOB OF THE SWIMMING POOL OPERATOR, POOL MANAGERS, AND LIFEGUARDS IS TO PROVIDE THE MAXIMUM AMOUNT OF BENEFIT WITH THE LEAST AMOUNT OF RISK.

- ALTHOUGH IT IS IMPOSSIBLE TO SUPPLY EVERY BIT INFORMATION REGARDING POOL OPERATIONS, AQUATIC TRAINING AND CONSULTING SERVICES HOPES THAT ITS MANUAL AND COURSE WILL PROVIDE YOU THE BASIC FUNDAMENTALS NECESSARY TO RUN A SAFE AND HEALTHY FACILITY.

AQUATIC TRAINING SERVICE'S MANUAL

- THE PROFESSIONAL SWIMMING POOL OPERATOR
- WATER BALANCE
- PREVENTION OF DISEASE TRANSMISSION
- POOL AND SPA WATER DISINFECTION
- POOL AND SPA WATER TREATMENT PROBLEMS
- WATER TESTING
- CHEMICAL AUTOMATION
- WATER CIRCULATION
- FILTRATION SYSTEMS
- SPA MAINTENANCE
- CHEMICAL SAFETY
- MAINTENANCE & OPERATION
- LEGALITY AND LIABILITY

ATCS

AQUATIC TRAINING & CONSULTING SERVICES

12 THINGS THAT CLOSE YOUR POOL

1. NO POOL OPERATOR ON DUTY
2. NO LIFEGUARD WITH CURRENT CERTIFICATIONS IN THE STAND
3. CHEMICALS ARE NOT IN SPECIFIED RANGES (ESPECIALLY CL AND PH)
4. CHEMICAL FEEDERS AT NOT WORKING FOR 24 HOURS
5. FILTRATION SYSTEM NOT WORKING FOR 1 HOUR
6. WATER IS BELOW THE SKIMMERS
7. MAIN DRAIN IS NOT EASILY VISIBLE
8. BATHROOM AND DRAINS ARE NOT OPERATIONAL
9. FACILITY PRESENTS DANGER TO PATRONS
10. FLOW RATE IS INSUFFICIENT FOR ADEQUATE TURNOVER
11. PHONE IS NOT OPERATIONAL
12. HEALTH INSPECTOR IS DENIED ACCESS TO THE FACILITY

THE PROFESSIONAL SWIMMING POOL OPERATOR'S QUALIFICATIONS:

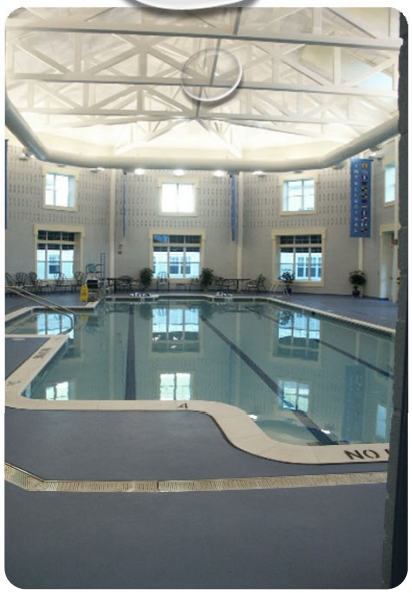
- AT LEAST 16 YEARS OF AGE
- ATTEND ALL SESSIONS
- 75% OR BETTER ON EXAM
- CERTIFICATION IS VALID FOR 3 YEARS IN MOST JURISDICTIONS

THE PROFESSIONAL SWIMMING POOL OPERATOR (PSPO)

A PSPO is someone with swimming pool and spa operations knowledge, including but not limited to water disinfection and chemistry, along with circulation, filtration, patron safety & health concerns, and other miscellaneous aquatic topics.

In short, a PSPO is

- RESPONSIBLE FOR THEIR FACILITY'S
  - SAFETY
  - HEALTH
  - MAINTENANCE
- RESPONSIBLE FOR THE MANAGEMENT OF THEIR
  - PATRONS
  - STAFF
  - SELF


REGARDLESS OF THE SIZE OR SHAPE OF YOUR POOL THERE ARE SOME BASICS WE ALL FOLLOW!

Basic Pool Operation Need To Knows

A. CERTIFIED POOL OPERATOR MUST BE PRESENT (OR IN IMMEDIATE CONTROL) FOR A POOL TO BE OPEN

B. GUARD TO SWIMMING PATRON RATIO IS 50 TO 1 FOR MOST STATE REGULATIONS, ATCS RECOMMENDS 25 TO 1

C. FACTORS THAT AFFECT NUMBER OF GUARDS ON DUTY: SKILL OF SWIMMERS, NUMBER OF SWIMMERS IN THE POOL, SHAPE OF FACILITY, TEMPERATURE OR ACTIVITY.

D. POOL READINGS CHLORINE AND PH TAKEN EVERY TWO HOURS, TOTAL ALKALINITY., CALCIUM HARD AND CYANURIC ACID EVERY WEEK.

E. PHONE MUST BE WORKING. IF A CELL PHONE IS DESIGNATED AS THE PHONE IT MUST BE FOR EMERGENCIES ONLY, OTHERWISE THE POOL MUST BE CLOSED

F. RESULTS IF NO LIFEGUARD IS ON THE DECK IS THAT POOL WILL BE CLOSED BY A HEALTH INSPECTOR

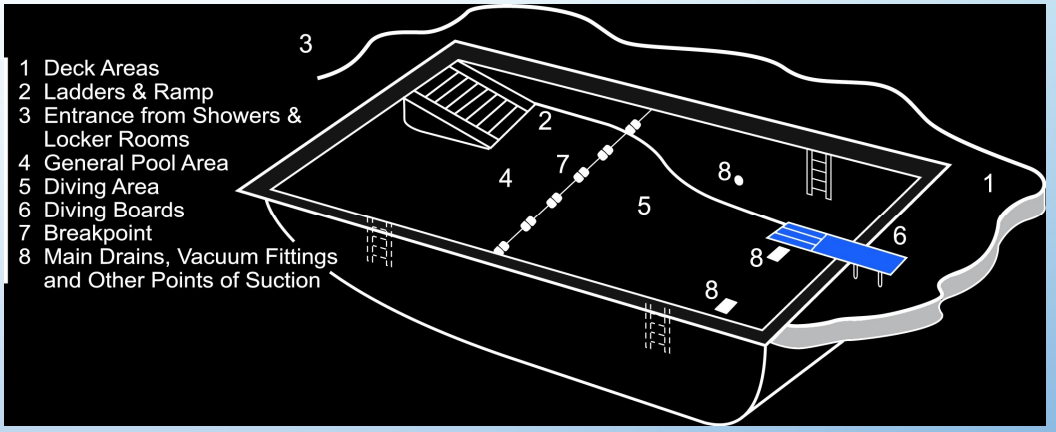
G. POOL CERTIFICATION MUST BE POSTED. BOTH POOL OPS AND LGT CERTS SHOULD BE POSTED IN THE GUARD ROOM AT EACH POOL.

QUESTIONS ON ALMOST EVERY POOL OPERATOR TEST!

LIFEGUARDS HOW MANY?

- MINIMUM NUMBER BY CODE
- SIZE OF POOL
- SHAPE OF POOL
- OBSTRUCTIONS TO VISION
- SKILL OF SWIMMERS
- LOCATION OF SWIMMERS

Consider the danger areas!!



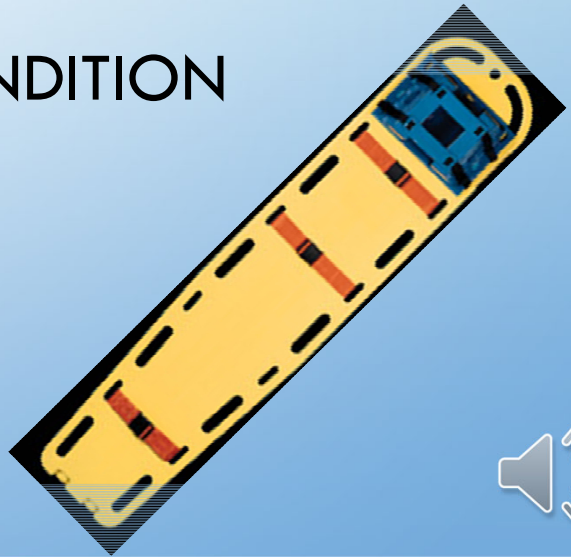
JOB DESCRIPTION OF A POOL OPERATOR

- CONDUCT A WEEKLY INSPECTION OF THE POOL OR SPA AND RELATED FACILITIES (BATHROOMS, EQUIPMENT ROOM, ETC.).
- ARRIVE AT THE FACILITY PRIOR TO OPENING TO MEASURE, RECORD, AND ADJUST, IF NECESSARY, ALL CHEMICAL LEVELS.
- BE ON-SITE OR PRESENT ACCORDING TO THE LOCAL JURISDICTIONAL CODE.
- MEASURE AND RECORD ALL NECESSARY INFORMATION IN THE TIME FRAME SPECIFIED: MOST PUBLIC FACILITIES REQUIRE THE CHLORINE AND PH TO BE TESTED EVERY TWO HOURS IN A MAIN POOL, EVERY HOUR IN A SPA, AND FOR THESE RECORDS TO REMAIN ON-SITE FOR TWO YEARS AND POSSESSED FOR AT LEAST THREE YEARS
- CLEAN THE FILTRATION SYSTEM WHEN APPROPRIATE
- MAINTAIN DISINFECTANT RESIDUALS ACCORDING TO THE LOCAL CODES.
- MAINTAIN WATER CHEMISTRY ACCORDING TO THE LOCAL CODES.
- ENSURE THAT CHEMICALS ARE USED ACCORDING TO MANUFACTURERS' INSTRUCTIONS AND ARE SAFELY DEPOSITED IN THE WATER.
- ENSURE THAT THE WATER TEMPERATURE FOR A HEATED PUBLIC POOL OR SPA DOES NOT EXCEED THE LOCAL CODES.
- SHOCK THE POOL/SPA ACCORDING TO THE LOCAL CODES.
- CLOSE A POOL OR SPA WHEN APPROPRIATE
- SIGN AND DATE ALL DOCUMENTS.

SAFETY EQUIPMENT

A POOL OPERATOR MUST ENSURE

- THE FACILITY HAS ALL REQUIRED SAFETY EQUIPMENT
- THE EQUIPMENT IS IN OPERATIONAL CONDITION
- THE STAFF TRAINED IN PROPER USE



SOME WORDS OF WISDOM

RUNNING A POOL IS A LOT ABOUT PUBLIC RELATIONS

- IT'S NOT ONLY WHAT YOU SAY, BUT HOW YOU SAY IT
- EDUCATE THE PATRONS AND STAFF
- ACT PROFESSIONALLY AND PEOPLE WILL TREAT YOU LIKE A PROFESSIONAL
- ENFORCE ALL THE RULES, ALL THE TIME
- ITS OKAY NOT TO KNOW EVERYTHING, JUST DON'T LIE

THE ACTIONS AT MY FACILITY SHOULD:

BE SAFE

Look Safe

Be Defendable

Be Liked By Patrons

LIFEGUARDS

- MAY OR MAY NOT BE REQUIRED BY CODE
- IF REQUIRED, LIFEGUARDS MUST 15 YEARS OR OLDER
- RED CROSS LIFEGUARD CERTIFICATIONS ARE VALID FOR TWO YEARS
- RED CROSS CPR CERTIFICATIONS ARE VALID FOR TWO YEARS
- IF LIFEGUARDS ARE NOT REQUIRED: CHECK LOCAL CODE FOR EXACT WORDING

ROLES OF A LIFEGUARD

5 ROLES OF A LIFEGUARD

1. RECOGNITION
2. PREVENTION
3. RESCUE
4. INITIATION
5. SUPPORT

SOME STATISTICS YOU SHOULD KNOW:

- 25% OF NON-BREATHERS ARE UNDER 3 YEARS OF AGE AND IN LESS THAN 3 FEET OF WATER.
- MOST RESCUES INVOLVE A VICTIM YOUNGER THAN 7, UNDER 4 FEET TALL AND IN 4 FEET OF WATER OR LESS.
- A BOY IS FOUR TIMES MORE LIKELY TO DROWN THAN A GIRL.
- DROWNING IS THE SECOND LEADING CAUSE OF DEATH IN YOUNG PEOPLE.
- 1 OUT OF EVERY 124,000 PATRONS WILL DIE DUE TO DROWNING AT SWIMMING POOLS IN THE U.S. THIS SUMMER.
- MOST DROWNINGS WHEN A LIFEGUARD IS PRESENT HAPPEN WITHIN SIX FEET OF THE LIFEGUARD

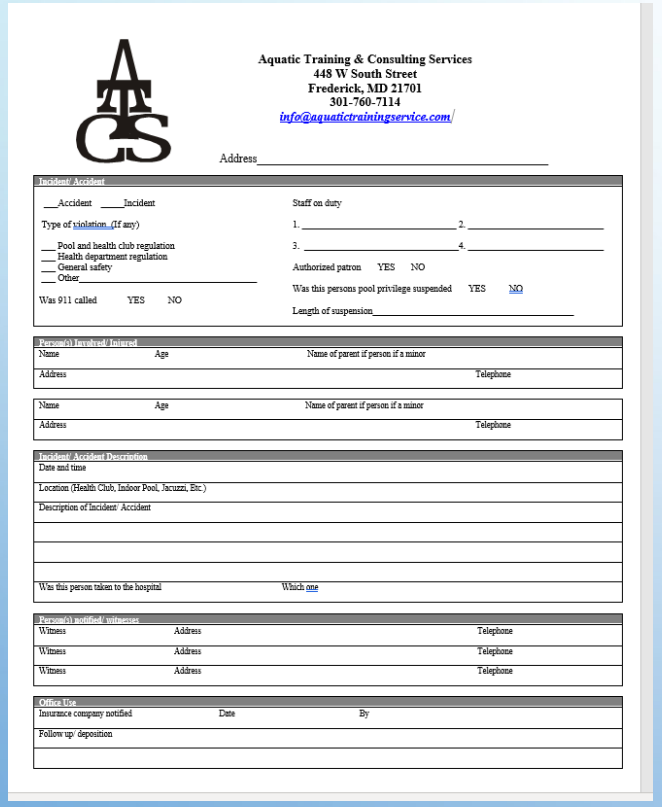
BE PREPARED!

Prevention is the key to a safe facility but when accident happen your staff should be ready.

- Do regular in-service trainings
- Review the Emergency Action Plan
- Always have a guard in the chair
- Post signs clearly for the public
- Do drills during regular hours
- Do not allow drugs and alcohol

RECORD KEEPING

- TYPICAL RECORDS
  - DAILY/WEEKLY OPERATING RECORD
  - POOL AND SPA ENTRAPMENT HAZARD CHECKLIST
  - ACCIDENT/ILLNESS REPORTS
  - BATHER REPRIMANDS
  - INSPECTION REPORTS
  - PREVENTIVE MAINTENANCE RECORDS
  - STAFF RECORDS



Aquatic Training & Consulting Services
448 W South Street
Frederick, MD 21701
301-760-7114
info@aquatictrainingservice.com

Address_____

Incident/ Accident

___Accident ____Incident

Type of violation..(If any)

___ Pool and health club regulation
___ Health department regulation
___ General safety
___ Other_____

Was 911 called YES NO

Staff on duty

1._____ 2._____

3._____ 4._____

Authorized patron YES NO

Was this persons pool privilege suspended YES NO

Length of suspension_____

Person(S) Involved/ Injured

Name	Age	Name of parent if person if a minor	
Address			Telephone
Name	Age	Name of parent if person if a minor	
Address			Telephone

Incident/ Accident Description

Date and time

Location (Health Club, Indoor Pool, Jacuzzi, Etc.)

Description of Incident/ Accident

Was this person taken to the hospital Which one

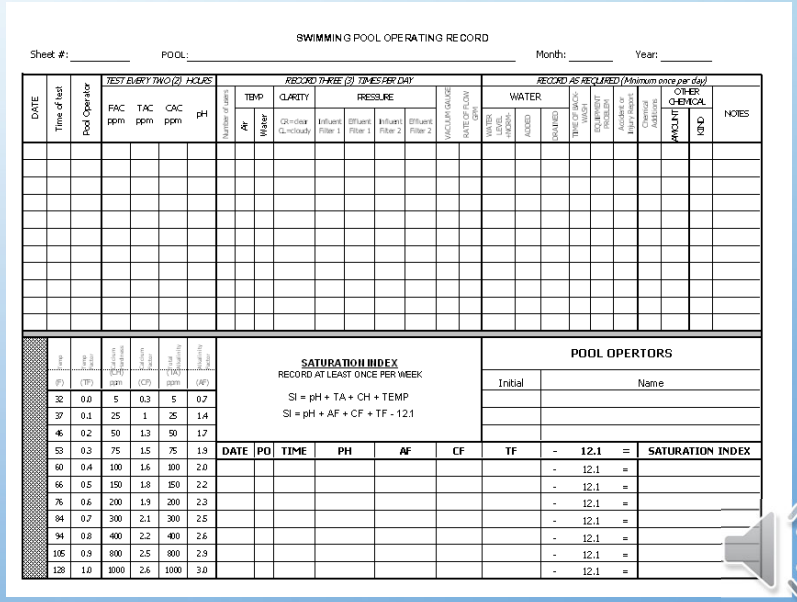
Person(S) Involved/ Witnesses

Witness	Address	Telephone
Witness	Address	Telephone
Witness	Address	Telephone

Office Use

Insurance company notified Date By

Follow up/ deposition



SWIMMING POOL OPERATING RECORD

Sheet #: _____ POOL: _____ Month: _____ Year: _____

DATE	Time of Test	Pool Operator	TEST EVERY TWO (2) HOURS				RECORD THREE (3) TIMES PER DAY									RECORD AS REQUIRED (Minimum once per day)								
			FAC ppm	TAC ppm	CAC ppm	pH	Number of Jumpers	TEMP Air	TEMP Water	CLARITY (CR=clear CL=cloudy)	PRESSURE Influent Filter 1	PRESSURE Effluent Filter 1	PRESSURE Influent Filter 2	PRESSURE Effluent Filter 2	VACUUM GAUGE	RATE OF FLOW GPM	WATER WATER LEVEL ADJUSTED	WATER ADDED	WATER DRAINED	TIME OF BACK WASH	EQUIPMENT PROBLEMS	Accident or Unusual Occurrence	Chemical Additions	OTHER CHEMICAL AMOUNT	OTHER CHEMICAL KIND	NOTES

(F)	(TF)	Total Hardness (CH) ppm	Calcium Hardness (CF)	Total Alkalinity (TA) ppm	Cyanuric Acid (AF)
32	0.0	5	0.3	5	0.7
37	0.1	25	1	25	1.4
46	0.2	50	1.3	50	1.7
53	0.3	75	1.5	75	1.9
60	0.4	100	1.6	100	2.0
66	0.5	150	1.8	150	2.2
76	0.6	200	1.9	200	2.3
84	0.7	300	2.1	300	2.5
94	0.8	400	2.2	400	2.6
105	0.9	800	2.5	800	2.9
128	1.0	1000	2.6	1000	3.0

SATURATION INDEX
RECORD AT LEAST ONCE PER WEEK

SI = pH + TA + CH + TEMP
SI = pH + AF + CF + TF - 12.1

DATE	PO	TIME	PH	AF	CF	TF	-	12.1	=	SATURATION INDEX
							-	12.1	=	
							-	12.1	=	
							-	12.1	=	
							-	12.1	=	
							-	12.1	=	
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							-	12.1	=	
							-	12.1	=	

POOL OPERTORS

Initial	Name

WHY ARE RECORDS IMPORTANT?

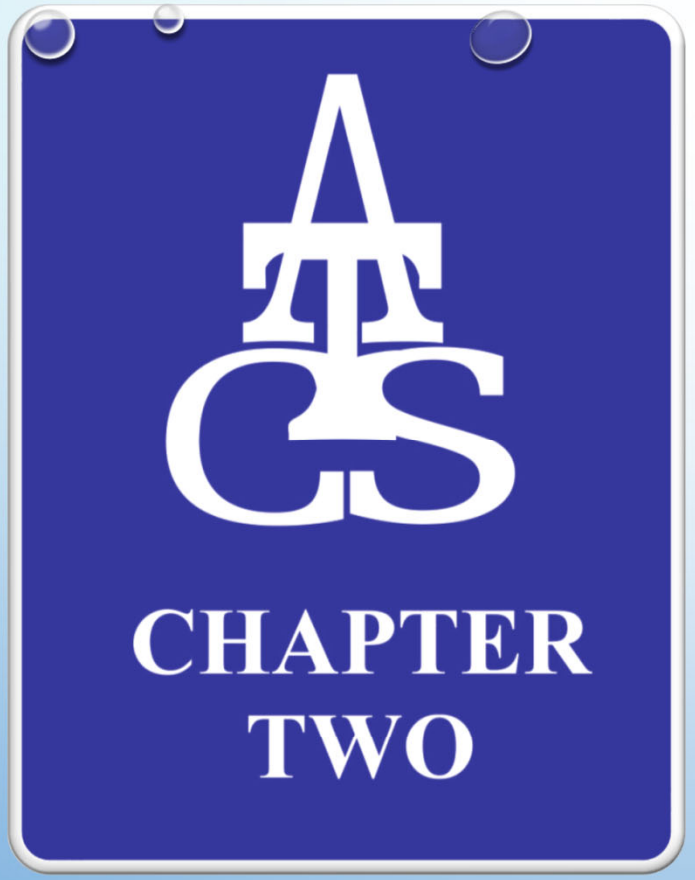
- SNAPSHOT INTO YOUR DAILY OPERATIONS
- BEST PROOF – OPERATED IN ACCORDANCE WITH CODES AND STANDARDS
- MAINTAIN RECORDS 3-5 YEARS (CHECK WITH ATTORNEY FOR LOCAL REQUIREMENTS)

ROLE OF THE HEALTH DEPARTMENT

- FORMULATE THE GUIDELINES
- REGULATE THE FACILITIES
- ENFORCE THE REGULATIONS
- INSPECT DUE TO RIGHT OF ACCESS
- ADMINISTER COMPLIANCE VIOLATIONS

RULES EVERY FACILITY SHOULD HAVE:

- Require everyone to shower before entering the pool
- Swimming is only permitted when a lifeguard is on duty
- NO ONE is permitted in the pool with open cuts, sores, rashes, or bandages (consider having all band-aids removed before entering the pool)
- No glass containers
- No running, pushing, or horseplay
- No diving in less than 5 feet
- Only 1 bounce and 1 person on the diving board at once



WATER BALANCE

HOW TO CHEMICALLY BALANCE YOUR SWIMMING POOL

WATER BALANCE
"POOL HAPPINESS"

FIVE FACTORS CRITICAL TO ACHIEVING WATER BALANCE:

- PH
- TOTAL ALKALINITY (TA)
- CALCIUM HARDNESS (CH)
- TOTAL DISSOLVED SOLIDS (TDS)
- TEMPERATURE (T)

Too Low of Readings Causes Corrosion

Too High of Readings Causes Scaling

PH

PH IS THE MOST IMPORTANT PART OF WATER BALANCE

pH is how acidic or basic a solution is.

pH is measured on a 0-14 scale. That means a neutral pH is 7.0 (distilled water).

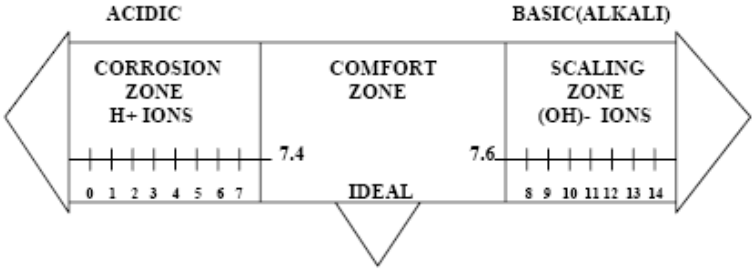
The pH of the human eye is 7.5. Therefore the pH should be maintained between 7.2-7.8.

pH should be tested every two hours in larger pools and every hour in a spa with phenol red.

High pH causes scaling & the loss of Chlorine's effectiveness

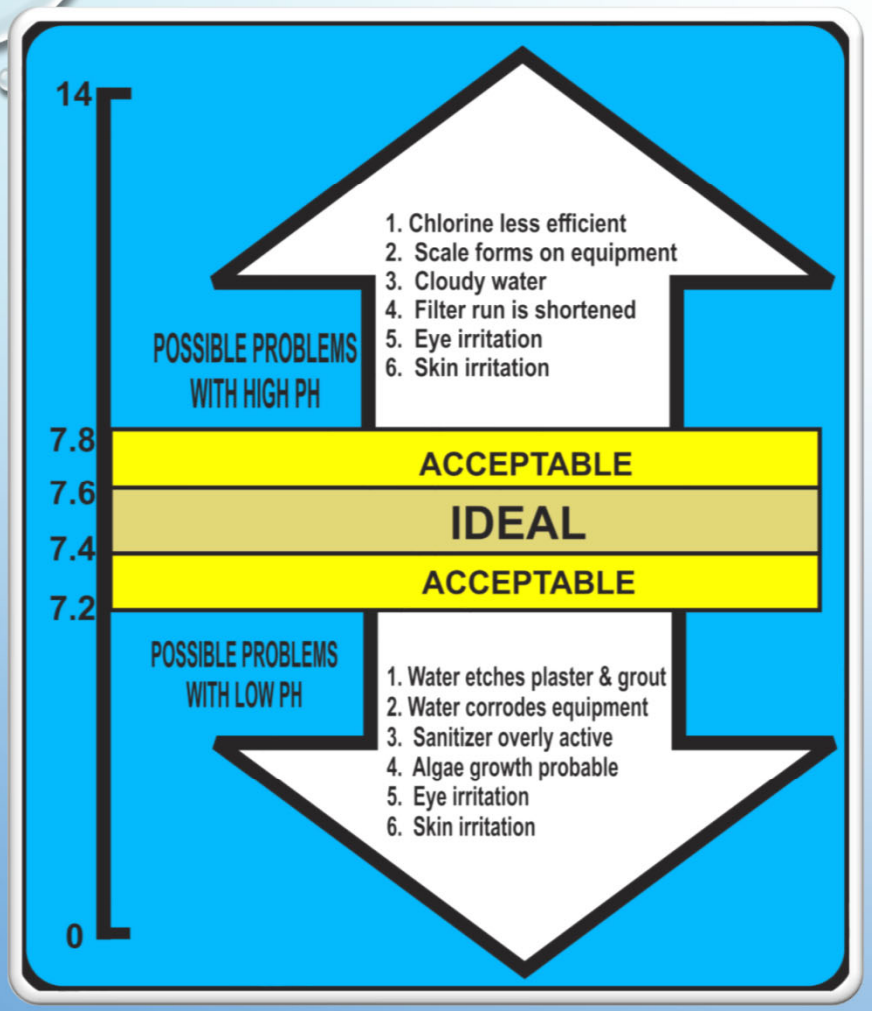
Low pH is corrosive & will damage metals in your pool and mechanical system.

WHAT IS pH?



PROBLEMS

LOW pH	HIGH pH
FASTER CHLORINE LOSS	FORMS SCALES
FORMS CHLORAMINES	CLOUDS WATER
EYE IRRITATION	SHORT FILTER RUNS
ETCHING OF PLASTER	POOR CHLORINE
WRINKLING OF LINER	HYPOCHLOROUS ACID
CORRODES EQUIPTMENT AND METAL ACCESSORIES	FEWER H+ IONS PRESENT



FACTORS TRYING TO AFFECT THE PH

SWIMMERS (PERSPIRATION)

SANITIZER

MAKE-UP WATER

Sanitizers effect on pH CHANGE

Chemicals	Gas Chlorine	Gas Cl_2	Lowers pH
	Sodium Hypochlorite	NaOCl	Raises pH
	Calcium Hypochlorite	$Ca(Ocl)^2$	Raises pH
	Lithium Hypochlorite	LiOCl	Raises pH
	DiChlorocyanuric	DiChlor	Nearly Neutral
	Trichlorcyanuric	TriChlor	Lowers pH
	Bromine		Lowers pH

PHENOL RED

PHENOL RED, LIQUID OR TABLET, IS THE MOST COMMON PH-TESTING REAGENT. IT IS AN ACID/BASE INDICATOR THAT CHANGES COLOR BETWEEN PH 6.4 AND 8.0.

THE MORE YELLOW THE COLOR, THE LOWER THE PH.

THE MORE RED THE COLOR, THE HIGHER THE PH.

THERE ARE PH METERS, WHICH ARE VERY ACCURATE AND ALSO VERY EXPENSIVE. IF THE DISINFECTANT LEVEL IS HIGH (ABOVE 10 PPM), ADD 1 DROP OF LIQUID SODIUM THIOSULFATE (DISINFECTANT NEUTRALIZER) TO NEUTRALIZE THE SAMPLE, BEFORE ADDING THE PHENOL RED.

THE PH USUALLY NEEDS TO BE TESTED EVERY 1-2 HOURS, CHECK WITH THE LOCAL HEALTH DEPARTMENT.

TESTING PH

PH TEST

- •YOU NEED TO WASH AND FILL THE LARGE COMPARATOR TUBE WITH 44 ML WATER SAMPLE.
- INSTILL 5 DROPS OF PH IND SOL. CLOSE THE CAP AND SWIRL TO MIX.
- MATCH THE RESULTED COLOR WITH THE COLORS IN THE CHART AND RECORD IT AS PH UNITS. IF THE RESULT SUGGESTS A PH
- ADJUSTMENT, SAVE THE SAMPLE FOR FUTURE REFERENCE.
- FOR A SAMPLE COLOR THAT FALLS BETWEEN TWO VALUES, THE AVERAGE OF THESE TWO VALUES IS YOUR PH UNIT.
- TO DECREASE PH: YOU NEED TO SEE ACID DEMAND TEST.
- TO INCREASE PH: YOU NEED TO SEE BASE DEMAND TEST.

If the pH of water is allowed to be either in the acidic or basic range for too long a period of time, problems can start to develop. These are long-range problems that can have serious effects on the pool surface and equipment as well as water quality. To adjust pH the pool operator should use one of the following methods:

PH ADJUSTMENT

TO INCREASE PH

- SODA ASH (SODIUM CARBONATE)

TO DECREASE PH

- MURIATIC ACID
- SODIUM BISULFATE
- CARBON DIOXIDE

TOTAL ALKALINITY

- MEASUREMENT OF CARBONATES, BICARBONATES, HYDROXIDES, AND CYANURATES IN THE WATER
- MEASURE OF WATER'S ABILITY TO RESIST A CHANGE TO ITS PH
- BUFFERING CAPACITY (THE PH BUFFER) IF THE TA IS TOO LOW THE PH WILL BOUNCE

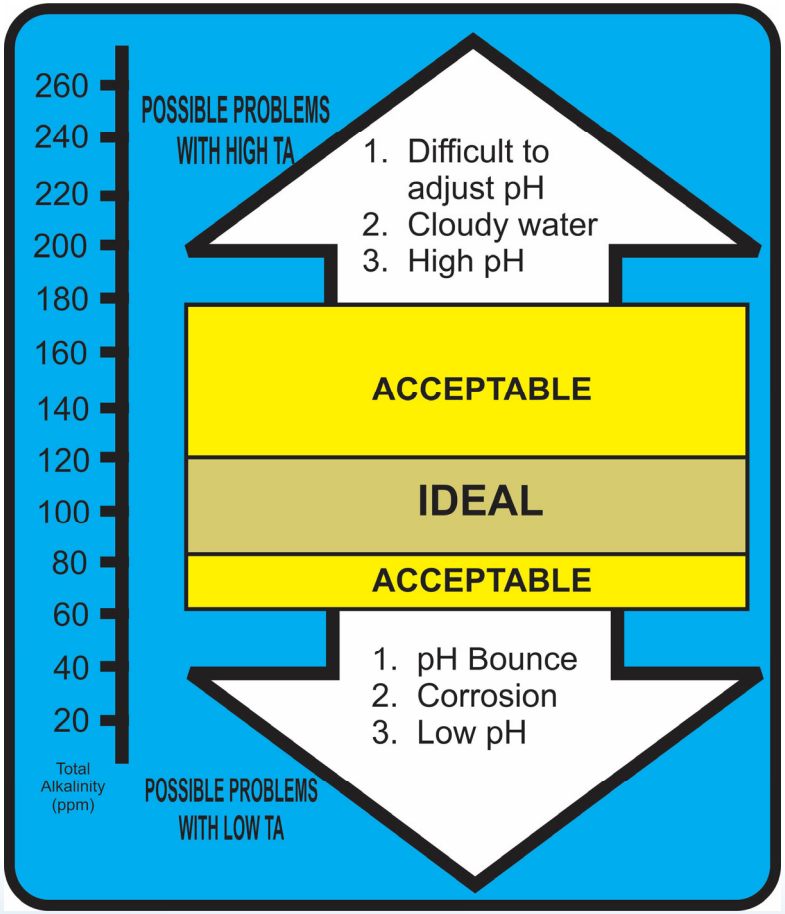
40 – 50 – 60 – 70 – 80 – 90 – 100 – 110 – 120 – 130 – 140 – 150 – 160 – 170 – 180 -190 -200

I----------Ideal----------I

I----------Acceptable----------I

Recommended Range:
60-180 ppm
Ideal Range:
80-120 ppm
80 – 100 with basic sanitizers
100 – 120 with acidic sanitizers

TOTAL ALKALINITY



Too High

pH is locked in place

Water is Cloudy

Scaling

Too Low

pH "bounces" up and down

Corrosion and Etching

TOTAL ALKALINITY

TOTAL ALKALINITY TEST

- You need to wash and fill the large comparator tube with 25 ml water sample.

- Instill 2 drops of R-007 THIOSULFATE N/10. Close the cap and mix.

- Instill 5 drops of R-008 TOTAL ALKALINITY INDICATOR. Close the cap and mix. You should notice the sample turning green.

- Instill R-009 SULFURIC ACID. You need to count every drop, and then mix after each drop until the water sample's color changes from green to red.

- Multiply the drops of SULFURIC ACID by ten (10). Record the result as parts per million

TEST ONCE PER WEEK IN A MAIN POOL AND ONCE PER DAY IN A SPA

Not controlling the Total Alkalinity is one of the biggest mistakes made by pool operators. Low TA will cause the pH to bounce making maintaining your facility nearly impossible. Facilities that use Carbon Dioxide at their facilities to maintain pH will experience high TA over time. To adjust TA the pool operator should use one of the following methods:

TOTAL ALKALINITY ADJUSTMENT

TO INCREASE TA

- BAKING SODA (SODIUM BICARBONATE)

TO DECREASE TA

- MURIATIC ACID
- SODIUM BISULFATE

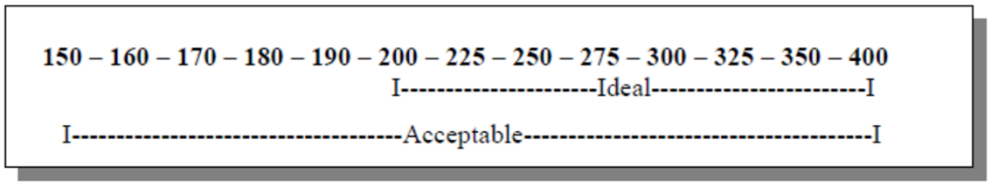
CALCIUM HARDNESS

POOL/SPA WATER NEEDS CALCIUM HARDNESS

- TOO HIGH CAUSES SCALING & CAN RESTRICT WATER FLOW IN YOUR PIPES AND DAMAGE YOUR HEATER.
- TOOL LOW CAUSES CORROSION AND WILL RUIN THE SIDES AND BOTTOM OF YOUR POOL STRUCTURE.

AMOUNT OF CALCIUM THAT CAN BE DISSOLVED IS CONTROLLED BY:

- WATER TEMPERATURE
- PH
- CARBONATE ALKALINITY



Recommended Range:
150-400 ppm
Ideal Range:
200-400 ppm

CALCIUM HARDNESS

Calcium Hardness Test

• You need to wash and fill the large comparator tube with 25 ml water sample.

• Add 20 drops R-0010. Swirl to mix.

• Add 5 drops R-0011L. Swirl to mix. If Calcium Hardness is present, sample will turn red.

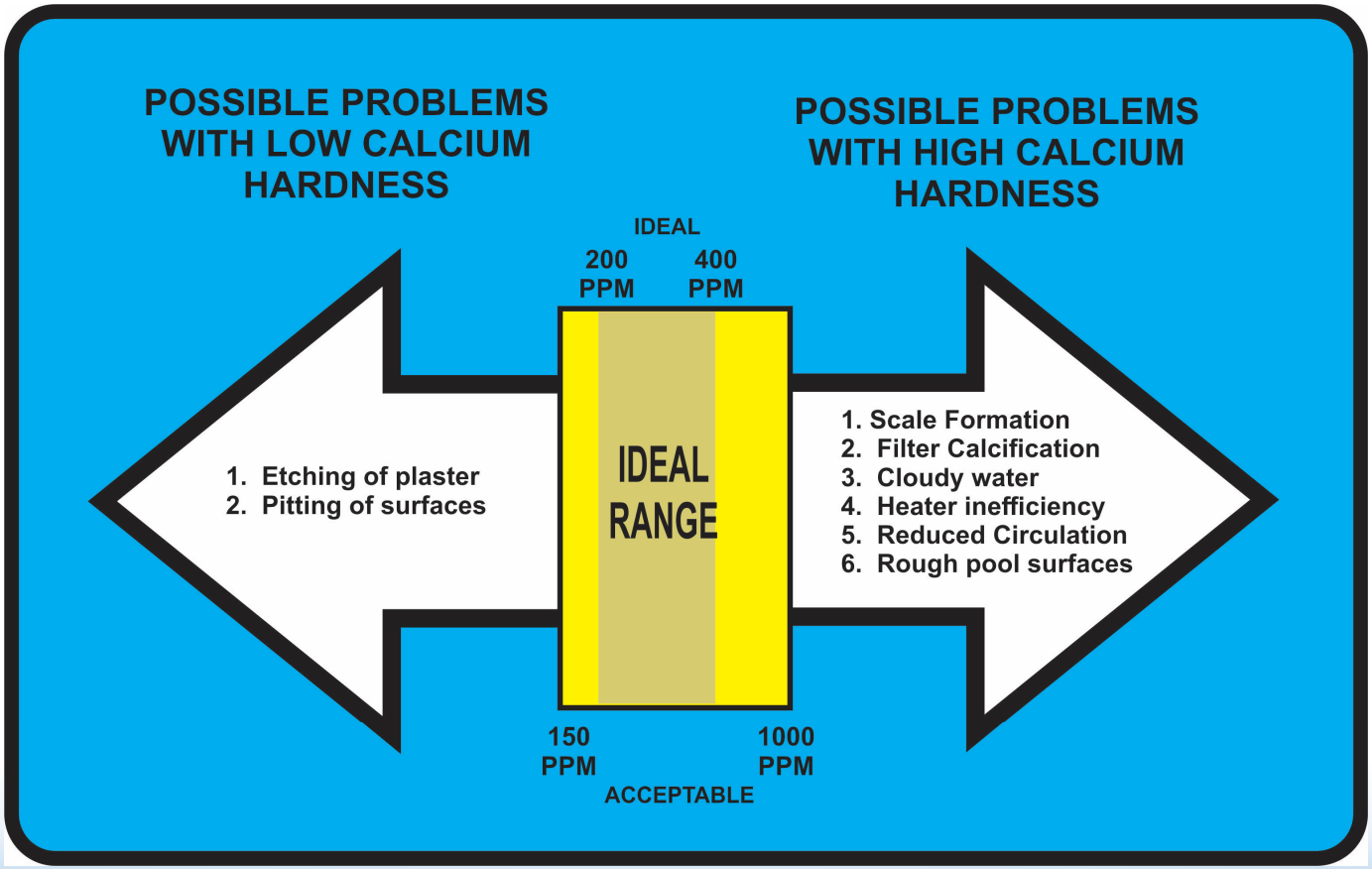
• Add R-0012 dropwise. After each drop, count and swirl to mix until color changes from red to blue.

• Multiply drops in Step 4 by 10. Record as parts per million (ppm) calcium hardness as calcium carbonate.

* When high CH is anticipated, this procedure may be used: Use 10 mL sample, 10 drops R-0010, 3 drops R-0011, and multiply drops in Step 4 by 25

TEST ONCE PER WEEK IN A MAIN POOL AND ONCE PER DAY IN A SPA

CALCIUM HARDNESS



Remember to make all chemical adjustments when possible at the end of the night. Calcium Chloride is also used as Ice Melt and that is not something, we want floating in the water for your swimmers to swallow!

To adjust CH the pool operator should use one of the following methods:

CALCIUM HARDNESS ADJUSTMENT

TO INCREASE CH

- CALCIUM CHLORIDE

TO DECREASE CH

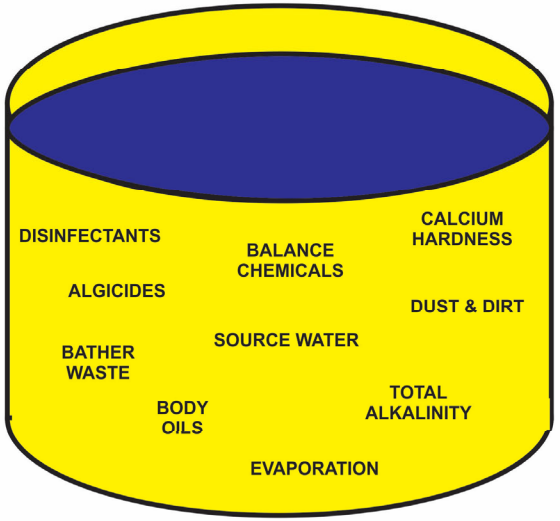
- REPLACE THE WATER WITH WATER THAT HAS LESS CALCIUM (DRAIN & FILL)

TOTAL DISSOLVED SOLIDS

All minerals, metals and matter that can not be eliminated with a chemical. Total Dissolved Solids should be kept below 1500 ppm (unless you operating a saltwater pool) and should be checked everyday in an indoor swimming pool.

SOURCES OF TOTAL DISSOLVED SOLIDS IN POOL WATER INCLUDE:

POTABLE WATER	200-600 PPM
BRACKISH WATER	3,000-5,000 PPM
SEA WATER	35,000 PPM
GREAT SALT LAKE	260,000 PPM



HOT TUBS ARE A TDS PROBLEM!

Cold water climates are not generally required to test TDS as their pools are used only for a portion of the year and are drained and refilled each season. Indoor pools and hot tubs are required to be checked once per!
To adjust TDS the pool operator should use one of the following methods:

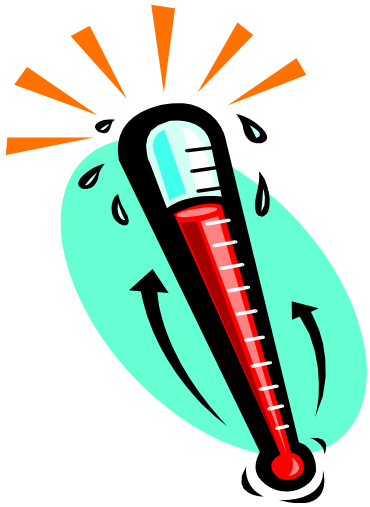
TOTAL DISSOLVED SOLIDS ADJUSTMENT

TO DECREASE TDS

- REPLACE THE WATER WITH WATER THAT HAS LESS TDS (DRAIN & FILL)

TEMPERATURE

- AFFECTS SOLUBILITY OF CHEMICALS
- MOST CHEMICALS MORE SOLUBLE AS TEMPERATURE INCREASES (CALCIUM CARBONATE DECREASES)
- TEMPERATURE SHOULD NOT BE CONSIDERED IN CHANGING WATER BALANCE



Ideal range for pools:

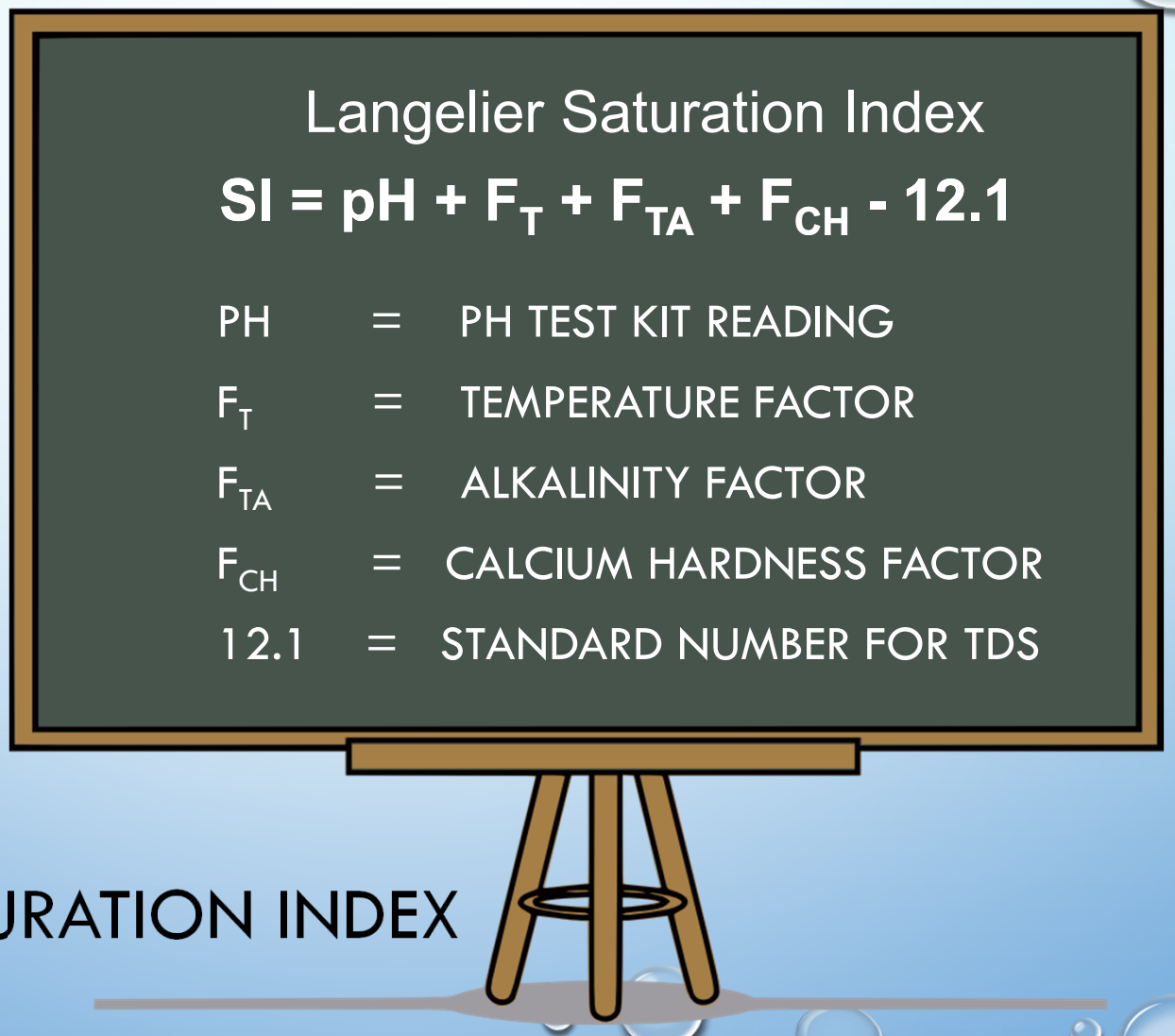
- Most pools operate between 83° F and 85° F
- Most spas operate between 101° F and 102° F

78° – 82° F

Maximum recommended for

General use pools:	88° F
Therapy pools:	96° F
Spas:	104° F

LANGELIER SATURATION INDEX



LANGELIER SATURATION INDEX

Langelier Saturation Index

$$\mathbf{SI = pH + F_T + F_{TA} + F_{CH} - 12.1}$$

The closer to 0 the SI is, the more balanced the water is.

