CALCULATION FORMULAS

1. Langlier Saturation Index (Page # 68-70)
SI = pH + Tf + Cf + Af – TDSf

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2. AMOUNT CONVERSIONS (Page # 25-26)
A. Ounces to Pounds: Ounces ÷ 16 = Pounds
B. Fluid Ounces to Gallons: Fluid Ounces ÷ 128 = Gallons

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3. SURFACE AREA SQUARE OR RECTANGLE (Page # 27)
Surface Area (in Square Feet) = Length X Width

---

4. **POOL VOLUME SQUARE OR RECTANGLE (Page # 27-28)**
Note: (**AVERAGE DEPTH** = shallow + deep ÷ 2)
Pool Volume (in Gallons) = Length X Width X **Average Depth** X 7.5

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5. POOL VOLUME IN 1 INCH OF WATER (Page # 32)
Length X Width X 7.5 X 0.0833 = Volume in 1 Inch of Water
Volume in 1 Inch of water X # of inches = Total Volume of Water Loss

---

6. COMBINED CHLORINE (Page # 76, 93)
Combined Chlorine = Total Chlorine – Free Chlorine
1. Test for Free Chlorine and Total Chlorine
2. Subtract Free Chlorine from Total Chlorine

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7. TURNOVER RATE (Page # 118)
Turnover Rate (in Hours) = Pool Volume ÷ Flow Rate ÷ 60

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8. FLOW RATE (Page # 119)
Flow Rate (in Gallons per Minute) = Pool Volume ÷ Turnover Rate ÷ 60

---

9. FILTER SURFACE AREA: (Page # 137-139)
Filter Area(FA), Filter Media Rate(FMR), Flow Rate(FR)
A. **FA** = FR ÷ FMR
B. **FMR** = FR ÷ FA
C. **FR** = FA X FMR

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10. BREAKPOINT CHLORINATION (Page # 76-78)

1. Determine the amount of Combined Chlorine:
   Combined Chlorine(CC) = Total Chlorine(TC) – Free Chlorine(FC)

2. Calculate the Breakpoint Chlorination(BPC) amount:
   Breakpoint(BPC) = CC X 10

3. Determine the desired change amount:
   Desired Change = BPC – FC

KEY PAGES

LANGELIER SATURATION INDEX

Saturation Index Factors

Temperature			Calcium Hardness expressed as $CaCO_3$		Total Carbonate Alkalinity	
°F	°C	Tf	ppm (mg/L)	Cf	ppm (mg/L)	Af
32	0.0	0.0	25	1.0	25	1.4
37	2.8	0.1	50	1.3	50	1.7
46	7.8	0.2	75	1.5	75	1.9
53	11.7	0.3	100	1.6	100	2.0
60	15.6	0.4	125	1.7	125	2.1
66	18.9	0.5	150	1.8	150	2.2
76	24.4	0.6	200	1.9	200	2.3
84	28.9	0.7	250	2.0	250	2.4
94	34.4	0.8	300	2.1	300	2.5
105	40.6	0.9	400	2.2	400	2.6
			800	2.5	800	2.9

Total Dissolved Solids

TDS	Factor
≤800	12.1
801-1,500	12.2
1,501-2,900	12.3
2,901-5,500	12.4
>5,500	12.5

The Saturation Index formula is as follows:

SI =	pH +	Tf +	Cf +	Af −	TDSf
Saturation Index	pH as tested	Temperature factor	Calcium factor	Alkalinity factor	TDS factor

SATURATION INDEX WORKSHEET

SI = pH + tF + cF + aF - TDSf =

	Value	Factor	New Value	Factor
pH				
Temperature				
Calcium Hardness				
Total Alkalinity				
Sub-Total				
Total Dissolved Solids				
Saturation Index				

	Value	Factor	New Value	Factor
pH				
Temperature				
Calcium Hardness				
Total Alkalinity				
Sub-Total				
Total Dissolved Solids				
Saturation Index				