Acceptable range: -0.3 to +0.5

Ideal range: -.3 to +.3

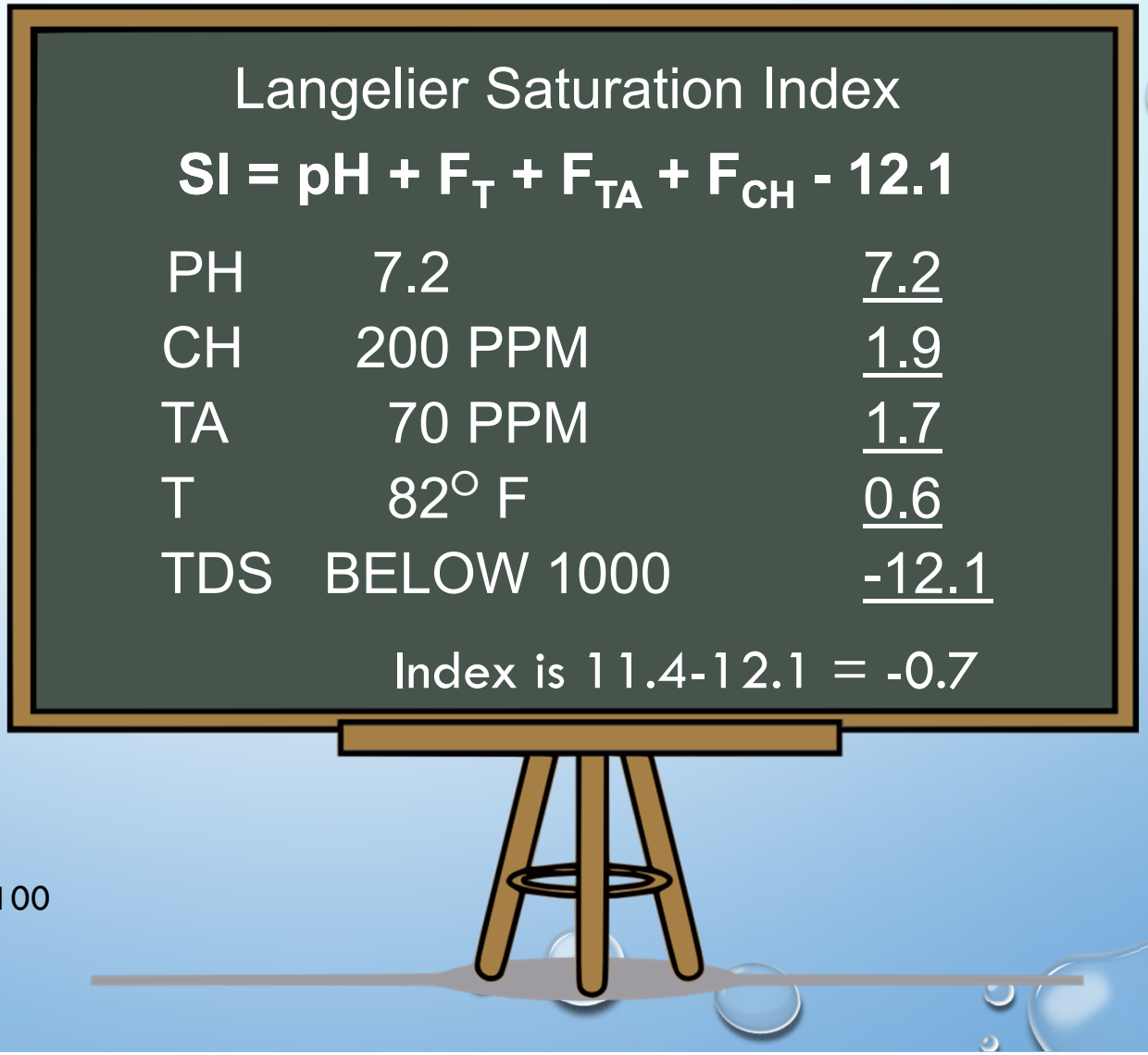
Below -0.5 – corrosion is produced

Above +0.5 – scale is produced

Formula = pH + CF + AF + TF – 12.1

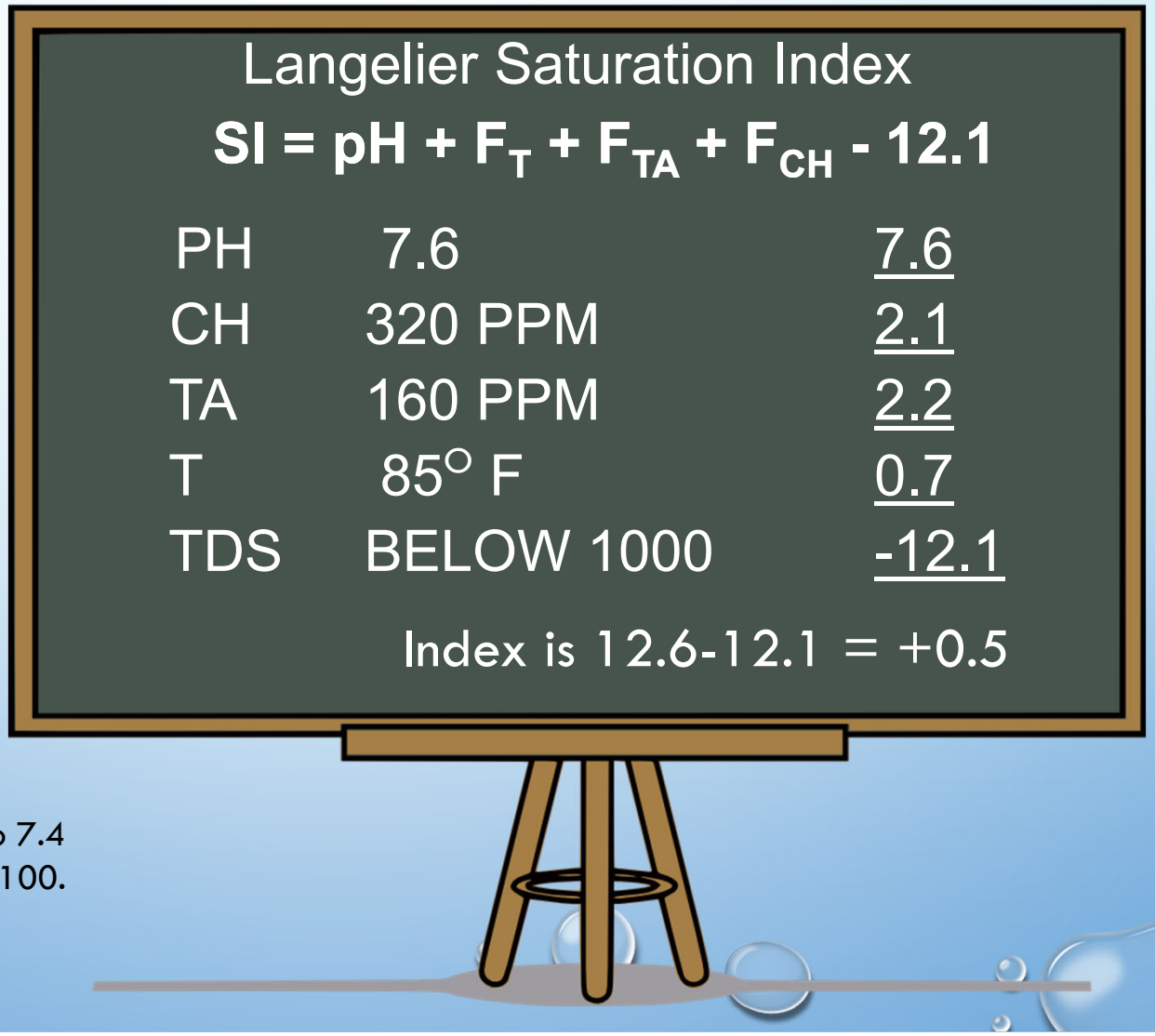
Calcium Hardness		Total Alkalinity		Temperature	
PPM	CF	PPM	AF	F	TF
5-24	0.3	5-24	0.7	32-26	0.0
25-49	1.0	25-49	1.4	37-45	0.1
50-74	1.3	50-74	1.7	46-52	0.2
75-99	1.5	75-99	1.9	53-59	0.3
100-140	1.6	100-149	2.0	60-65	0.4
150-199	1.8	150-199	2.2	66-75	0.5
200-299	1.9	200-299	2.3	76-83	0.6
300-399	2.1	300-399	2.5	84-93	0.7
400-799	2.2	400-799	2.6	94-104	0.8
800-999	2.5	800-999	2.9	105-127	0.9
1000 +	2.6	1000 +	3.0	128 +	1.0

LANGELIER SATURATION INDEX EXAMPLE 1



Recommendations:
Add Soda Ash and raise pH to 7.5
Add Baking Soda and raise TA to 100

LANGELIER SATURATION INDEX EXAMPLE 2



Recommendations:
Add Muriatic Acid and lower pH to 7.4
This should also lower TA closer to 100.

TAYLOR TEST KIT: DETERMINING TA WITHOUT THE MATH

DETERMINING WHAT TO CHANGE

- THERE IS NO RIGHT ANSWER
- GENERALLY IF THE OTHER READING ARE ACCEPTABLE, THE POOL OPERATOR WILL ADJUST PH
- FOCUS ON THE IDEALS
- TYPICALLY THE POOL OPERATOR WON'T ADJUST TEMPERATURE OR TDS TO ACHIEVE WATER BALANCE

CHEMICAL ADDITION

- IF ADDING LARGE AMOUNTS OF CHEMICALS NEED TO BE ADDED IT IS ADVISABLE TO ADD SMALLER AMOUNTS OVER SEVERAL DAYS
- ADD CHEMICALS AT NIGHT WHEN POSSIBLE WHEN NO ONE WILL BE SWIMMING. IF ADDING PRIOR TO THE SWIM DAY, THE POOL OPERATOR SHOULD DILUTE THE CHEMICAL AND KEEP THE POOL CLOSED FOR AT LEAST 30 MINUTES
- SEQUENCE FOR CHEMICAL ADJUSTMENT
    - IF TOTAL ALKALINITY NEEDS TO BE ADJUSTED, CHANGE FIRST;
    - IF CALCIUM HARDNESS NEEDS TO BE ADJUSTED, DO THIS NEXT;
    - IF PH NEEDS TO BE ADJUSTED, DO THIS NEXT (RETEST FIRST, IF ALKALINITY ALSO CHANGED)
    - IF SANITIZERS, CYA, OTHER CHEMICAL PARAMETERS NEEDS TO BE ADJUSTED THEN DO THIS LAST

HOW MUCH CHEMICALS DO I USE?

NEED TO KNOW:

- GALLONAGE OF POOL/SPA
- CALCULATED CHANGE
- PROPER CHEMICAL TO MAKE THE CHANGE

NEED TO REMEMBER:

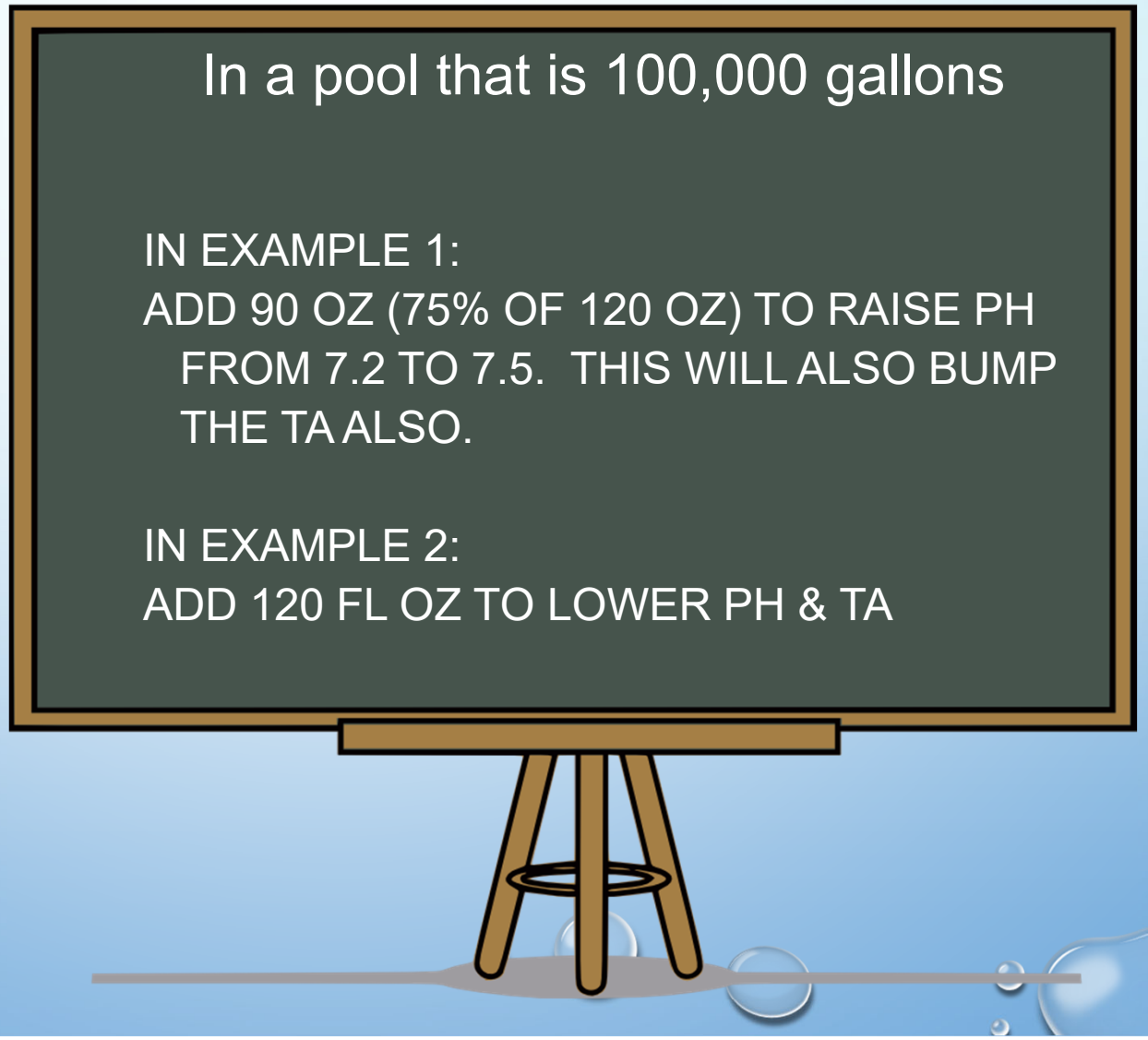
- WEAR YOUR PERSONAL PROTECTIVE EQUIPMENT
- REFER TO YOUR SAFETY DATA SHEETS (A.K.A. MATERIAL SAFETY DATA SHEETS)
- CHEMICALS GO INTO WATER (NEVER WATER INTO CHEMICALS)
- READ THE DIRECTIONS

DOSAGES REQUIRED TO CHEMICALLY TREAT 10,000 GALLONS OF WATER

This information can be found in your book, in the Taylor Test Kit, and on the packaging

PARAMETER – CHEMICAL	REQUIRED DOSAGE
DECREASE PH	
AMOUNT OF MURIATIC ACID TO CHANGE FROM 7.8 TO 7.6	12 FLUID OZS.
INCREASE PH	
AMOUNT OF SODA ASH TO CHANGE PH FOR 7.0 TO 7.4	12 OZS.
DECREASE TOTAL ALKALINITY	
MURIATIC ACID TO REDUCE 10 PPM	1.6 PTS.
MURIATIC ACID TO REDUCE 50 PPM	1.0 GALLON
MURIATIC ACID TO REDUCE 100 PPM	2.0 GALLONS
INCREASE TOTAL ALKALINITY	
SODIUM BICARBONATE TO INCREASE 10 PPM	1.5 LBS.
SODIUM BICARBONATE TO INCREASE 50 PPM	7.5 LBS.
SODIUM BICARBONATE TO INCREASE 100 PPM	15 LBS.
INCREASE CALCIUM HARDNESS	
CALCIUM CHLORIDE (100%) TO INCREASE 10 PPM	1 LB.
CALCIUM CHLORIDE (100%) TO INCREASE 50 PPM	5 LBS.
CALCIUM CHLORIDE (100%) TO INCREASE 100 PPM	10 LBS.

LANGELIER SATURATION INDEX ADJUSTING EXAMPLE 1 AND EXAMPLE 2



LET'S REVIEW:

PH

7.2 TO 7.8

CHECK EVERY TWO HOURS

- ↓ Muriatic Acid
- ↑ Soda Ash

TOTAL ALKALINITY

60 TO 180 PPM

CHECK ONCE PER WEEK

- ↓ Muriatic Acid
- ↑ Baking Soda

CALCIUM HARDNESS

150 TO 400

CHECK ONCE PER WEEK

- ↓ Drain & Fill
- ↑ Calcium Chloride

TOTAL DISSOLVED SOLIDS

UNDER 1500 PPM

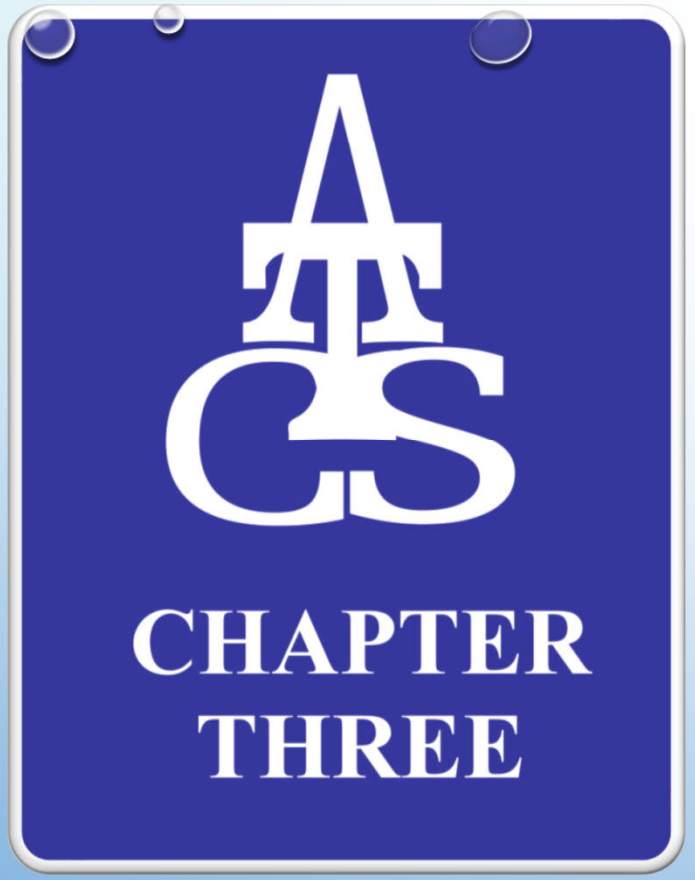
CHECK ONCE PER WEEK

- ↓ Drain & Fill
- ↑ Do not Raise

TEMPERATURE

UNDER 88 FOR MAIN POOL

UNDER 104 FOR SPA



PREVENTING DISEASE TRANSMISSION

RECREATIONAL WATER ILLNESSES

Disease transmission seldom occurs in swimming pools in the United States. Aquatic facilities that are maintained with an appropriate disinfectant like chlorine will eliminate the source of disease before infection can occur. In the rare circumstance that a pool does become the pathway for disease transmission usually there has been a breakdown in the disinfectant levels at the facility. A pool should be considered this pathway if multiple patrons are affected with the same disease or show similar symptoms.

- THE POOL OPERATOR IS RESPONSIBLE FOR ENSURING THE FACILITY IS SAFE AND HEALTHY
- THE POOL OPERATOR'S MAIN SOURCE OF CONTAMINANTS IS THE SWIMMERS

HOW DO MICROORGANISMS END UP IN THE POOL?

- UP TO 38,000 MICRO-ORGANISMS ARE DISCHARGED WITH CLEARING OF THE NOSE.
- 100 MILLION TO 1 BILLION MICRO-ORGANISMS ARE DISCHARGED FROM 1 GRAM (1/3 OF AN OUNCE) OF SALIVA.
- AN ACTIVE SWIMMER CAN CONTRIBUTE 1-2 PINTS OF BODILY FLUIDS PER HOUR. (TO INCLUDE PERSPIRATION, URINE, SALIVA, NOSE DISCHARGE ETC.)
- HANDS MAY SHED ½ TO 5 MILLION ORGANISMS IN A SINGLE WASHING.
- A PERSON SHEDS A LAYER OF DEAD SKIN EACH TIME THEY TAKE A SHOWER, GET INTO A POOL, ETC.

Photo by sabrina shulz

RECREATIONAL WATER ILLNESSES
DISEASES OF CONCERN

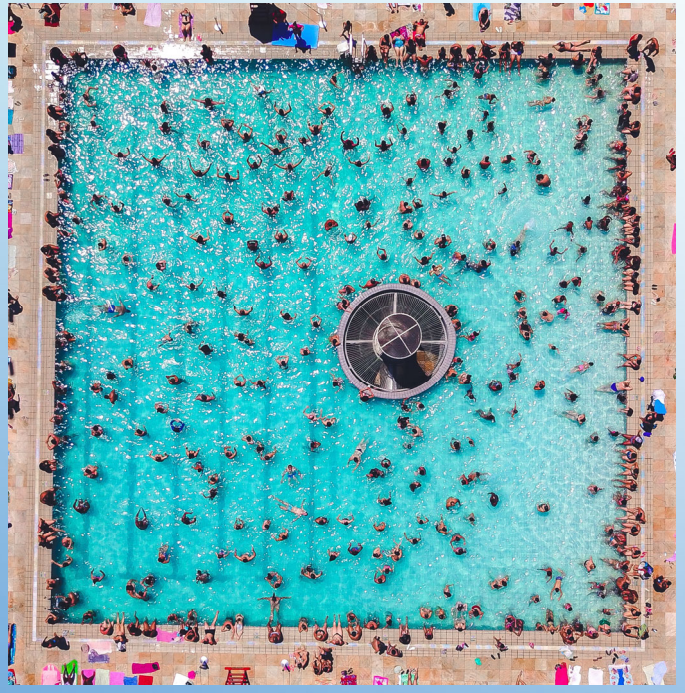


Photo by Sergio Souza

BACTERIA

- PSEUDOMONAS AERUGINOSA
- E. COLI
- STAPHYLOCOCCI
- STREPTOCOCCI

VIRUSES

- HEPATITIS A
- LEGIONELLA
- NORWALK-LIKE
- HIV

PARASITES

- GIARDIA
- CRYPTOSPORIDIUM PARVUM

RECREATIONAL WATER ILLNESSES PREVENTION

Photo by VisionPic.Net

- PROHIBIT USE BY PERSONS WITH OPEN WOUNDS OR KNOWN INFECTIONS
- TREAT AND TEST THE WATER ACCORDING TO CODE
- REQUIRE SOAP SHOWERS PRIOR TO ENTRY
- CONTROL INTRODUCTION OF DIRT AND INFECTIOUS MATERIAL BY MAKING SURE SWIM CLOTHES ARE CLEAN
- REMOVE DEBRIS FROM BOTTOM
- MAINTAIN CIRCULATION AND FILTRATION
- DISINFECT LOCKER ROOMS, TOILET AREAS DAILY; CHECK HOURLY
- IF PROVIDING TOWELS, BE SURE THEY ARE PROPERLY LAUNDERED
- WORK WITH YOUR LOCAL HEALTH DEPARTMENT

HOW IS DISEASE TRANSMITTED:

IN ORDER FOR A DISEASE TO BE TRANSMITTED, THE FOLLOWING FOUR ELEMENTS MUST BE PRESENT:

1. A **PATHOGEN** MUST BE PRESENT
2. THERE IS **ENOUGH OF THAT PATHOGEN** PRESENT TO CAUSE A DISEASE
3. A PERSON MUST BE **SUSCEPTIBLE** TO THE PATHOGEN
4. THE PATHOGEN PASSES THROUGH AN **ENTRY SITE** AND INTO THE BODY

(WITHOUT EACH OF THESE FOUR CRITERIA, INFECTION CANNOT OCCUR)

IN ADDITION, THERE ARE FOUR WAYS FOR A PATHOGEN TO ENTER THE BODY:

1. **DIRECT CONTACT** - TOUCHING ANOTHER PERSON'S BODY FLUIDS
2. **INDIRECT CONTACT** - TOUCHING A CONTAMINATED OBJECT
3. **AIRBORNE** - INHALING INFECTED DROPLETS SUCH AS A SNEEZE OR COUGH
4. **VECTOR-BORNE** - SKIN PIERCED BY AN INFECTIOUS MATERIAL (I.E. INSECT STINGS, ANIMAL BITES)

According to the Center for Disease Controls website:
"The germs that cause recreational water illnesses (RWIs) can be spread when swallowing water that has been contaminated with fecal matter (poop). How? If someone has diarrhea, that person can easily contaminate an entire aquatic venue. The water is shared by all swimmers. It's communal bathing water. It's not sterile. It's not drinking water."

"The good news is that most germs causing RWIs are killed by chlorine within a few minutes. However, chlorine doesn't kill everything right away. It takes time to kill germs and some germs, such as Cryptosporidium (or Crypto for short), can live in properly treated water for days. This means even the best maintained aquatic venues can spread germs."

Germ	Time
E. coli O157:H7 Bacterium	Less than 1 minute
Hepatitis A Virus	About 16 minutes
Giardia Parasite	About 45 minutes
Crypto Parasite	About 15,300 minutes or 10.6 days [1]

WHAT TO DO ABOUT BLOOD & VOMIT
ACCORDING TO THE CDC WEBSITE

VOMIT

"VOMITING IN THE POOL WHILE SWIMMING IS A COMMON EVENT. OFTEN, VOMITING RESULTS FROM SWALLOWING TOO MUCH WATER, MEANING THAT THE VOMIT IS PROBABLY NOT INFECTIOUS. HOWEVER, IF THE CONTENTS OF THE STOMACH ARE VOMITED, IT IS IMPORTANT TO ACT IMMEDIATELY.

RESPONDING TO A VOMIT INCIDENT (WHEN VOMIT CONTAINS MORE THAN REGURGITATED WATER)

THE GERMS MOST LIKELY TO BE SPREAD BY VOMIT ARE NOROVIRUSES (ALSO KNOWN AS NORWALK-LIKE VIRUSES).

RESPOND TO THE VOMIT INCIDENT AS YOU WOULD RESPOND TO A FORMED FECAL INCIDENT, USING CDC'S FECAL INCIDENT RESPONSE RECOMMENDATIONS FOR POOL STAFF CDC-PDF[PDF – 4 PAGES]. THE TIME AND CHLORINE LEVEL COMBINATIONS NEEDED TO KILL NOROVIRUSES AND *GIARDIA* ARE SIMILAR. SINCE KILLING *GIARDIA* IS THE BASIS FOR CDC'S FORMED FECAL INCIDENT RESPONSE RECOMMENDATIONS, THIS PROTOCOL SHOULD BE ADEQUATE FOR DISINFECTING A POTENTIALLY INFECTIOUS VOMIT INCIDENT."

BLOOD

"GERMS FOUND IN BLOOD (FOR EXAMPLE, HEPATITIS B VIRUS OR HIV) ARE SPREAD WHEN INFECTED BLOOD OR CERTAIN BODY FLUIDS GET INTO THE BODY AND BLOODSTREAM (FOR EXAMPLE, BY SHARING NEEDLES OR BY SEXUAL CONTACT). CHLORINE KILLS GERMS FOUND IN BLOOD AND CDC IS NOT AWARE OF ANY INSTANCES IN WHICH A PERSON HAS BECOME INFECTED WITH THESE GERMS AFTER BEING EXPOSED TO A BLOOD SPILL IN A POOL.

DOES CHLORINE KILL THE GERMS IN BLOOD?

YES. THESE GERMS DO NOT SURVIVE LONG WHEN DILUTED INTO PROPERLY CHLORINATED POOL WATER.

SWIMMERS WANT SOMETHING TO BE DONE AFTER A BLOOD SPILL. SHOULD THE POOL BE CLOSED FOR A SHORT PERIOD OF TIME?

THERE IS NO PUBLIC HEALTH REASON TO RECOMMEND CLOSING THE POOL AFTER A BLOOD SPILL. HOWEVER, SOME POOL STAFF CHOOSE TO DO SO TEMPORARILY TO SATISFY PATRONS."

PLEASE REFER TO HEALTHYSWIMMING.ORG FOR MORE INFORMATION FROM THE CDC

Photo by edneil Jocusol

RECREATIONAL WATER ILLNESSES FECAL ACCIDENT PREVENTION

- **PLEASE** DON'T SWIM WHEN YOU HAVE DIARRHEA…THIS IS ESPECIALLY IMPORTANT FOR KIDS IN DIAPERS. YOU CAN SPREAD GERMS INTO THE WATER AND MAKE OTHER PEOPLE SICK.
- **PLEASE** WEAR SWIM DIAPERS
- **PLEASE** DON'T SWALLOW THE POOL WATER. IN FACT, TRY YOUR BEST TO AVOID EVEN HAVING WATER GET IN YOUR MOUTH.
- **PLEASE** WASH YOUR HANDS WITH SOAP AND WATER AFTER USING THE TOILET OR AFTER CHANGING DIAPERS. YOU CAN PROTECT OTHERS BY REALIZING THAT GERMS ON YOUR BODY END UP IN THE WATER.

Regardless of the type of diaper, rubber pants with elastic around the legs and waist must be worn!

RECREATIONAL WATER ILLNESSES
FECAL ACCIDENT RESPONSE

(CHECK WITH YOUR LOCAL HEALTH DEPARTMENT FOR YOUR EXACT PROCEDURES!)

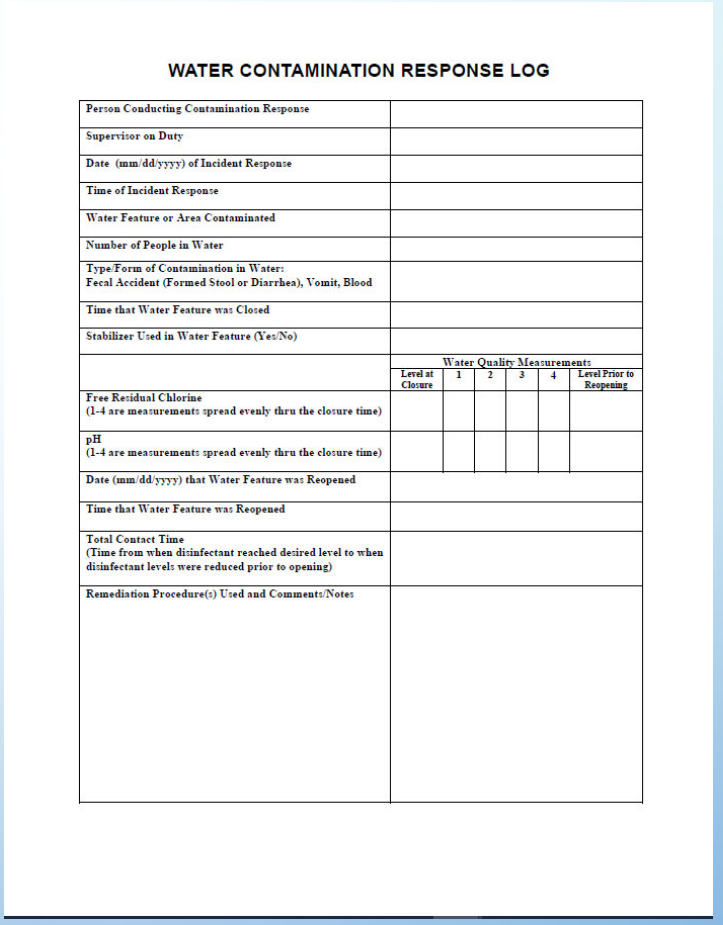
DIARRHEA OR LOOSE-STOOL DISCHARGE:

- DIRECT EVERYONE TO LEAVE POOL
- REMOVE FECAL MATERIAL
- RAISE FREE CHLORINE TO AT LEAST 20.0 PPM; MAINTAIN PH 7.2 – 7.5
- MAINTAIN FOR AT LEAST 8 HOURS
- DOCUMENT CLOSURE ON LOG SHEETS
- REOPEN ONCE FREE CHLORINE IN ACCEPTABLE RANGE

SOLID FECAL DISCHARGE:

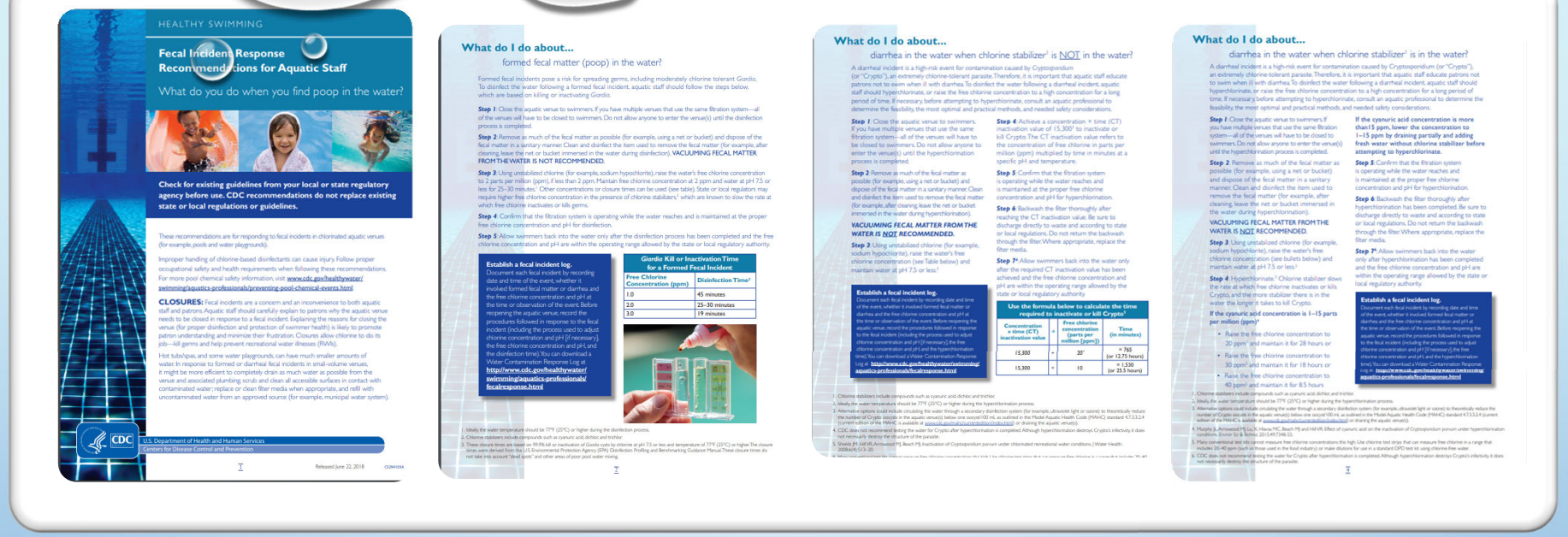
- DIRECT EVERYONE TO LEAVE POOL
- REMOVE FECAL MATERIAL
- RAISE FAC TO 10 PPM IN THE IMMEDIATE AREA OF THE CONTAMINATION (10 FT BY 10 FT)
- RAISE FREE CHLORINE TO AT LEAST 2.0 PPM; MAINTAIN PH 7.2 – 7.5
- MAINTAIN FOR AT LEAST 30 MIN.
- DOCUMENT CLOSURE ON LOG SHEETS
- REOPEN WHEN DISINFECTION LEVEL IS ACCEPTABLE

Document The Event



WATER CONTAMINATION RESPONSE LOG

Person Conducting Contamination Response						
Supervisor on Duty						
Date (mm/dd/yyyy) of Incident Response						
Time of Incident Response						
Water Feature or Area Contaminated						
Number of People in Water						
Type/Form of Contamination in Water: Fecal Accident (Formed Stool or Diarrhea), Vomit, Blood						
Time that Water Feature was Closed						
Stabilizer Used in Water Feature (Yes/No)						
	Water Quality Measurements					
	Level at Closure	1	2	3	4	Level Prior to Reopening
Free Residual Chlorine (1-4 are measurements spread evenly thru the closure time)						
pH (1-4 are measurements spread evenly thru the closure time)						
Date (mm/dd/yyyy) that Water Feature was Reopened						
Time that Water Feature was Reopened						
Total Contact Time (Time from when disinfectant reached desired level to when disinfectant levels were reduced prior to opening)						
Remediation Procedure(s) Used and Comments/Notes						



HEALTHYSWIMMING.ORG IS HERE TO HELP!

THE CDC'S WEBSITE HAS GREAT INFORMATION

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

PREVENTING DISEASE TRANSMISSION AT YOUR FACILITY INCLUDES KEEPING YOUR EMPLOYEES SAFE IN THEIR WORKPLACE!

The U.S. Department of Labor, OSHA, governs many aspects of worker safety. One of those areas is protection of workers against transmission of disease.

The following information is reprinted from "Occupational Exposure to Blood borne Pathogens: Precautions for Emergency Responders", a publication form the U.S. Department of Labor, Occupational Safety and Health Administration. OSHA 3130, 1992, (reprinted).

•OSHA recognizes the need for a regulation that prescribes safeguards to protect workers against the health hazards from exposure to blood and certain body fluids containing blood borne pathogens and to reduce their risk of this exposure.

•OSHA's blood borne pathogens standard requires the employer to prepare a written exposure control program.

•The standard applies to every employer with one or more employees who can reasonably be expected to come into contact with blood and other specified body fluids in performing their duties.

•Occupational exposure means a "reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of the employees' duties."

•A written exposure control plan is necessary for the safety and health of workers. Employees must develop a plan that identifies and documents the tasks, procedures, and job classifications covering instances where there is exposure to blood or other potentially infectious materials.

•As required under the standard, a written exposure plan is required that provides documentation of the following key elements.

- •Identification of job classification
- •A schedule of how and when the provisions of the standard will be implemented
- •Procedures for evaluating the circumstances of an exposure incident.

•All persons with a potential for exposure must be provided with adequate training and information including general explanations of the modes of transmission, symptoms, epidemiology, warning signals relating to possible exposure, and procedures to follow if exposure occurs.

•Employers must make available, free of charge and at a reasonable time and place, the Hepatitis B vaccine and vaccination series to all employees who are at risk of occupational exposure.

•Employees should immediately report exposure incidents. Employers must treat reports in the strictest confidence. At the time of the exposure incident, the exposed employee must be directed to a health care professional.

•There are 2 types of employee-related records, required by the blood borne pathogens standard: medical and training. The blood borne pathogens standard also requires employers to maintain and to keep accurate training records for 3 years and to include the following:

- •Training dates
- •Content or a summary of the training
- •Names and qualifications of trainers(s), and
- •Names and job titles of trainees.

For a complete copy of this or any other free OSHA publication, contact them at:

U.S. Dept. of Labor, OSHA, 200 Constitution Avenue, Washington, DC 20210

1-202-693-1888, 1-800-321-OSHA

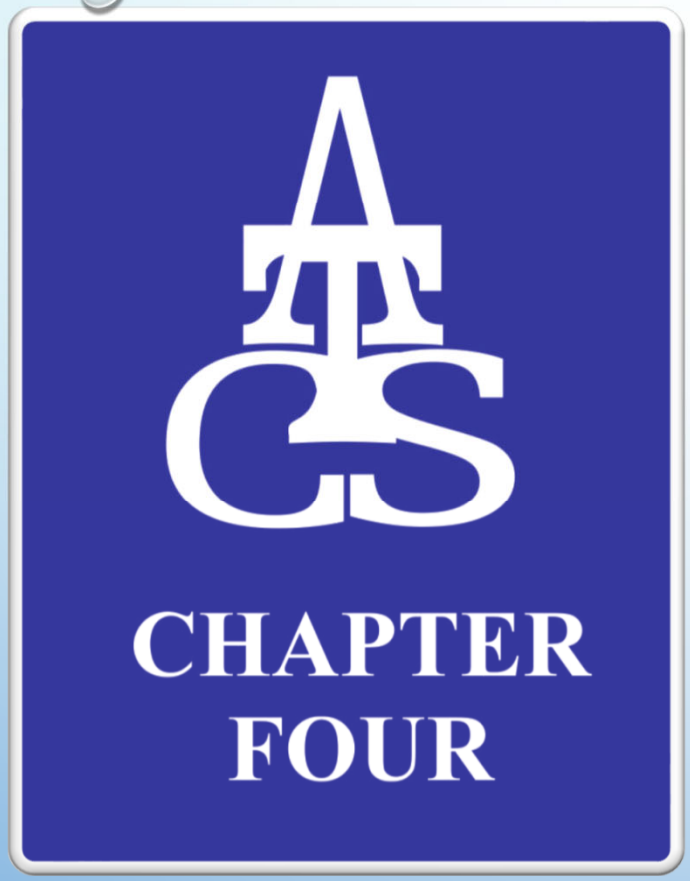
www.osha.gov. for over 300 articles on the bloodborne pathogen standard

EMPLOYEES HAVE THE RIGHT TO:

- THEY MAY COME IN CONTACT WITH BLOOD IN THEIR WORKPLACE
- THEY MAY COME IN CONTACT WITH DANGEROUS CHEMICALS IN THEIR WORKPLACE
- PERSONAL PROTECTIVE EQUIPMENT IS PROVIDED BY THEIR EMPLOYER
- MATERIAL SAFETY DATA SHEETS ARE AVAILABLE FOR ALL THE CHEMICALS THEY USE

EMPLOYEES HAVE THE RESPONSIBILITY TO:

- KNOW WHERE TO GET INFORMATION ON HAZARDOUS CHEMICALS USED ON THE JOB.
- LEARN TO READ AND UNDERSTAND LABELS AND MSDS.
- IDENTIFY CHEMICAL HAZARDS BEFORE STARTING A JOB AND ASK QUESTIONS.
- USE PERSONAL PROTECTIVE EQUIPMENT AND FOLLOW SAFE WORK PRACTICES.
- FOLLOW EMPLOYER'S PROCEDURES FOR DISPOSAL AND CLEAN UP.
- LEARN EMERGENCY PROCEDURES.
- EAT, DRINK, APPLY COSMETICS OR SMOKE AWAY FROM HAZARDOUS CHEMICALS



DISINFECTION

- **DISINFECTION -** (SANITIZE): THE PROCESS OF DESTROYING LIVING MICROORGANISMS AND BACTERIA IN SUFFICIENT NUMBERS (BY DEFINITION – 99.9%) TO PREVENT THE TRANSMISSION OF DISEASE. *(REFERENCE 1)*

- **DISINFECTANT** – (SANITIZER): THE CHEMICAL OR DEVICE THAT KILLS OR INACTIVATES THE MICROORGANISMS PRESENT IN POOL/SPA WATER *(REFERENCE 4)*. THE MOST COMMON IN THE INDUSTRY ARE CHLORINE AND BROMINE

RF1

People like a pool that looks good. The bluish color comes from the light refraction on the water. That is why the deep end looks bluer than the shallow. Poorly taken care of water can become cloudy or even turn green.

A pool that has been balanced according to the Saturation Index will be blue and look clear and inviting. Now it is time to add disinfection. Once people begin using the pool, disinfection becomes critical. A swimming pool is not the source of the disease, but rather the pathway of transmission if the disinfectant levels are NOT kept in the proper ranges as recommended by the local Health Department. The prevention of and subsequent elimination of the possible spread of disease is one of the PSPO's main jobs.