SATURATION INDEX WORKSHEET

SI = pH + tF + cF + aF - TDSf =

	Value	Factor	New Value	Factor
pH				
Temperature				
Calcium Hardness				
Total Alkalinity				
Sub-Total				
Total Dissolved Solids				
Saturation Index				

	Value	Factor	New Value	Factor
pH				
Temperature				
Calcium Hardness				
Total Alkalinity				
Sub-Total				
Total Dissolved Solids				
Saturation Index				

SATURATION INDEX WORKSHEET

SI = pH + tF + cF + aF - TDSf =

	Value	Factor	New Value	Factor
pH				
Temperature				
Calcium Hardness				
Total Alkalinity				
Sub-Total				
Total Dissolved Solids				
Saturation Index				

	Value	Factor	New Value	Factor
pH				
Temperature				
Calcium Hardness				
Total Alkalinity				
Sub-Total				
Total Dissolved Solids				
Saturation Index				

HMC

(How Much Chemical)
CHEMICAL ADJUSTMENT WORKSHEET

A x	B x	C =	TOTAL
AMOUNT OF CHEMICAL (FROM APPENDIX B-2 OR PRODUCT LABEL)	**ACTUAL POOL VOLUME**	**DESIRED CHEMICAL CHANGE**	
	Block #2 (From word problem) _____**GAL**	*Block #4* (From word problem) _____**PPM** (CALCULATED)	
	÷ **10, 000 Gallons**	*Block #5* (From page #259) ÷ _____**PPM** (GIVEN)	
Block #1 (From page #259) _____**(AMT)**	*Block #3* x _____	*Block #6* x _____	*Block #7* _____**(AMT)**

HMC

(How Much Chemical)
CHEMICAL ADJUSTMENT WORKSHEET

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CHEMICAL ADJUSTMENT WORKSHEET

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Block #1 (From page #259) _____**(AMT)**	*Block #3* x _____	*Block #6* x _____	*Block #7* _____**(AMT)**

BPC = 1-2-3 PLUS HMC
BREAKPOINT CHLORINATION

STEP 1: To determine the amount of CC
TC - FC = CC

STEP 2: Calculate breakpoint amount by taking CC & multiplying times 10
CC X 10 = Breakpoint

STEP 3: From CC in Step 2 - Remove existing FC from word problem
BP - FC = Desired Change
Desired change in HMC Block #4

A x	B x	C =	TOTAL
AMOUNT OF CHEMICAL (FROM APPENDIX B-2 OR PRODUCT LABEL)	**ACTUAL POOL VOLUME**	**DESIRED CHEMICAL CHANGE**	
	Block #2 (From word problem) _____**GAL**	*Block #4* (From word problem) _____**PPM** (CALCULATED)	
	÷ **10, 000 Gallons**	*Block #5* (From page #259) ÷ _____**PPM** (GIVEN)	
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Block #1 (From page #259) _____**(AMT)**	*Block #3* x _____	*Block #6* x _____	*Block #7* _____**(AMT)**