Photo by MATTHIAS COOPER

Slide 2

RF1 Rob Fox, 3/21/2020

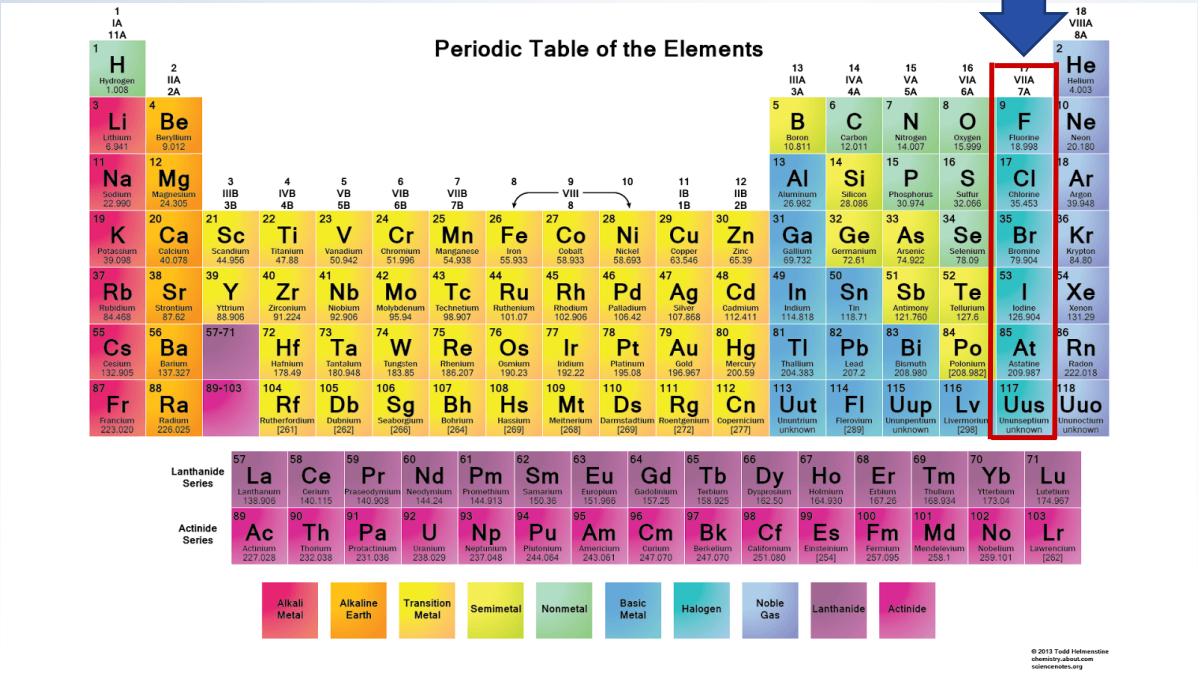
Photo by Ezequiel de silva

WATER BALANCE IS IMPORTANT!

- DISINFECTANTS WILL LAST LONGER IN BALANCED WATER
- BATHER DISCOMFORT IS USUALLY CAUSED BY INCORRECT PH

SANITATION
CHEMISTRY OF CHLORINATION

HALOGEN FAMILY



Halogen: Any element found in the Group VII of the periodic table. Due to their tremendous chemical reactivity, the halogens never occur free in nature, they must be prepared from their stable salt (i.e. sodium chloride [NaCl]. Chlorine, (considered to be the best oxidizer and algaecide) bromine, and iodine are examples of halogens.

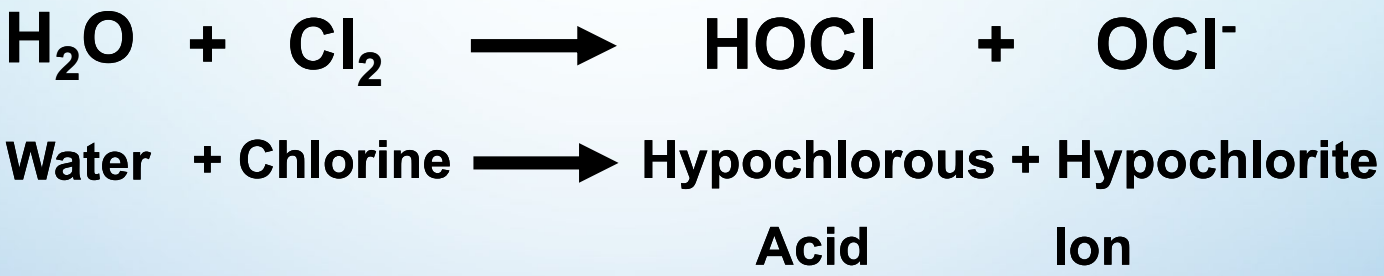
Photo by PIXABAY

CHLORINE IS THE BEST BECAUSE IT IS THE BEST OXIDIZER!

OXIDATION

- OXIDATION IS THE REMOVAL OF ORGANIC AND INORGANIC MATTER NOT DESIRED IN THE WATER
- OXIDATION CAN BE DONE WITH:
  - CHLORINE
  - POTASSIUM MONOPERSULFATE
  - OZONE
  - FORMULATED PRODUCTS
  - HYDROGEN PEROXIDE

CHEMISTRY OF CHLORINATION



FREE AVAILABLE CHLORINE (FAC)

- FORMED WHEN CHLORINE IS ADDED TO WATER
- THE ACTIVE SANITIZER
- COMBINATION OF HYPOCHLOROUS ACID AND HYPOCHLORITE IONS AND CHLORINE ASSOCIATED WITH CYANURIC ACID

STABILIZER

THERE ARE 6 TYPES OF COMMONLY USED CHLORINE, DIVIDED INTO 2 CATEGORIES:

- **UNSTABILIZED (INORGANIC):** THESE COMPOUNDS DO NOT CONTAIN CARBON AND ARE VERY SENSITIVE TO UV LIGHT. THIS MEANS THAT WHEN THE SUN COMES OUT, THE WILL DISSIPATE (GO AWAY.)

- **STABILIZED (ORGANIC):** THESE COMPOUNDS DO CONTAIN CARBON USUALLY IN COMBINATION WITH ELEMENTS SUCH AS: HYDROGEN, OXYGEN, NITROGEN, AND SULFUR, AND ARE NOT SENSITIVE TO UV LIGHT.

UNSTABILIZED OR INORGANIC CHLORINES ARE SENSITIVE TO THE SUN'S UV RAYS. USE OF THESE IS VERY IMPRACTICAL FOR AN OUTDOOR FACILITY. THESE FACILITIES NEED TO USE AN ADDITIONAL CHEMICAL KNOWN AS A **STABILIZER**, TO PREVENT THE UV RAYS FROM DECOMPOSING (EATING UP) THE CHLORINE RESIDUAL (OR CHLORINE LEVEL).

CYANURIC ACID (CYA):

- **CYANURIC ACID (CYA)**: the chemical used to stabilize an outdoor pool. CYA is added directly through a skimmer. CYA is added directly through a skimmer after being thoroughly diluted in a bucket of water or kneaded through old hosiery (note: this is one of very few chemicals that should ever be added through a skimmer. Always add chemicals directly to the pool unless otherwise directed.)
- For your initial addition, add cya slowly over the course of several days. Depending on the size of the pool, it may take quite a bit of CYA to get the pool "stabilized" in the beginning of the season.
- {***Dosage for cyanuric acid is approximately 3 lb. Per 10,000 gallons to increase 30 ppm***}.
- Put the cyanuric acid into the skimmers and add only a cup or so per skimmer per day until the desired level is reached. Be sure the pool has been recently backwashed (see ch. 9 for info. On backwashing) BEFORE adding the CYA. Most jurisdictions do not require daily testing because the level does not change that quickly. CYA will need to be added periodically throughout the summer. Wait 24-48 hours after each addition before adding more. This will assure adequate circulation and re-testing to avoid overdosing.

CYANURIC ACID (CYA):

Health Department regulation for Cyanuric Acid (CYA) is 30-50 in outdoor pools and it must be tested every week for a pool.

CYA is not used indoors.

When the CYA value is tested and found to be too low, begin adding the Cyanuric Acid as described previously. Most jurisdictions are strict on the CYA levels. In some jurisdictions, the Chlorine level is based on the CYA level and other factors will at times play into what the Health Department considers an acceptable level.

If the CYA level gets too high especially if it goes above 100 ppm, the pool must be partially or totally drained in order to lower the level. There is no chemical to lower the CYA level.

DRAIN & FILL TO LOWER!

The pool operator should shoot for a reading of 50 ppm to maximize chlorine efficiency. As CYA levels go past 50 reduced stabilization occurs, If the CYA level is above 100 ppm, no additional stabilization is obtained, and reports have shown reduced disinfection and oxidation at elevated levels sometimes referred to as chlorine lock.

SIX TYPES OF CHLORINE

- GAS CHLORINE
- SODIUM HYPOCHLORITE
- CALCIUM HYPOCHLORITE
- LITHIUM HYPOCHLORITE
- TRICHLOROCYANURIC
- DICHLOROCYANURIC

GAS CHLORINE

$$CL_2 + H_2O \rightarrow HOCL + HCL$$

- Gas is an excellent sanitizer, however, due to its toxicity and for this reason most jurisdictions do not allow its use at public pools. The gas is sold in steel tanks that are kept in a room separate from the rest of the circulation system. **This room must have ventilation at floor level** and be able to exchange the air within 1-4 minutes due to the fact that the gas is heavier than air and will sink in the event of a leak.
- **A bottle of household ammonia is also required** within the confines of the gas tank room. When ammonia comes in contact with the gas in the event of a leak, a white mist is formed identifying the leak. The tank that is presently being used, will sit on a scale, and is weighed daily. This is how the CPO will know when the tank is almost empty. The other tanks, not currently in use, **must be chained to the wall to prevent tipping over.**
- **A self-contained breathing apparatus is also required**. A person, preferably the CPO, specially trained in the proper use of the self-contained breathing apparatus must be on site at all times. Keep the self-contained breathing apparatus in operational order and OUT of the chlorine room.
- It is important not to throw water on a chlorine gas leak. If water comes in contact with a chlorine gas leak, hypochlorous acid is formed which will increase corrosion and leakage. Careful handling of the equipment will help ensure safety and prevent leaks.
- **Gas chlorine has an extremely low ph**. Straight hydrochloric acid is formed when it mixes with water. Therefore, sodium carbonate (soda ash) is needed on a daily basis to keep the ph in the proper range.
- ***{It takes approximately 1.3 oz. Of gas per 10,000 gallons of water to raise the free chlorine level 1 ppm.}***

SODIUM HYPOCHLORITE

NaOCL

$$NAOCL + H_2O \rightarrow HOCL + NAOH$$

- **Sodium hypochlorite is one of the most widely used chlorines in the industry**. This is most likely due to the ease of use and the low cost. Sodium is a thick, yellowish liquid. It is usually stored in large vats and is delivered by a tanker truck. Always keep dry chlorine on hand, in case the liquid runs dry.
- Sodium hypochlorite, "bleach," comes in at an extremely high ph, above 13, therefore the addition of muriatic acid is necessary on a daily basis to maintain ph in the proper range. **Never mix muriatic acid and chlorine directly together as it makes mustard gas** (a fatal gas used as a chemical weapon used in world war 1).
- Sodium hypochlorite is very unstable and looses its composition quickly. The hotter it is, the quicker it decomposes. It needs to be stored in a cool dark place. To ensure the quality of the bleach. Liquid chlorine has a short shelf life, so only order a month supply at a time.
- In most systems, liquid chlorine is fed into the system via a chemical feeder.

{It takes approximately 10 oz. Of sodium hypochlorite per 10,000 gallons of water to raise the free chlorine level 1 ppm.}

CALCIUM HYPOCHLORITE

$Ca(OCL)_2$

$$CA(OCL)_2 + 2H_2O \rightarrow HOCL + CA(OH)$$

- Calcium hypochlorite is either a dry granular or a tablet form. It can be dissolved in water to produce a liquid form, although this is not recommended for daily disinfection. Calcium hypochlorite is very hard to dissolve. This property is definitely a disadvantage, especially for vinyl liners and pools with fresh plaster or paint. Dissolving it in lukewarm water will help.
- The ph of calcium hypochlorite is around 11-12; therefore the addition of muriatic acid will be needed on a daily basis to keep the ph in the proper range.
- For many years, granular calcium hypochlorite was not very practical to use as the daily disinfectant due to its insolubility. However, with the invention of erosion feeders and the introduction of calcium hypochlorite in a tablet or puck form, it is practical. The tablets are fed through an erosion feeder, which is plumbed into the circulation system. The tablets dissolve easily and with its high chlorine content, it helps to keep the pool sparkling clear. Be sure to use only compatible tablets or pucks in your erosion feeders.

Erosion feeders are enclosed apparatuses used to dispense disinfectants. Water flows through the feeder eroding the solids inside and sending the disinfected water into the system.

- A possible disadvantage of calcium hypochlorite is that over time, it will raise the calcium hardness level in the pool. In areas with “soft” water this is usually not a problem. If the fill water is “hard,” this can be a disadvantage. Regular testing will allow the CPO to monitor the calcium hardness level.
- Calcium hypochlorite is an excellent choice to use for cleaning up bodily fluid spills. See the local health department regulations for specific procedures in handling these spills. It is an excellent oxidizer. **Oxidizers,** like chlorine and bromine, rid the contaminants and micro-organisms out of the pool water. Their chemical action literally burns the bad stuff off sending the gases into the atmosphere.
- ***{It takes approximately 2 oz. Of calcium hypochlorite per 10,000 gallons of water to raise the free chlorine level 1 ppm.}***

LITHIUM HYPOCHLORITE

LiOCL

$LIOCL + H_2O \rightarrow HOCL + LIOH$

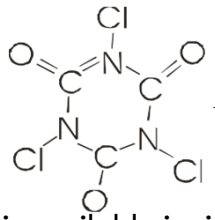
- Lithium hypochlorite is also a granular. The main advantage of using lithium over calcium is that it is very soluble. The ACC is much less than calcium, but it is better for vinyl liners and freshly painted or plastered pools because of its solubility. Pound for pound, it is more expensive than calcium. This disinfectant is mainly used by backyard pool owners who are willing to pay for the speed that lithium hypochlorite dissolves.
- The ph of lithium hypochlorite is about 11; therefore the addition of muriatic acid will be needed in order to keep the ph in the proper range.
- Lithium hypochlorite is also an excellent choice for cleaning up bodily fluid spills. See the local health department regulations for specific procedures in handling these spills. It is a good choice to use for “shocking” needs.

{It takes approximately 3.8 oz. Of lithium hypochlorite per 10,000 gallons of water to raise the free chlorine level 1 ppm.}

TRICHLOR

Pre-Stabilized

•Tri-Chloro-S-Triazinetrione: (Trichloroisocyanuric Acid)



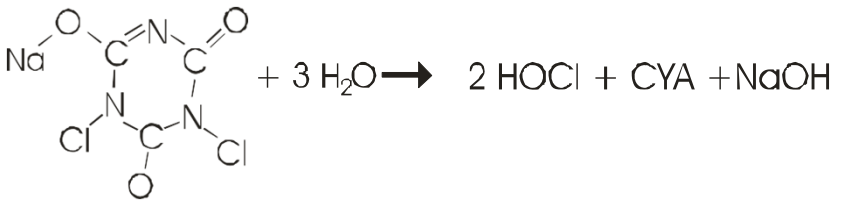
$+ 3\ H_2O \rightarrow 3\ HOCl + CYA$

- Tri-chlor is a solid and is available in sizes ranging from 1" tabs to large sticks. It has a very low solubility rate and therefore is excellent for erosion feeders, floaters, and skimmer use. (Skimmer use is NOT allowed at a commercial facility in most jurisdictions). The size of the erosion feeder (based on the size of the pool), determines the size of the tablets. Note: be careful to reorder the appropriate size and always use the feeder exclusively according to manufacturers recommendations.
- Chemically, tri-chlor breaks down into the hypochlorous acid ion, and cyanuric acid. Some jurisdictions do not allow tri-chlor to be used on an indoor pool.
- Tri-chlor has a low ph (2.8-3.0), therefore the addition of sodium carbonate (soda ash) is needed on a daily basis to keep the ph in the proper range.
- ***{It takes approximately 1.5 oz. Of trichloro-s-triazetrione per 10,000 gallons of water to raise the free chlorine level 1 ppm.}***

DICHLOR

Pre-Stabilized

•Sodium Dichloro-S-Triazinetrione: (Sodium Dichloroisocyanuric Acid)



- Di-chlor is granular chlorine and it contains cyanuric acid. It is very soluble, and is usually used by dissolving it in water, adding a little soda ash, and feeding it into the system with chemical feeder like those used to feed sodium hypochlorite.
- The general mixing formula is as follows; 12 pounds of di-chlor,1 ½ pounds soda ash, and 55 gallons of water
- Fill a 55- gallon vat ¾ full of water, mixing in the soda ash as it fills. All at once, pour in the di-chlor, put the lid on, and allow to sir for about 10 minutes. Stir until completely dissolved (using a wooden handle, not metal) and fill the vat the rest of the way.
- The ph of di-chlor in the dry form is about 4.0. By adding the soda ash and water, the ph rises to 7.5.

SANITIZER EFFECT ON PH

- THE PH OF SANITIZER WILL EFFECT PH OF WATER
  - GAS CHLORINE <1.0
  - TRICHLOR 3.0
  - BROMINE TABLETS 4.5
  - BIGUANIDE 5.5
  - DICHLOR 6.5
  - CALCIUM HYPOCHLORITE 10.6
  - LITHIUM HYPOCHLORITE 11.7
  - SODIUM HYPOCHLORITE 12.8

BASED ON A 1% SOLUTION

ACCEPTABLE FREE AVAILABLE CHLORINE LEVELS

Photo by David ortega

THE MODEL AQUATIC HEALTH CODE RECOMMENDS:

- FOR SWIMMING POOLS NOT USING CYANURIC ACID TO STABILIZE :
  1.0 - 10.0 PPM
- FOR SWIMMING POOLS USING CYANURIC ACID TO STABILIZE :
  2.0 - 10.0 PPM
- FOR SPAS :
  4.0 - 10.0 PPM
- IDEAL RANGE FOR POOLS:
  2.0 – 4.0 PPM
- IDEAL RANGE FOR SPAS:
  3.0 – 5.0 PPM

Public swimming pools should check the main pool every 2 hours and spas & baby pools every hour

SANITATION PH AFFECT ON CHLORINE

CHLORINE'S KILLING POWER DEPENDENT ON PH

PH	%HOCL	%OCL-	
6.5	90.0	10.0	
7.0	72.5	27.5	
7.2	66.0	34.0	←
7.5	50.0	50.0	
7.8	32.0	68.0	←
8.0	21.5	78.5	

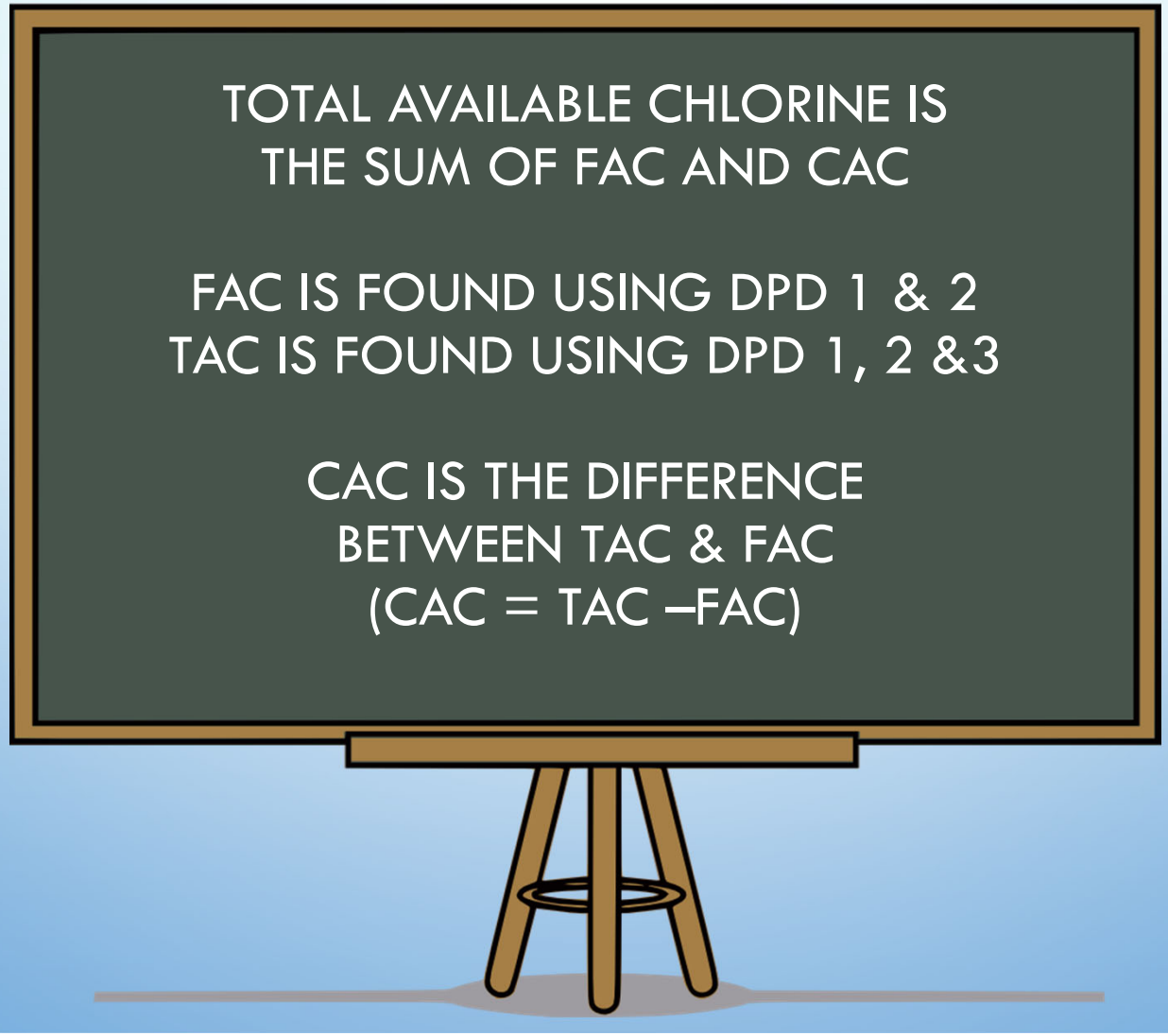
The lower the pH the more effective the chlorine

COMBINED AVAILABLE CHLORINE (CAC)

Photo by andrea piacquadio

- FREE CHLORINE THAT REACTS WITH PERSPIRATION, URINE, AND OTHER NITROGEN CONTAINING CONTAMINANTS
- CHLORAMINES CAUSE UNPLEASANT ODOR AND EYE IRRITATION
- CHLORAMINES PROVIDE NO DISINFECTION

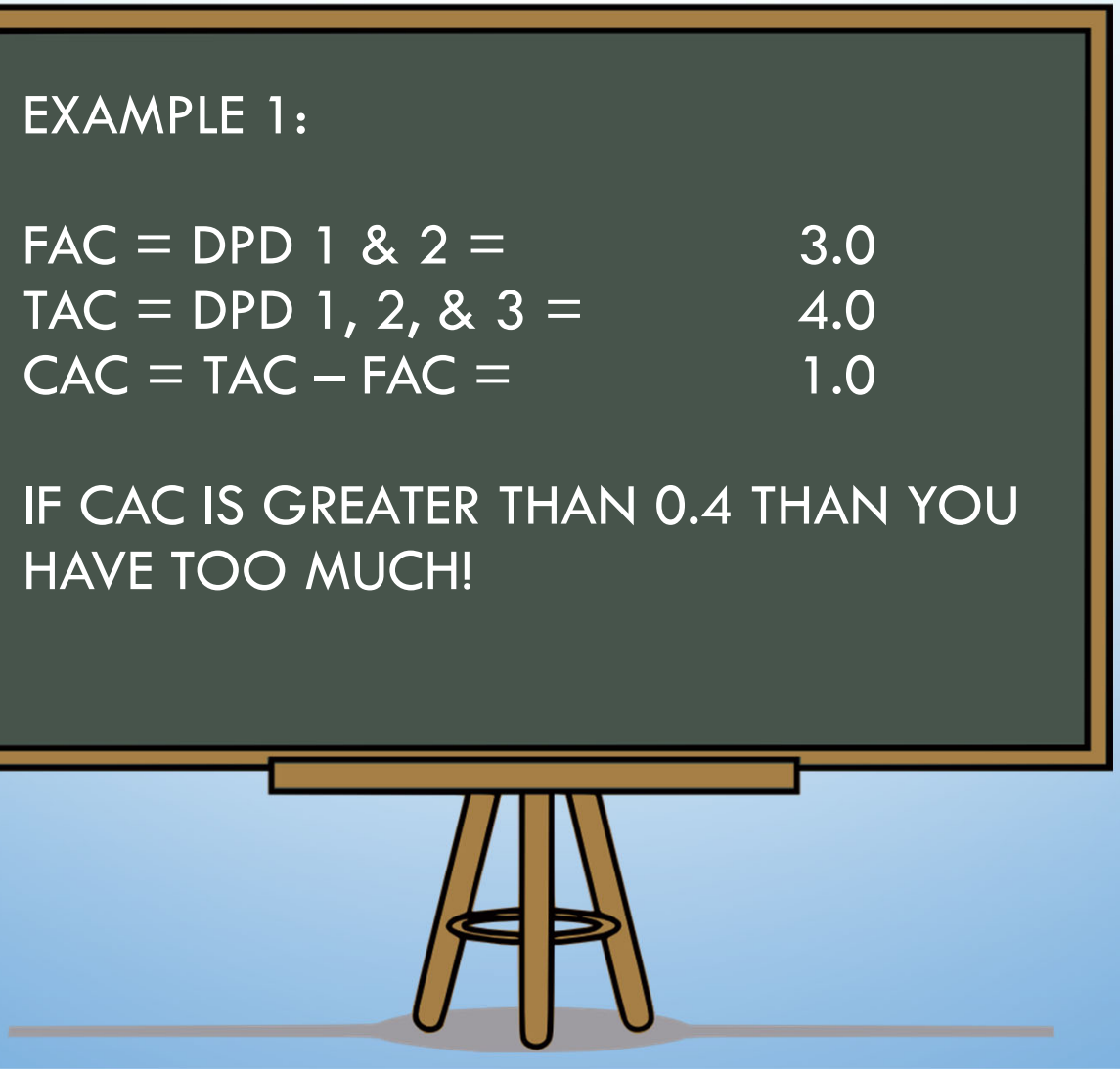
CHLORINE + AMMONIA = CHLORAMINES


TOTAL AVAILABLE CHLORINE IS
THE SUM OF FAC AND CAC
FAC IS FOUND USING DPD 1 & 2
TAC IS FOUND USING DPD 1, 2 &3
CAC IS THE DIFFERENCE
BETWEEN TAC & FAC
(CAC = TAC –FAC)

EXAMPLE 1:

FAC = DPD 1 & 2 = 3.0
TAC = DPD 1, 2, & 3 = 4.0
CAC = TAC – FAC = 1.0

IF CAC IS GREATER THAN 0.4 THAN YOU HAVE TOO MUCH!



HOW DOES THE POOL OPERATOR ELIMINATE THE COMBINED CHLORINE?

BREAKPOINT CHLORINATION

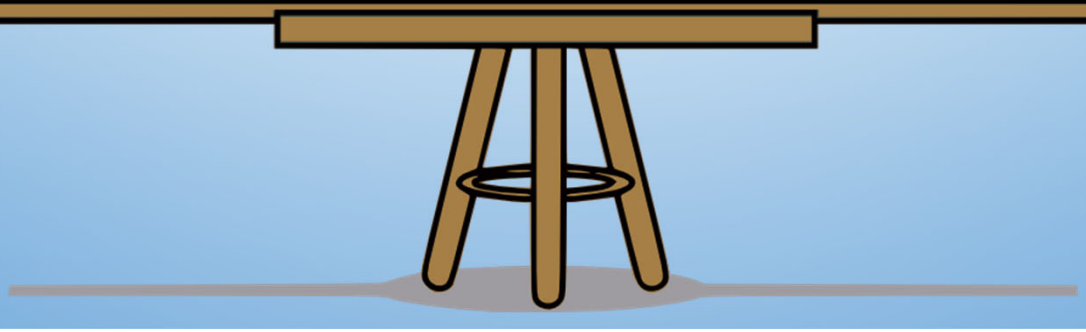
- METHOD OF REDUCING INORGANIC COMBINED CHLORINE (AMMONIA NITROGEN BASED)
- WILL NOT REDUCE MORE PREVALENT ORGANIC BASED CHLORAMINES
- BREAKPOINT IS ACHIEVED BY RAISING THE FREE AVAILABLE CHLORINE 10 TIMES THE COMBINED CHLORINE LEVEL

EXAMPLE 1:

FAC = DPD 1 & 2 = 3.0
TAC = DPD 1, 2, & 3 = 4.0
CAC = TAC – FAC = 1.0

BREAKPOINT = FAC + (10 X CAC)
BREAKPOINT = 3.0 + (10 X 1)
BREAKPOINT = 13

FOR THIS EXAMPLE, THE POOL OPERATOR MUST RAISE THE CHLORINE LEVEL TO 13 PPM.



WHAT ABOUT SUPERCHLORINATION OR SHOCKING THE POOLB

SUPERCHLORINATION

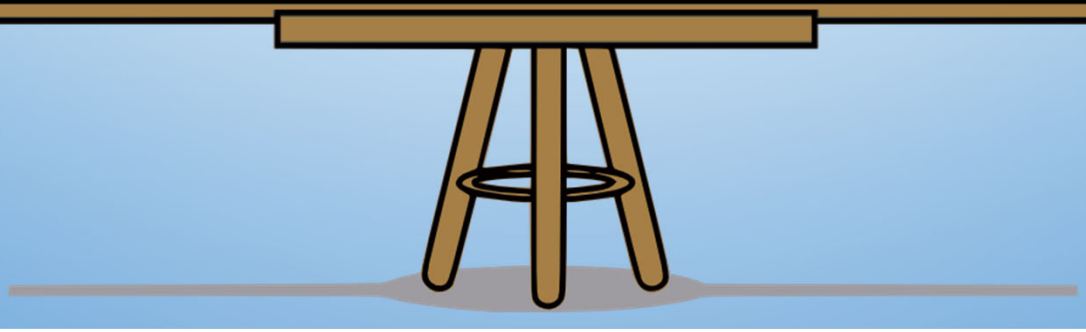
- METHOD OF ACHIEVING BREAKPOINT BY RAISING THE FREE AVAILABLE CHLORINE 10 TO 15 PPM SO THAT BREAKPOINT IS SURPASSED AND THE REMAINING RESIDUAL IS LEFT FOR OPENING THE NEXT DAY.
- SHOCKING IS THE METHOD OF SUPERCHLORINATION BY ADDING ALL NECESSARY CHLORINE TO THE POOL AT THE END OF THE DAILY OPERATING HOURS.
- SUFFICIENT AMOUNT OF CHLORINATING COMPOUND (10 PPM – 30 PPM) CAN REDUCE CLOUDY WATER, SLIME FORMATION, MUSTY ODORS, ALGAE, BACTERIA, IMPROVE ABILITY TO MAINTAIN SANITIZER RESIDUAL, AND PROVIDE A RESPONSE TO A FECAL CONTAMINATION

EXAMPLE 2:

FAC = DPD 1 & 2 = 2.5
TAC = DPD 1, 2, & 3 = 3.0
CAC = TAC – FAC = 0.5

BREAKPOINT = FAC + (10 X CAC)
BREAKPOINT = 2.5 + (10 X 0.5)
BREAKPOINT = 7.5

SUPERCHLORINATION OF 10 PPM WILL RESULT IN A FAC READING OF 5.0 PPM.



HOW MUCH CHLORINE DO YOU ADD TO THE POOL?

CALCIUM HYPOCHLORITE RAISES FAC 1.0 FOR EVERY 2 OZ PER 10,000 GALLONS

ADD 20 OZ FOR EVERY 10,000 GALLONS TO SUPERCHLORINATE

SO DOES THE POOL OPERATOR USE BREAKPOINT TO LOWER CHLORINEB

NO!!!

- **SODIUM THIOSULFATE** (DE-CHLOR) IS A CHLORINE NEUTRALIZER THAT WILL ELIMINATE FREE AVAILABLE CHLORINE FROM THE WATER.
- BREAKPOINT CHLORINATION WILL ONLY LOWER CHLORINE LEVELS IF THERE IS COMBINED CHLORINE PRESENT.
- SODIUM THIOSULFATE IS USED AT A RATE OF 1 OZ. PER 10,000 GALLONS TO REDUCE 1 PPM, AND ½ OZ. PER 10,000 GALLONS WILL REDUCE BROMINE 1 PPM.

WHAT IS HYPERCHLORINATIONB

THE INTENTIONAL RAISING OF THE CHLORINE LEVEL TO INACTIVATE PATHOGENS DUE TO A FECAL CONTAMINATION OR OTHER CONTAMINATION.

- **LOWERING THE CYA TO 15 PPM OR LOWER**
- RAISING THE FAC TO 20 PPM OR HIGHER
- CLOSING THE FACILITY FOR AT LEAST 8 ½ HOURS (LENGTH OF CLOSURE DEPENDS ON AMOUNT OF FAC IN THE WATER: 20 PPM IS 28 HOURS; 30 PPM IS 18 HOURS; AND 40 PPM IS 8 ½ HOURS)
- REOPEN WHEN FAC IS BELOW MAXIMUM ACCEPTABLE LEVEL

MAINTAINING CHLORINE LEVELS

- USE CHEMICAL FEEDERS
- USE AUTOMATED CONTROLLERS
- FREQUENT TESTING (AT LEAST EVERY TWO HOURS)
- MAINTAIN APPROPRIATE PH LEVEL

BROMINE

$$H_2O + Br_2 \longrightarrow HOBr + OBr^-$$

Water + Bromine → Hypobromous Acid + Hypobromite Ions

- NOT AS EFFECTIVE AS CHLORINE EXCEPT IN VERY HOT WATER
- CAN NOT BE USED OUTDOORS BECAUSE IT CAN NOT BE STABILIZED
- CONTINUES TO DISINFECT AFTER IT COMBINES WITH AMMONIA
- EXCELLENT FOR USE IN INDOOR HOT TUBS AND THERAPY POOLS

ACCEPTABLE FREE AVAILABLE BROMINE LEVELS

Photo by pixabay

THE MODEL AQUATIC HEALTH CODE RECOMMENDS:

- FOR INDOOR SWIMMING POOLS :
  3.0 - 8.0 PPM
- FOR SPAS :
  4.0 - 8.0 PPM
- IDEAL RANGE FOR POOLS:
  3.0 – 5.0 PPM
- IDEAL RANGE FOR SPAS:
  4.0 – 6.0 PPM

Public swimming pools should check the main pool every 2 hours and spas & baby pools every hour

ULTRAVIOLET LIGHT SYSTEMS

- ULTRAVIOLET LIGHT SYSTEMS ARE SECONDARY DISINFECTION SYSTEM
- POOL OPERATOR WILL STILL BE REQUIRED TO MAINTAIN AN ACCEPTABLE FREE AVAILABLE CHLORINE LEVEL
- ELIMINATES COMBINED CHLORINE THROUGHOUT THE DAY. BY ELIMINIATING CHLORAMINES IT IMPROVES AIR QUALITY
- CHLORINE CONSUMPTION WILL INCREASE WITH THE USE OF UV SYSTEMS.

CHLORINE GENERATION SALTWATER POOLS

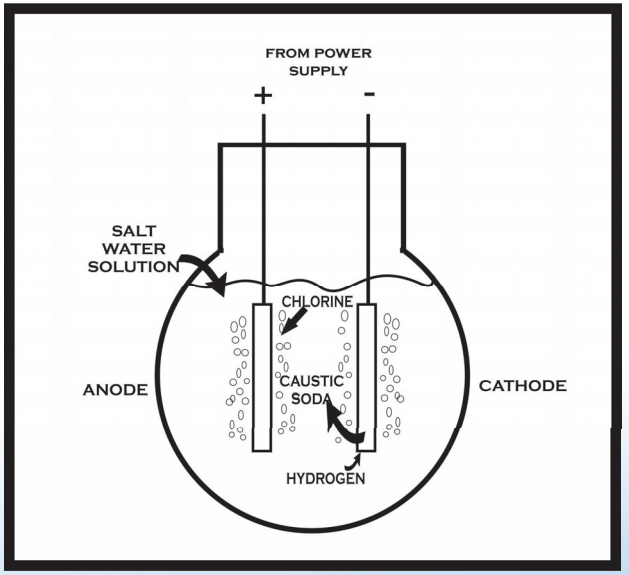
- ELECTROLYSIS OF SALT (SODIUM CHLORIDE)

  (REMOVES CHLORINE FROM SALT TO CREATE ITS OWN DISINFECTANT)

- WHEN FAC USED UP, REVERTS BACK TO SALT TO BE REGENERATED AGAIN

- WHEN THE POOL OPERATOR REMOVES WATER, ADDITIONAL SALT WILL NEED TO BE ADDED

- TDS WILL BE HIGHER (USUALLY MAINTAINED AT 3,000-3,400 PPM). WHEN CALCULATING SATURATION INDEX THE POOL OPERATOR SHOULD USE -12.2 TO REPRESENT TDS IN THE CALCULATION.



OTHER SANITIZERS

The following miscellaneous sanitizers are acceptable forms of disinfection in some jurisdictions. Check with the local Health Department regulations for prior approval BEFORE considering one of these sanitizers. Some of them may be required to be used combination with chlorine or bromine.

OZONE

A BLUISH, IRRITATING GAS WITH A PUNGENT ODOR. IT KILLS BACTERIA AND OXIDIZES ORGANIC COMPOUNDS INCLUDING CHLORAMINES, SOAPS, OILS, AND WASTES. OZONE OXIDIZES RAPIDLY AND COMPLETELY. OZONE CONTINUALLY SHOCKS THE WATER

IONIZATION

UTILIZES A CURRENT BETWEEN SILVER AND COPPER ELECTRODES AND RELEASES THESE

BAQUACIL

THIS IS A HYDROGEN PEROXIDE BASED PRODUCT LINE. THIS IS ONE PRODUCT THAT MUST NOT BE USED WITH CHLORINE OR BROMINE. ONLY PRODUCTS THAT ARE PART OF THE BAQUACIL LINE CAN BE USED. A WARNING STICKER, STATING THAT BAQUACIL IS USED SHOULD BE PLACED ON THE FILTER.

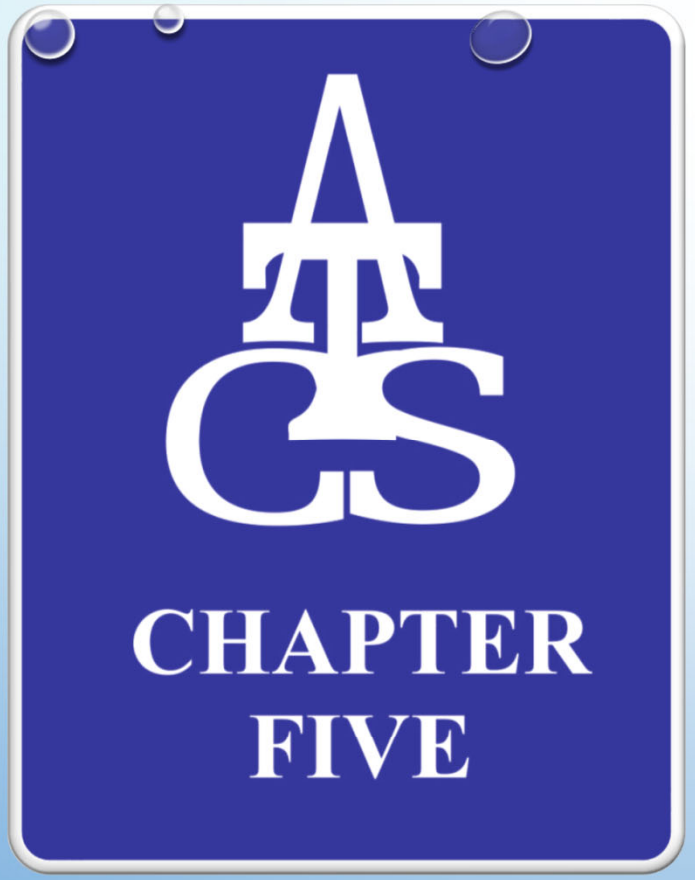
IODINE

THE REDUCED PH DEPENDENCE, INCREASED PATHOGENIC ORGANISM EFFECTIVENESS, AND RESIDUAL PERSISTENCE, GIVE IODINE SUPERIOR ADVANTAGES OVER CONVENTIONAL CHLORINATION OR BROMINATION OF SWIMMING POOLS

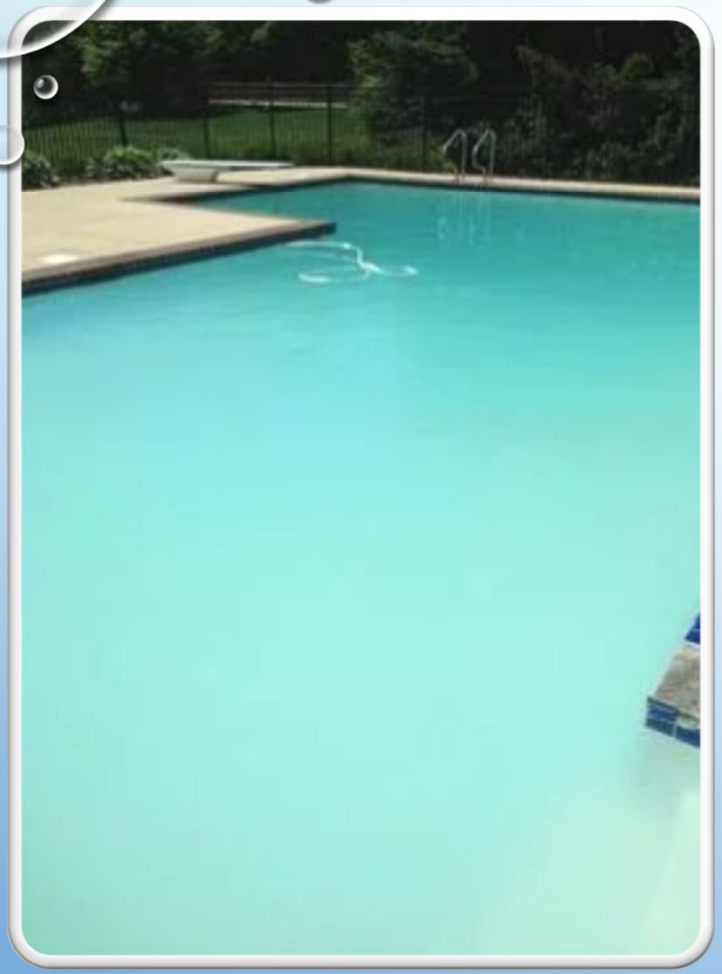
LET'S REVIEW!

Fill in the chart with the range of each reading and the chemical name that raises and lowers each reading:

Chemical	Minimum	Maximum	Raise	Lower
Chlorine	1.0	10	Add chlorine	Add Sodium Thiosulfate
pH	7.2	7.8	Add Soda Ash	Add Muriatic Acid
Total Alkalinity	60	180	Add Baking Soda	Add Muriatic Acid
Calcium Hardness	150	400	Add Calcium Chloride	Drain And Fill
Cyanuric Acid	30	50	Add Cyanuric Acid	Drain And Fill
Total Dissolved Solids	**No Minimum**	1500	**Not Applicable**	Drain And Fill



TROUBLESHOOTING



CLOUDY WATER MOST COMMON WATER PROBLEM

THE ONLY WAY TO HAVE CLEAR WATER ALL THE TIME IS NEVER LET ANYONE SWIM IN IT!

POSSIBLE CAUSES OF CLOUDY WATER:

- UNUSUALLY HIGH BATHER LOAD
- WATER NOT PROPERLY BALANCED
- LOW SANITIZER LEVEL
- PROBLEM WITH CIRCULATION SYSTEM
- PROBLEM WITH FILTRATION SYSTEM
- AIR IN YOUR SYSTEM

CLEARING UP THE POOL

Photo by Sarah schorer

UNUSUALLY HIGH BATHER LOAD

- THIS WILL USUALLY CORRECT ITSELF ON ITS OWN AFTER A FULL TURNOVER OF THE WATER.

- ALL POOLS HAVE AN ASSIGNED CAPACITY LEVEL. BE SURE TO ADHERE TO THE APPROPRIATE BATHER LOAD.

CLEARING UP THE POOL

WATER NOT PROPERLY BALANCED

- CHECK ALL OF THE CHEMICAL RANGES
- MAKE APPROPRIATE ADJUSTMENTS
- RECORD ALL ADJUSTMENTS MADE
- PROBLEM COULD TAKE A DAY OR SO TO RESOLVE

CLEARING UP THE POOL

LOW SANITIZER LEVEL / HIGH COMBINED CHLORINE

- POOL OPERATOR SHOULD CHECK IF SUPERCHLORINATION IS NECESSARY.

- ADD CHLORINE IF LEVELS ARE LOW.

CLEARING UP THE POOL

Photo by rob fox

CIRCULATION OR FILTRATION PROBLEM

- IS PRESSURE TOO HIGH IN FILTER TANKS?
- IS FLOW RATE TOO LOW?
- DOES SYSTEM NEED TO BE BACKWASHED?

CLEARING UP THE POOL

AIR IN THE SYSTEM

- IS THE WATER LEVEL TOO LOW?
- IS A SKIMMER BLOCKED?
- CAN YOU SEE AN AIR BUBBLE ON THE TOP OF FILTER?
- STOP AIR FROM ENTERING SYSTEM
- RAISE WATER LEVEL IF NECESSARY
- USE AIR BLEEDER VALVE TO RELEASE AIR

PROLONGED CLOUDINESS

CLEAR IN THE MORNING & CLOUDY IN AFTERNOON

- **USUALLY CAUSED BY SYSTEM BEING TOO SMALL FOR THE AMOUNT OF WATER OR BATHER LOAD**
- IF A REPAIR ON THE SYSTEM WAS RECENTLY MADE THIS IS PROBABLY THE ANSWER
- IF PUMP OR FILTER SIZE IS TOO SMALL, IT WILL BE ABLE TO KEEP UP WHEN THERE IS NO BATHERS BUT NOT DURING PEAK SWIMMING HOURS.

SPECIALTY CHEMICALS

- WATER IS COMPLEX, AFFECTED BY MANY OUTSIDE FACTORS
- SPECIALTY CHEMICALS DESIGNED TO CORRECT ONE OF THOSE PROBLEMS
- MOST NEED TO BE USED IN ADDITION TO A SANITIZER

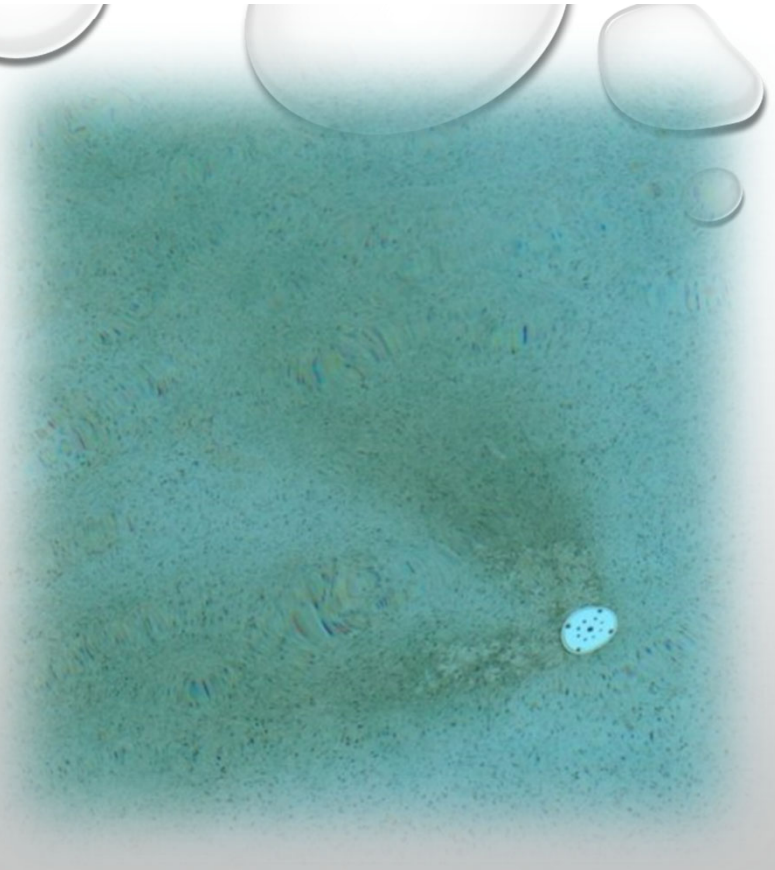


Photo by culator.com

MINERAL STAINING

Always check the fill water for calcium, iron, copper, manganese, etc.

To help determine if water has a high mineral content:
Green = Copper Brown = Iron Black =Cobalt
And Pink = Cobalt

SEQUESTERING AGENT

Use a chelating or **sequestering agent** to increase the water's ability to hold metals in solution, instead of allowing them to precipitate out and stain the pool's surface. Sequestering agent prevent further staining, they do not remove stains!

ALGAE

The appearance of algae indicates the there has been a period of time where the pool has not received enough chlorine or there is a part of the pool that is not getting enough chlorine.

GREEN ALGAE

GREEN ALGAE ARE USUALLY FREE-FLOATING. *(REFERENCE 1, PG. 44)* WHEN IT ATTACHES TO THE WALLS, IT IS EASILY BRUSHED AWAY, LEAVING THE OPERATOR TO BELIEVE THE PROBLEM HAS BEEN SOLVED. SIMPLY BRUSHING IT IS NOT THE SOLUTION. WITHOUT PROPER TREATMENT, CERTAIN STRAINS OF GREEN ALGAE CAN CAUSE AN "ALGAE BLOOM". THIS MEANS THE POOL CAN LOOK LIKE SPLIT-PEA SOUP IN A MATTER OF HOURS. KEEPING THE DISINFECTANT LEVEL IN THE PROPER RANGE IS THE BEST MEANS OF PREVENTION. REGULAR BRUSHING OF THE WALLS IS ALSO VERY IMPORTANT IN ALGAE PREVENTION.

MUSTARD ALGAE

MUSTARD (YELLOW) ALGAE ARE OFTEN FOUND ON THE SHADED SIDE OF THE POOL. *(REFERENCE 1, PG. 45)* IT IS A WALL CLINGING ALGAE THAT IS VERY DIFFICULT TO KILL. ACTUALLY A MEMBER OF THE GREEN ALGAE FAMILY, YELLOW ALGAE EXHIBITS CERTAIN CHARACTERISTICS THAT MAKE IT VERY DIFFICULT TO KILL.

BLACK ALGAE

BLUE-GREEN (BLACK ALGAE) ARE ROUND SLICK SPOTS, USUALLY CONGREGATING IN AREAS OF POOR CIRCULATION. BLACK ALGAE HAVE A COVERING THAT MAKES IT EXTREMELY DIFFICULT TO KILL. THIS OUTER COVERING MUST BE REMOVED PRIOR TO TREATING THE ALGAE. IT IS REMOVED BY USING AN ALGAE BRUSH WITH STAINLESS STEEL BRISTLES, BRUSHING BACK AND FORTH MANY TIMES TO REMOVE THE ENTIRE COVER.

PREVENTION OF ALGAE

- BRUSH THE POOL WALLS REGULARLY. (DAILY IF THE POOL HAS DEVELOPED ALGAE IN THE PAST)
- KEEP THE DISINFECTANT LEVELS IN THE PROPER RANGES AT ALL TIMES.
- KEEP SKIMMER BASKETS CLEAN AND SCRUB THE INSIDES OF THE SKIMMERS DAILY IN POOLS THAT HAVE DEVELOPED ALGAE IN THE PAST. SCRUB THE INSIDES OF THE SKIMMERS REGULARLY NO MATTER WHAT. UNDER THE WEIRS AND IN THE SKIMMER THROAT IS A HAVEN FOR ALGAE GROWTH.
- USE ALGISTATS IF THE POOL HAS A HISTORY OF ALGAE GROWTH, ESPECIALLY DURING A VERY HOT SUMMER WHEN THE WATER TEMPERATURE CAN BECOME VERY WARM.
- KEEP THE CYANURIC ACID (CYA) LEVEL BELOW 50 PPM.
- KEEP THE FILTER(S) CLEAN. BACKWASH AS NEEDED, BUT TOO OFTEN.
- IMMEDIATELY TREAT THE FIRST SIGN OF ALGAE.

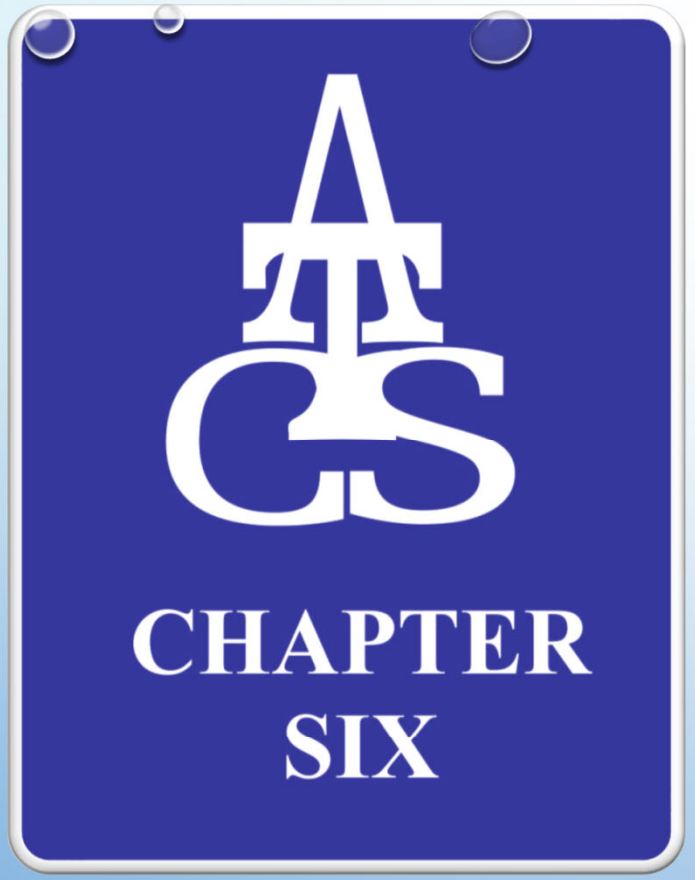
TREATING VISIBLE ALGAE

- UNLIGHT IS NEEDED FOR ALGAE TO GROW. TREAT IT DURING THE DAY WHEN THE SUN IS SHINING.
- BRUSH, BRUSH, AND BRUSH MORE!!! USE A STAINLESS-STEEL ALGAE BRUSH (UNLESS THE POOL SURFACE IS A VINYL LINER OR ANOTHER SURFACE WHERE THE MANUFACTURER DOES NOT RECOMMEND USING IT. A NYLON BRUSH WILL WORK JUST NOT AS WELL.
- METHODS OF "KILLING IT":
  - SUPERCHLORINATE THE POOL TO 30 PPM. THIS IS GOING TO CAUSE DOWN TIME BUT IS ONE OF THE MORE EFFECTIVE METHODS. BE SURE ADDING THIS AMOUNT OF CHLORINE WILL NOT DAMAGE THE POOL SURFACE, AND REMEMBER TO ADD A SEQUESTERING AGENT BEFORE, IF HIGH MINERAL CONTENT IS A PROBLEM.
  - USE SOME TYPE OF A QUAT, POLYQUAT, OR COPPER BASED ALGAECIDAL TREATMENT. FOLLOW THE MANUFACTURER'S RECOMMENDATIONS EXPLICITLY. ADDING LESS THAN THE REQUIRED AMOUNT WILL NOT TAKE CARE OF PART OF THE PROBLEM. THE ENTIRE AMOUNT IS NEEDED FOR THE TREATMENT TO BE EFFECTIVE. THIS TYPE OF TREATMENT CAN BE EXTREMELY EXPENSIVE.
  - BLACK ALGAE CAN BE SPOT TREATED USING TABS OF TRI-CHLOR OR A SPECIALLY MADE ALGAE TREATMENT FOR SPOT TREATMENT. THIS USUALLY INVOLVES TURNING OFF THE SYSTEM AT NIGHT AND PLACING THE TABS DIRECTLY ON THE BLACK ALGAE SPOTS, THEN REMOVING THEM BEFORE OPENING. CONTINUE TREATING THE SPOTS FOR SEVERAL DAYS AFTER VISIBLE SIGNS OF ALGAE HAVE DISAPPEARED.
- IF IT IS POSSIBLE, USE A SEPARATE VACUUMING SYSTEM TO AVOID HAVING THE ALGAE RUN THROUGH THE FILTRATION SYSTEM. EVEN THOUGH, IT HAS BEEN TREATED, IT ONLY TAKES A LIVE SPORE TO ATTACH WITHIN THE SYSTEM AND BEGIN TO GROW AGAIN.
- AFTER CLEANING UP THE ALGAE, BE SURE TO THOROUGHLY CLEAN ALL EQUIPMENT THAT WAS USE IN THE PROCESS. DISINFECT ALL BRUSHES, VACUUM HEADS, POLES, ETC.

LET'S REVIEW!

Fill in the chart with the range of each reading and the chemical name that raises and lowers each reading:

Chemical	Minimum	Maximum	Raise	Lower
Chlorine	1.0	10	Add chlorine	Add Sodium Thiosulfate
pH	7.2	7.8	Add Soda Ash	Add Muriatic Acid
Total Alkalinity	60	180	Add Baking Soda	Add Muriatic Acid
Calcium Hardness	150	400	Add Calcium Chloride	Drain And Fill
Cyanuric Acid	30	50	Add Cyanuric Acid	Drain And Fill
Total Dissolved Solids	**No Minimum**	1500	**Not Applicable**	Drain And Fill

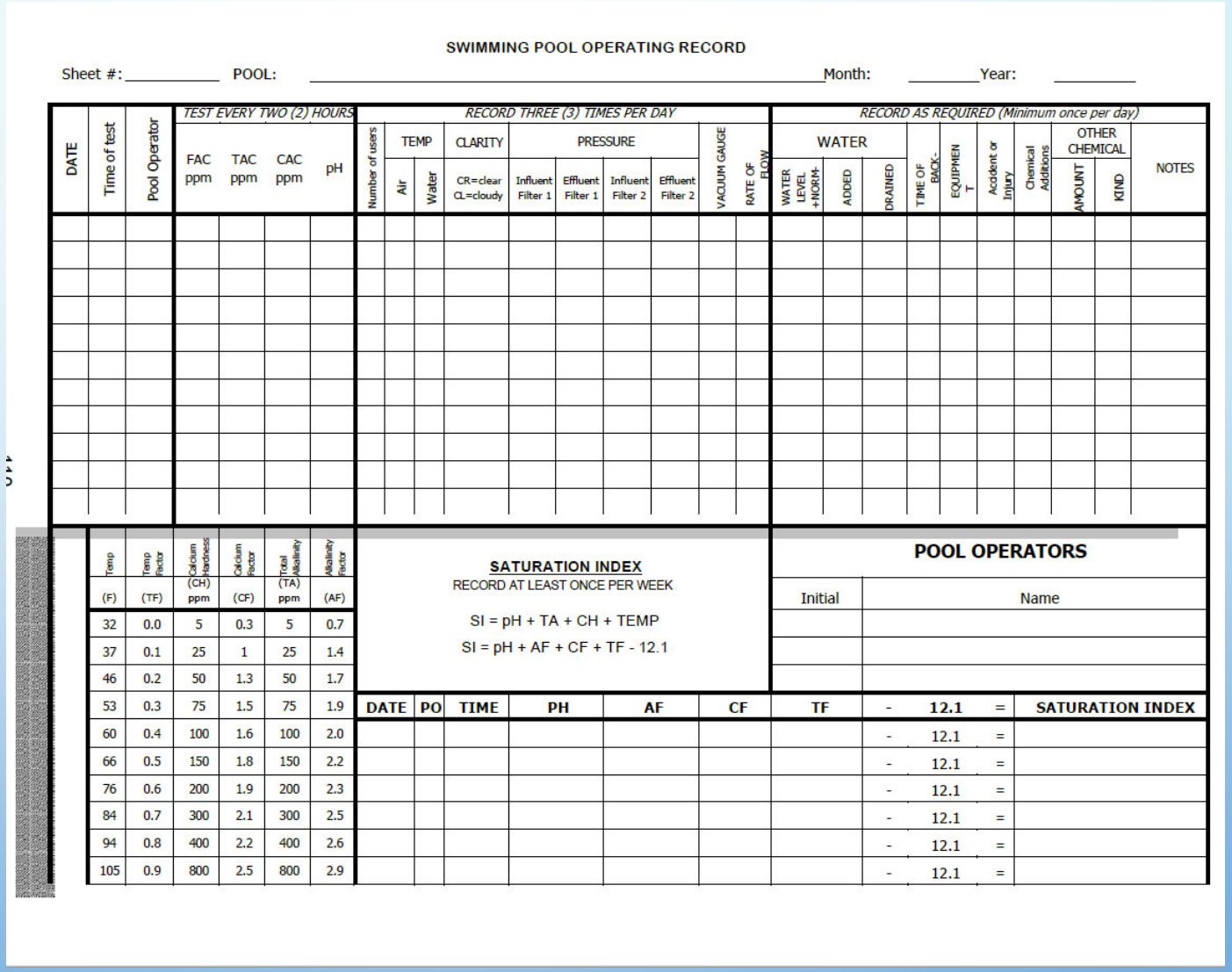


WATER TESTING

WATER TESTING

1. READ THE TEST KIT DIRECTIONS THOROUGHLY.
2. TAKE THE WATER SAMPLE WELL BELOW THE SURFACE OF THE WATER.
3. RINSE THE COMPARATOR/CELLS BEFORE BEGINNING THE TEST. PUT THE COMPARATOR INTO THE WATER UPSIDE DOWN AND THEN TURN RIGHT SIDE UP SEVERAL INCHES BELOW THE WATER'S SURFACE. THE COMPARATOR IS THE DEVICE THAT THE WATER READINGS ARE TESTED IN. THERE ARE MANY DIFFERENT TYPES OF COMPARATORS; SOME TEST KITS USE INDIVIDUAL TESTING CELLS. REFER TO INDIVIDUAL TEST KIT DIRECTIONS.
4. CHECK WITH THE LOCAL HEALTH DEPARTMENT AS TO THE FREQUENCY OF TESTING AND THE PROPER RANGES.
5. KEEP ALL TEST KITS AND REAGENTS OUT OF SUNLIGHT AND OUT OF THE REACH OF CHILDREN.
6. REPLACE REAGENTS ACCORDING TO MANUFACTURER RECOMMENDATIONS. USUALLY LIQUID REAGENTS SHOULD BE REPLACED ANNUALLY AND TABLETS AT LEAST EVERY 3 YEARS.
7. COMPARE ALL TESTS USING THE SAME LIGHT SOURCE.
8. ALTERNATE TESTING SITES TO ASSURE ALL "DEAD SPOTS" ARE ADEQUATELY TREATED. (DEAD SPOTS ARE AREAS OF POOR CIRCULATION).
9. NEUTRALIZE EXTREMELY HIGH CHLORINE/BROMINE LEVELS (ABOVE 10 PPM) BEFORE TESTING THE PH. USE A DROP OF SODIUM THIOSULFATE (FOUND IN THE TEST KIT), BEFORE USING THE PHENOL RED.
10. ALWAYS DOUBLE-CHECK A CHLORINE/BROMINE READING IF IT APPEARS TO BE "0." IT CAN "BLEACH OUT." **BLEACHING OUT"** CAN HAPPEN IF A CHLORINE OR BROMINE READING IS EXTREMELY HIGH (ABOVE 10 PPM)

LOG ALL CHEMICAL TESTS



SWIMMING POOL OPERATING RECORD

Sheet #:_____ POOL: _____ Month: _____ Year: _____

DATE	Time of test	Pool Operator	*TEST EVERY TWO (2) HOURS*				*RECORD THREE (3) TIMES PER DAY*										*RECORD AS REQUIRED (Minimum once per day)*									
			FAC ppm	TAC ppm	CAC ppm	pH	Number of users	TEMP		CLARITY	PRESSURE				VACUUM GAUGE	RATE OF FLOW	WATER			TIME OF BACK--	EQUIPMENT	Accident or Injury	Chemical Additions	OTHER CHEMICAL		NOTES
								Air	Water	CR=clear CL=cloudy	Influent Filter 1	Effluent Filter 1	Influent Filter 2	Effluent Filter 2			WATER LEVEL +NORM-	ADDED	DRAINED					AMOUNT	KIND	

Temp (F)	Temp Factor (TF)	Calcium Hardness (CH) ppm	Calcium Factor (CF)	Total Alkalinity (TA) ppm	Alkalinity Factor (AF)
32	0.0	5	0.3	5	0.7
37	0.1	25	1	25	1.4
46	0.2	50	1.3	50	1.7
53	0.3	75	1.5	75	1.9
60	0.4	100	1.6	100	2.0
66	0.5	150	1.8	150	2.2
76	0.6	200	1.9	200	2.3
84	0.7	300	2.1	300	2.5
94	0.8	400	2.2	400	2.6
105	0.9	800	2.5	800	2.9

SATURATION INDEX

RECORD AT LEAST ONCE PER WEEK

SI = pH + TA + CH + TEMP

SI = pH + AF + CF + TF - 12.1

POOL OPERATORS

Initial	Name

DATE	PO	TIME	PH	AF	CF	TF	- 12.1 =	SATURATION INDEX
							- 12.1 =	
							- 12.1 =	
							- 12.1 =	
							- 12.1 =	
							- 12.1 =	
							- 12.1 =	

WATER TEST KITS

- DISINFECTANT DETERMINATION
- DPD (N,N-DIMETHYL-P-PHENYLONE-DIAMINE), LIQUID OR TABLET FORM, IS THE MOST COMMON CHLORINE/BROMINE TESTING REAGENT. THIS INDICATOR TURNS THE SAMPLE PINK IN THE PRESENCE OF DISINFECTANT RESIDUAL. THE PINKER THE SAMPLE, THE HIGHER THE CHLORINE/BROMINE READING.
- TABLETS:
  - DPD #1: TESTS FREE AVAILABLE CHLORINE AND TOTAL AVAILABLE BROMINE
  - DPD #3: TESTS TOTAL AVAILABLE CHLORINE (THERE IS NO #2 TABLET)
- LIQUID:
  - DPD #1 AND #2: TESTS FREE AVAILABLE CHLORINE AND TOTAL AVAILABLE BROMINE
  - DPD #3: TESTS TOTAL AVAILABLE CHORINE
- POWDER
  - FILL COMPARATOR TUBE TO 25 ML
  - ADD TWO LEVEL SCOOPS TO SAMPLE
  - COUNT DROPS OF TITRATING REAGENT UNTIL SAMPLE TURNS FROM PINK TO CLEAR. MULTIPLY NUMBER OF DROPS BY .2

WATER TESTING
TEST KITS

WHICH TEST KIT IS RIGHT FOR MY FACILITY?

- WHAT DO YOU NEED TO TEST FOR
- HOW OFTEN ARE YOU GOING TO USE IT
- HOW MANY PEOPLE ARE GOING TO USE IT
- HOW MUCH TIME DO YOU WANT TO SPEND TESTING

ARE TEST STRIPS ACCEPTABLE?

- ONLY PROVIDE INDICATOR OF A RANGE
- NOT THE ACCURACY REQUIRED BY MOST HEALTH DEPARTMENTS

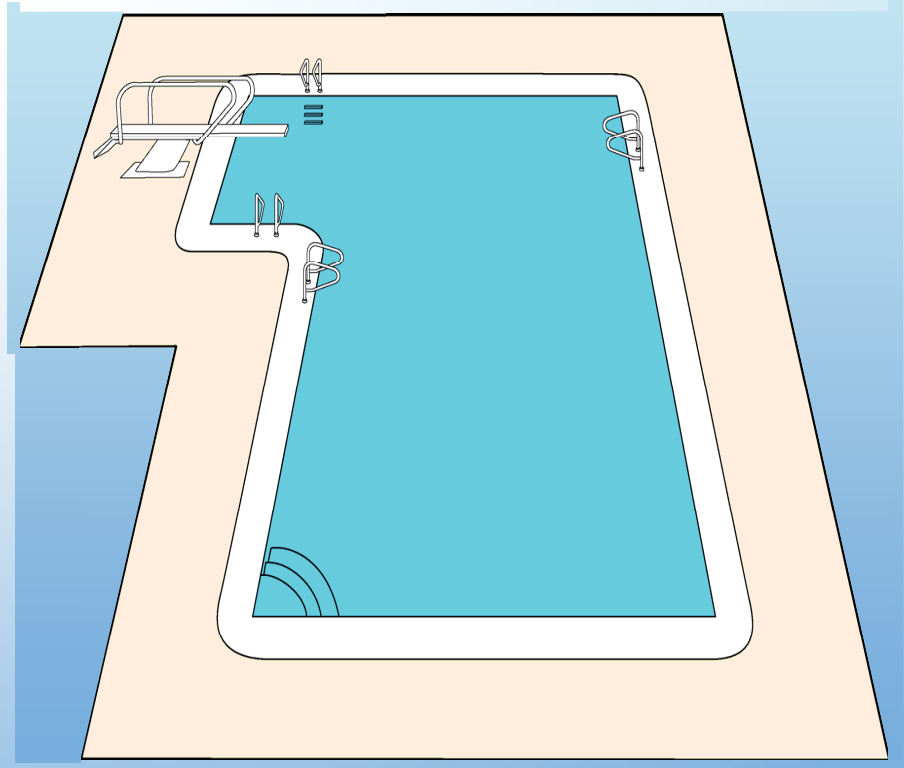
WATER TESTING
TESTING PROCEDURES

- RINSE THE TEST TUBE WITH TEST WATER (RINSE 3 TIMES WITH WATER TO BE TESTED)
- MEASURE CAREFULLY
- HOLD VERTICAL, CAP, AND DON'T USE FINGERS

WATER TESTING
TESTING PROCEDURES

COLLECTING WATER SAMPLE

- TAKE SAMPLE FROM VARYING SPOTS AROUND THE POOL THROUGHOUT THE DAY
- BE SURE THAT SAMPLES REPRESENT ENTIRE BODY OF WATER
- TAKE APPROXIMATELY 12" - 18 " BELOW WATER SURFACE
- DO NOT TAKE WATER SAMPLE IN FRONT OF INLET FITTING OR AT THE SAME LOCATION EACH TIME



WATER TESTING
TESTING PROCEDURES

- TEST SANITIZER RESIDUAL FIRST
  - IF TOO HIGH WILL AFFECT OTHER TESTS
- STORE TEST EQUIPMENT PROPERLY
- ANTICIPATE REPLACEMENT REAGENT REQUIREMENTS
- TESTS ARE ONLY AS ACCURATE AS PERSON DOING TEST
  - FEWER PEOPLE – MORE ACCURATE
  - PEOPLE VIEW COLORS DIFFERENTLY
    - DPD TITRANT SYSTEM DOES NOT REQUIRE COLOR MATCHING

WATER TESTING
SANITIZERS

- PROBLEMS WITH HIGH SANITIZER
  - BLEACHING OUT OF REAGENT
  - WHEN IN EXCESS OF 10 – 15 PPM PRODUCES FALSE LOW READING OR NO READING AT ALL
  - WORKAROUND
    - DILUTION
    - ADD MORE DPD
    - USE DPD-FAS

TAYLOR TEST KIT DIRECTIONS

Reproduced from K-2006 instruction:

Guide book (#2004B) amplifies these instructions and should be read to use this product properly.

POOL & SPA WATER TESTS

1. Read precautions on all labels.
2. Keep test kit out of reach of children.
3. Store test kit in cool, dark place.
4. Replace reagents once each year.
5. Do not dispose of solutions in pool or spa.
6. Rinse tubes before and after each test.
7. Obtain samples 18" (45 cm) below water surface.
8. Hold bottle vertically when dispensing.

Instr. #5138

Chlorine (Free, Combined) Test

1. Rinse and fill large comparator tube to desired mark with water to be tested.

NOTE: For 1 drop = 0.2 ppm, use 25 mL sample. For 1 drop = 0.5 ppm, use 10 mL sample.

2. Add 2 dippers R-0870. Swirl until dissolved. If free chlorine is present, sample will turn pink.

NOTE: If pink color disappears, add R-0870 until color turns pink.

3. Add R-0871 dropwise, swirling and counting after each drop, until color changes from pink to colorless.
4. Multiply drops in Step 3 by drop equivalence (Step 1). Record as parts per million (ppm) free chlorine (FC).
5. Add 5 drops R-0003. Swirl to mix. If combined chlorine is present, sample will turn pink.
6. Add R-0871 dropwise, swirling and counting after each drop, until color changes from pink to colorless.
7. Multiply drops in Step 6 by drop equivalence (Step 1). Record as ppm combined chlorine (CC).

pH Test

1. Rinse and fill large comparator tube to 44 mL mark with water to be tested.
2. Add 5 drops R-0004. Cap and invert to mix.
3. Match color with color standard. Record as pH units and save sample if pH needs adjustment. If sample color is between two values, pH is average of the two. To LOWER pH: See acid demand test. To RAISE pH: See base demand test.

Acid Demand Test

1. Use treated sample from pH test.
2. Add R-0005 dropwise. After each drop, count, mix, and compare with color standards until desired pH is matched. See treatment tables to continue.

Base Demand Test

1. Use treated sample from pH test.
2. Add R-0006 dropwise. After each drop, count, mix, and compare with color standards until desired pH is matched. See treatment table to continue.

Total Alkalinity Test

1. Rinse and fill large comparator tube to 25 mL mark with water to be tested.*
2. Add 2 drops R-0007. Swirl to mix.
3. Add 5 drops R-0008. Swirl to mix. Sample should turn green.
4. Add R-0009 dropwise. After each drop, count and swirl to mix until color changes from green to red.
5. Multiply drops in Step 4 by 10. Record as parts per million (ppm) total alkalinity as calcium carbonate.

**When high TA is anticipated,* this procedure may be used: Use 10 mL sample, 1 drop R-0007, 3 drops R-0008, and multiply drops in Step 4 by 25.

Calcium Hardness Test

1. Rinse and fill large comparator tube to 25 mL mark with water to be tested.*
2. Add 20 drops R-0010. Swirl to mix.
3. Add 5 drops R-0011L. Swirl to mix. If calcium hardness is present, sample will turn red.
4. Add R-0012 dropwise. After each drop, count and swirl to mix until color changes from red to blue.
5. Multiply drops in Step 4 by 10. Record as parts per million (ppm) calcium hardness as calcium carbonate.

**When high CH is anticipated,* this procedure may be used: Use 10 mL sample, 10 drops R-0010, 3 drops R-0011L, and multiply drops in Step 4 by 25.

Cyanuric Acid Test

1. Rinse and fill CYA dispensing bottle (#9191) to 7 mL mark with water to be tested.
2. Add R-0013 to 14 mL mark. Cap and mix for 30 seconds.
3. Slowly transfer cloudy solution to small comparator tube until black dot on bottom just disappears when viewed from top.
4. Read tube at liquid level on back of comparator block. Record reading as parts per million (ppm) cyanuric acid.

taylor 7/05

Powder/Titrating Reagent Testing Method Instructions

TESTING DISINFECTANT LEVEL

POWDER DIRECTIONS

Chlorine (Free, Combined) Test

1. Rinse and fill large comparator tube to desired mark with water to be tested.

NOTE: For 1 drop = 0.2 ppm, use 25 mL sample. For 1 drop = 0.5 ppm, use 10 mL sample.

2. Add 2 dippers R-0870. Swirl until dissolved. If free chlorine is present, sample will turn pink.

NOTE: If pink color disappears, add R-0870 until color turns pink.

3. Add R-0871 dropwise, swirling and counting after each drop, until color changes from pink to colorless.
4. Multiply drops in Step 3 by drop equivalence (Step 1). Record as parts per million (ppm) free chlorine (FC).
5. Add 5 drops R-0003. Swirl to mix. If combined chlorine is present, sample will turn pink.
6. Add R-0871 dropwise, swirling and counting after each drop, until color changes from pink to colorless.
7. Multiply drops in Step 6 by drop equivalence (Step 1). Record as ppm combined chlorine (CC).

LIQUID DIRECTIONS

Free, Combined & Total Chlorine (DPD)

1. Fill small tube to 9 mL mark with sample water.
2. Add 5 drops R-0001 and 5 drops R-0002. Cap and invert to mix.
3. Match color.* Record as ppm free chlorine (Cl_2).
4. Add 5 drops R-0003. Cap and invert to mix.
5. Match color immediately. Record as ppm total chlorine (Cl_2).
6. Subtract free chlorine (FC) from total chlorine (TC). Record as ppm combined chlorine (CC) as (Cl_2). Formula: TC – FC = CC.

Total Bromine

1. Fill small tube to 9 mL mark with sample water.
2. Add 5 drops R-0001 and 5 drops R-0002. Cap and invert to mix.
3. Match color.* Record as ppm total bromine (Br_2).

***If color is off-scale:** Repeat test using 4.5 mL sample diluted to 9 mL mark with tap water. Multiply reading by 2 to obtain approximate sanitizer level.

***If color is still off-scale:** Repeat test using 1.8 mL sample diluted to 9 mL mark with tap water. Multiply reading by 5 to obtain approximate sanitizer level.

OR

Free & Combined Chlorine (FAS-DPD)

1. Fill large tube to desired mark with sample water.

NOTE: For 1 drop = 0.2 ppm, use 25 mL sample. For 1 drop = 0.5 ppm, use 10 mL sample.

2. Add 2 dippers R-0870. Swirl until dissolved. If free chlorine is present, sample will turn pink.

NOTE: If pink color disappears or no pink color develops, add R-0870 until color turns pink.

3. Add R-0871 dropwise, swirling and counting after each drop, until color changes from pink to colorless.
4. Multiply drops in Step 3 by drop equivalence (Step 1). Record as ppm free chlorine (Cl_2).
5. Add 5 drops R-0003. Swirl to mix. If combined chlorine is present, sample will turn pink.
6. Add R-0871 dropwise, swirling and counting after each drop, until color changes from pink to colorless.
7. Multiply drops in Step 6 by drop equivalence (Step 1). Record as ppm combined chlorine (Cl_2).

TESTING PH

pH Test

1. Rinse and fill large comparator tube to 44 mL mark with water to be tested.
2. Add 5 drops R-0004. Cap and invert to mix.
3. Match color with color standard. Record as pH units and save sample if pH needs adjustment. If sample color is between two values, pH is average of the two. To LOWER pH: See acid demand test. To RAISE pH: See base demand test.

Acid Demand Test

1. Use treated sample from pH test.
2. Add R-0005 dropwise. After each drop, count, mix, and compare with color standards until desired pH is matched. See treatment tables to continue.

Base Demand Test

1. Use treated sample from pH test.
2. Add R-0006 dropwise. After each drop, count, mix, and compare with color standards until desired pH is matched. See treatment table to continue.

TESTING TOTAL ALKALINITY

Total Alkalinity Test

1. Rinse and fill large comparator tube to 25 mL mark with water to be tested.*
2. Add 2 drops R-0007. Swirl to mix.
3. Add 5 drops R-0008. Swirl to mix. Sample should turn green.
4. Add R-0009 dropwise. After each drop, count and swirl to mix until color changes from green to red.
5. Multiply drops in Step 4 by 10. Record as parts per million (ppm) total alkalinity as calcium carbonate.

*__When high TA is anticipated,__ this procedure may be used: Use 10 mL sample, 1 drop R-0007, 3 drops R-0008, and multiply drops in Step 4 by 25.

TESTING CALCIUM HARDNESS

Calcium Hardness Test

1. Rinse and fill large comparator tube to 25 mL mark with water to be tested.*
2. Add 20 drops R-0010. Swirl to mix.
3. Add 5 drops R-0011L. Swirl to mix. If calcium hardness is present, sample will turn red.
4. Add R-0012 dropwise. After each drop, count and swirl to mix until color changes from red to blue.
5. Multiply drops in Step 4 by 10. Record as parts per million (ppm) calcium hardness as calcium carbonate.

* ***When high CH is anticipated,*** this procedure may be used: Use 10 mL sample, 10 drops R-0010, 3 drops R-0011L, and multiply drops in Step 4 by 25.

TESTING CYANURIC ACID

Cyanuric Acid Test

1. Rinse and fill CYA dispensing bottle (#9191) to 7 mL mark with water to be tested.
2. Add R-0013 to 14 mL mark. Cap and mix for 30 seconds.
3. Slowly transfer cloudy solution to small comparator tube until black dot on bottom just disappears when viewed from top.
4. Read tube at liquid level on back of comparator block. Record reading as parts per million (ppm) cyanuric acid.

taylor
7/05

OTHER WATER TESTS

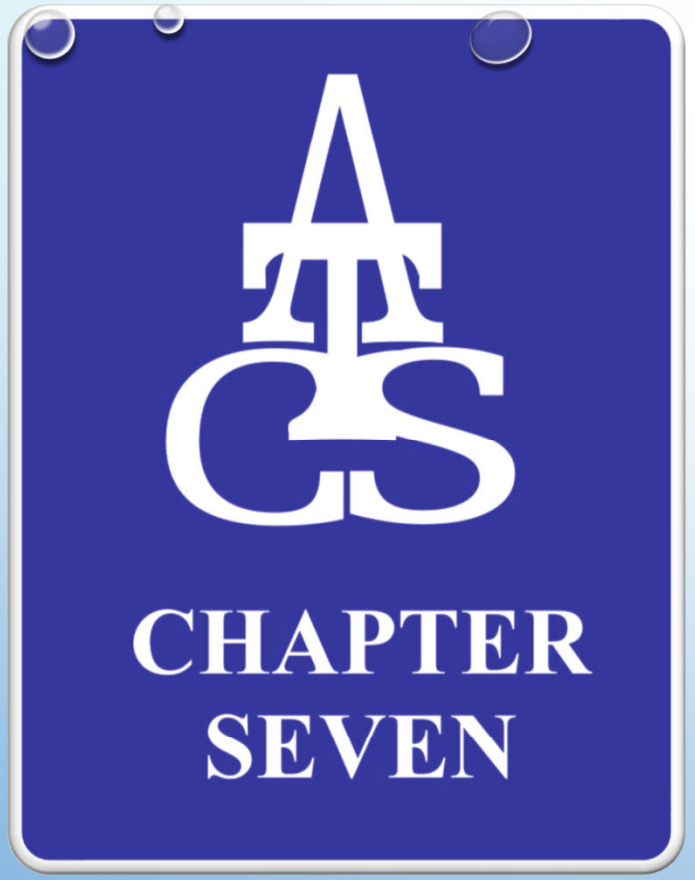
- TEMPERATURE
- METALS
- TDS
- HYDROGEN PEROXIDE
- SALT
- NITRATE AND PHOSPHATE
- TEST STRIPS

REMEMBER AT LEAST ONCE PER WEEK YOU WILL ALSO NEED TO CALCULATE THE SATURATION INDEX TO DETERMINE IF YOUR WATER IS IN BALANCE. USE THE WATERGRAM FOR THIS READING!

LET'S REVIEW!

Fill in the chart with the range of each reading and the chemical name that raises and lowers each reading:

Chemical	Minimum	Maximum	Raise	Lower
Chlorine	1.0	10	Add chlorine	Add Sodium Thiosulfate
pH	7.2	7.8	Add Soda Ash	Add Muriatic Acid
Total Alkalinity	60	180	Add Baking Soda	Add Muriatic Acid
Calcium Hardness	150	400	Add Calcium Chloride	Drain And Fill
Cyanuric Acid	30	50	Add Cyanuric Acid	Drain And Fill
Total Dissolved Solids	**No Minimum**	1500	**Not Applicable**	Drain And Fill



CHEMICAL AUTOMATION & CHEMICAL FEEDERS

CHEMICAL AUTOMATED TESTING

WHAT YOU NEED TO KNOW ABOUT ORP:

OXIDATION REDUCTION POTENTIAL READING

- ORP IS A MEASURE OF THE OXIDIZING CAPABILITY PRESENT IN THE WATER.
- SANITIZERS PRODUCE MEASURABLE ELECTRICAL OUTPUT THAT CAN BE MEASURED IN MILLIVOLTS.
- THE ORP DOES NOT TELL HOW MUCH CHEMICAL IS IN THE WATER, RATHER IT EXPRESS THE EFFECTIVENESS OF THE HYPOCHLOROUS ACID IN THE WATER.
- THE ORP DRINKING WATER STANDARD IS 650 MV MEETS.
- MOST POOLS AND HOT TUBS WILL BE KEPT AROUND 750 MV .
- THE ORP READING ON AN AUTOMATED TESTING SYSTEM MAY VARY FROM POOL TO POOL WHEN THE NUMBER IS COMPARED TO THE MANUAL TEST RESULT. THE IMPORTANT THING IS TO FIND THE CORRECT ORP READING THAT PRODUCES THE DESIRED MANUAL READING AND SET THE SYSTEM TO MAINTAIN THAT READING.

CHEMICAL AUTOMATED TESTING

WHAT YOU NEED TO KNOW ABOUT PH:

PH READING

- PH IS MEASURED ON A 14 POINT SCALE AND WILL GIVE A NUMBER SIMILAR TO MANUAL READINGS.
- THE POOL OPERATOR WILL NEED TO FREQUENTLY CALIBRATE THE AUTOMATED TESTING MACHINE TO MATCH THE MANUAL READING.
- ALWAYS ASSUME THAT THE MANUAL READING IS CORRECT AND THAT THE AUTOMATED TESTING SYSTEM NEEDS TO BE ADJUSTED.
- THE AUTOMATED TESTING SYSTEM CAN BE SET TO MAINTAIN THE PH AND ACTIVATE THE CARBON DIOXIDE OR MURIATIC ACID FEEDER TO LOWER THE PH AS IT INCREASES.

CHEMICAL AUTOMATED TESTING

PROBLEMS WITH THESE SYSTEMS:

PROBLEMS THAT EXIST

- MANY POOL OPERATOR BELIEVE THAT THE AUTOMATED TESTING SYSTEM IS HANDLING ALL OF THE READINGS…IT IS NOT! THESE SYSTEM MAINTAIN DISINFECTANT AND PH ONLY!
- AUTOMATED SYSTEMS THAT UTILIZE CARBON DIOXIDE TO MAINTAIN THE PH, OFTEN EXPERIENCE VERY HIGH TOTAL ALKALINITY BECAUSE OF THE HYDROXIDES PRODUCED. TOTAL ALKALINITY MUST BE MAINTAINED MANUALLY.
- OFTEN THE CHEMICAL FEEDERS THAT ARE ATTACHED TO THE AUTOMATED TESTING SYSTEM ARE TOO LARGE AND CHANGE THE POOL TOO QUICKLY. CHECK THE FEEDER SIZES.
- MONTHLY MAINTENANCE NEEDS TO BE MAINTAINED ON THE PROBES
- MANUAL TESTS CAN BE TAKEN FROM THE RESERVOIR AREA BUT THIS SHOULD NOT BE THE PRIMARY TESTING SPOT!