Atlantic Solutions

Pounds of Salt required for 3200 ppm																	
Pool Size -- Gallons																	
Current Salt Level (ppm)	8,000	10,000	12,000	14,000	16,000	18,000	20,000	22,000	24,000	26,000	28,000	30,000	32,000	34,000	36,000	38,000	40,000
0	213	267	320	373	427	480	533	587	640	693	747	800	853	907	960	1013	1067
200	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
400	187	233	280	327	373	420	467	513	560	607	653	700	747	793	840	887	933
600	173	217	260	303	347	390	433	477	520	563	607	650	693	737	780	823	867
800	160	200	240	280	320	360	400	440	480	520	560	600	640	680	720	760	800
1000	147	183	220	257	293	330	367	403	440	477	513	550	587	623	660	697	733
1200	133	167	200	233	267	300	333	367	400	433	467	500	533	567	600	633	667
1400	120	150	180	210	240	270	300	330	360	390	420	450	480	510	540	570	600
1600	107	133	160	187	213	240	267	293	320	347	373	400	427	453	480	507	533
1800	93	117	140	163	187	210	233	257	280	303	327	350	373	397	420	443	467
2000	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400
2200	67	83	100	117	133	150	167	183	200	217	233	250	267	283	300	317	333
2400	53	67	80	93	107	120	133	147	160	173	187	200	213	227	240	253	267
2600	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
2800	27	33	40	47	53	60	67	73	80	87	93	100	107	113	120	127	133
3000	13	17	20	23	27	30	33	37	40	43	47	50	53	57	60	63	67
3200	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal	ideal
3400	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
3600+	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute	dilute

DAILY LOG

POOL#/NAME_____ GALLONS_____

Recommended PPM*	1.0-3.0	0-.2 Max	7.2-7.8	80-120	200-400	30-50	Flo Rate	Filt. Pres		
FUNCTION ⇨	FREE CHL	COMB CHL	Ph	T.A.	HARD-NESS	CY-ACID			**ADJUSTMENTS**	**√BY**
MON. AM										
MID										
_____ PM										
DATE										
TUE. AM										
MID										
_____ PM										
DATE										
WED. AM										
MID										
_____ PM										
DATE										
THU. AM										
MID										
_____ PM										
DATE										
FRI. AM										
MID										
_____ PM										
DATE										
SAT. AM										
MID										
_____ PM										
DATE										
SUN. AM										
MID										
_____ PM										
DATE										

This log ***must*** be prominently displayed in pump room and readily available for review by local health inspector.

***NATIONAL RECOMMENDED PARAMETERS.** Please check with local Health Dept. for variations in your locality.

PROPERTY NAME:**_____**

ATLANTIC SOLUTIONS, INC REP:_____919-933-4250

Pool Drain Safety (VGB) Compliance Data
PERMIT CANNOT BE ISSUED IF FORM IS INCOMPLETE
A separate form is required for each pumping system.

Name of Pool_____

Address _____

1. **Pump Flow**

Pump Manufacturer _____Model #_____Horsepower_____

Maximum Pump Flow. Maximum flow rate *from pump curve*: _____gpm. (Provide supporting evidence if flow reduction)

2. **Drain Sump Measurements** This is the area under the floor drains, if field built sump may need to remove drain cover one time to measure. (Check here if sumpless _____, then proceed to next section)

Sump shape: Round- width:_____inches diameter; **OR** Square- _____inches X _____inches

Sump minimum depth _____ inches Diameter of outlet pipe in sump _____ inches
Distance of top (inside) of outlet pipe from bottom of cover/grate _____ inches
Sump manufacturer and model # if available_____

3. **Drain Cover/Grate Data**

Number of drains on each pump _____ Distance between drains (on centers) _____
Cover/grate manufacturer _____, model _____, Lifespan: _____
Maximum flow rating of cover/grate_____gpm (floor); _____ gpm (wall)

Date drain cover/grates installed: _____ **EXPIRATION DATE**: _____

4. **Equalizer Covers**

Number of *operable* skimmer equalizers_____ **OR** Have the equalizers been disabled? YES / NO

Equalizer fitting Manufacturer_____, model_____,
Lifespan_____
Equalizer fitting maximum flow rating _____

Date equalizer cover/grates installed: _____ **EXPIRATION DATE**: _____

5. **Safety Vacuum Release System (SVRS)** – SVRS required if dual drains are closer than 3 feet on center or pump has a single drain with blockable cover or sump.