LIQUID CHEMICAL FEEDERS

- ALL CHEMICALS FOR DISINFECTION MUST BE FED THROUGH MECHANICAL FEEDERS
- USES
  - DISPENSES DISINFECTANTS
  - DISPENSES ACIDS
  - SLURRY FEEDING DE
- WORKS BY ROLLERS APPLYING PRESSURE TO THE FEED TUBE WHICH DRAWS CHEMICAL UP FROM THE VAT AND PUSHING IT THROUGH THE TUBING INTO THE EFFLUENT SIDE OF THE CIRCULATION SYSTEM

GAS FEEDERS

- TWO MAIN TYPES
  - GAS CHLORINE (RARELY USED)
  - CARBON DIOXIDE (USED IN COMBINATION WITH AN AUTOMATED TESTING SYSTEM)
- BASIC EQUIPMENT
  - INJECTOR TO PULL GAS OUT
  - CONTROL DEVICE
  - YOKE, OR CYLINDER UNIT
- CARBON DIOXIDE GAS IS NOT DANGEROUS
- GAS METERED IN STANDARD CUBIC FEET PER HOUR (SCFH)
- VAPOR CRYSTALS ON FEED EQUIPMENT DURING OPERATION – NORMAL
- ANNUALLY – INSPECT CHECK-VALVE AND TUBING

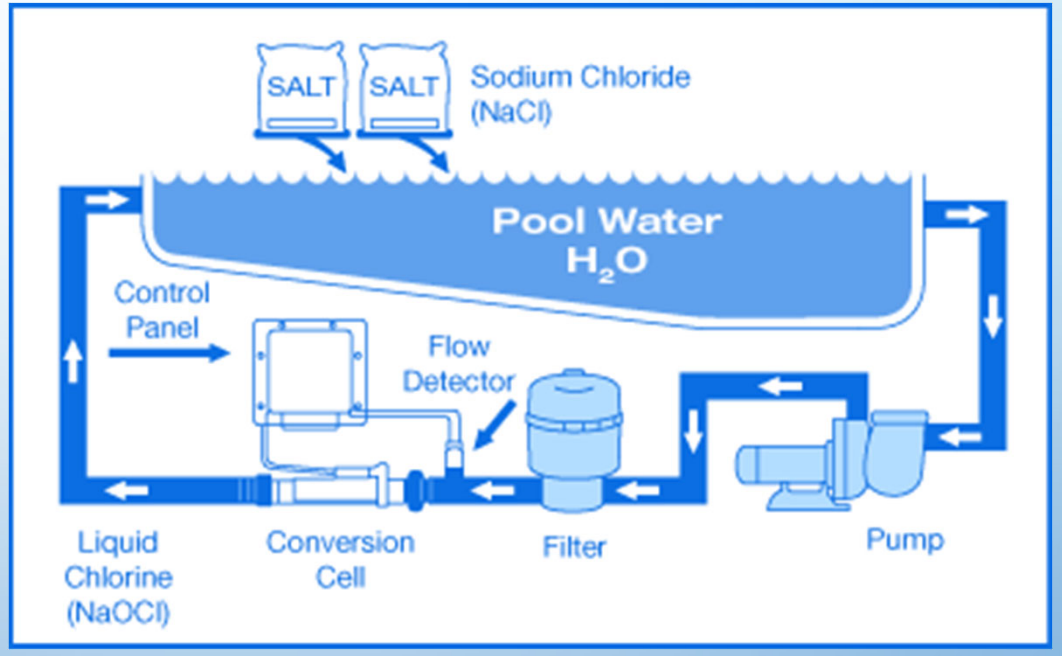
SOLID CHEMICAL FEEDERS
EROSION FEEDERS

- EROSION – GRADUAL WEARING AWAY OF A SOLID BY FRICTION
- CHEMICAL ERODED BY FLOW AND THE SOLUTION COMES OUT DISCHARGE AND THE AMOUNT IS CONTROLLED BY THE FLOW
- CALLED BY NAME OF CHEMICAL DISPENSED (I.E. CHLORINATOR, BROMINATOR)
- USE ONLY ONE DISINFECTANT IN FEEDER AND MAKE SURE THAT THE BRAND IS COMPATIBLE WITH THE FEEDER
- FLOWMETER MAY BE REQUIRED, CHECK CODES
- WHENEVER BACKWASHING CLOSE FEEDER REGULATING VALVES TO PREVENT UNNECESSARY EROSION AND BUILD UP OF PRESSURE IN THE FEEDER
- IN PRESSURE FEEDERS
  - DO NOT OPEN LID WITH PUMP RUNNING
  - BEFORE OPENING CHECK TO RELEASE PRESSURE

CHLORINE/BROMINE GENERATORS

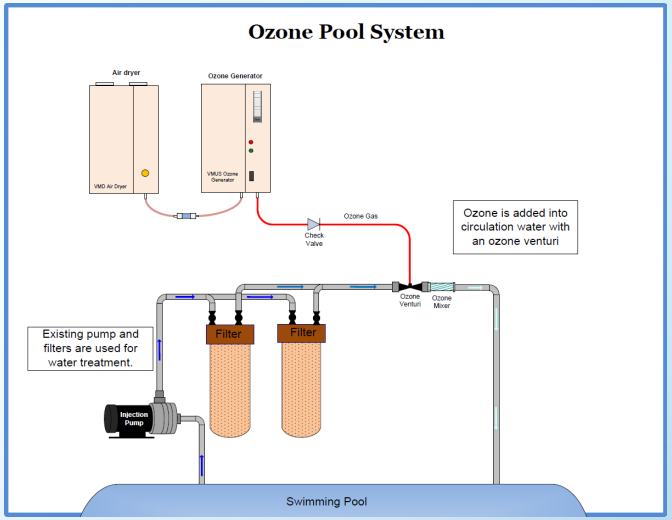
- THROUGH ELECTROLYSIS GENERATE ACTIVE SANITIZER FROM SALTS
  - SODIUM CHLORIDE
  - SODIUM BROMIDE

- TWO METHODS
  - BRINE TANK
  - IN-LINE



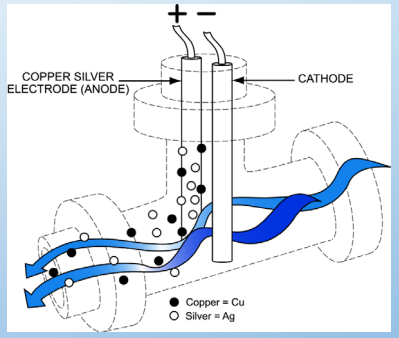
OZONATORS

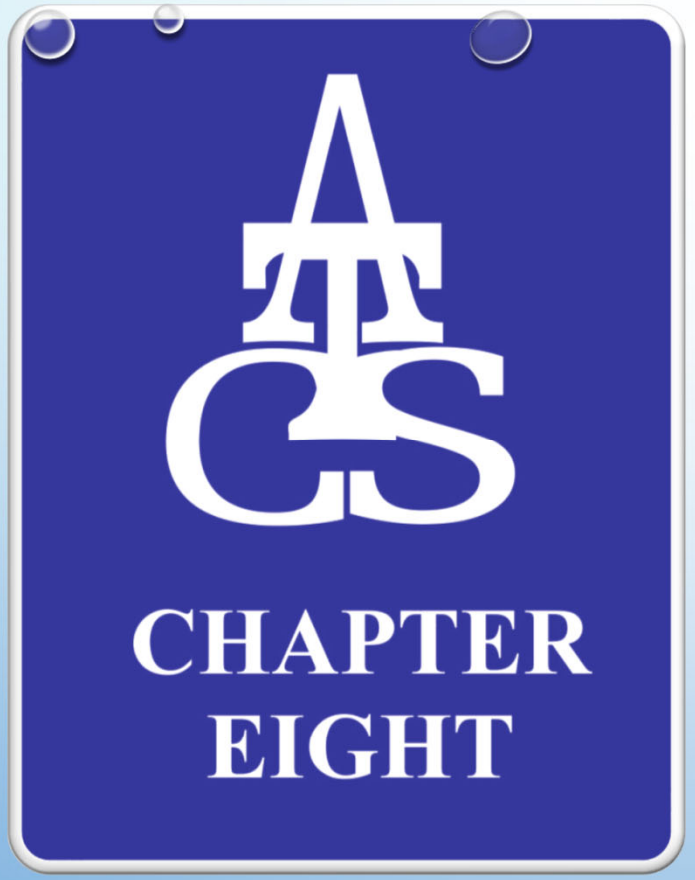
- CREATE OZONE THROUGH UV LAMPS AND ELECTRICAL VOLTAGE (CORONA DISCHARGE)
- OZONE MUST BE USED WITH EPA REGISTERED SANITIZER



IONIZERS AND MINERAL SYSTEMS

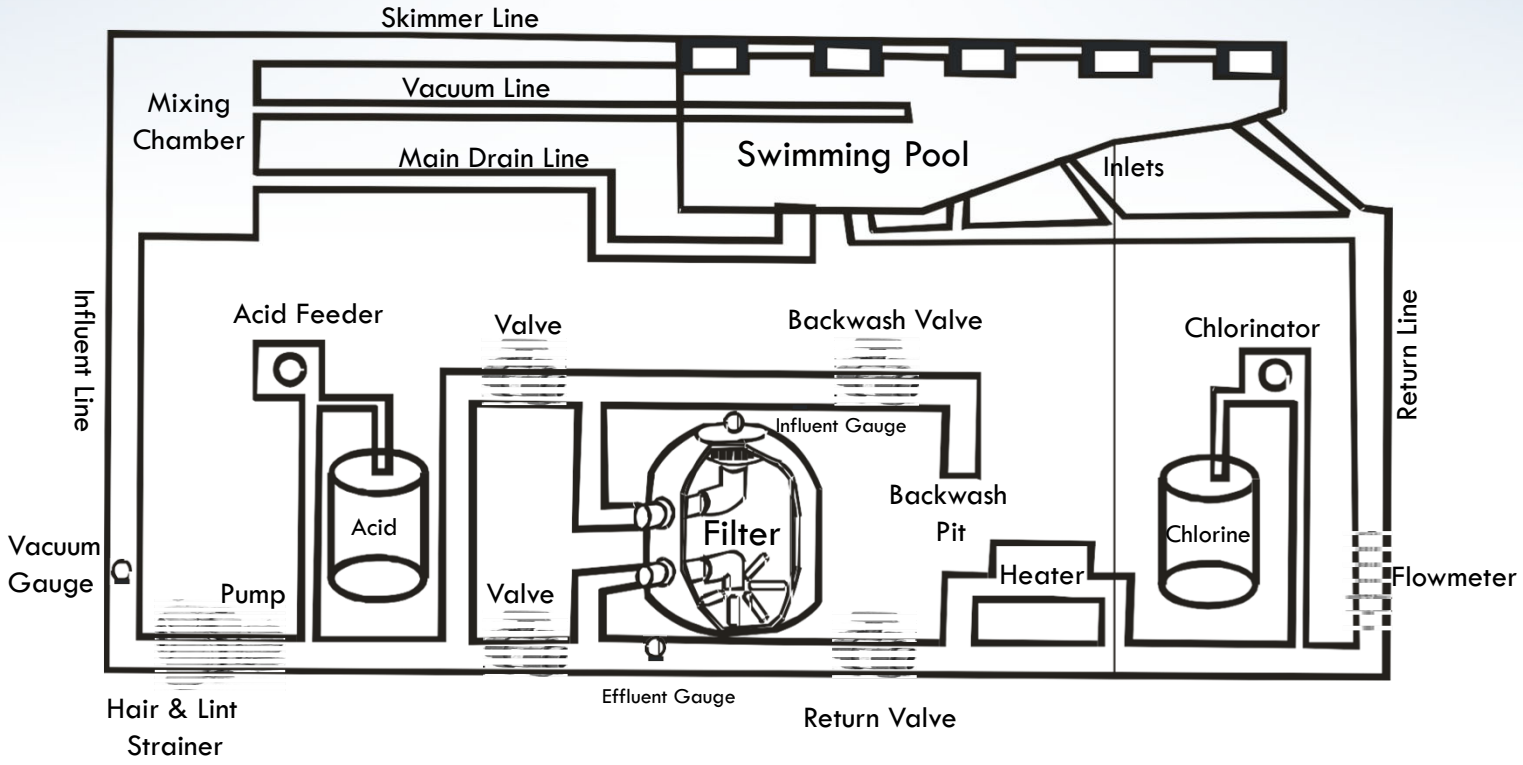
- IONIZERS – ELECTROLYTIC DEVICES THAT DELIVER SILVER AND/OR COPPER IONS INTO WATER
- MUST BE USED IN COMBINATION WITH EPA REGISTERED SANITIZER





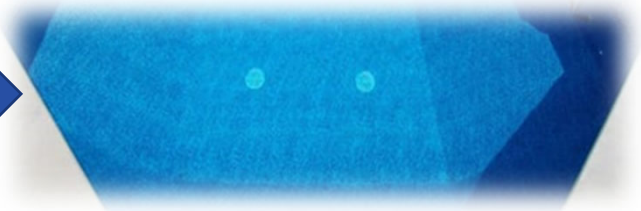
WATER CIRCULATION

WATER CIRCULATION



INFLUENT LINES

MAIN DRAIN

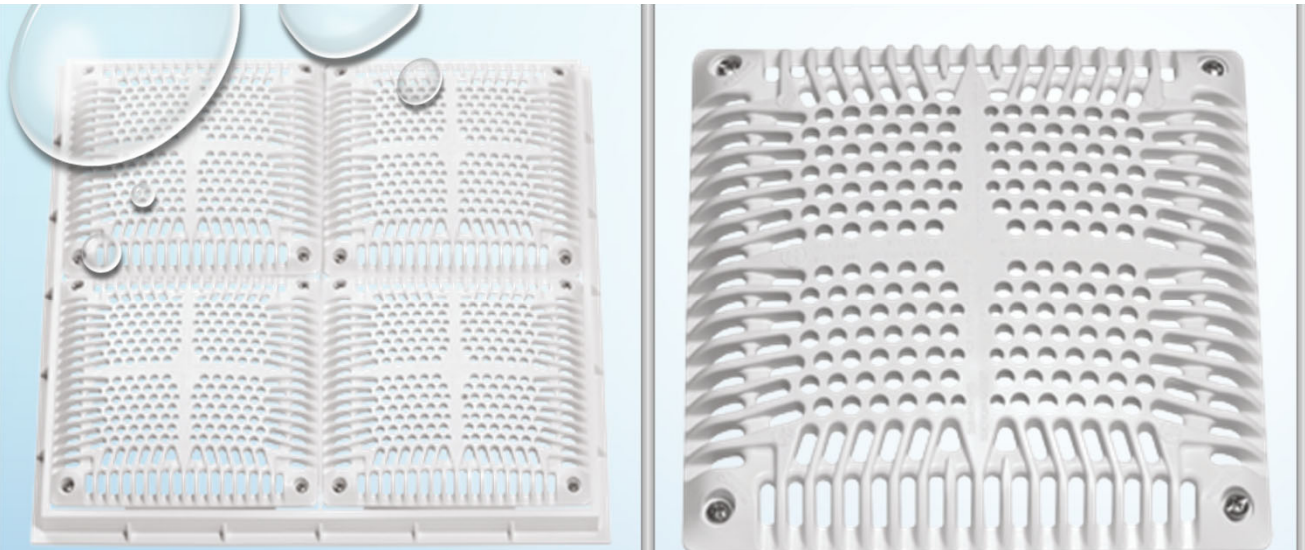


SKIMMER

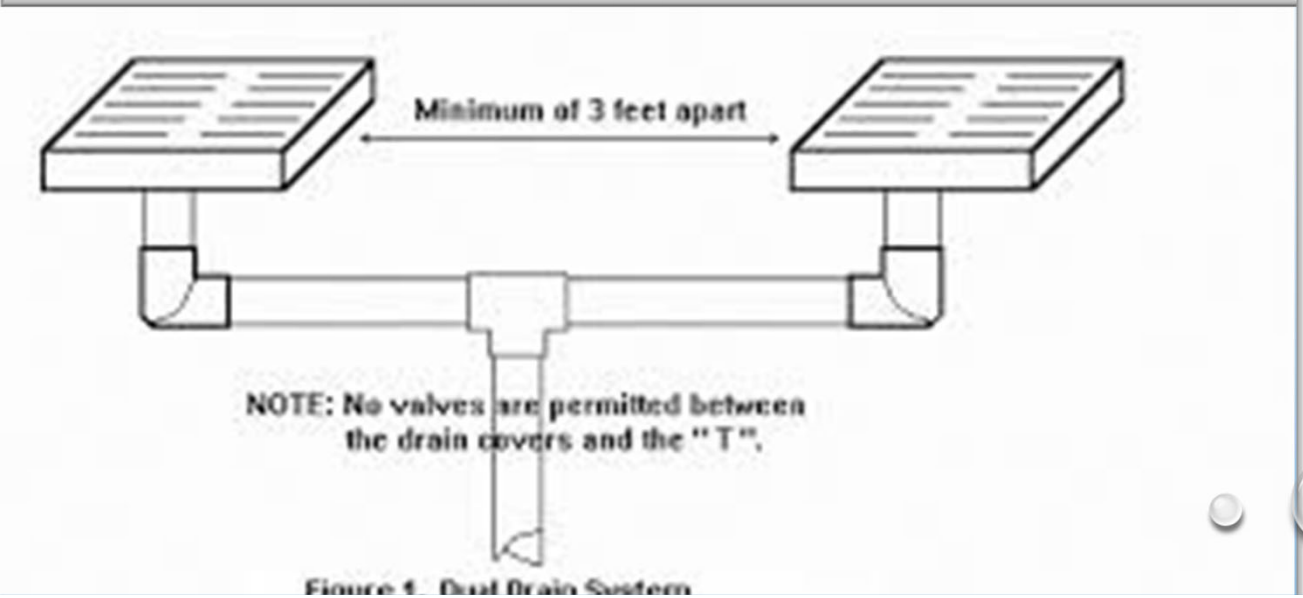
VACUUM

MAIN DRAIN

- DEEPEST PART OF THE POOL
- ON THE BOTTOM OF THE POOL
- AT LEAST TWO DRAIN COVERS
- ANTI-VORTEX COVERS
- MUST BE SECURED AND NOT BROKEN TO BE OPEN



Photos provided by Hayward



DUAL MAIN DRAINS

- 2009 VIRGINIA GRAEME BAKER ACT
  - REQUIRE TO HAVE DUAL MAIN DRAINS THAT CANNOT BE ISOLATED AND ARE AT LEAST THREE FEET APART
  - BY HAVING TWO DRAINS, AN INDIVIDUAL CANNOT CREATE A VACUUM SEAL BY THEMSELVES
  - **ANTI-VORTEX DRAIN COVER** IS LARGER AND ROUNDED INSTEAD OF FLUSH WITH THE POOL BOTTOM. THE WATER IS PULLED IN AND UNDER THE COVER

SUCTION ENTRAPMENT GUIDELINES

- TO PREVENT HAIR ENTRAPMENT, LIMB ENTRAPMENT, MECHANICAL ENTRAPMENT, BODY ENTRAPMENT, & EVISCERATION
- SUCTION ENTRAPMENT PREVENTION MUST BE PART OF YOUR DAILY SAFETY INSPECTION

Daily Checklist
☐ Main drain, vacuum, inlet covers and/or fittings in place, secured and unbroken **(hourly)**
☐ Skimmers checked (baskets, weirs, lids & flow adjusters) for blockage **(hourly)**
☐ Warning/alert signs in place around the pool with emergency instructions and phone numbers
☐ On/Off switch to pump clearly labeled and location of pump clearly identified

(From U.S. Consumer Product Safety Commission,
Guidelines for Entrapment Hazards: Making Pools and Spas Safer)

Items to be Checked in Filter Room and Pool Before Filling and After Periodic Maintenance and Cleaning Procedures
☐ Proper Suction drain covers installed and inspected for breakage (Main and wading pools)
☐ Suction drain covers firmly and properly affixed using manufacturer's recommended parts
☐ Suction drain covers firmly and properly affixed using manufacturer's recommended parts
☐ Proper return covers installed (Main and wading pools)
☐ Skimmers checked (baskets, weirs, lids & flow regulators) for blockage
☐ All skimmer throats checked for blockage (Main and wading pools)
☐ All valves and filter lines labeled and functional
☐ Vacuum covers or fittings in place (if applicable)
☐ Location of the On/Off switch to circulation pump clearly identified
☐ On/Off switch to circulation pump clearly labeled

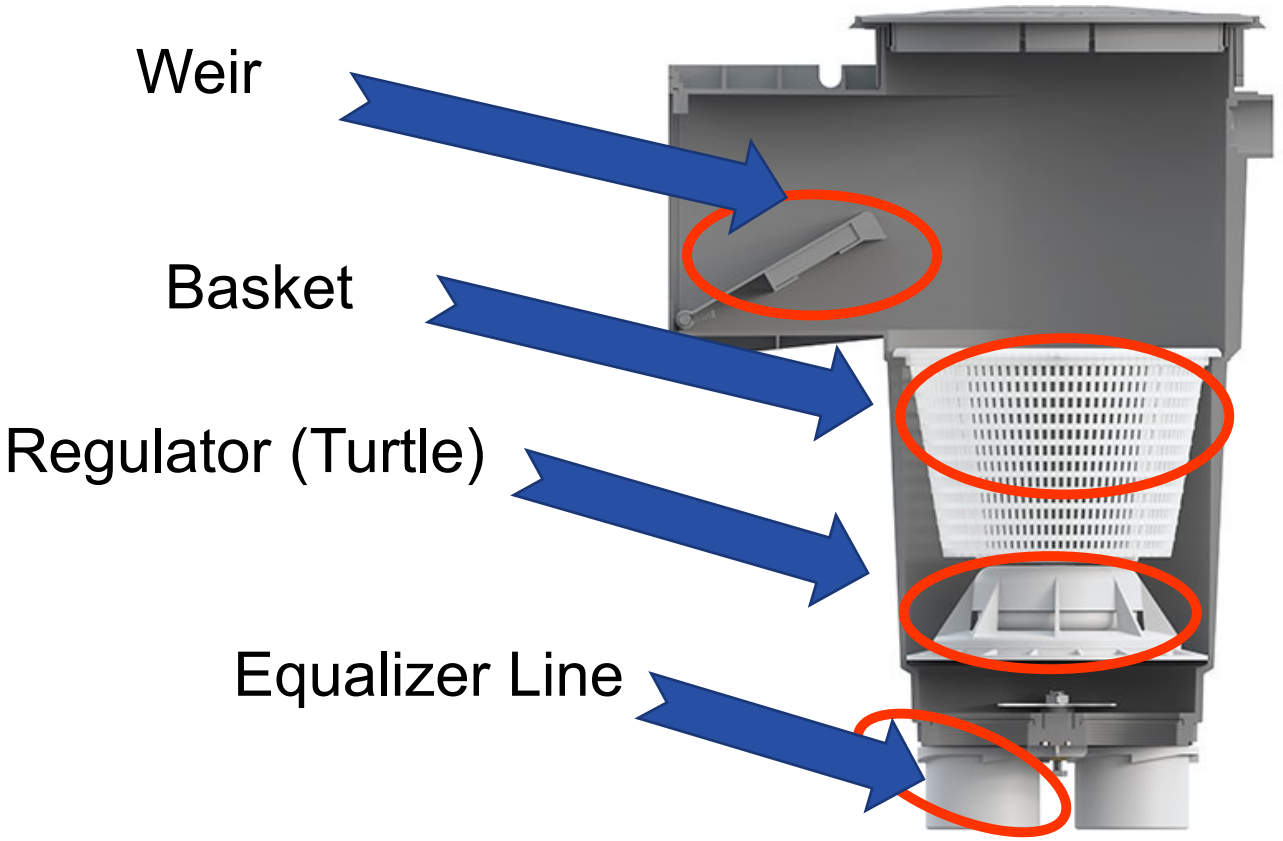
DAILY ENTRAPMENT PREVENTION

- **Check Drain Covers Daily**
- **Check Water Is Above Bottom of Skimmers**
- **Empty Skimmer Baskets Daily**
- **On/Off Switch is Clearly Marked**

HYDROSTATIC RELIEF VALVE

RELEASES UNDERGROUND WATER PRESSURE WHEN THE POOL IS EMPTY

SKIMMERS

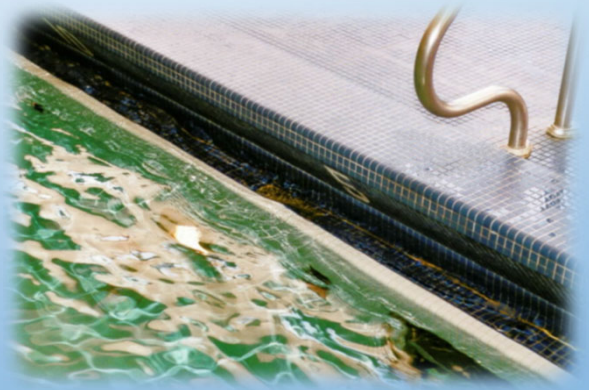


The skimmer line is responsible for removing debris off the surface of the water. Water level should be maintained at halfway to three quarters of the way up the hole in order to ensure that water is pulled into the system. At least 50% of the water entering the circulation system has to come through the skimmer line.

Photos provided by Hayward

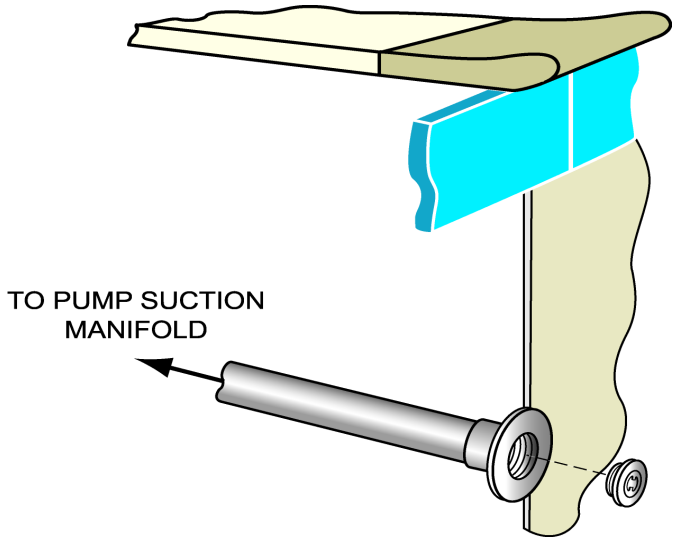
GUTTERS

- ONE BIG SKIMMER AROUND THE PERIMETER OF THE POOL
- USE BALANCING (SURGE) TANK
- CONTINUOUS OVERFLOW INTO TROUGH IN ORDER TO REDUCE WAVES
- USES GRAVITY TO HAVE WATER FLOW INTO POOL PIPING SYSTEM



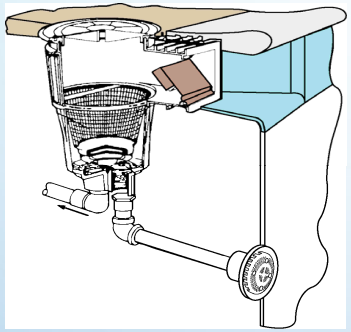
VACUUM LINE

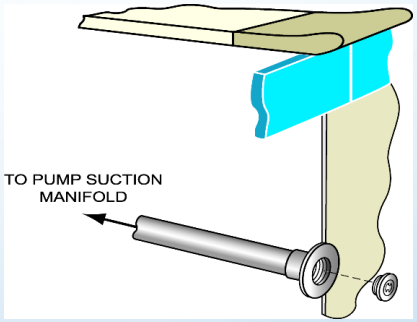
VACUUM OUTLETS



- ONE METHOD OF CONNECTING SUCTION VACUUMING EQUIPMENT TO CIRCULATION SYSTEM
- SHUT VALVE, CAP LINE WHEN NOT IN USE

THE CIRCULATION SYSTEM
METHODS OF VACUUMING





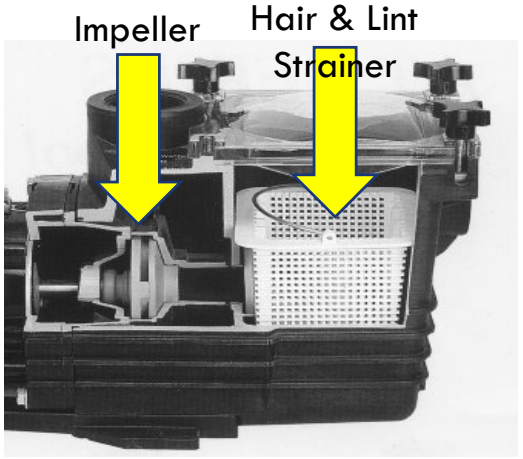
VACUUM PROCEDURES

- Attach the vacuum head to the pole, and the hose to the vacuum head.
- Place the vacuum head into the water and allow it to sink to the bottom.
- Prime the vacuum hose by filling it with water BEFORE hooking it up to the port.
- This is most easily achieved by feeding the hose straight down the wall into the water, so it fills with water.
- Plug the other end of the hose into the vacuum hole or bottom of the skimmer, whichever is used to vacuum

DO NOT PLUG THE VACUUM HOSE INTO THE PORT, UNLESS IT HAS WATER IN IT!

HAIR & LINT STRAINER

- IS ALWAYS LOCATED BEFORE OR ABOVE THE PUMP. IT IS THE LAST DEFENSE FOR THE PUMP.
- PROTECTS THE IMPELLER WHICH IS WHAT IS MOVING THE WATER THROUGH THE SYSTEM
- PUMP CAVITATION OCCURS WHEN WATER IS NOT MAKING IT TO THE MOTOR
- CAVITATION IS USUALLY THE RESULT OF A FULL BASKET



Photos provided by Hayward

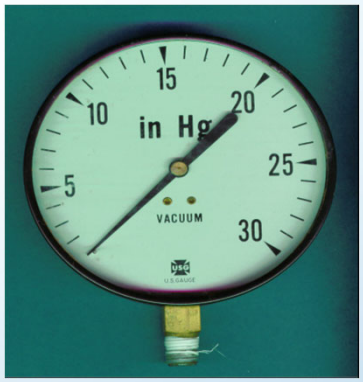
CLEANING THE BASKET & PRIMING THE PUMP

Cleaning the basket should be done each time the system is backwashed

1. Turn of the pump
2. Close influent and effluent valves
3. Open Hair & Lint Basket area
4. Remove dirty basket
5. Replace with clean basket (facilities should have two basket)
6. Clean dirty basket after it has dried

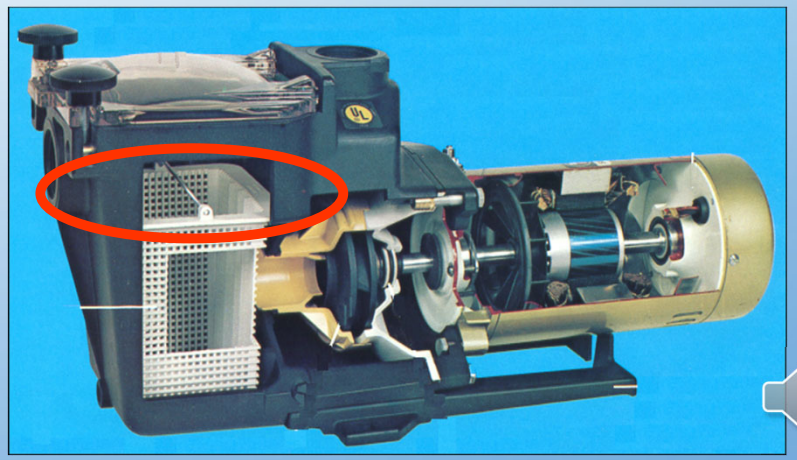
Priming the Pump is essential. The system must always have water running through it.

1. Fill basket area completely with water (Use buckets of water or a hose if needed).
2. Secure the lid on the hair and lint pot area. Any air on the suction side of the pump will prohibit a pump from "catching prime".
3. Open effluent line valve
4. Turn on pump influent valves to begin flow as vacuum pressure begins to increase



VACUUM GAUGE

- PRIOR TO PUMP
- INDICATES HOW HARD THE PUMP IS WORKING TO GET WATER FROM POOL/SPA



PROBLEMS TO AVOID WHEN PRIMING THE PUMP

Above ground pumps are the most difficult with which to work. The header valves must be closed prior to turning off the pump in order to clean the strainer. If these valves are not closed, all the water will run back to the pool and the pump will need to be re-primed prior to starting the system..

Below level systems (flooded suction) are the easiest to work with. All header valves must be closed before cleaning the hair strainer to prevent the water from rushing from the pool and out of the hair strainer. These pumps are called “flooded suction” pumps and prime themselves with gravity

PUMP/MOTOR

THE MOTOR MAKES THE PUMP WORK. THE IMPELLER IS ATTACHED TO THE SHAFT OF THE MOTOR, AND THE MOTOR SPINS THE IMPELLER, CIRCULATING THE WATER. THE NUMBER OF GALLONS PER MINUTE A PUMP WILL PRODUCE IS DEPENDENT ON THE POWER OF THE MOTOR.

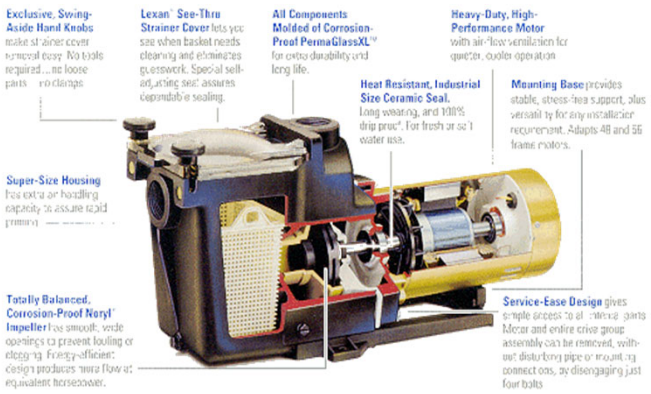


Photo courtesy of Hayward

CIRCULATION PUMP

- SELF PRIMING (AT OR ABOVE GRADE)
  - DESIGNED TO BE INSTALLED AT POOL SURFACE LEVEL OR HIGHER
  - SELF PRIMING
    - AFTER INITIAL CHARGE
  - DRAWS AIR OUT OF SUCTION LINE OF SYSTEM

- FLOODED SUCTION (BELOW GRADE)
  - DESIGNED TO BE INSTALLED BELOW WATER SURFACE LEVEL
  - POOR AT VENTING AIR FROM SYSTEM
  - USES GRAVITY TO BEING SUCTION WATER TO PUMP

PROBLEMS WITH THE CIRCULATION PUMP

IF SELF PRIMING PUMP WON'T PRIME, CAUSE MAY BE

- INSUFFICIENT LIQUID IN PUMP BODY
- AIR LEAK
- LEAK AT STRAINER COVER
- BLOCKED SUCTION LINE
- PLUGGED IMPELLER
- BAD MECHANICAL SEAL (PACKING GLAND)
- NOT ENOUGH WATER IN POOL
- SUCTION VALVE CLOSED
- DIRTY FILTER

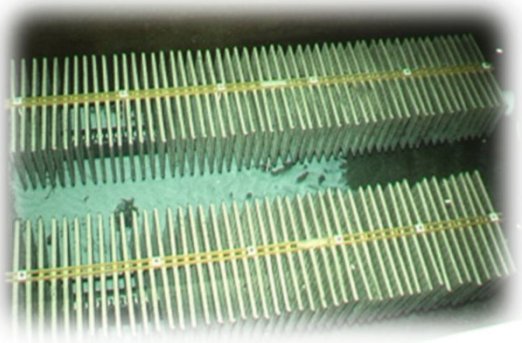
FILTER

Filters remove small particulate matter from the pool. Filters do not remove microorganisms.

The water passes through the filter media (sand, DE, or cartridge) leaving behind any particulate matter that is trapped by the filter media.

Sand Filter

Cartridge Filter



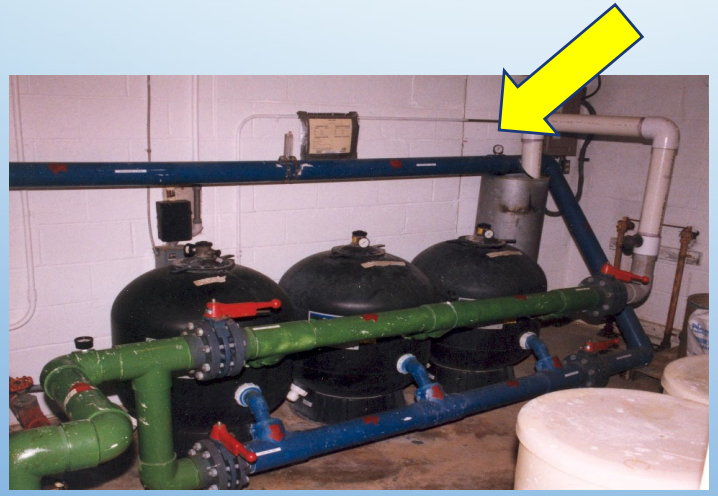
Diatomaceous Earth Filter

Refer to Chapter 9 for more information on filters.

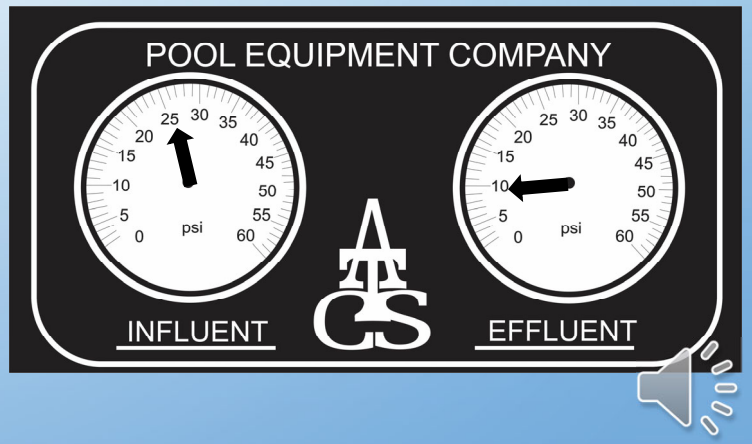
Photos courtesy of Hayward and _____

INFLUENT PRESSURE GAUGE AND EFFLUENT PRESSURE GAUGE

- INFLUENT GAUGE LOCATED ON TOP OF THE FILTER, ON PIPING FROM PUMP TO FILTER, ON GAUGE PANEL
- INDICATES PRESSURE EXERTED BY PUMP TO PUSH WATER THROUGH FILTER



- EFFLUENT GAUGE LOCATED ON PIPING AFTER FILTER OR ON GAUGE PANEL
- INDICATES PRESSURE EXERTED BY PUMP TO PUSH WATER BACK TO THE POOL AFTER IT EXITS THE FILTER



TURNOVER RATE

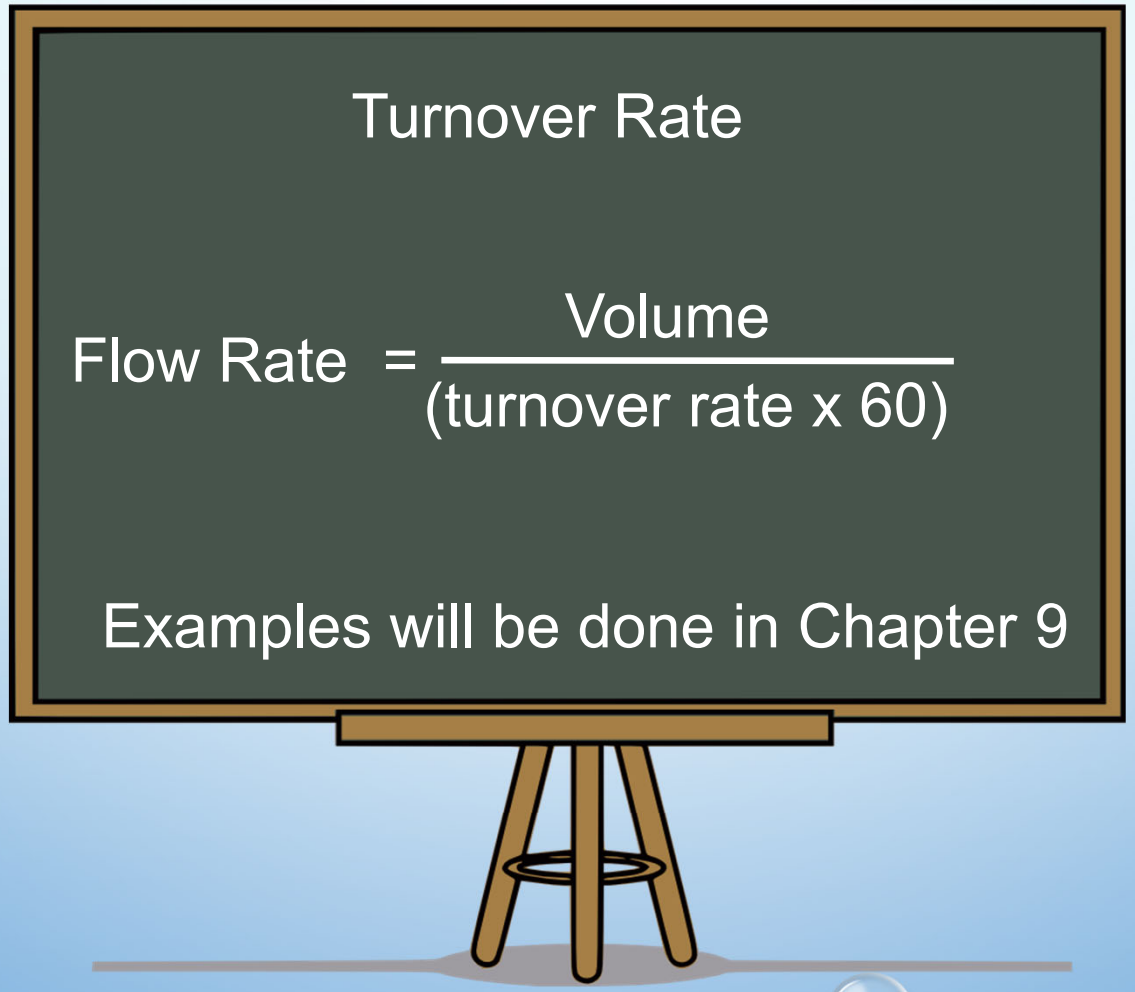
Turnover rate is the amount of time it takes all of the water in the pool to go through the filtration system and return to the pool basin.

MODEL AQUATIC HEALTH CODE RECOMMENDS:

- 6 HOURS FOR MAIN POOLS
- 1 HOURS FOR BABY POOLS
- 30 MINUTES FOR HOT TUBS

MARYLAND HEALTH CODE RECOMMENDS:

- 6 HOURS FOR MAIN POOLS
- 2 HOURS FOR BABY POOLS
- 30 MINUTES FOR HOT TUBS


Turnover Rate
Flow Rate = Volume / (turnover rate x 60)
Examples will be done in Chapter 9

HEATER

Heater: If the pool has a Heater, it should be installed after the filter and before the chemical injection points. Most systems require the heater to be turned off when the circulation pump is turned off for any reason, even if it will be off for only a few minutes. Some heaters are to be turned off several minutes before turning off the rest of the system (see manufacturer's instructions). Only turn the heater back on after the main (re-circulating) pump has been turned back on.

In order to size the heater, the operator BTUSs = Gallons x 8.33 x °F temperature rise

TYPES OF HEATERS AVAILABLE

- GAS/OIL FIRED
- ELECTRIC
- HEAT PUMP
- SOLAR
- HEAT EXCHANGER

Photos courtesy of Hayward

CHLORINATOR

Chemical Feeders introduce the disinfectant chemicals and pH adjusters to the filtered water. Most systems have the chemical injection points AFTER the filters and heaters.

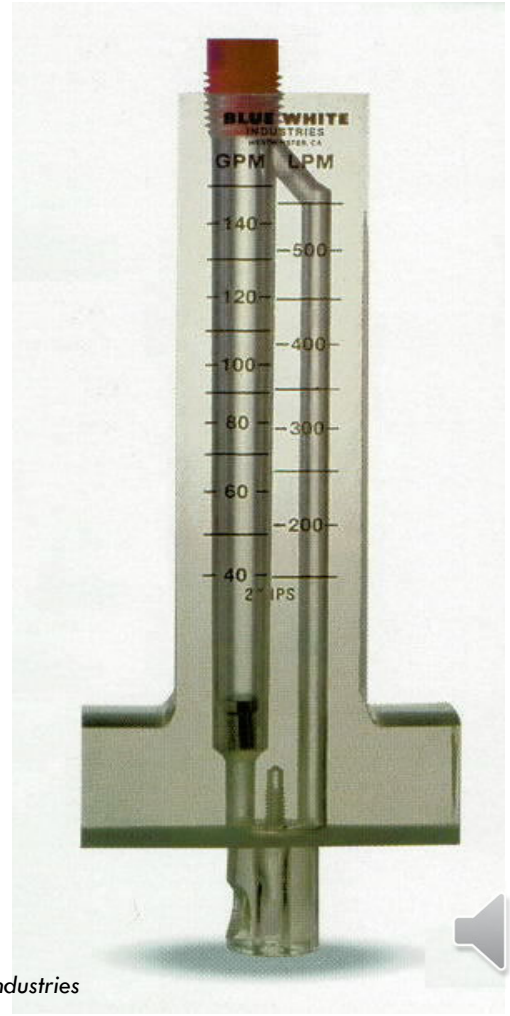
Photos courtesy of Hayward and Blue & White Industries

FLOW METER

- INDICATES RATE OF FLOW IN GALLONS PER MINUTE
- MINIMUM FLOW RATE CALCULATED TO MEET TURNOVER RATE
- INSTALLED ON RETURN LINE AFTER HEATER, BEFORE CHEMICAL FEEDER
- REQUIRES TO BE INSTALLED STRAIGHT PIPE

IF FLOW RATE DROPS TO, OR BELOW THE MINIMUM FLOW RATE:

- CLEAN THE SKIMMER BASKETS
- CLEAN THE HAIR & LINT BASKET
- BACKWASH THE FILTER
- CHANGE THE FILTER MEDIA
- CHECK FOR OBSTRUCTION IN PIPING OR EQUIPMENT



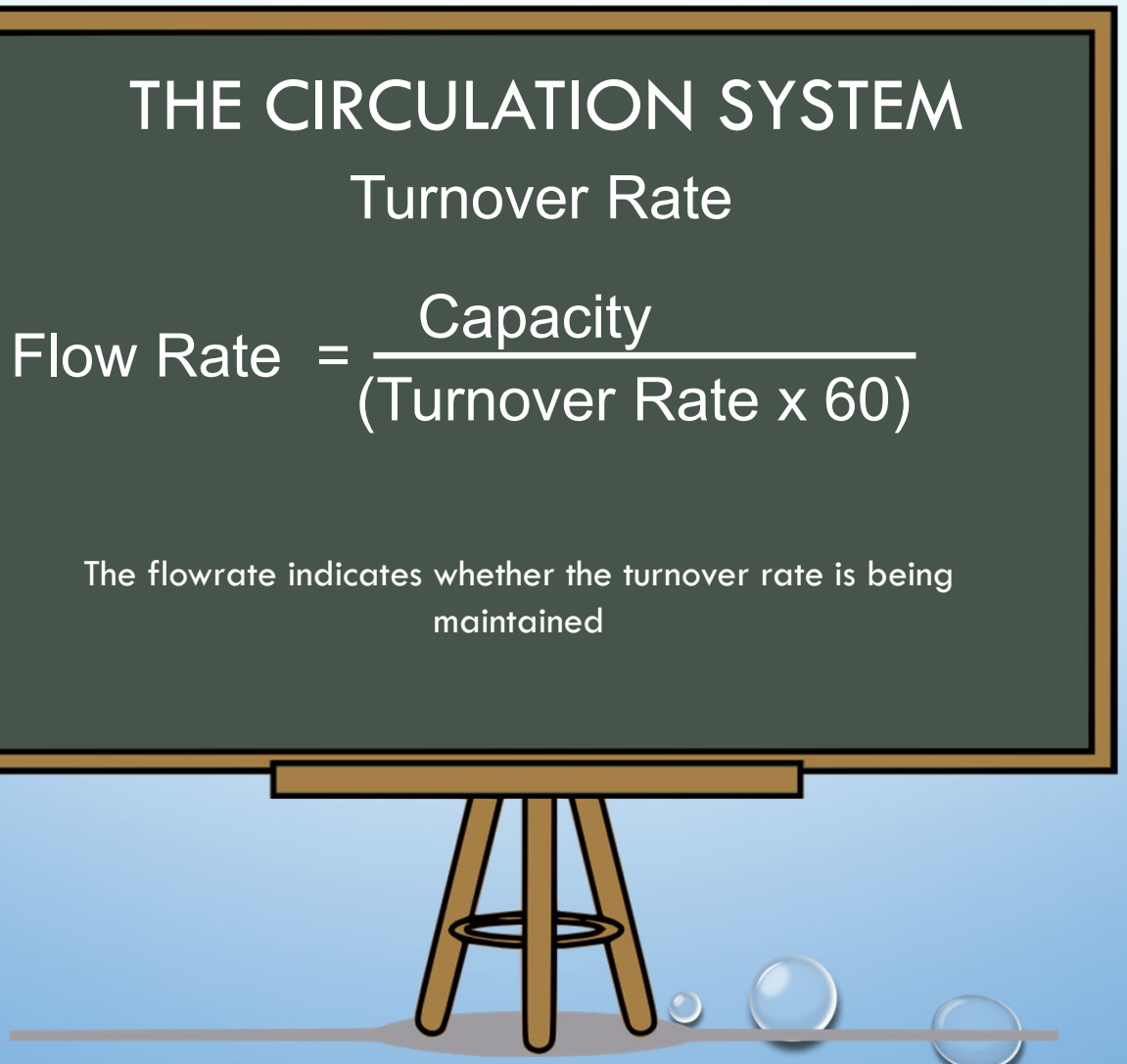
Photos courtesy of Blue & White Industries

THE CIRCULATION SYSTEM

Turnover Rate

$$\text{Flow Rate} = \frac{\text{Capacity}}{(\text{Turnover Rate} \times 60)}$$

The flowrate indicates whether the turnover rate is being maintained

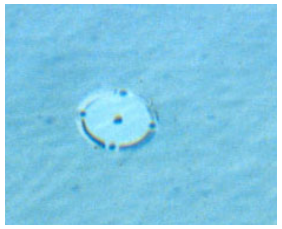


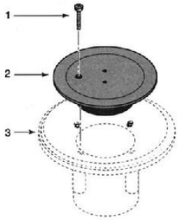
RETURN LINE AND RETURN INLETS

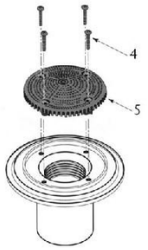
Return Line and Inlets (Returns): The return line carries cleaned, heated, and chemically treated water back to the pool. It enters the pool through inlets or returns.

These inlets or returns are located on the sides or the bottom of the pool. On a gutter pool, the returns can be located around the bottom edge of the gutter.

Inlets are adjustable to ensure that each one has the same amount of pressure thus producing an equal distribution of disinfected water.







Photos courtesy of Pentair

VALVES

There will be many valves and pipes in the pump room. Most commercial valves are open if the handle is running with the pipe and closed if the handle is running across the pipe.

Most jurisdictions require that all valves and pipes are colored and/or labeled for easy identification. A valve legend should be posted in the pump room, easily visible and clearly reflect the locations of all the pertinent valves and pipes and the color coding for each.

Photos courtesy of Pentair

VALVES

Valve handle is 90°, or perpendicular to pipe – Valve is closed

Righty Tighty

Lefty Loosey

Valve handle in line with pipe – Valve is open

Photos provided by Hayward

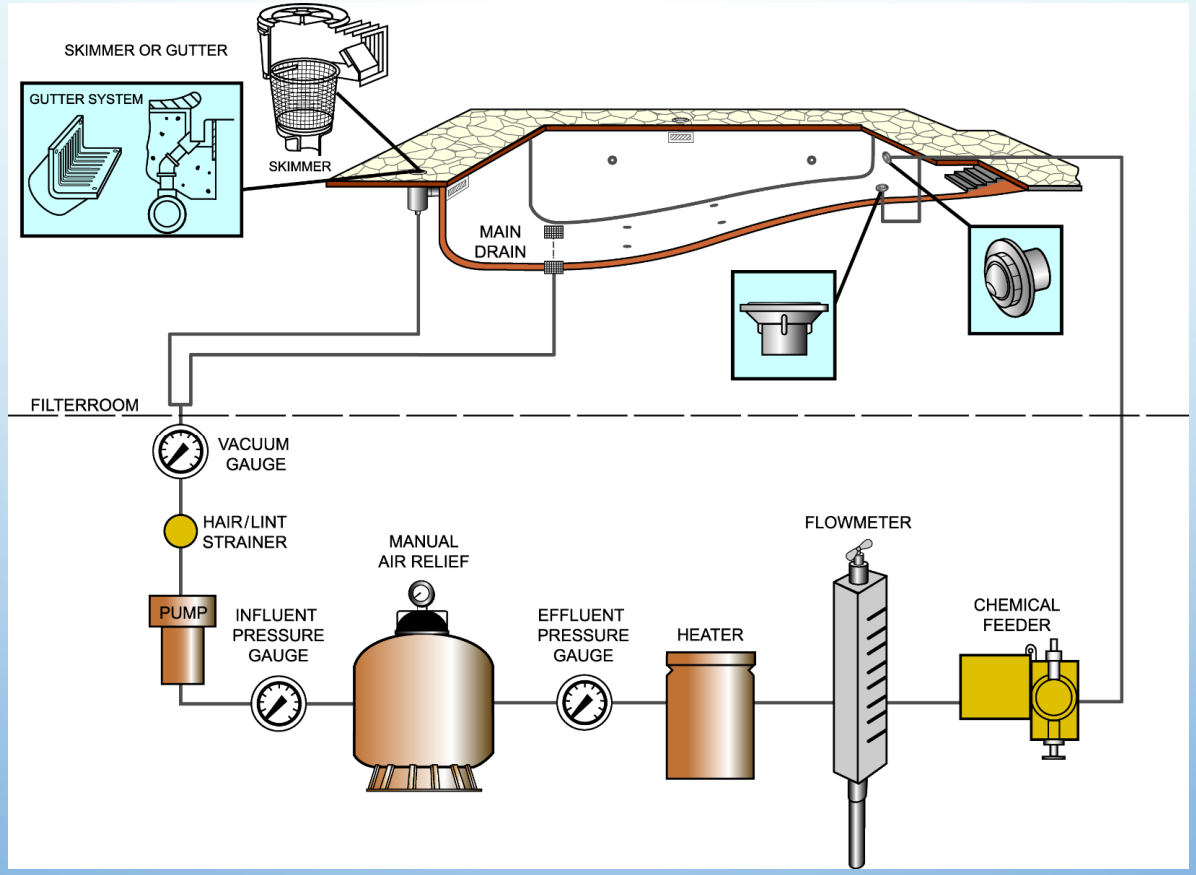
Appendix C
Sample Data Sheet

SWIMMING POOL DATA SHEET		
	Main Pool	**Wading Pool**
Gallon Capacity	83,330 Gallons	1,687 Gallons
Surface Area	2,580 Square Feet	256 Square Feet
Flow Rate	173 GPM	14 GPM
Inlets	12 Floor Returns	3 Floor Returns
Sanitizer	Sodium Hypochlorite	Sodium Hypochlorite

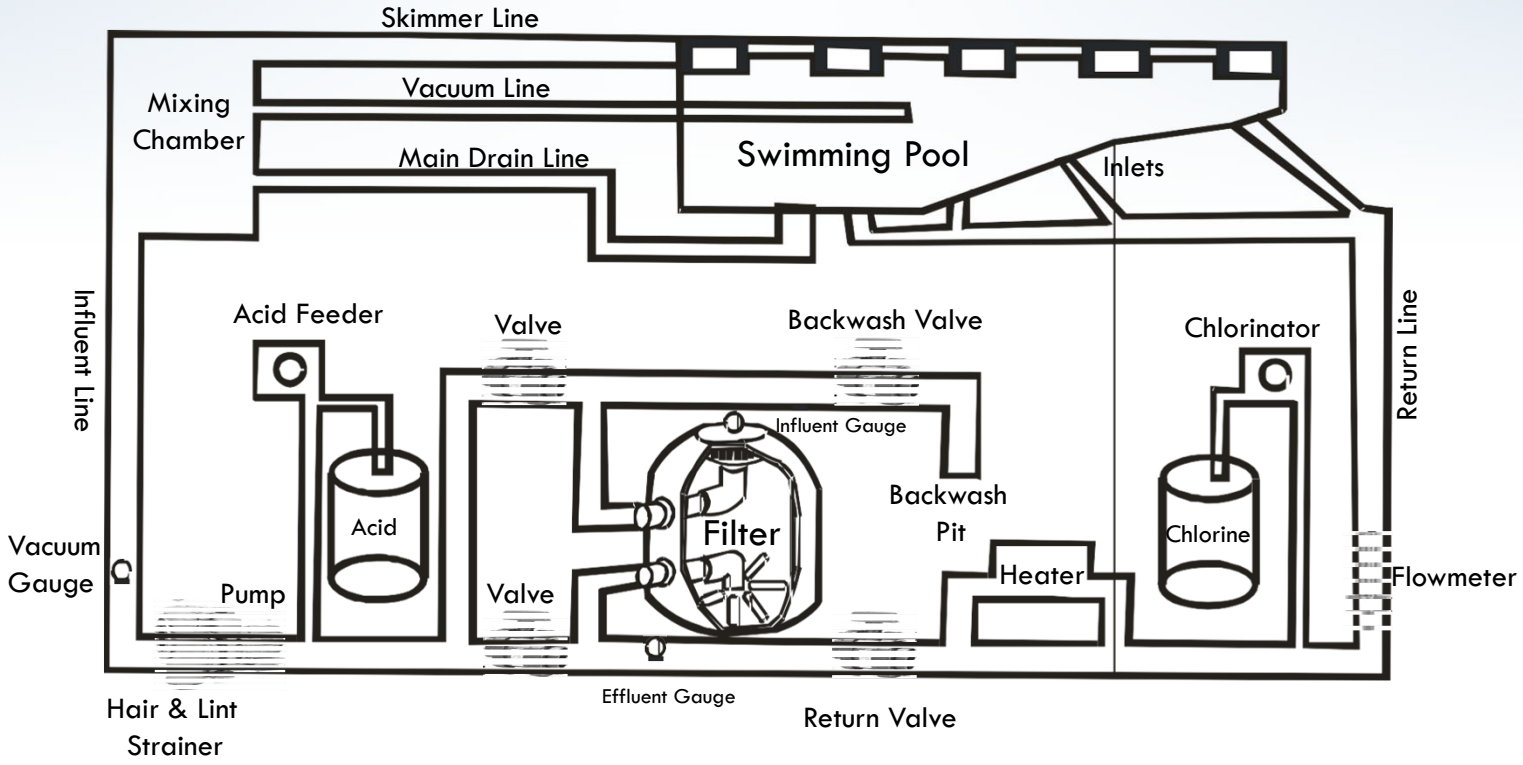
OPERATING INSTRUCTIONS		
	Main Pool	**Wading Pool**
To Filter:	Open valves labeled skimmer, main drain, filter, and return. Close valves labeled vacuum, backwash, and waste.	Set multi-port valve to FILTER.
To Backwash:	Open valves labeled skimmer, main drain, backwash, and waste. Close valves labeled vacuum, filter, and return.	Set multi-port valve to BACKWASH, and after backwashing, set multi-port valve to rinse for about 20 seconds.
To Vacuum:	Open valves labeled skimmer, vacuum, and return. Close valves labeled main drain, backwash, and waste.	Set multi-port valve to FILTER. Vacuum through the skimmer. The other skimmers may need to be closed in order to get enough suction
Important Notes:	1. Always turn off pump before changing any valve settings 2. Never run chlorinator while system is off or backwashing	

Remember: If you have questions about how to operate your system, ask you supervisor. Do not turn the system on with valves in a position that you are not certain about. The water must be able to get out of the pool via the main drain, skimmer and/or vacuum line and it must have somwhere to go via the return or backwash line. **IF YOU DON'T KNOW.....ASK!!!!**

THE CIRCULATION SYSTEM



WATER CIRCULATION



AIR CIRCULATION SYSTEM

Air Handling System is equipment that brings in outdoor air into a building and removes air from a building for the purpose of introducing air with fewer contaminants and removing air with contaminants created while bathers are using aquatic venues. The system contains components that move and condition the air for temperature, humidity, and pressure control, and transport and distribute the air to prevent condensation, corrosion, and stratification, provide acceptable indoor air quality, and deliver outside air to the breathing zone.

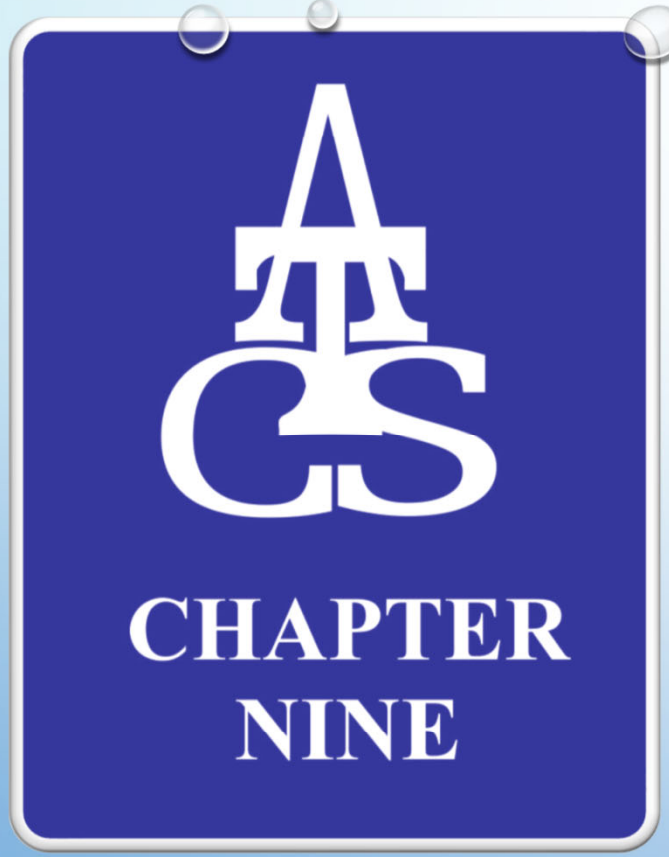
The air system should maintain the relative humidity between 40% and 60%. It should also maintain the temperature ideally within 2 °F (no more than 5 °F) of the water temperature. The inability to maintain the appropriate humidity and temperature level promotes corrosion, poor air quality, mold, mildew and bather discomfort.

Air return vent should be low to the floor to extract chloramines hovering above the surface of the water in order to improve air quality. Air system should be changing 4 to 8 times per hour depending on whether mechanical cooling are not

LET'S REVIEW!

Fill in the chart with the range of each reading and the chemical name that raises and lowers each reading:

Chemical	Minimum	Maximum	Raise	Lower
Chlorine	1.0	10	Add chlorine	Add Sodium Thiosulfate
pH	7.2	7.8	Add Soda Ash	Add Muriatic Acid
Total Alkalinity	60	180	Add Baking Soda	Add Muriatic Acid
Calcium Hardness	150	400	Add Calcium Chloride	Drain And Fill
Cyanuric Acid	30	50	Add Cyanuric Acid	Drain And Fill
Total Dissolved Solids	**No Minimum**	1500	**Not Applicable**	Drain And Fill



FILTRATION

FILTRATION SYSTEMS

FILTER MEDIA – MATERIAL WITHIN THE FILTER THAT COLLECTS THE DIRT

- SAND FILTERS
- CARTRIDGE
- DIATOMACEOUS EARTH (DE)

- PARTICLES MEASURED IN MICRONS
  - 25 MICRONS = 1/1000 OF AN INCH
  - HUMAN VISION – DOWN TO 40 MICRONS

- EFFECTIVENESS
  - DEPENDS ON TYPE OF FILTER, SURFACE AREA, VELOCITY OF WATER, CONDITION OF MEDIA, & AMOUNT OF PARTICULATE MATERIAL IN WATER

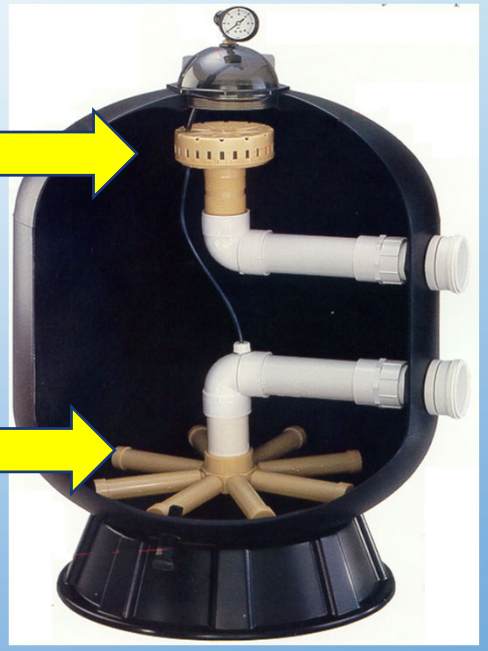
FILTERS

- REMOVES FINE SUSPENDED PARTICLES FROM WATER
- MOST COMMON MEDIA
  - SAND
  - DIATOMACEOUS EARTH
  - FABRIC CARTRIDGES

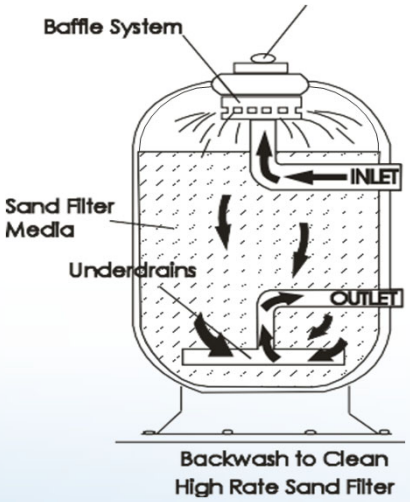
SAND FILTERS

Sand Filters: Sand filters typically can filter particulate matter down to about 15 microns. One micron is one millionth of a meter (0.00004 inch). The human can see particles 40 microns or larger. Water comes into the filter through the filter influent line (the top pipe) and is dispersed through the diffuser.

The **diffuser** evenly distributes the water through the sand bed. The sand in a filter is #20 grade filter sand. This is the only grade of sand that should be placed in the filter. Most manufacturers recommend that a layer of pea gravel be placed in the bottom of the tank to support the laterals.



Laterals are the rungs located in the bottom of the filter tank. They have very fine slots in them that allow the water to pass through but not sand. A broken lateral can allow sand into the return lines and thus into the pool basin



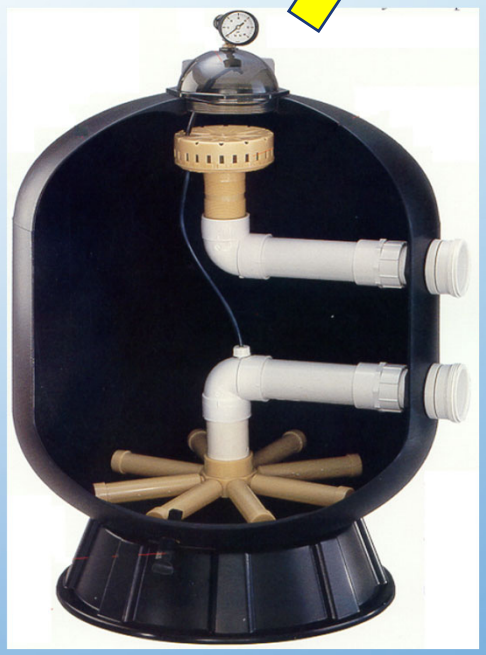
HIGH RATE SAND FILTERS

FILTERING

- REMOVES SMALL PARTICULATE MATTER FROM THE WATER
- WATER MOVES IN THROUGH THE INFLUENT LINES AND THROUGH THE DIFFUSER (BAFFLE SYSTEM)
- DIRT COLLECTS ON THE TOP OF THE SAND OR IN THE FIRST FEW INCHES OF THE SAND MEDIA
- CLEAN WATER EXITS THE TANK THROUGH THE LATERALS
- HIGH RATE SAND FILTER USE ONLY ONE SIZE OF SAND
- A BROKEN LATERAL WILL ALLOW SAND TO ENTER THE POOL THROUGH THE RETURN LINES

MANUAL AIR RELIEF VALVES

- BLEEDS OUT EXCESS AIR TRAPPED INSIDE OF THE TANK
- RELIEF VALVE IS LOCATED ON THE TOP OF THE TANK
- ALWAYS TURN OFF THE PUMP AND OPEN THE AIR-RELIEF BEFORE LOOSENING CLAMPS OR LIDS



FILTER PERFORMANCE

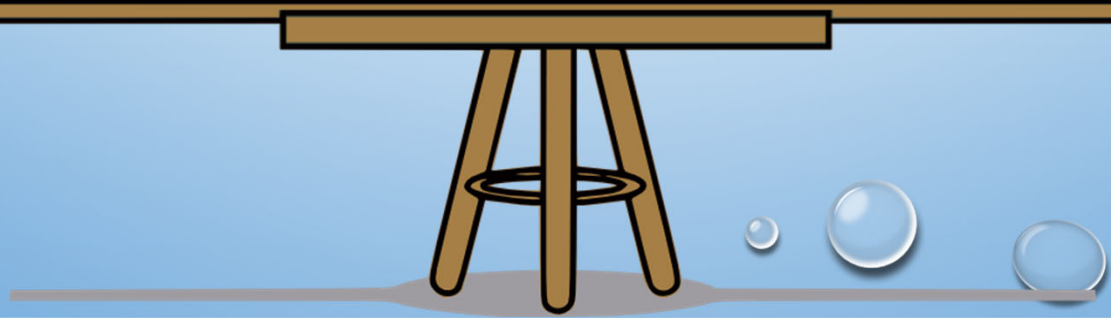
Design Flow Rate

Filter Rate	x	Filter Area	=	Flow Rate
(gpm/sq.ft.)		(sq.ft.)		(gpm)

Example:
A high rate sand filter has a filter rate of 25 gpm and a filter area of 5.0 sq.ft.

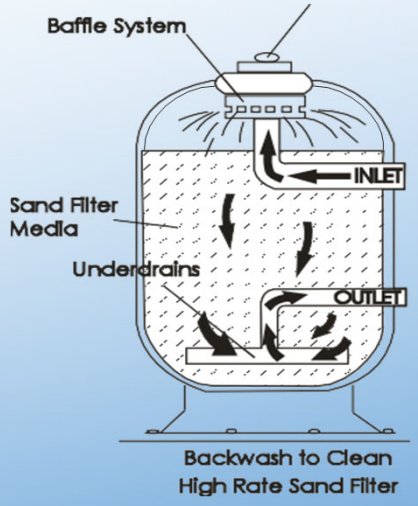
What is the design flow rate of the filter?

$$\begin{array}{r} 25 \\ \times \quad 5.0 \\ \hline 125 \text{ gpm} \end{array}$$



BACKWASHING

- THE REVERSE OF FLOW THROUGH THE FILTER IN ORDER TO CLEAN IT
- TWO THINGS INDICATE IT IS TIME TO BACKWASH
- FLOWRATE IS TOO LOW (BELOW MINIMUM)
- PRESSURE DIFFERENTIAL IS MORE THAN 15



CALCULATING THE PRESSURE DIFFERENTIAL

INFLUENT PRESSURE

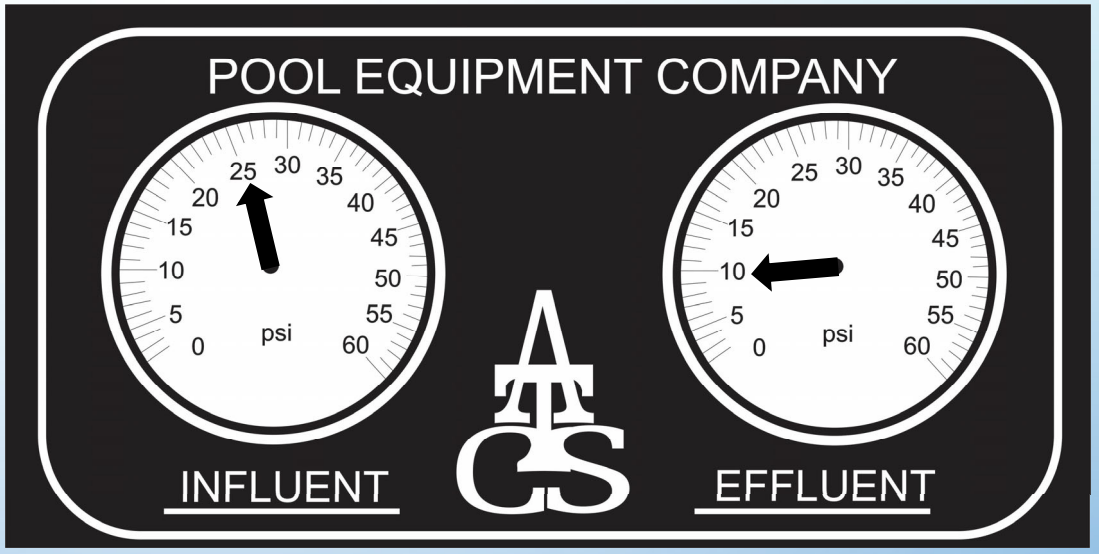
- GAUGE LOCATED ON TOP OF THE FILTER, ON PIPING FROM PUMP TO FILTER, ON GAUGE PANEL INDICATES PRESSURE EXERTED BY PUMP TO PUSH WATER THROUGH FILTER

EFFLUENT PRESSURE

- GAUGE LOCATED ON PIPING AFTER FILTER OR ON GAUGE PANEL INDICATES PRESSURE EXERTED BY PUMP TO PUSH WATER BACK TO THE POOL AFTER IT EXITS THE FILTER

PRESSURE DIFFERENTIAL

- THE DIFFERENCE BETWEEN INFLUENT AND EFFLUENT PRESSURE



EXAMPLE:

INFLUENT = 25 PSI

EFFLUENT = 10 PSI

DIFFERENTIAL = 15 PSI

WHEN TO CLEAN THE FILTER BASED ON PRESSURE DIFFERENTIAL

- WHEN THE PRESSURE DIFFERENTIAL INCREASES FROM ITS STARTING DIFFERENTIAL TO THE FOLLOWING, ITS TIME TO BACKWASH/CLEAN THE FILTER:

  - RAPID RATE SAND FILTERS 8 PSI
  - HIGH RATE SAND FILTERS 15 PSI
  - CARTRIDGE FILTERS 10 PSI
  - PRESSURE DE 10 PSI
  - VACUUM DE 15” OF HG.

  (UNLESS MANUFACTURERS INSTRUCTIONS DIFFER)

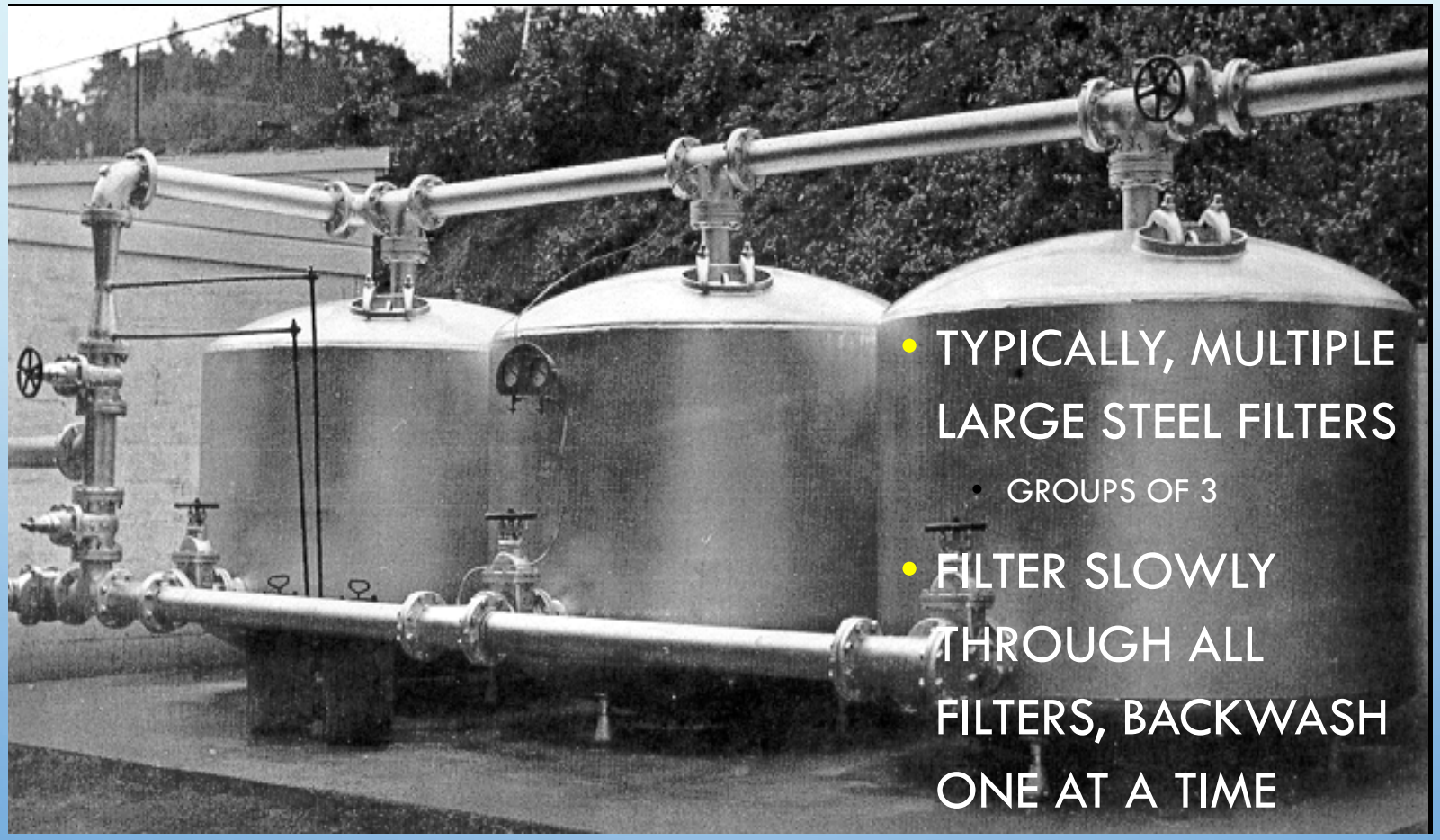
Important:

BACKWASHING

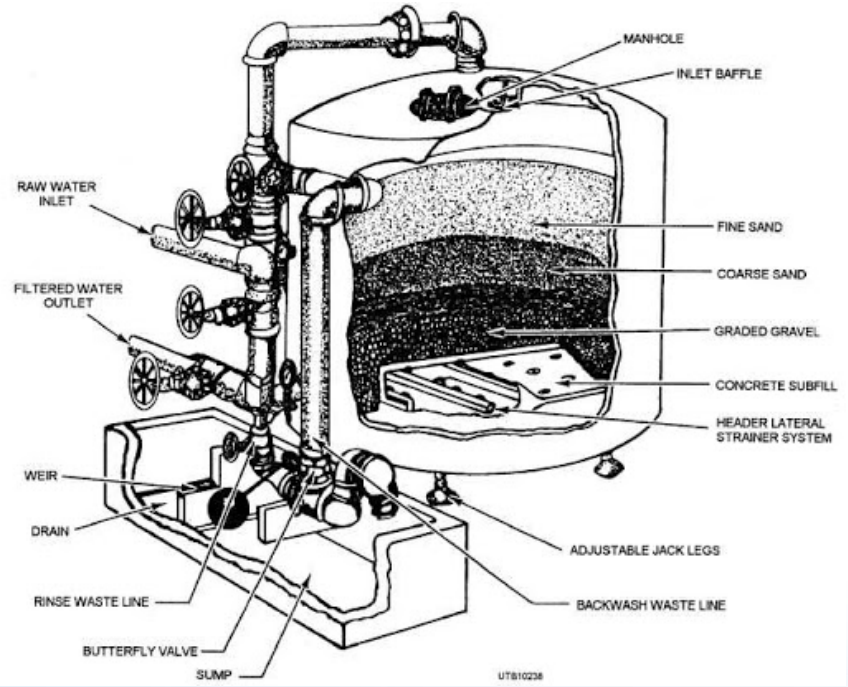
Do not open and close valves while the pump is running.

Always shut the pump “off” first

RAPID RATE SAND FILTERS



- TYPICALLY, MULTIPLE LARGE STEEL FILTERS
  - GROUPS OF 3
- FILTER SLOWLY THROUGH ALL FILTERS, BACKWASH ONE AT A TIME



RAPID RATE SAND FILTERS

- THIN BED OF SAND SUPPORTED BY LAYERS OF GRADED GRAVEL
  - MAJORITY OF FILTRATION DONE IN TOP 3-4 INCHES
- REQUIRE USE OF FILTER ALUM (ALUMINUM SULFATE)
- USUALLY HAS MULTIPLE TANKS THAT ARE BACKWASHED ONE AT A TIME

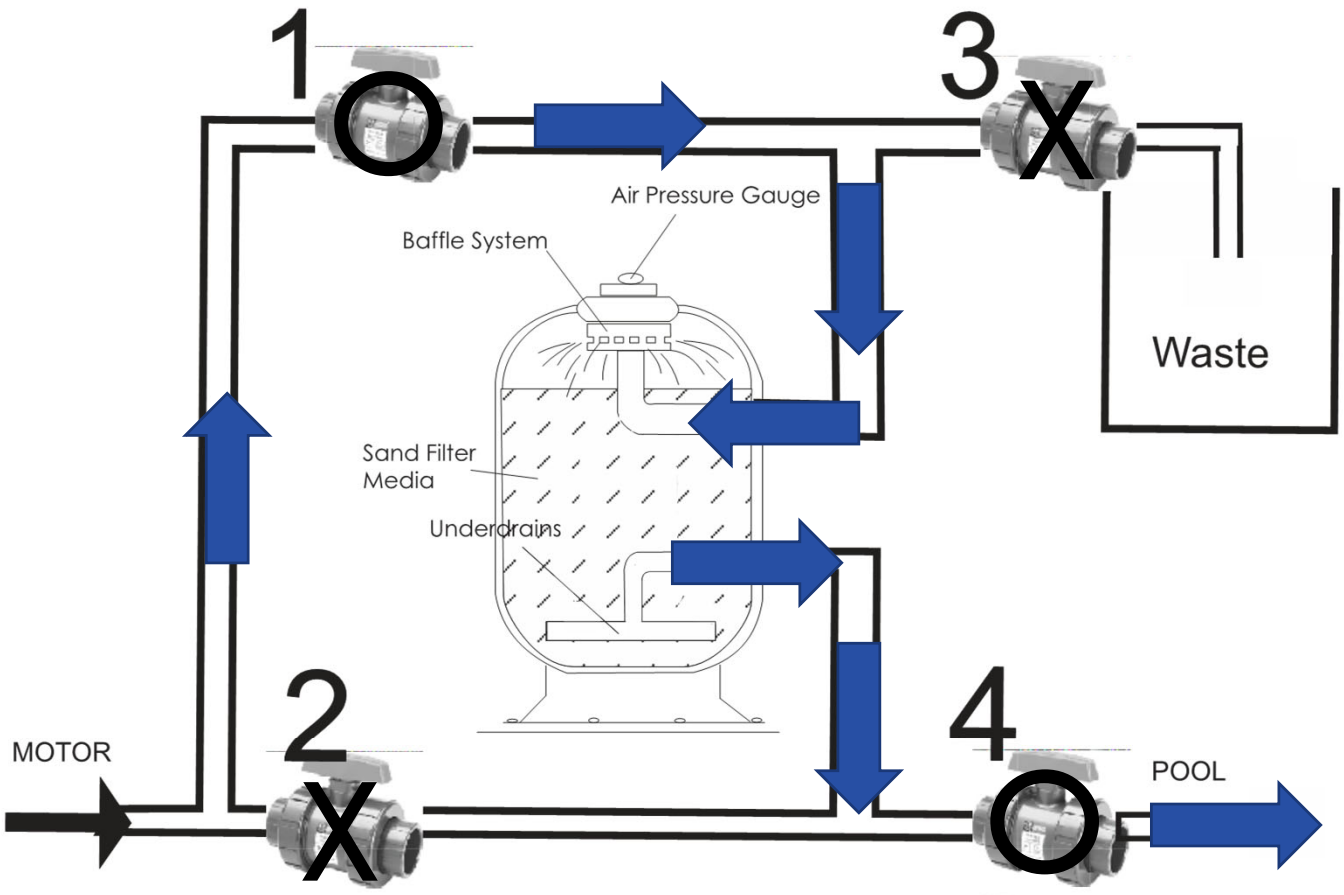
FILTER SAND

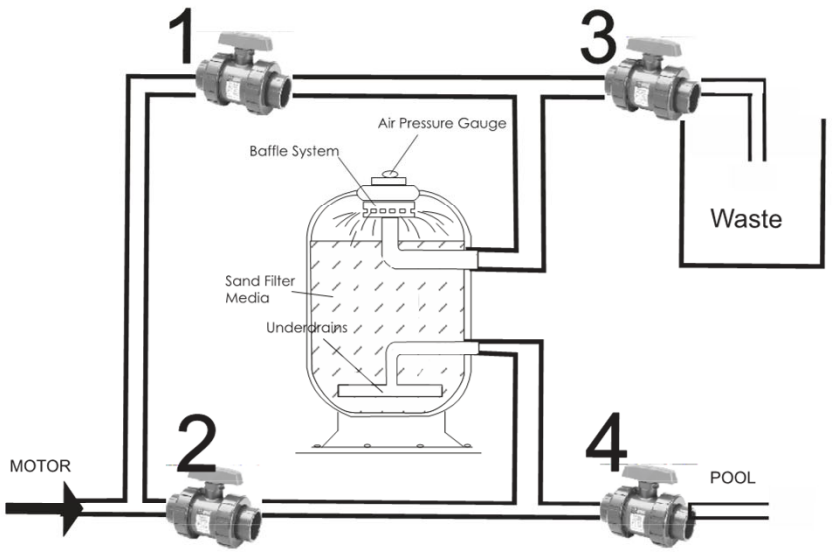
SAND IS GENERALLY SCHEDULED TO BE CHANGE EVERY 2-3 YEARS IN AN INDOOR POOL AND EVERY 7-8 YEARS IN AN OUTDOOR SEASONAL POOL. THIS IS CALLED RECHARGING THE SYSTEM. SAND HAS VERY SHARP EDGES OBSERVED UNDER A MICROSCOPE. OVER TIME, THE SAND PARTICLES LOSE THEIR SHARP EDGES AND THEY SMOOTH MAKING IT MORE DIFFICULT TO CATCH SMALL PIECES OF DIRT.

FLOCCULENT

SOMETIMES A COAGULANT OR FLOCCULENT IS USED TO AID A SAND FILTER. A FLOCCULENT CREATES AN ADDITIONAL LAYER ON THE FILTER BED THAT CAUSES SMALL PIECES OF DIRT TO STICK TOGETHER. NOW THAT THE DIRT IS BIGGER, THE FILTER IS ABLE TO REMOVE THE DIRT. **ALUMINUM SULFATE (ALUM) IS THE MOST COMMONLY USED FLOCCULATING AGENT.** A FLOCCULENT IS ONLY GOOD FOR ONE FILTER RUN AS IT WILL BE REMOVED BY BACKWASHING.

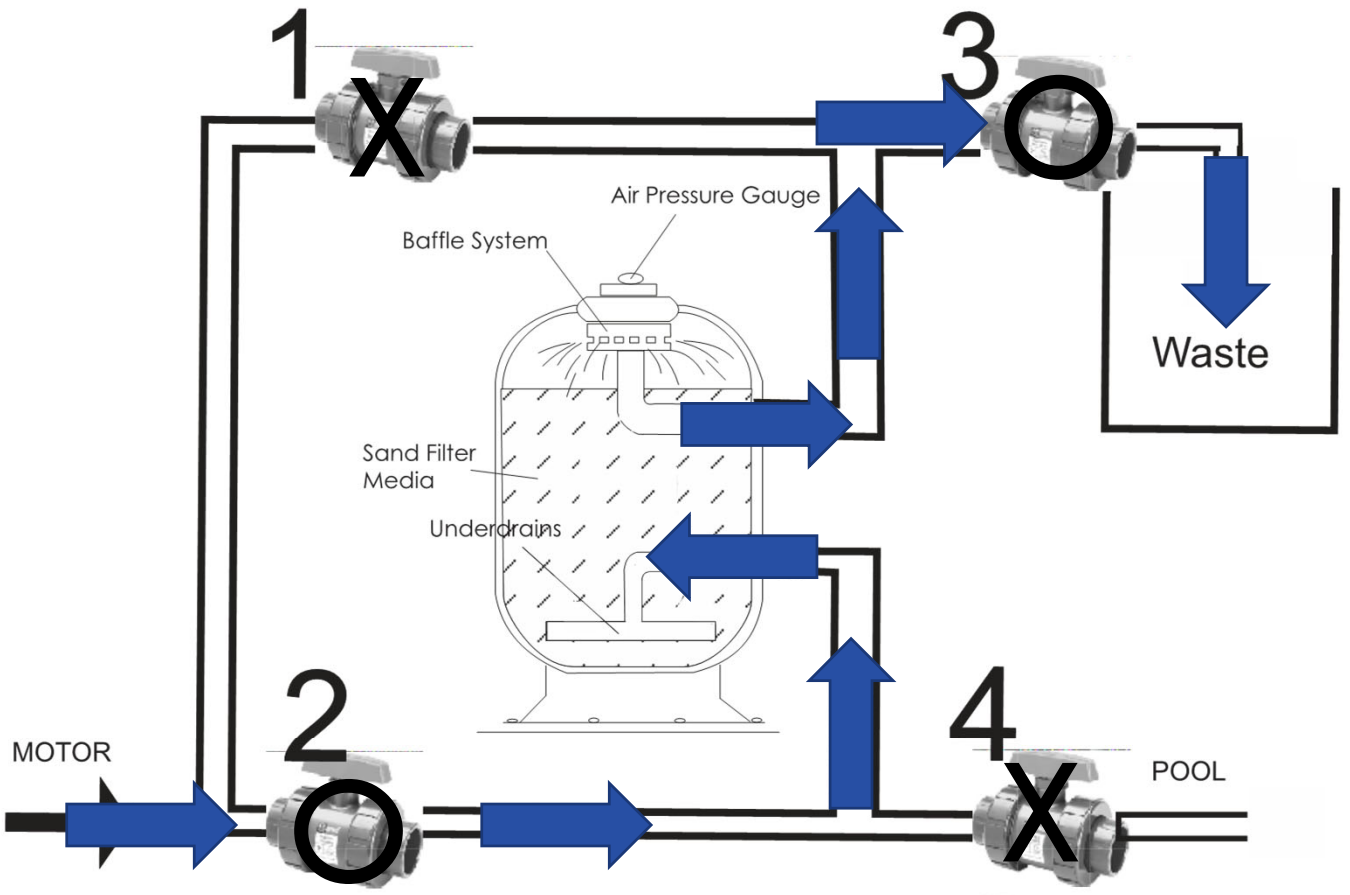
FILTER


1
O
3
X
Air Pressure Gauge
Baffle System
Waste
Sand Filter
Media
Underdrains
MOTOR
2
X
4
O
POOL



	OPEN	CLOSED
FILTER	1, 4	2, 3
BACKWASH		
DRAIN		
BYPASS		

BACKWASH


1
X
3
O
Air Pressure Gauge
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Sand Filter
Media
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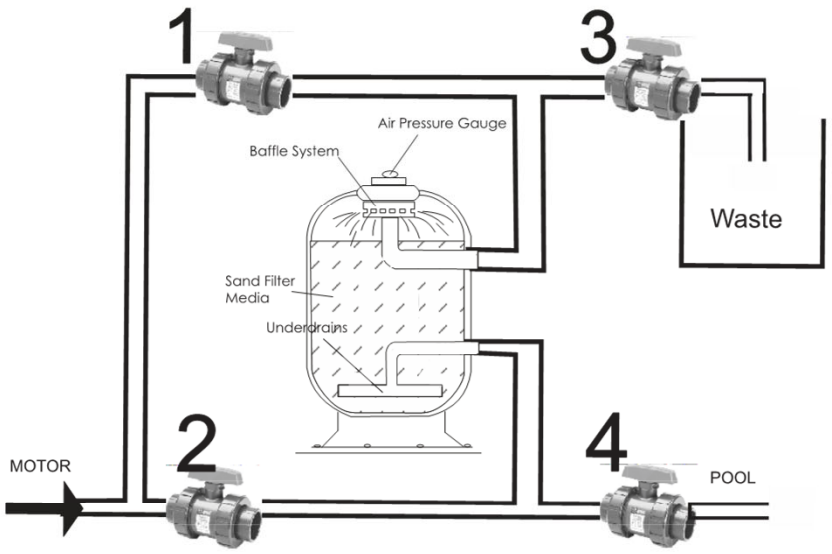
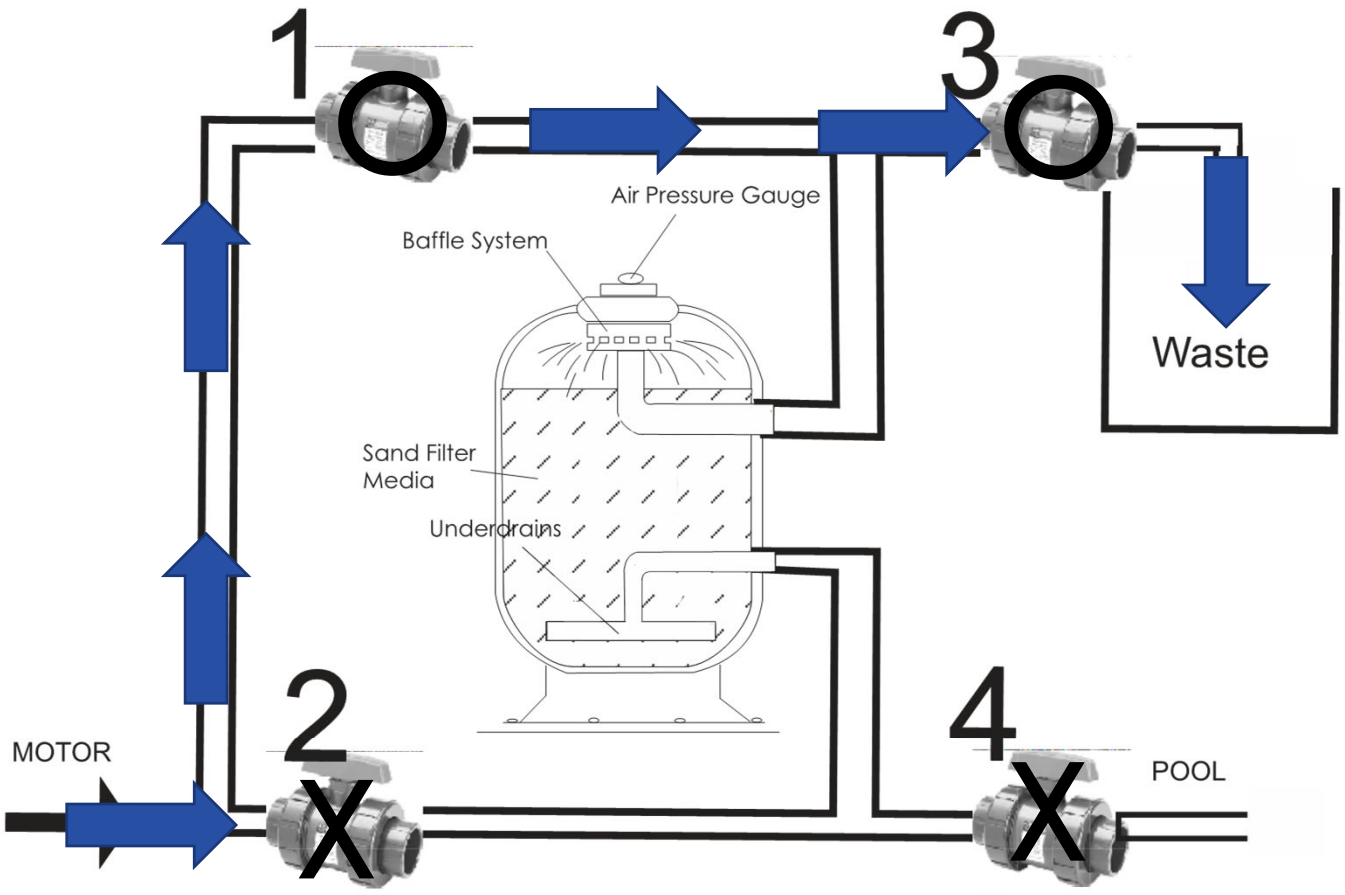
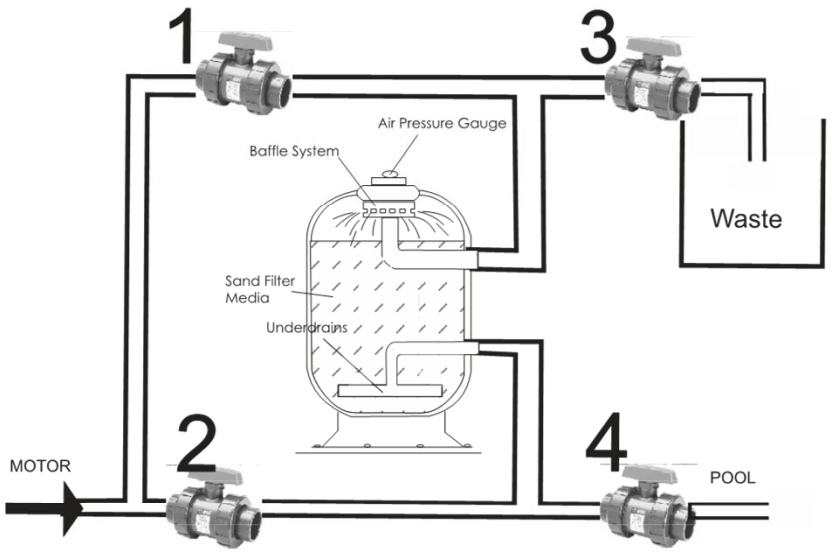
MOTOR
2
O
4
X
POOL