Safety Vacuum Release System manufacturer - _____

Vacuum line- Choose One
_____ No vacuum line in pool **OR**
_____Protective cover on vacuum lines installed before May 1, 2010 **OR**
_____ Self-closing, self-latching cover designed to be opened with a tool on vacuum lines installed after May 1, 2010

Full name of person providing this information _____
Signature _____Date_____
NCDHHS

RULES GOVERNING PUBLIC SWIMMING POOLS

15A NCAC 18A. 2500

NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL HEALTH
ENVIRONMENTAL HEALTH SERVICES SECTION

ALL ENVIRONMENTAL HEALTH Rules can be accessed at the following address:

https://ehs.ncpublichealth.com/faf/pti/pools.htm

PRACTICE QUESTIONS

1. **Determine the square footage area of a high-rate sand filter that has a flow rate of 380 gpm and is designed to operate at 16 gpm per square feet.**

   (A) 23.75 SQ FT (B) 19.5 SQ FT (C) 29 SQ FT (D) 10.8 SQ FT

---

2. **Legionnaires disease is spread by?**

   (A) Skin Contact (B) Breathable Droplets of Water
   (C) Over Chlorinated Pools (D) Alkalinity Too Low

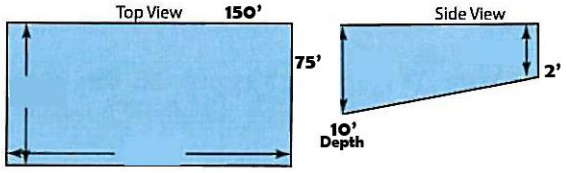
---

3. **What condition could lead to immediate closure of pool?**

   (A) Main drains not visable (B) Crack in pool deck
   (C) No lifeguard on duty (D) No underwater lights installed

---

4. **You are the operator for a pool that is 150 feet long and 75 feet wide. It has a depth range from 10 feet to 2 feet. What is the volume in gallons for this facility?**



   (A) 1,012,500 gal (B) 6,750 gal (C) 506,250 gal (D) 400,000 gal

---

5. **Your pool is 40 feet long and 20 feet wide. The water level in your pool dropped 5 inches overnight. What is the volume of missing water in gallons?**

   (A) 2,850 gal (B) 3,400 gal (C) 2,499 gal (D) 968 gal

---

6. **For a pool that is 155,000 gallons, what flow rate in gallons per minute(gpm) is needed for a 6 hour turnover?**

   (A) 430.55 gpm (B) 4305.6 gpm (C) 861.1 gpm (D) 86.1 gpm

7. **You are the operator of a 300,000 gallon outdoor pool. The water tests give you the following reading:**
   pH: 7.2
   Temperature: 76 degrees F
   Calcium Hardness: 150 ppm
   Total Alkalinity: 50ppm
   Total Dissolved Solids: 700 ppm
   What is the Saturation Index for this pool?

   (A) -0.3 (B) -0.6 (C) -0.8 (D) 0.3

---

8. **If you have a diarrheal incident in your pool, you must raise the free chlorine level to 20 ppm and keep it there for how long?**

   (A) 24 Hrs (B) 25.5 Hrs (C) 255 Hrs (D) 12.75 Hrs

---

9. **Which reagent is used to test pH?**

   (A) OTO (B) DPD (C) Phenol Red (D) Sodium Thiosulfate

---

10. **What is ORP measured in?**

    (A) Megavolts (B) Millivolts (C) Microvolts (D) Kilovolts

---

11. **You have a 25,000 gallon hotel pool with a calcium hardness level of 100 ppm. How much calcium chloride (77%) would be required to increase this to 300 ppm?**

    (A) 60 Lbs (B) 100 Lbs (C) 300 Lbs (D) 250 Lbs

---

12. **You operate a 70,000 gallon pool, and your chemical test readings are: Total Chlorine is 2.4 ppm, and Free Chlorine is 1.0 ppm. How much calcium hypochlorite is needed to reach breakpoint?**

    (A) 200 Lbs (B) 15.56 Lbs (C) 8.35 Lbs (D) 11.38 Lbs