	OPEN	CLOSED
FILTER	1, 4	2, 3
BACKWASH	2, 3	1, 4
DRAIN		
BYPASS		

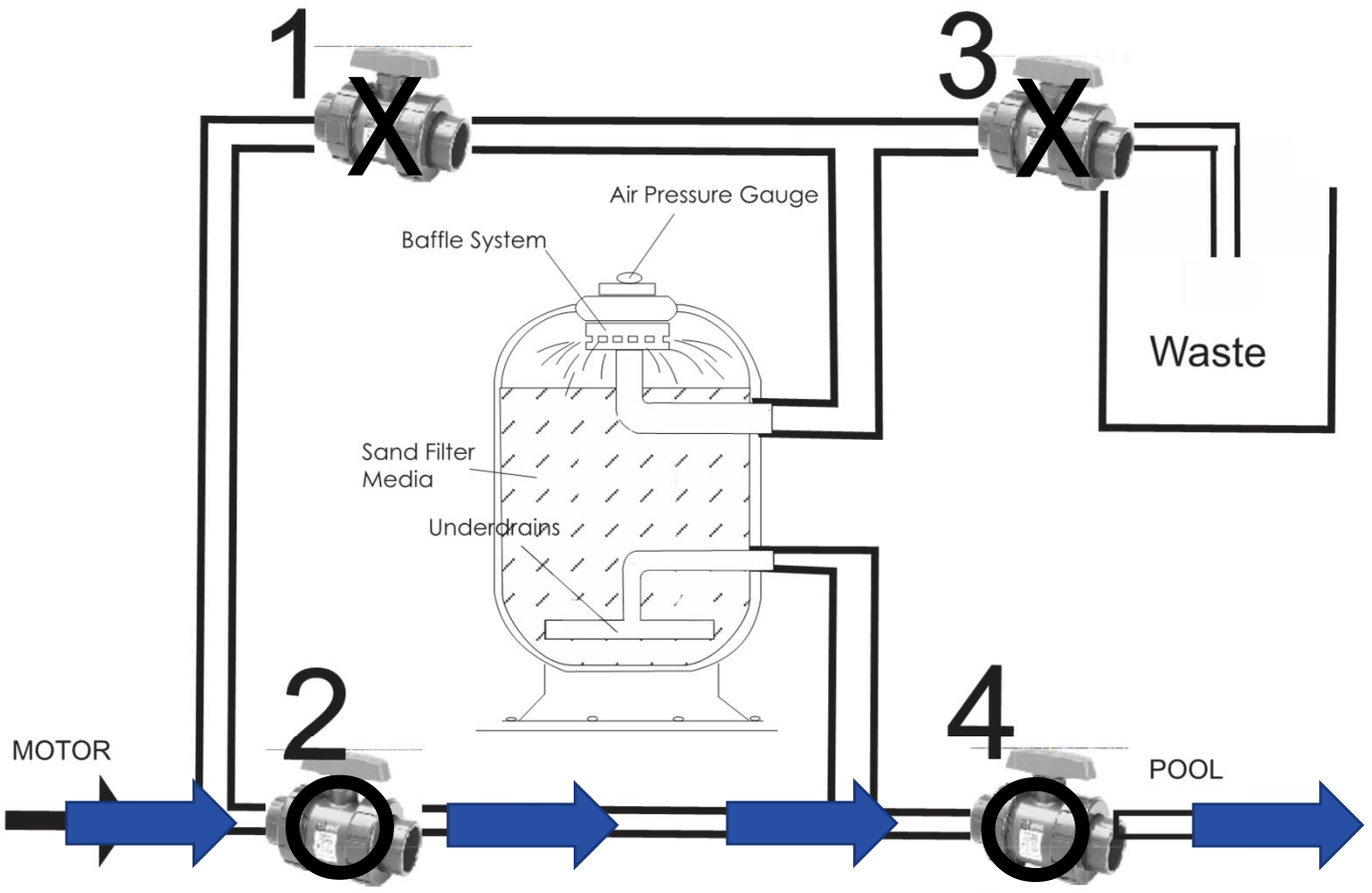
DRAIN

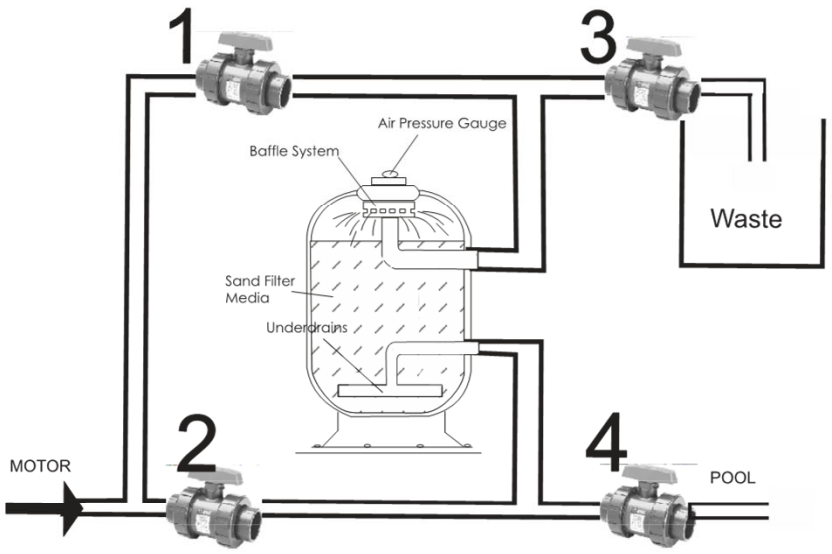

1
3
Air Pressure Gauge
Baffle System
Waste
Sand Filter
Media
Underdrains
2
4
MOTOR
POOL



	OPEN	CLOSED
FILTER	1, 4	2, 3
BACKWASH	2, 3	1, 4
DRAIN	1, 3	2, 4
BYPASS		

BYPASS


1
X
3
X
Air Pressure Gauge
Baffle System
Waste
Sand Filter
Media
Underdrains
2
4
MOTOR
POOL



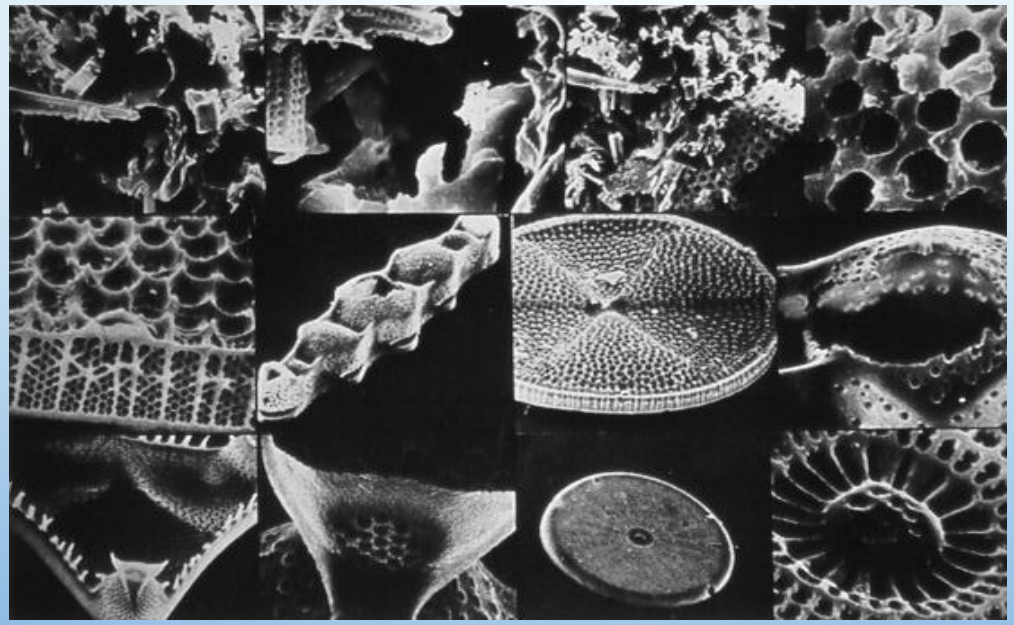
	OPEN	CLOSED
FILTER	1, 4	2, 3
BACKWASH	2, 3	1, 4
DRAIN	1, 3	2, 4
BYPASS	2, 4	1, 3

MULTI-PORT VALVES

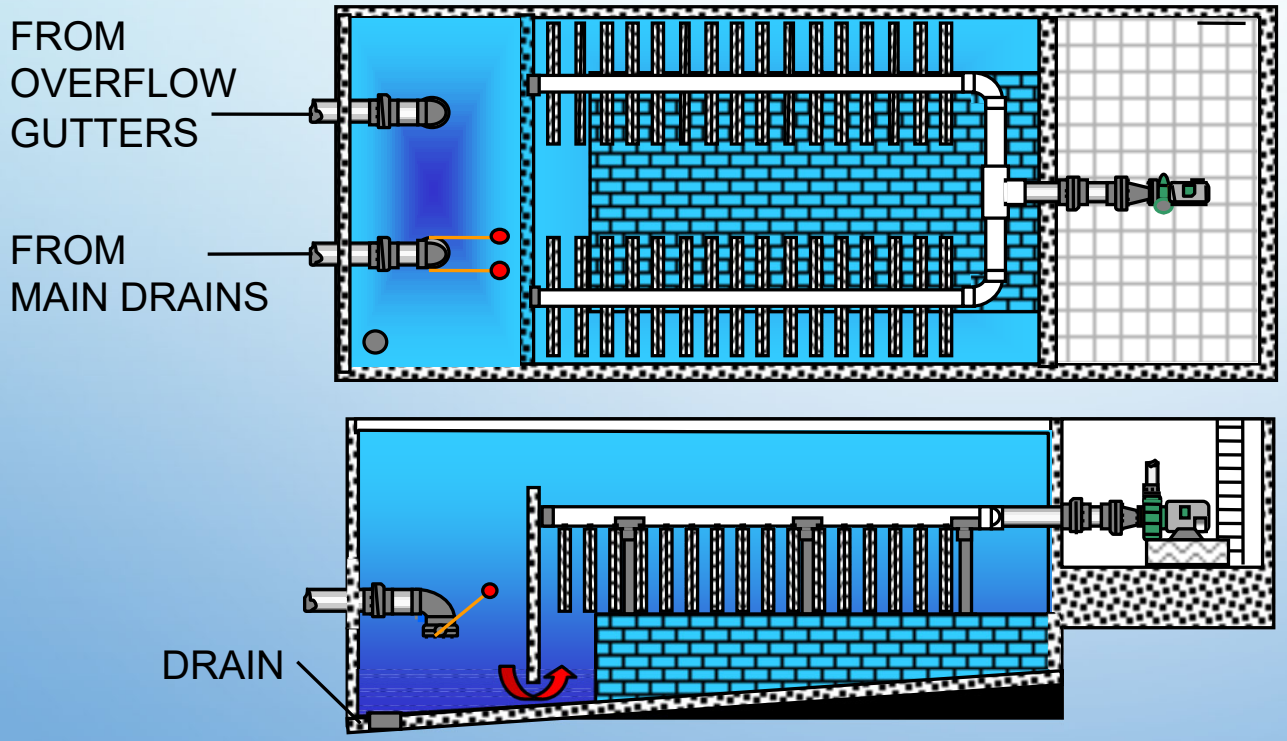
MULTI-PORT VALVES ARE USED ON SMALLER SYSTEMS AND CAN SET THE FILTER SYSTEM TO FILTER, BACKWASH AND DRAIN IN THE TURN OF A HANDLE. IT IS IMPORTANT TO ALWAYS TURN OFF THE PUMP BEFORE TURNING THE HANDLE. IT IS USUALLY A GOOD IDEA TO PUT THE SYSTEM IN RINSE FOR A FEW MOMENTS AFTER BACKWASHING BEFORE PUTTING THE SYSTEM BACK INTO FILTER.

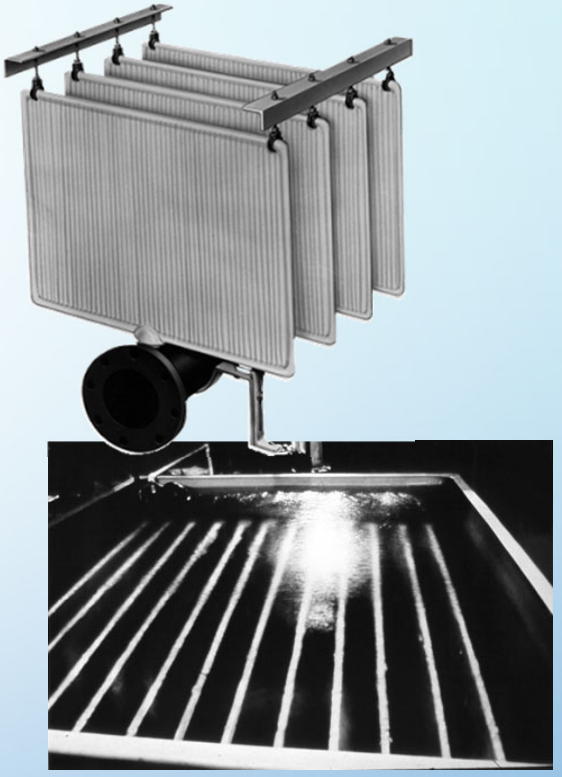
DIATOMACEOUS EARTH FILTERS

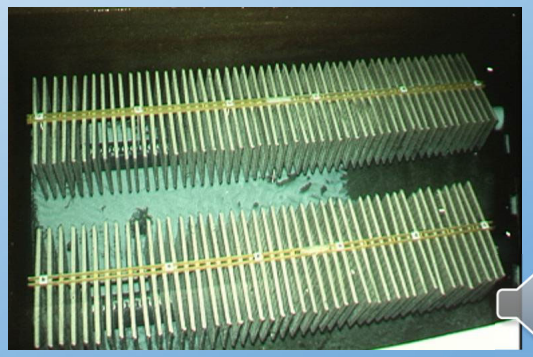
- DIATOMACEOUS EARTH ARE FOSSIL REMAINS OF MARINE LIFE - DIATOMS



VACUUM DE FILTERS

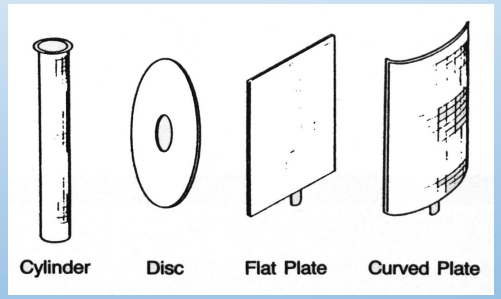


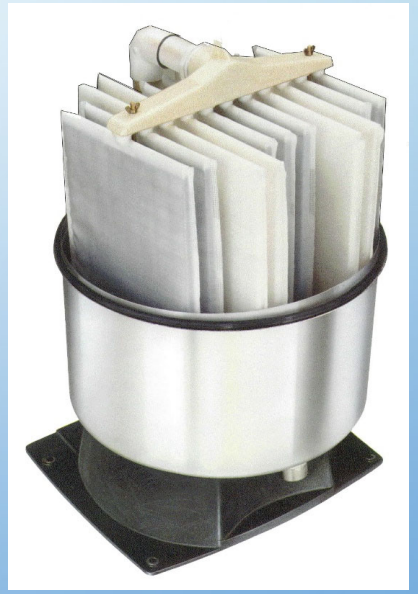




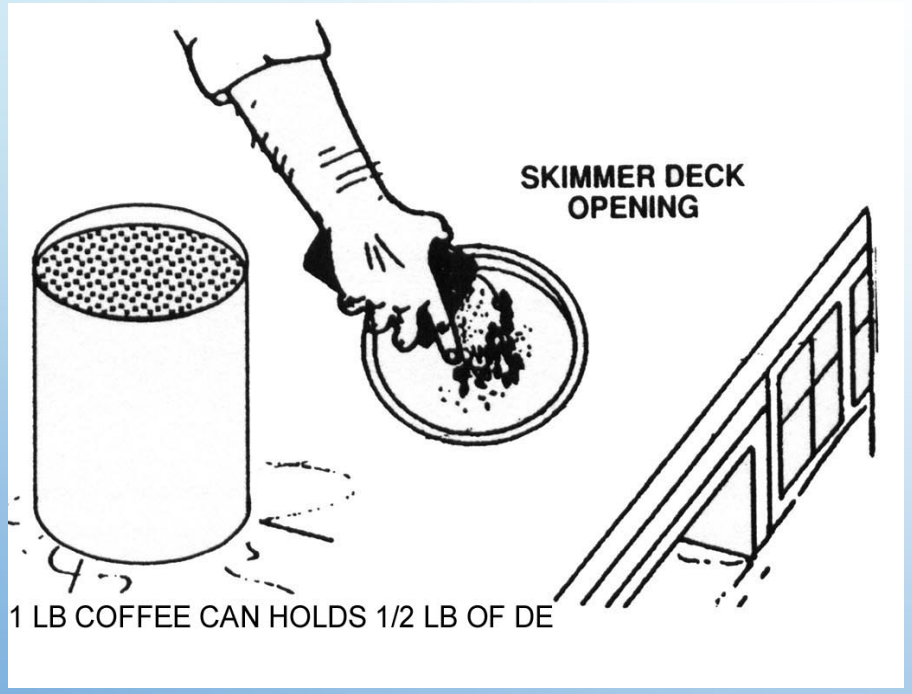
DE FILTERS PRESSURE

- DE SUPPORTED IN THE TANK BY FABRIC COVERED LEAVES, RODS OR DISKS (SEPTUMS)



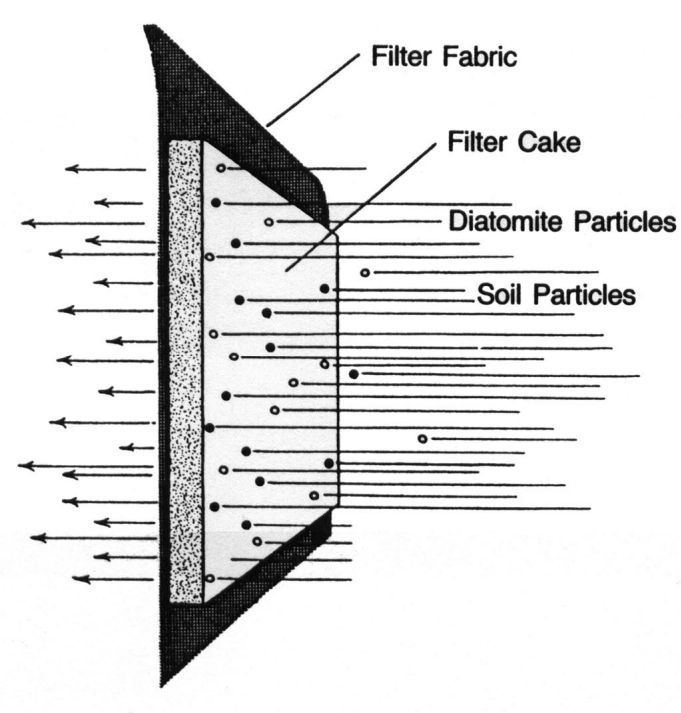


PRE-COATING THE CARTRIDGES



- **PRE-COAT POT:** A ONE-SHOT DEAL BETWEEN FILTER RUNS. THE ENTIRE AMOUNT THAT THE FILTER HOLDS IS ADDED ALL AT ONCE. IT THOROUGHLY COATS ALL THE ELEMENTS AND, UNLESS THE SYSTEM GOES OFF FOR ANY REASON, IT WILL REMAIN THERE UNTIL THE FILTER RUN IS OVER AND NEEDS TO BE CLEANED. (SEE "CLEANING D.E FILTERS" BELOW) THE ELEMENTS SHOULD BE PRECOATED WITH **2 OUNCES OF D.E. PER SQUARE FOOT OF FILTER SURFACE AREA.** DO NOT FORGET TO COUNT THE FRONT AND THE BACK OF THE ELEMENT WHEN CALCULATING THE TOTAL SURFACE AREA OF THE ELEMENT.

HOW THE DE CARTRIDGES WORK



- WATER MUST PASS THROUGH DE COATED SEPTUMS TO GET CLEAN
- THE DE AND THE DIRT EVENTUALLY FALLS TO THE BOTTOM OF THE PIT
- THIS WILL HAVE TO BE MANUALLY CLEANED

SLURRY FEED

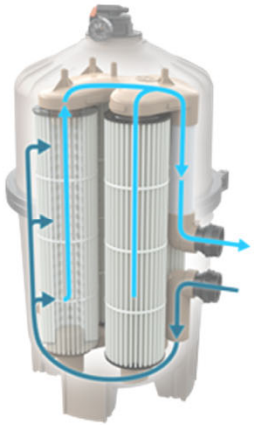
SLURRY FEEDER: THE D.E IS ALSO ADDED SLOWLY DURING THE FILTER RUN. BY THE END OF THE FILTER RUN, THE ELEMENTS WILL HAVE THE D.E. "CAKED ON". THIS MAKES THEM A LITTLE HARDER TO CLEAN BUT IT ALSO EXTENDS THE FILTER RUN AND, SOME SAY, THIS METHOD ALLOWS THE FILTER TO WORK EVEN BETTER. THE DOWNFALL CAN BE THAT THE "CAKED ON" DIATOMACEOUS EARTH IS VERY DIFFICULT TO REMOVE FOR CLEANING.

CLEANING THE DE FILTER

FOR VACUUM DE FILTER

- CLEAN ALL SKIMMER BASKETS
- TURN OFF ALL CHEMICAL FEEDERS
- TURN OFF THE SYSTEM (THIS WILL ALLOW THE D.E TO FALL TO THE BOTTOM OF THE FILTER TANK)
- WASH OFF THE ELEMENTS AND REMOVE THE D.E FROM THE TANK (IT IS THROWN AWAY)**
- CLEAN ELEMENTS AND REPLACE OR PUT A SECOND SET OF ELEMENTS IN AND SOAK THE DIRTY ONE IN A CLEANING SOLUTION TO DEGREASE IT
- PRE-COAT OR SLURRY FEED THE D.E BACK INTO THE FILTER AND RESUME OPERATION
- TURN ON ALL CHEMICAL FEEDERS

PRESSURE DE FILTERS ARE BACKWASHED



Photos provided by Hayward

CARTRIDGE FILTERS

- SINGLE LARGE OR CLUSTER OF CARTRIDGES
- FILTERS OUTSIDE TO INSIDE OF CARTRIDGE
- DIRT CAPTURED IN FABRIC

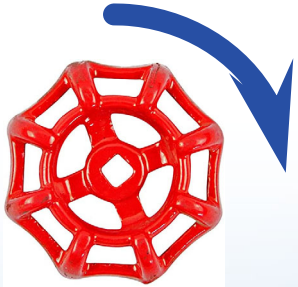
Photos provided by Hayward

CARTRIDGE FILTERS

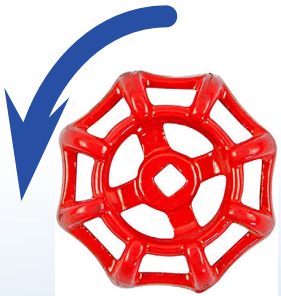
- CLEAN WHEN PRESSURE DIFFERENTIAL INCREASES 10 PSI
  - TURN SYSTEM OFF
  - REMOVE DIRTY CARTRIDGES
  - INSTALL CLEAN SPARES
  - MANUALLY CLEAN DIRTY ONES

VALVES

Valve handle is 90°, or perpendicular to pipe – Valve is closed



Righty Tighty



Lefty Loosey

Valve handle in line with pipe – Valve is open

Photos provided by Hayward

MULTIPORT VALVES (ROTARY)

Multi-port valves are used on smaller systems and can set the filter system to filter, backwash and drain in the turn of a handle. It is important to always turn off the pump before turning the handle.

It is usually a good idea to put the system in rinse for a few moments after backwashing before putting the system back into filter.

Photos provided by Hayward

FORMULAS FOR POOL CAPACITY

L = length W = width V = volume D = depth r = radius (half of the diameter of a circle)
π = (pi) 3.14 (a factor used in calculations with circles)

SURFACE AREA
Rectangular pool = L x W Circular pool = r^2 x π Right triangle = (L x W) ÷ 2

AVERAGE DEPTH
For constant slope: [D (minimum) + D (maximum)] ÷ 2 = AVERAGE DEPTH
Note: For multi-depth pools calculate the volume in sections of constant slope and add them together.

CUBIC FEET OF VOLUME (surface area times average depth)
Rectangular pool V = L x W x D Circular pool V = r^2 x π x D

POOL GALLONAGE IN CUBIC FEET (cubic foot of water = 7.5 gallons)
Rectangular pool gallons = L x W x D x 7.5 Circular pool gallons = r^2 x π x D x 7.5

TURNOVER RATE
Pool Volume / Flow rate / 60 = Hours

FLOW RATE (MINIMUM)
Pool Volume / Turnover Rate (hours) / 60 = Gallons per Minute

FILTER SURFACE AREA
Flow rate / Filtering Ability = Sq Feet of Filter Surface Area Needed

FILTER FLOW CAPACITY
Filter Area x Filtering Ability x Required Turnover x 60 = Filter Flow Capacity

MAXIMUM USER CAPACITY
Surface Area / Health code bather capacity = Max User Capacity

Quick Reference Conversion Table

Ounces to Pounds	Milliliters to Liters
Ounces ÷ 16 = Pounds	Milliliters ÷ 1000 = Liters
Fluid Ounces to Gallons	Meters to Feet
Fluid Ounces ÷ 128 = Gallons	Meters x 3.28 = Feet
Liters to Gallons	Fluid Ounce to Milliliters
Liters ÷ 3.785 = Gallons	Fluid Ounce x 29.57 = Milliliters
Fluid Ounces to Cups	Celsius (°C) to Fahrenheit (°F)
Fluid Ounces ÷ 8 = Cups	°F = (9/5 x °C) + 32
Yards to Feet	Fahrenheit (°F) to Celsius (°C)
Yards x 3 = Feet	°C = 5/9 x (°F - 32)
Cubic Feet to Gallons	Quarts to Gallons
Cubic Feet x 7.48 = Gallons	Quarts ÷ 4 = Gallons

CALCULATIONS

EXAMPLE 1: Rectangle Pool Volume in Gallons & Flowrate

Length of pool:	75 Feet
Width of pool:	50 Feet
Shallow End Depth:	3 Feet
Deep End Depth:	5 Feet
Turnover Rate:	6 Hours

Volume of pool in gallons = Length x Width x Average Depth x 7.5

Volume of pool in gallons = 75 x 50 x 4 x 7.5 = 112,500 gallons

$$\text{Minimum Flow Rate} = \frac{\text{Capacity}}{(\text{Turnover Rate} \times 60)} = \frac{112{,}500}{(6 \times 60)} = 312.5 \text{ gpm}$$

CALCULATIONS

EXAMPLE 2: Circular Pool Volume in Gallons & Flowrate

Diameter of pool:	8 Feet
Shallow End Depth:	3 Feet
Deep End Depth:	4 Feet
Turnover Rate:	30 Minutes

Volume of pool in gallons = Radius x Radius x 3.14 x Average Depth x 7.5

Volume of pool in gallons = 4 x 4 x 3.14 x 3.5 x 7.5 = 1,319 gallons

$$\text{Minimum Flow Rate} = \frac{\text{Capacity}}{\text{(Turnover Rate)}} = \frac{1{,}319}{(30)} = 44 \text{ gpm}$$

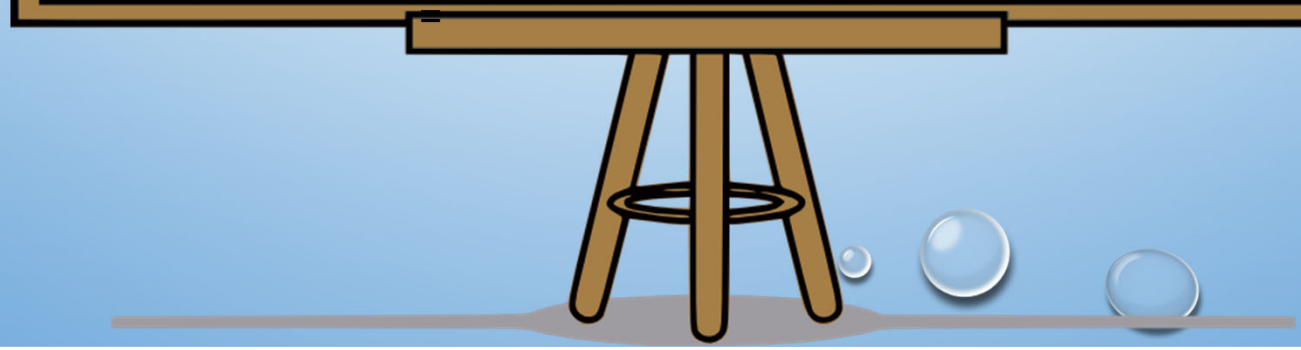
CALCULATIONS

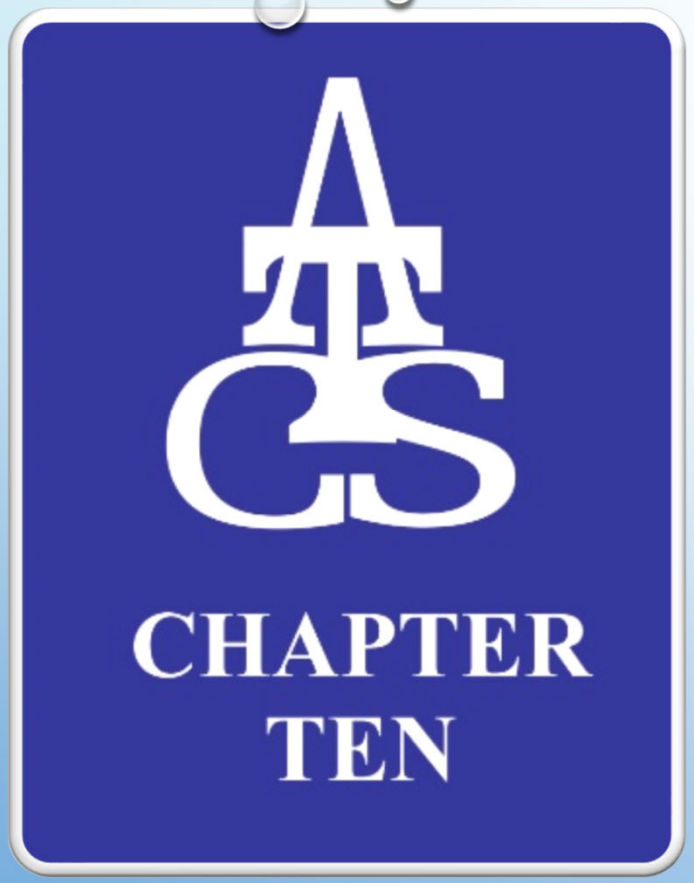
EXAMPLE 3: Current Turnover Rate

Volume of pool: 150,000
Current Flow Rate: 350 gpm

$$\text{Current Turnover Rate} = \frac{\text{Capacity}}{(\text{Flow Rate} \times 60)}$$

Turnover Rate in hours: 150,000 ÷ 350 ÷ 60 = 7.14 hours





SPA MAINTENANCE

HOT WATER CHEMISTRY AND SPAS

- MENTAL AND PHYSICAL RELAXATION DERIVED
- CONDUCIVE TO RELIEVING ACHES AND PAINS
- EVERY PUBLIC SPA SHOULD BE MAINTAINED BY A PSPO

HOT WATER CHEMISTRY AND SPAS

However

A CASUAL ATTITUDE BY PSPO CAN QUICKLY PRODUCE AN UNHEALTHY AND UNSAFE ENVIRONMENT

CHANGE THE WATER FREQUENTLY

- SMALLER VOLUME OF WATER THAN POOL, MORE BATHERS PER GALLON

- GREATER AMOUNT OF BATHER WASTE IN A SPA

The formula for changing the water

Volume of water ÷ 3 = Number of Uses before change

For example, if there are 600 gallons of water in the hot tub then every 200 uses (600 ÷ 3 = 200) it should be changed.
If 20 people each day use the hot tub then the water should be changed every 10 days (200 ÷ 20 = 10)

FOAMING

- CAUSED BY COMBINATION OF
  - ORGANIC WASTES AND AERATION; OR
  - OVERUSE OF SIMPLE QUAT ALGICIDES;
  - HIGH BATHER LOADS;
  - HIGH PH;
  - HIGH TDS;
  - HIGH TEMPERATURE

- DEFOAMERS – SILICON BASED EMULSIONS
  - BREAK-UP AND DISSIPATE FOAM
  - THEY ONLY HIDE THE PROBLEM, THEY DON'T SOLVE THE PROBLEM

WATER REPLACEMENT INTERVAL (WRI)

- IF TDS EXCEEDS THE SOURCE-WATER TDS BY 1,500 PPM OR MORE; OR
- WRI LESS THAN OR EQUAL TO THE NUMBER DAYS SINCE LAST TIME WATER WAS DRAINED;
    1. DRAIN THE SPA COMPLETELY
    2. CLEAN IT THOROUGHLY
    3. REFILL IT WITH SOURCE WATER

TEMPERATURE

- EFFECTS
  - BACTERIAL GROWTH
  - CHEMICAL REACTION TIME
  - HIGH TDS
  - HIGHER LEVELS OF ORGANIC WASTE
- IDEAL 98° - 104°
- MAXIMUM SUGGESTED TEMPERATURE 104°

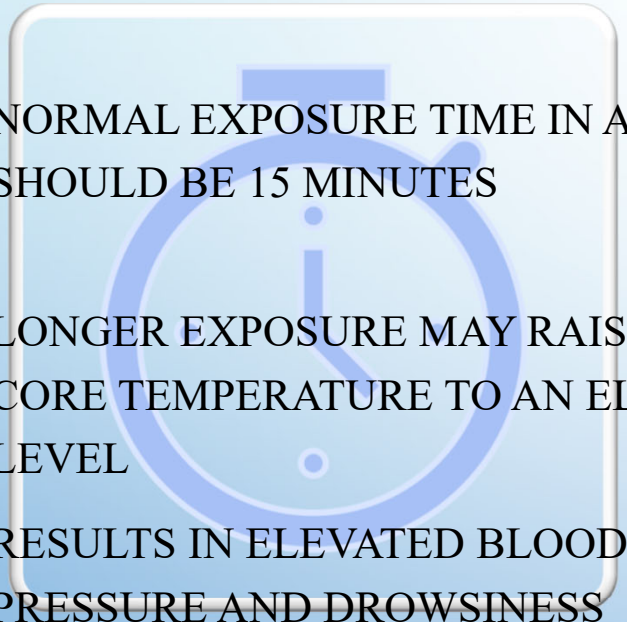
DISEASE PREVENTION

- TOTAL DISSOLVED SOLIDS WILL DEVELOP QUICKLY IN A SMALL VOLUME OF WATER
- AT 102° THE AVERAGE PERSON PERSPIRES 3 PINTS OF FLUID PER HOUR, COMPARED TO 1 PINT PER HOUR FOR A SWIMMER IN A POOL
- PSEUDOMONAS LIVES IN WATER 89 DEGREES OR WARMER
- SANITIZER WILL NOT LAST AS LONG IN HIGH TEMPERATURES
- VIRUSES AND BACTERIA CAN GROW MORE RAPIDLY AT HIGH TEMPERATURES.

HEATING PROBLEMS

- ALWAYS REMEMBER TO TURN OFF THE HEATER WHEN TURNING OFF THE CIRCULATION SYSTEM FOR ANY REASON. THE HEATING ELEMENTS CAN BE DAMAGED IF THE HEATER IS LEFT ON WHEN THE WATER IS NOT CIRCULATING.
- USING A COVER AT NIGHT OR WHEN THE SPA IS CLOSED WILL HELP RETAIN HEAT AND HELP CUT DOWN ON EVAPORATION.
- BE FAMILIAR WITH THE LOCAL HEALTH DEPARTMENT REGULATION FOR TEMPERATURE MAXIMUM. IT IS USUALLY 104°.

HYPERTHERMIA



- NORMAL EXPOSURE TIME IN A SPA SHOULD BE 15 MINUTES
- LONGER EXPOSURE MAY RAISE BODY CORE TEMPERATURE TO AN ELEVATED LEVEL
- RESULTS IN ELEVATED BLOOD PRESSURE AND DROWSINESS

RULES THAT SHOULD BE FOLLOWED:

a. Use of the spa should be no longer than 15 minutes at a time. Blowers should be on a timer with a maximum of 15 minutes and should be out of reach of patrons using the spa.

b. NO ALCOHOL.

c. Persons with high blood pressure, elderly, children, and pregnant women should consult a physician before using the spa.

d. Children under the age of five should not use the spa. (Most jurisdictions require higher disinfectant levels, and the higher temperatures can pose a health risk for young children. Many children tend to "swim" around and not just sit and relax. This movement can raise the body temperature even higher).

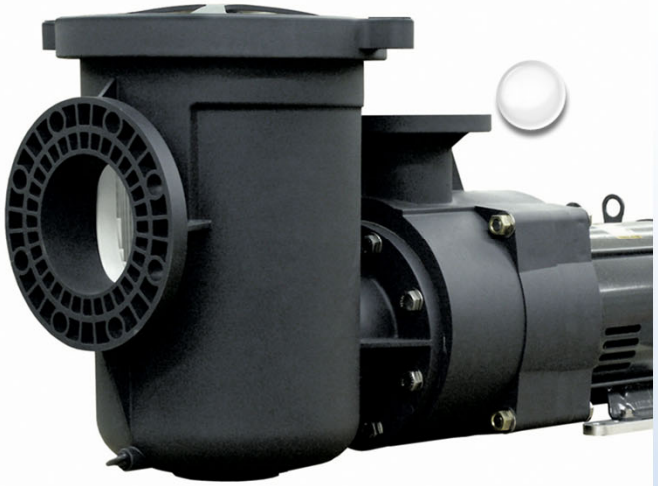
SUCTION ENTRAPMENT

IN ADDITION TO THE CONSIDERATIONS COVERED IN CHAPTER 8:

- HAVE A STAFF PERSON WALK THROUGH SPA AREA AT LEAST EVERY ½ HOUR
- CHECK AND COMPLETE POOL AND SPA ENTRAPMENT HAZARD CHECKLIST DAILY PRIOR TO OPENING
- SPA SHOULD HAVE AN EMERGENCY SHUT OFF SWITCH CLOSE AT HAND

TURNOVER RATE

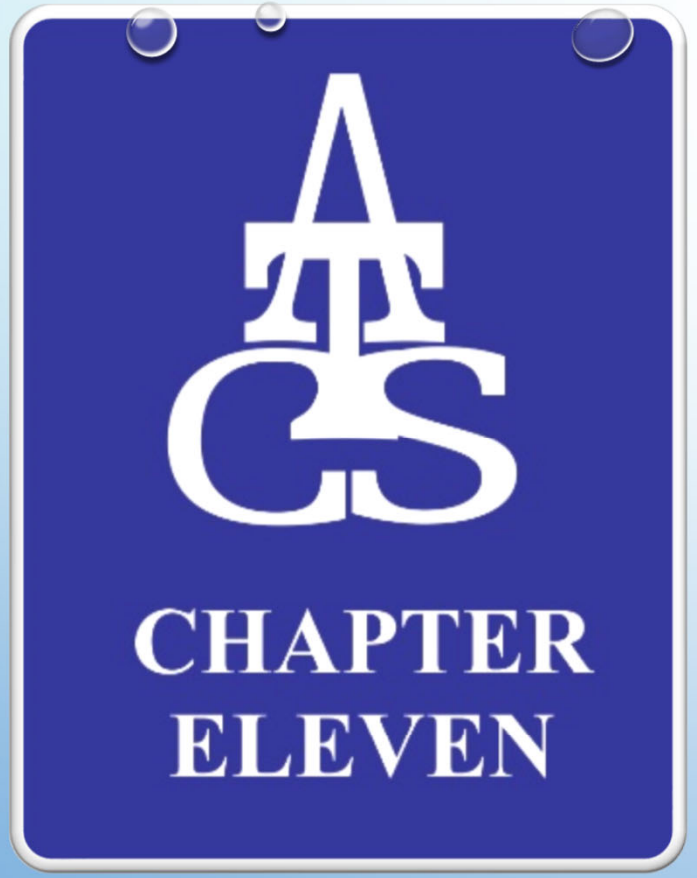
- TURNOVER RATE - EVERY 30 MINUTES MINIMUM (SOME HEALTH DEPARTMENTS ARE 15 MINUTES I.E. VIRGINIA
- THIS MEANS 48 TIMES PER DAY ALL OF THE WATER HAS GONE THROUGH THE FILTER



- SUGGESTED DISINFECTION RANGES:
  - CHLORINE 4.0 TO 10.0 PPM (IDEAL 4.0 - 5.0 PPM)
  - BROMINE 4.0 TO 8.0 PPM
- CHECK EVERY 1 HOUR

THE FOLLOWING QUALITIES MAKE BROMINE A BETTER DISINFECTANT IN SPA WATER:

1. BROMINE IS MORE STABLE THAN CHLORINE AT HIGHER TEMPERATURES
2. COMBINED BROMINE (BROMAMINES) PROVIDE DISINFECTION WHERE COMBINED CHLORINE (CHLORAMINES) DOES NOT.
3. BROMINE IS EFFECTIVE OVER A WIDER PH RANGE
4. COMBINED BROMINE ARGUABLY HAS LESS OF A DISAGREEABLE ODOR THAN COMBINED CHLORINE.
5. COMBINED BROMINE ELIMINATES SOME BATHER DISCOMFORT WHICH CAN BE CAUSED BY COMBINED CHLORINE.



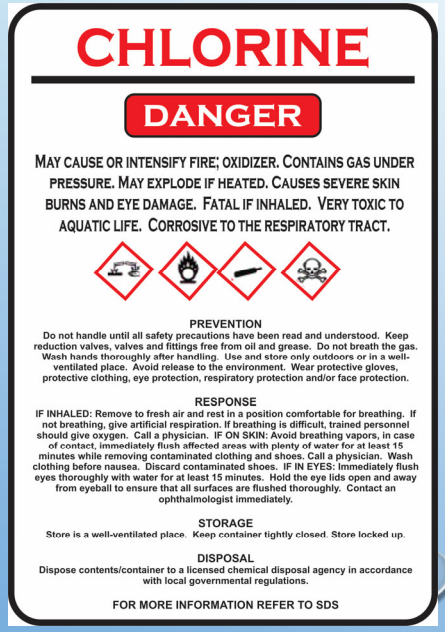
CHEMICAL SAFETY

CHEMICAL SAFETY

MANY CHEMICAL SAFETY HAZARDS EXIST IN THE AQUATIC ENVIRONMENT. TAKE PRECAUTIONS AT ALL TIMES!

MANY OF THE CHEMICALS USED IN A POOL PUMP ROOM ARE EITHER CORROSIVES OR OXIDIZERS.

ALL CONTAINERS IN THE PUMP ROOM MUST HAVE THE ORIGINAL CONTAINER LABEL ON THEM. NEVER PUT A CHEMICAL INTO AN UNLABELED CONTAINER!

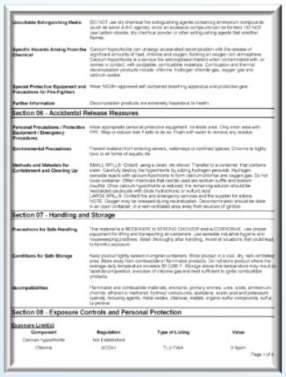


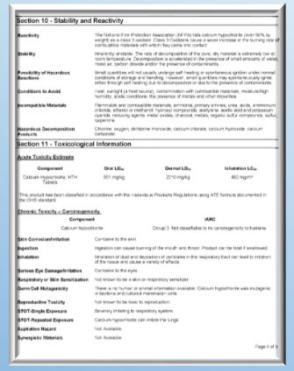
Container labels should contain the following information:

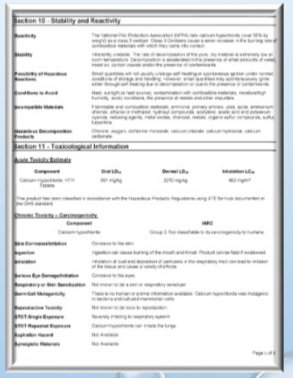
- Identity of the chemical
- Reactivity of the chemical
- First Aid procedures
- Personal safety warnings, (i.e. do not breathe dust, use in ventilated area, use goggles, gloves, splash apron, and respirator)
- Name and address of the manufacturer
- All containers must have labels prominently affixed and shall provide chemical name and hazard warnings

SAFETY DATA SHEETS







SAFETY DATA SHEETS, OFTEN REFERRED TO AS MATERIAL SAFETY DATA SHEET (MSDS), ARE INFORMATIONAL SHEETS ON CHEMICALS. ALWAYS READ THE ENTIRE MSDS, ESPECIALLY THE FIRST AID SECTION.

KEEP THE MSDS IN AN EASY TO ACCESS AREA AND PERIODICALLY MAKE SURE THAT ALL CHEMICALS HAVE SHEETS. THIS INCLUDES TESTING REAGENTS, CLEANING PRODUCTS, AND ANYTHING THAT IS USED OR STORED WITHIN THE POOL ENCLOSURE. THE CHEMICAL COMPANY OR STORE WHERE THE PRODUCTS ARE PURCHASED MUST SUPPLY THE MSDS.

CHEMICAL STORAGE

1. ALWAYS KEEP THE DOOR LOCKED BUT HAVE THE KEY EASILY ACCESSIBLE IN CASE OF AN EMERGENCY.

2. KEEP BAGS OF CHEMICALS OFF THE FLOOR. KEEPING THE BAGS OF BULK CHEMICALS IN SMALL TRASH CANS WITH A LOCKABLE LID IS A GREAT WAY TO KEEP THE PUMP ROOM CLEANED, ORGANIZED AND WILL KEEP THE CHEMICALS DRY. ALSO, LAMINATE OR PUT IN A PLASTIC SHEET COVER, THE MSDS FOR THAT PRODUCT AND TAPE IT TO THE CONTAINER. YOUR CHEMICAL ROOM WILL BE LESS HAZARDOUS IF THE CHEMICALS ARE SECURELY STORED, AND THE MSDS WILL BE READILY ACCESSIBLE IF NEEDED.

3. MAKE SURE CONTAINERS ARE COVERED WITH THE ORIGINAL TOP.

   A. ALL CHEMICALS SHOULD BE KEPT IN THEIR ORIGINAL CONTAINER (ESPECIALLY OXIDIZERS) OR A MARKED CONTAINER THAT INCLUDES THE MSDS SHEET ATTACHED TO IT.

   B. SODIUM AND ACID VATS ARE TO BE KEPT COVERED AND AS FAR AWAY FROM EACH OTHER AS POSSIBLE. TRY NOT TO HAVE THESE VATS SITTING DIRECTLY UNDER THE CHEMICAL FEEDERS, AS IT WILL CAUSE THEM TO CORRODE EASILY.

   C. ALL CONTAINERS ARE PROPERLY LABELED AND CONTAIN THE ORIGINAL CHEMICAL.

   D. DUST COVERS ON ALL CORROSIVE MATERIALS; THEY WILL EASILY CORRODE METALS.

4. KEEP DIFFERENT CHEMICALS AWAY FROM EACH OTHER (EX: CHLORINES AND ACIDS).

   A. STORE ALIKE CHEMICALS TOGETHER.

   B. HAVE A SEPARATE STORAGE AREA FOR CLEANERS, ETC.

5. ALWAYS KEEP PUMP/CHEMICAL ROOM CLEAN, ORGANIZED, AND LOCKED.

6. ALWAYS CLEAN UP SPILLS IMMEDIATELY.

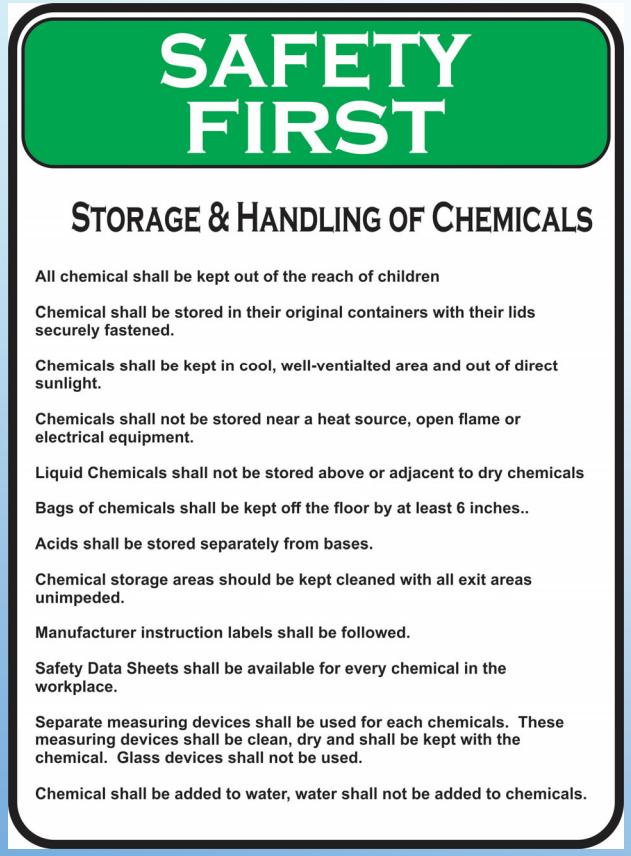
ADDING CHEMICALS TO THE POOL

- AFTER PUTTING ON THE PROPER SAFETY EQUIPMENT, PUT WATER INTO A PLASTIC BUCKET (NOT METAL). ALWAYS ADD CHEMICAL TO WATER (STIR UNTIL DISSOLVED) AND UNLESS OTHERWISE DIRECTED, POUR AROUND THE POOL'S PERIMETER. NOTE: DO NOT USE METAL TO STIR THE CHEMICALS. USE A WOODEN OR PLASTIC SPOON OR HANDLE.
- NEVER ADD ANY CHEMICAL WHILE THE POOL IS IN USE.
- NEVER POUR CHEMICALS INTO THE SKIMMER, UNLESS SPECIFICALLY DIRECTED BY THE MANUFACTURER. THIS SENDS A STRONG CONCENTRATION DIRECTLY TO THE PUMP AND CAN DAMAGE THE MOTOR.
- READ MSDS ON ALL CHEMICALS BEFORE ADDING AND ALWAYS READ THE MANUFACTURERS RECOMMENDATIONS FOR CORRECT METHOD OF ADDING.

PERSONAL PROTECTIVE EQUIPMENT

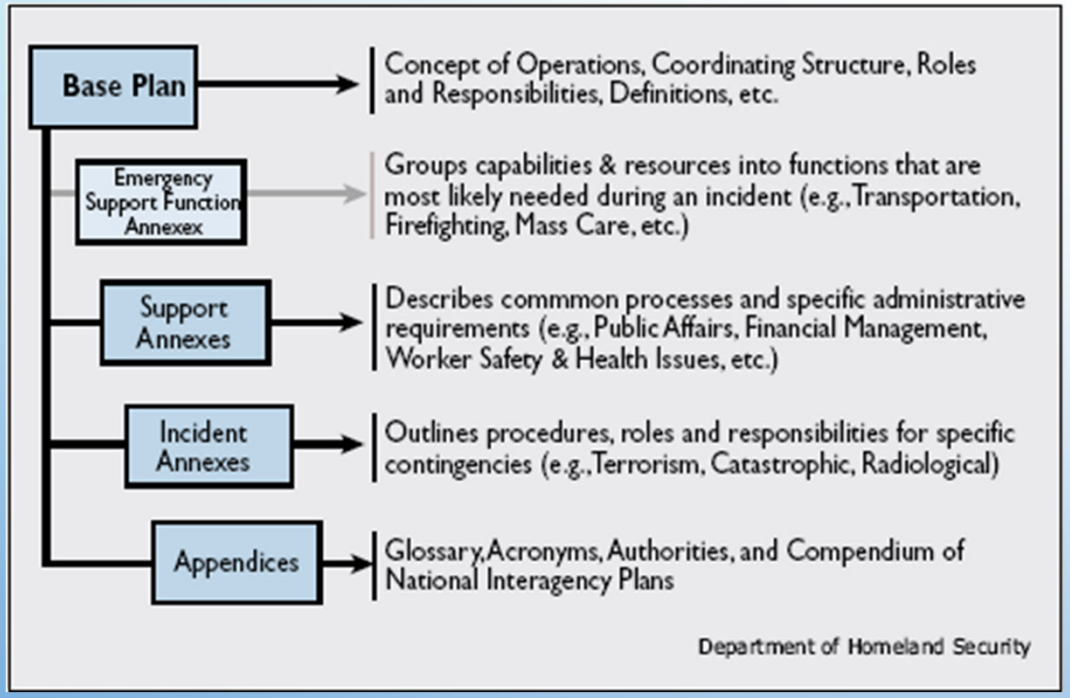
- MUST HAVE ONSITE THE PROPER SAFETY EQUIPMENT TO HANDLE THE CHEMICALS:
  - GOGGLES OR FACE SHIELD
  - CHEMICAL RESISTANT APRON
  - CHEMICAL RESISTANT GLOVES
  - DUST MASK OR RESPIRATOR
- EYEWASH STATION MUST BE PROVIDED

CHEMICAL SAFETY TIPS



1. Read the label
2. Keep chemicals out of patrons' reach
3. Store chemicals off the floor in a clean well-ventilated area
4. Always add chemical to water; not water to chemicals
5. Wear proper safety equipment
6. Close all containers when finished
7. Keep reactive chemicals apart
8. Different measuring devices
9. Keep pool chemicals away from other chemical, paints and fertilizers
10. Do not reuse empty containers for other chemicals
11. Dispose of empties per MSDS
12. Never mix chemicals together unless directions tell you to
13. Pour with care
14. Broadcast dry chemicals with no bathers in area and upwind
15. Clean up spills quickly
16. Train staff
17. Be careful!

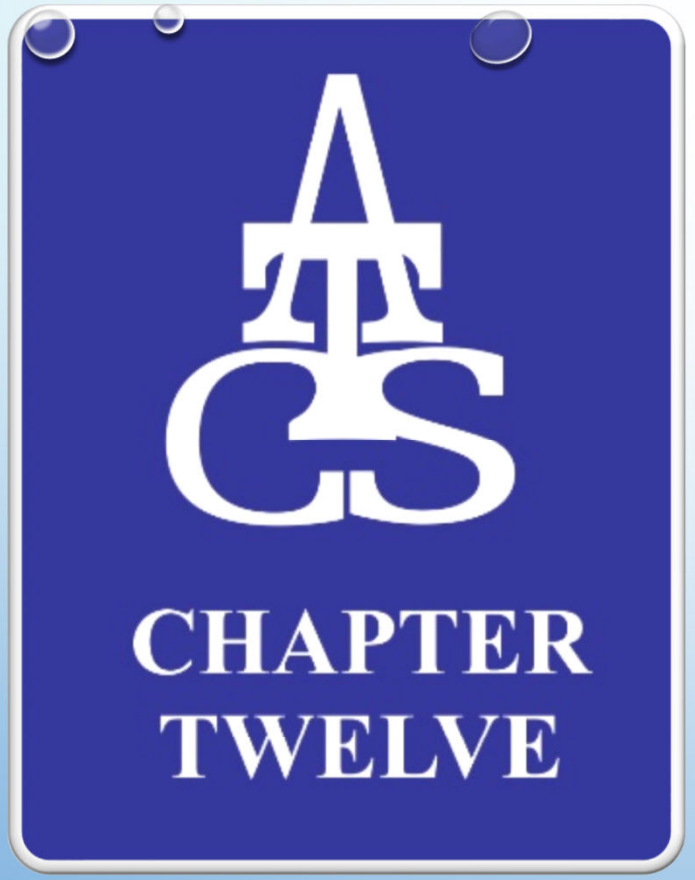
EMERGENCY ACTION PLANS



- GUIDELINES AND PROCEDURES FOR HANDLING EMERGENCIES
  - ACCIDENTS
  - EQUIPMENT FAILURES
  - UTILITY FAILURES
  - STORM WARNINGS
  - OTHER EMERGENCIES
- DEVELOP; PRACTICE; REVIEW; ADJUST

IN THE EVENT OF A CHEMICAL SPILL

1. Keep all patrons and staff safe!
2. Close off the area.
3. Evacuate, if fumes are present.
4. Call 911, if fumes are present OR if someone is injured.
5. Consult your Materials Safety Data Sheets.
6. If the spill is minor and dry, sweep it up carefully and replace in original container or dispose of it.
7. If the spill is minor and liquid, dilute the area WELL with water.



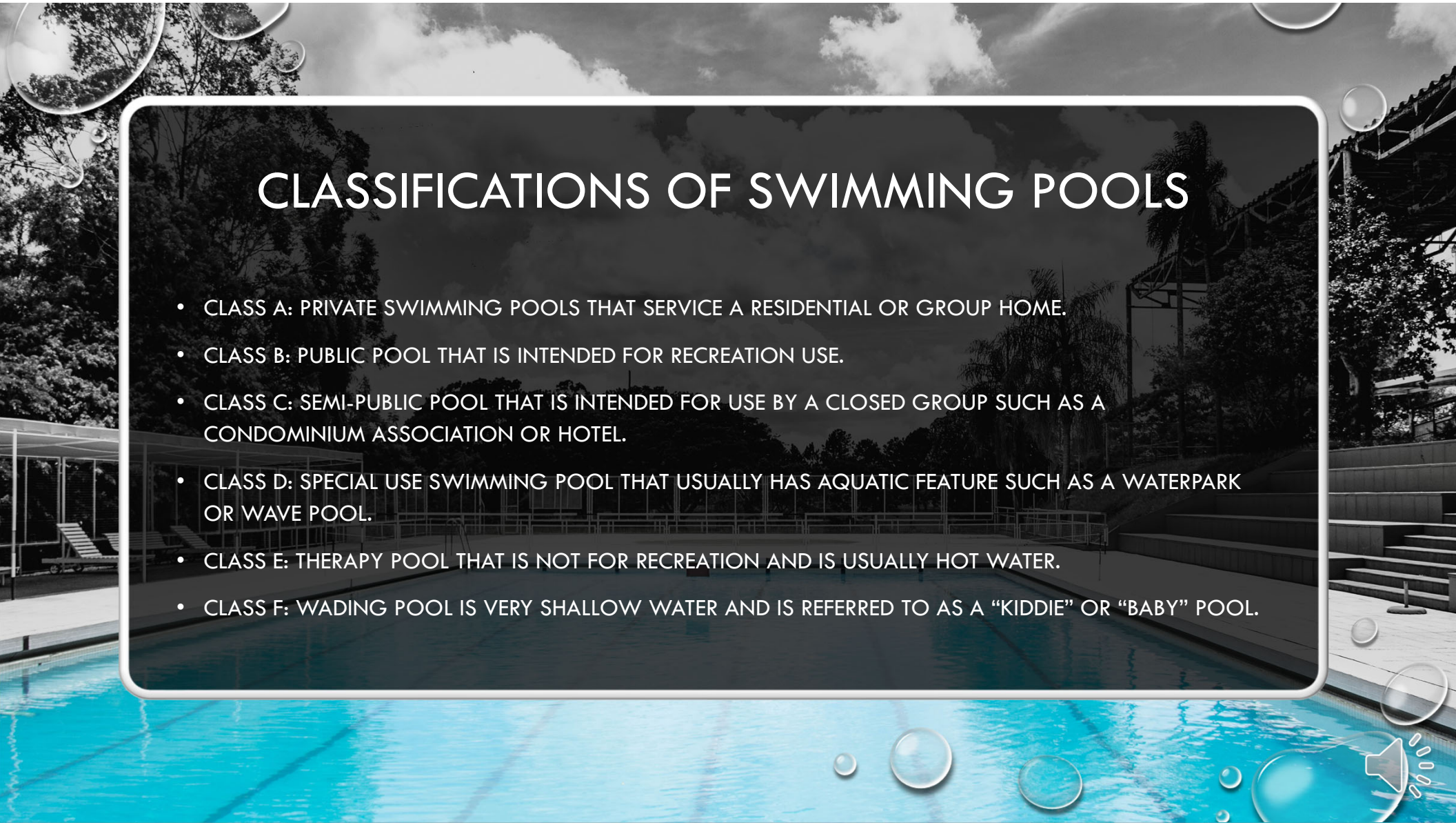
DAILY AND SEASON OPERATING PROCEDURES

PREVENTIVE & ROUTINE MAINTENANCE

VISUAL AND MANUAL INSPECTIONS OF THE POOL, EQUIPMENT, AND ENVIRONMENT NEED TO BE COMPLETED EVERY DAY. A CHECKLIST TO BE INITIALED BY THE STAFF WHEN THE INSPECTIONS ARE COMPLETED IS THE BEST WAY TO KEEP TRACK OF NEEDED MAINTENANCE AND SUPPLIES. NOTE ANY UNUSUAL FINDINGS SUCH AS ACTS OF VANDALISM OR BROKEN EQUIPMENT, ETC.

TYPE OF AQUATIC VENUES

- FLAT WATER AQUATIC VENUES ARE WHERE THE WATER LINE IS STATIC EXCEPT FOR MOVEMENT MADE BY USERS USUALLY AS A HORIZONTAL USE AS IN SWIMMING.
- AGITATED WATER AQUATIC VENUES WHERE AQUATIC FEATURES DISCHARGE, SPRAY, OR MOVE THE WATER'S SURFACE ABOVE AND/OR BELOW THE STATIC WATER LINE THROUGH MECHANICAL MEANS .IN THESE VENUES PEOPLE ARE STANDING OR PLAYING VERTICALLY.
- HOT WATER AQUATIC VENUES ARE WHERE THE WATER TEMPERATURE IS MAINTAINED OVER 90 DEGREES F.



CLASSIFICATIONS OF SWIMMING POOLS

- CLASS A: PRIVATE SWIMMING POOLS THAT SERVICE A RESIDENTIAL OR GROUP HOME.
- CLASS B: PUBLIC POOL THAT IS INTENDED FOR RECREATION USE.
- CLASS C: SEMI-PUBLIC POOL THAT IS INTENDED FOR USE BY A CLOSED GROUP SUCH AS A CONDOMINIUM ASSOCIATION OR HOTEL.
- CLASS D: SPECIAL USE SWIMMING POOL THAT USUALLY HAS AQUATIC FEATURE SUCH AS A WATERPARK OR WAVE POOL.
- CLASS E: THERAPY POOL THAT IS NOT FOR RECREATION AND IS USUALLY HOT WATER.
- CLASS F: WADING POOL IS VERY SHALLOW WATER AND IS REFERRED TO AS A “KIDDIE” OR “BABY” POOL.

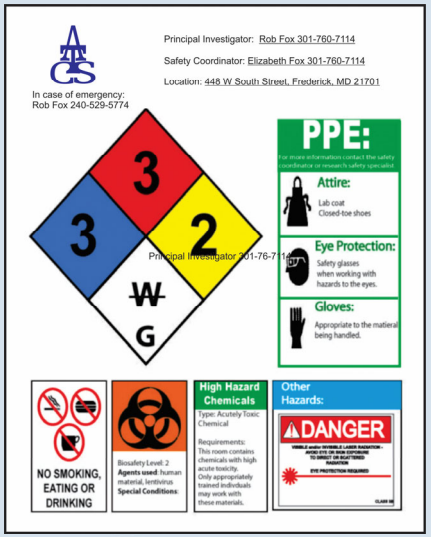
BARRIERS

All aquatic facilities must enclose their chemical and mechanical spaces to prevent access from the public. These enclosures could include walls or fencing that is at least six feet high. These enclosures cannot impede patron accessibility to the swimming pool, locker rooms or exit areas. All doors and gates that provide barriers in the facility must have self-latching gates. All emergency exit areas need to be well marked and unencumbered.

SIGNAGE

Signage is extremely important at facilities. Signage that is required at all pools include:

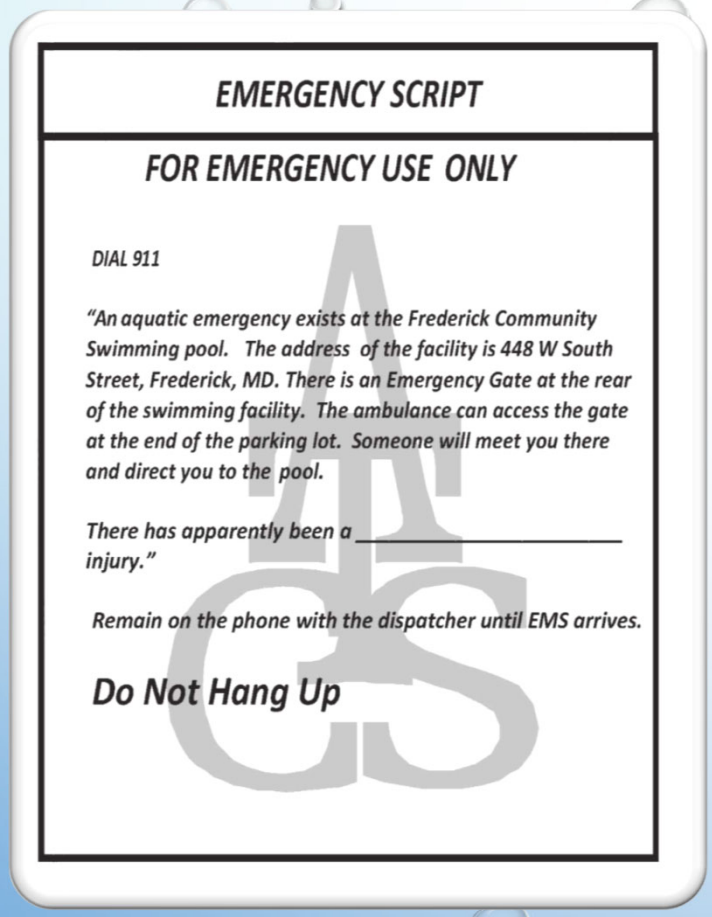
-Emergency phone instructions
-Unauthorized area signs
-Chemical danger signs
-Variable water depth signs
-First aid location
-Management contact information
-Hours of operations
-Pool rules



DEPTH MARKERS

All swimming pools must have water depths clearly marked. Permanent depth markers must indicate the minimum and maximum depth on both sides of the pool and at the break in the floor slope where the pool goes from shallow to deep. Depth marking should be on the tile line, coping stones, and/or printed on the deck and shall be no more than 25 feet apart. For shallow water (less than five feet), the depth should be marked as the pool gets each foot deeper. In addition, all areas that are less than 5 feet deep must be marked with “No Diving” markers.

EMERGENCY RESPONSE PLANS



EMERGENCY SCRIPT

FOR EMERGENCY USE ONLY

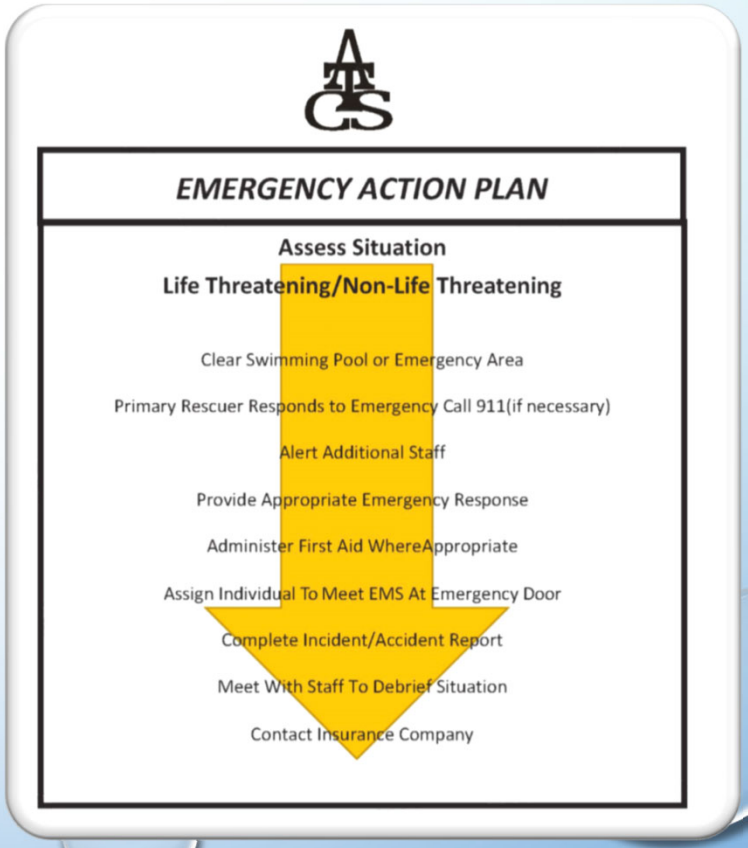
DIAL 911

"An aquatic emergency exists at the Frederick Community Swimming pool. The address of the facility is 448 W South Street, Frederick, MD. There is an Emergency Gate at the rear of the swimming facility. The ambulance can access the gate at the end of the parking lot. Someone will meet you there and direct you to the pool.

There has apparently been a _____ injury."

Remain on the phone with the dispatcher until EMS arrives.

Do Not Hang Up



EMERGENCY ACTION PLAN

Assess Situation

Life Threatening/Non-Life Threatening

Clear Swimming Pool or Emergency Area

Primary Rescuer Responds to Emergency Call 911(if necessary)

Alert Additional Staff

Provide Appropriate Emergency Response

Administer First Aid WhereAppropriate

Assign Individual To Meet EMS At Emergency Door

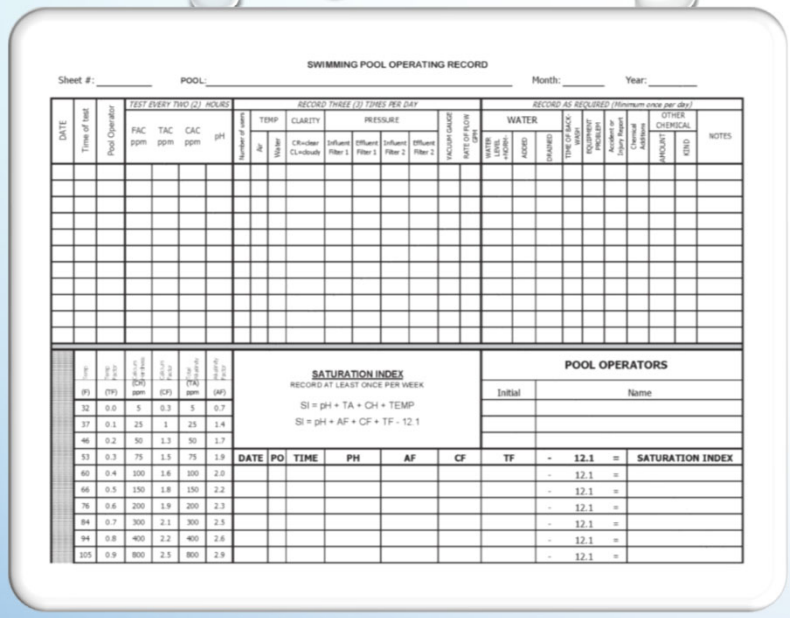
Complete Incident/Accident Report

Meet With Staff To Debrief Situation

Contact Insurance Company

Each facility should have their Emergency Action Plan and Emergency Call Script posted.

RECORD KEEPING



SWIMMING POOL OPERATING RECORD

Sheet #: _____ POOL: _____ Month: _____ Year: _____

DATE	Time of test	Pool Operator	TEST EVERY TWO (2) HOURS: FAC ppm	TAC ppm	CAC ppm	pH	RECORD THREE (3) TIMES PER DAY: Number of users	TEMP: Air	TEMP: Water	CLARITY: CR=clear CL=cloudy	PRESSURE: Influent Filter 1	PRESSURE: Effluent Filter 1	PRESSURE: Influent Filter 2	PRESSURE: Effluent Filter 2	VACUUM GAUGE	RATE OF FLOW GPM	RECORD AS REQUIRED (Minimum once per day): WATER: WATER LOSS +ADD-	WATER: ADDED	WATER: DRAINED	TYPE OF CHECK WATER	EQUIPMENT PROBLEM	Accident or Injury Report	Chemical Additions	OTHER CHEMICAL: AMOUNT	OTHER CHEMICAL: KIND	NOTES

Time (F)	Temp (TF)	Fac (CH) ppm	Calcium (CF)	Tac (TA) ppm	Stabilizer (AF)
32	0.0	5	0.3	5	0.7
37	0.1	25	1	25	1.4
46	0.2	50	1.3	50	1.7
53	0.3	75	1.5	75	1.9
60	0.4	100	1.6	100	2.0
66	0.5	150	1.8	150	2.2
76	0.6	200	1.9	200	2.3
84	0.7	300	2.1	300	2.5
94	0.8	400	2.2	400	2.6
105	0.9	800	2.5	800	2.9

SATURATION INDEX
RECORD AT LEAST ONCE PER WEEK

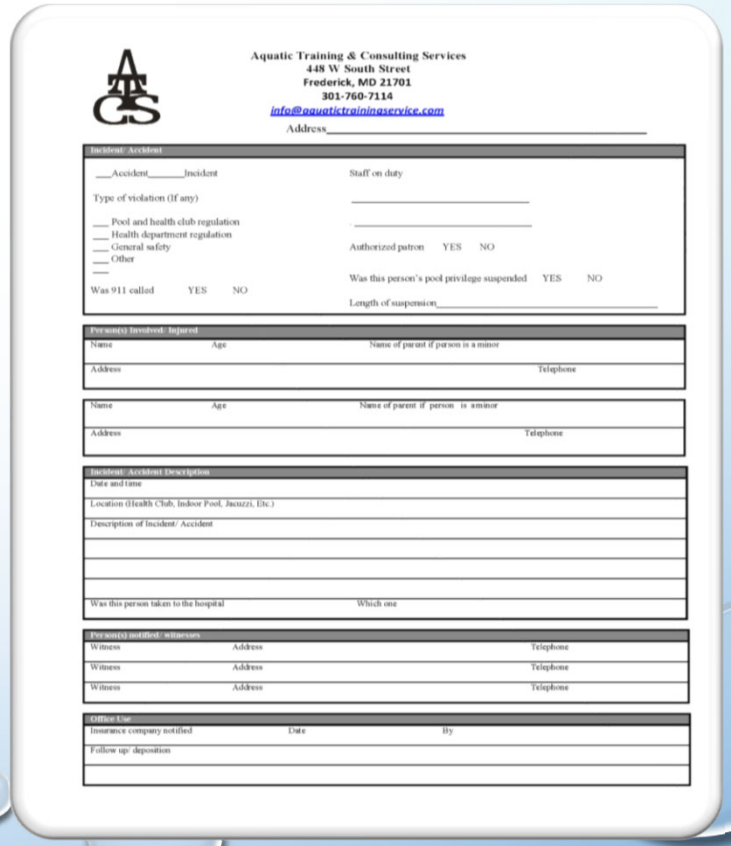
SI = pH + TA + CH + TEMP

SI = pH + AF + CF + TF - 12.1

DATE	PO	TIME	PH	AF	CF	TF	- 12.1 =	SATURATION INDEX
							- 12.1 =	
							- 12.1 =	
							- 12.1 =	
							- 12.1 =	
							- 12.1 =	

POOL OPERATORS

Initial	Name



Aquatic Training & Consulting Services
448 W South Street
Frederick, MD 21701
301-760-7114
info@aquatictrainingservice.com
Address_____

Incident: Accident

___Accident_____Incident

Staff on duty

Type of violation (If any)

___ Pool and health club regulation
___ Health department regulation
___ General safety
___ Other
___

Authorized patron YES NO

Was this person's pool privilege suspended YES NO

Was 911 called YES NO

Length of suspension_____

Person(s) Involved: Injured

Name Age Name of parent if person is a minor

Address Telephone

Name Age Name of parent if person is a minor

Address Telephone

Incident: Accident Description

Date and time

Location (Health Club, Indoor Pool, Jacuzzi, Etc.)

Description of Incident/ Accident

Was this person taken to the hospital Which one

Person(s) notified: witnesses

Witness Address Telephone

Witness Address Telephone

Witness Address Telephone

Office Use

Insurance company notified Date By

Follow up/ deposition

Record keeping including the need to keep accurate and timely records of the following areas:

- Operational conditions (e.g., water chemistry, water temperature, filter pressure differential, flow meter reading, and water clarity).
- Maintenance performed (e.g., backwashing, change of equipment).
- Incidents and response (e.g., fecal incidents in the water and injuries).
- Staff training and attendance.

PREVENTIVE & ROUTINE MAINTENANCE PLAN

- PSPO RESPONSIBLE FOR
  - IMPLEMENTATION OF PROCEDURES
    - MAINTAIN AND PREVENT LONG-RANGE DETERIORATION OF FACILITY
    - INCLUDES DAILY, WEEKLY, MONTHLY, SEASONAL AND ANNUAL ACTIVITIES
  - PROCEDURES MUST BE IN WRITING
  - MASTER LIST OR CALENDAR
- WHEN ITEM COMPLETED – DATE AND INITIAL
- INVENTORY OF EQUIPMENT
  - LOCATION
  - DATE PURCHASED
  - REPAIR HISTORY
  - PARTS LISTS
  - OWNER'S MANUALS
  - ADD MFG. MAINTENANCE ITEMS TO MASTER LIST

DAILY OPENING PROCEDURES

- The professional swimming pool operator shall ensure that a daily facility preventive maintenance inspection is done before opening and that includes:
- Drain covers, vacuum fitting covers, SKIMMER equalizer covers, and any other suction outlet covers are in place, secure, and unbroken.
- Skimmer baskets, weirs, lids, flow adjusters, and suction outlets are free of any blockage.
- Inlet and return covers and any other fittings are in place, secure, and unbroken.
- Safety warning signs and other signage are in place and in good repair.
- Entrapment prevention systems are operational.
- Recirculation, disinfection systems, controller(s), and probes are operating as required.
- Underwater lights and other lighting are intact with no exposed wires or water in lights.
- Slime and biofilm have been removed from accessible surfaces of the pool.
- Doors to nonpublic areas (chemical storage spaces, offices, etc.) Are locked.
- Fecal/vomit/blood incident contamination response protocols, materials, and equipment are available.
- Electrical devices are in good working condition.
- Water clarity is such that the bottom and objects on the bottom of the pool are clearly visible.

DAILY CLOSING PROCEDURES

- DAILY CLOSING PROCEDURES MIGHT INCLUDE
  - EQUIPMENT TAKEN OUT – STORED
  - LOST AND FOUND DRIED, FOLDED, PUT AWAY
  - BATHHOUSES CLEANED AND SANITIZED
  - TRASH CANS EMPTIED
  - FILTER EQUIPMENT CHECKED
  - DECKS CLEANED
  - LIGHTS TURNED ON/OFF
  - SECURITY TURNED ON
  - DOORS AND ENTRY POINTS LOCKED

OFF-SEASON MAINTENANCE

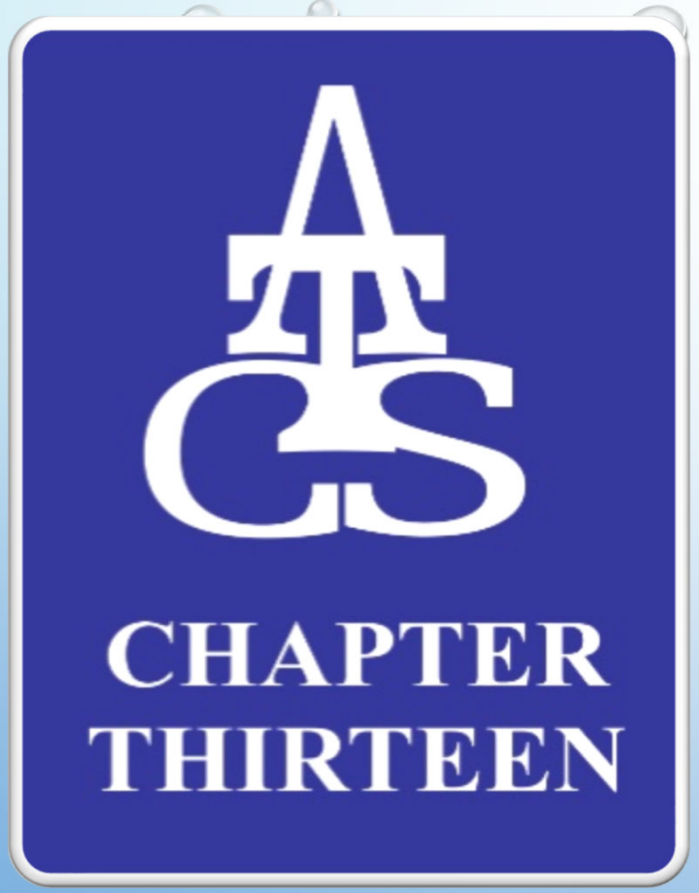
- PREOPENING PROCEDURES
  - WINTER DAMAGE WILL NEED TO BE REPAIRED
  - POOL WILL NEED TO BE DRAINED & CLEAN
  - EACH POOL WILL NEED TO BE CHECKED BY THE HEALTH DEPARTMENT PRIOR TO OPENING
- WINTERIZATION
  - VARIES DEPENDING ON CLIMATE
  - PURPOSE:
    - PREVENT DAMAGE TO SHELL
    - PREVENT OR REDUCE BUILD-UP OF RUST AND DETERIORATION OF EQUIPMENT
    - MINIMIZE VANDALISM
    - IDENTIFY REPAIR NEEDS PRIOR TO REOPENING

UNDERWATER LIGHTING

DIFFERENT TYPES OF LIGHTING

- WET NICHE - UNDERWATER
- DRY NICHE – LENS PART OF POOL
- LED

WET-NICHE lights are lights that are located within the pool (compared to dry-niche lights, which actually are outside of the pool). **NEVER turn a wet-niche light on when it is not in water**. The water of the pool is used to cool the light. If the glass is not wet, the light can explode



LEGAL AND LIABILITY

LIABILITY – RISK MANAGEMENT

- PSPO
  - PREVENT OR AT LEAST REDUCE LIABILITY FOR STAFF AND EMPLOYER
  - PREVENT OR AT LEAST REDUCE LIABILITY FOR FACILITY EXPOSURE TO LAWSUITS
- COULD THE STAFF, ACTING REASONABLY, FORESEE AND PREVENT SITUATION FROM OCCURRING?

COMMON REASONS FOR LIABILITY SUITS

1. FAILURE TO PROVIDE SAFE FACILITIES
2. FAILURE TO PROVIDE SAFE ENVIRONMENT
3. FAILURE TO PROVIDE SAFETY EQUIPMENT
4. THE AREA LACKS RING BUOYS, LIFEBOATS, RESTRAINING LINES.
5. FAILURE TO SUPERVISE
6. FAILURE TO POST
7. FAILURE TO COMPLY TO LAWS
8. FAILURE TO PROVIDE SECURITY
9. FAILURE OF AN EMPLOYEE TO PROPERLY PERFORM HIS DUTIES
10. IMPROPER ACTION
11. LACK OF ACTION

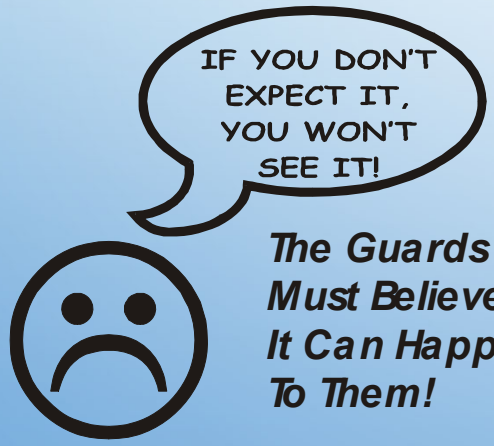
VIGILANCE

THE KEY TO VICTIM RECOGNITION

DEFINITION OF VIGILANCE :

The ability to see and recognize a signal event and then take the appropriate action.

A signal event is either occurring or has the high potential of occurring that could lead to an aquatic accident.



The Guards Must Believe It Can Happen To Them!

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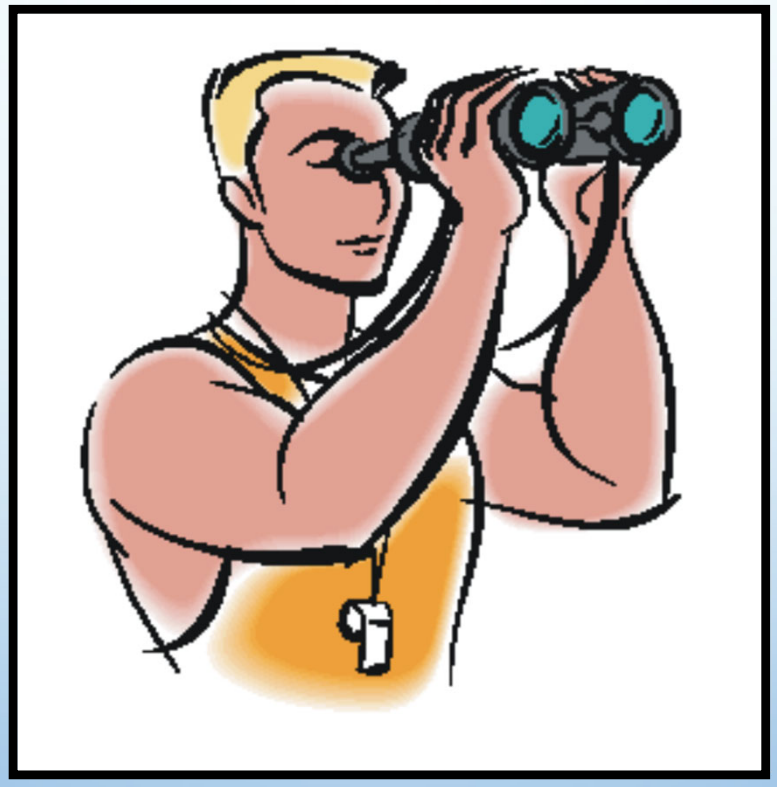
SCANNING



Defend The Water…Not The People!

5 FACTORS TO SCANNING EFFECTIVELY

1. Head in constant motion
2. Keep A Consistent Pattern
3. Pronounced Downward Head Swing
4. Pick Up All Of The Corners
5. Scan Within10 to 15 Seconds

WHAT'S THE DEAL WITH A "PRONOUNCED DOWNWARD HEAD SWING?"

The majority of drownings at guarded facilities happen within 6 feet of the guard chair.

If they don't look down, they'll never see them.

WHAT TO AVOID WHEN SCANNING:

- LOOKING BUT NOT SEEING,
- SCANNING TOO FAST,
- FAVORING ONE SIDE,
- STUTTER SCANNING, &
- SCANNING "UNCONSCIOUSLY."

NO MOVEMENT FOR 10 - GET THEM!

WOULDN'T YOU RATHER SAVE 100 PEOPLE THAT DIDN'T NEED IT, THAN MISS JUST ONE THAT DID?

THE NATIONAL AQUATIC SAFETY COMPANY

No Movement for 10 - Get Them!

5 ROLES OF A LIFEGUARD

1. RECOGNITION
2. PREVENTION
3. RESCUE
4. INITIATION
5. SUPPORT

My Actions Should
-Be Safe
-Look Safe
-Be Defendable
-Be Liked by Patrons

THE WORST THING YOU CAN DO IS DO NOTHING!

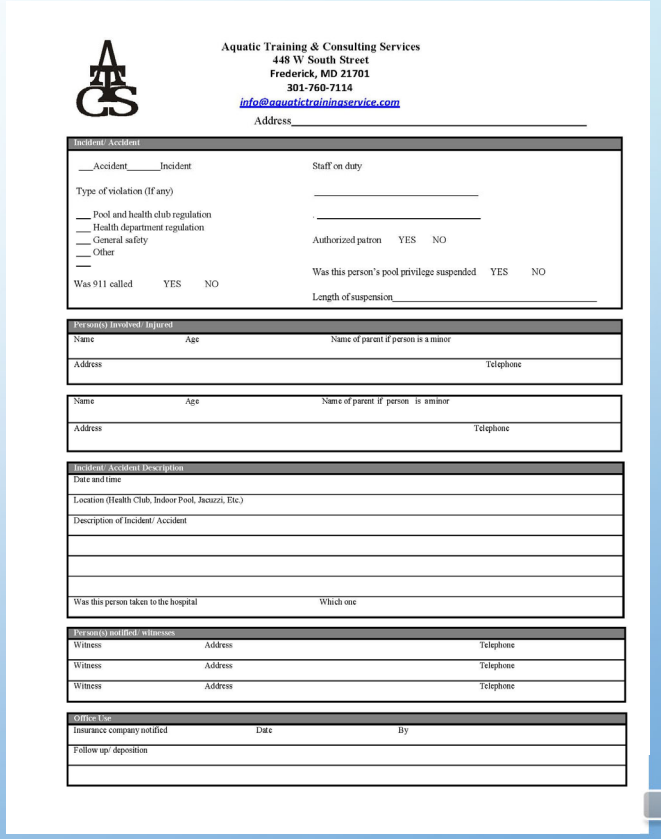
LIABILITY – RISK MANAGEMENT

Negligence is a term that can sum up almost everything mentioned in this section. This one word is the single most common cause of lawsuits in the aquatic industry. Covering a broad area of topics, negligence is doing something wrong, not doing what should've been done, going beyond the level of training, etc. Not doing your job the exact way it should've been done. Negligence covers many things.

- Elements of negligence:
  - Legal duty of care
  - Breach of duty
  - Breach was cause of injury
  - Substantial damage
- For liability to exist all four elements must exist
- Close monitoring – difference between winning and losing a lawsuit

WHEN AN ACCIDENT OCCURS

- IMMEDIATE AND TEMPORARY CARE
- FILL OUT ACCIDENT REPORT ASAP
- COPY REPORT TO ADMINISTRATOR WITHIN 1 HOUR
- CONTACT INSURANCE CARRIER, IF NECESSARY
- IF MAJOR ACCIDENT, DEBRIEF ALL INVOLVED



Aquatic Training & Consulting Services
448 W South Street
Frederick, MD 21701
301-760-7114
info@aquatictrainingservice.com

Address_____

Incident/ Accident

___Accident_____Incident

Type of violation (If any)

___ Pool and health club regulation
___ Health department regulation
___ General safety
___ Other
___

Was 911 called YES NO

Staff on duty

_____

_____

Authorized patron YES NO

Was this person's pool privilege suspended YES NO

Length of suspension_____

Person(s) Involved/ Injured

Name Age Name of parent if person is a minor

Address Telephone

Name Age Name of parent if person is a minor

Address Telephone

Incident/ Accident Description

Date and time

Location (Health Club, Indoor Pool, Jacuzzi, Etc.)

Description of Incident/ Accident

Was this person taken to the hospital Which one

Person(s) notified/ witnesses

Witness Address Telephone

Witness Address Telephone

Witness Address Telephone

Office Use

Insurance company notified Date By

Follow up/ deposition

SWIM AT YOUR OWN RISK

Lessens liability, does not negate it.
Facility can still be considered negligence.
Staff must enforce posted rules.

LIGHTNING SAFETY

- MANY STATES REQUIRE SUSPENSION OF ACTIVITY WHEN THUNDERSTORMS ARE IN AREA
- PSPO NEEDS TO DETERMINE SAFE AND NON-SAFE AREAS WITHIN FACILITY
- FOLLOW 30/30 RULE TO MINIMIZE RISK, THERE IS NO DIFFERENCE BETWEEN THUNDER AND LIGHTNING
- IF POOL HAS BEEN CERTIFIED AS GROUNDED, THEN THE FACILITY MAY REMAIN OPEN

AMERICANS WITH DISABILITIES ACT OF 1990

- NO INDIVIDUAL CAN BE DISCRIMINATED AGAINST BASED ON DISABILITY
- REASONABLE ACCOMMODATIONS MUST BE MADE