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PAPER 6

PROBLEM SOLVING IN RESIDENTIAL SWIMMING POOLS

INTRODUCTION:

In this PAPER, we will look at specific problems you might encounter associated with mechanical maintenance residential swimming pool equipment (i.e. NOT the electrical side – that's for the professional electrician to take care of) We will outline symptoms of and reasons for their occurrence, and suggest remedies to overcome the problems.

Problems may be categorised according to the item which acts as the main source of the problems.
These categories are as follows:

Water Chemistry
Filtration Equipment
Skimmer Box issues
Suction and Return Lines
Preferred Surface Circulation Patterns
Manually operated Valves
Automatic Cleaning Devices, Sanitation/Chlorine Dispensers and pH Controllers
Ancillary Electrical Equipment
Heating Equipment
Water Levels in the Pool

WATER CHEMISTRY PROBLEMS

MANY OF THE PROBLEMS IN RESIDENTIAL SWIMMING POOLS STEM FROM IMPROPER POOL WATER MAINTENANCE

Most swimming pool water chemistry problems are the result of one or more of the following:

- No free chlorine or other sanitiser available
- Poor water circulation
- Failure to test and balance water regularly
- Reading the test results incorrectly.

- Lack of proper pool maintenance
- Neglecting periodic super-chlorination and fresh water replacement occasionally (Could be rainfall).

All pools need to be "Balanced" i.e. there is a distinct relationship between several factors of pool chemistry. For example, chlorine is less effective if the pH in the water is high.

The GENERAL CONSENSUS of correctly balanced pool water is as follows:

Value	Concrete	Vinyl	Fibreglass
pH	7.6	7.4 - 7.6	6.8 - 7.6
Calcium Hardness	400 - 500 ppm	100 ppm	100 ppm
Total Alkalinity	100-120 ppm	100-120 ppm	100-120 ppm
Residual Chlorine	2-3 ppm	1.5-3 ppm	1.5-3 ppm

In most cases the pool builder or manufacturer will supply a list of the ideal ranges of water balances to the pool owner at the time of handover.

FILTRATION EQUIPMENT PROBLEMS

Tip; The model and serial number of the pump must be given when ordering spare parts. However, in the interests of safety and to prevent further damage to the equipment, the repair of filtration equipment should be left in the hands of a specialist to carry out the work.

Common problems which develop in the pump, motor or filter tank are as follows.

PVC SKIMMER BOX PROBLEMS

Broken weir flaps are common, due to (a) old age deteriorating the PVC material (b) Wear & Tear, (c) interference by swimmers (children) Replace it. They can also become jammed in the closed position causing water to surge and restrict water flow to the pump.

Cracked skimmer body: due to the pool surrounds sinking, pulling down the pipework and straining the skimmer until it fractures. May need a new skimmer fitted or cracks to be filled with resin.

Blockages: The skimmer basket (being broken) allowing foreign material to be sucked into the suction line and blocking it. Replace the broken basket. If debris has entered the pump this may also need servicing.

PVC products should be replaced if they have been installed for more than 25 years.

SUCTION AND RETURN LINE PROBLEMS

PVC Pipe has a use-by date of 25 to 30 years after which time embrittlement can cause cracking and leaks. Replace the lines (Don't bother digging up the old pipes, just lay new ones over the top of them)

PVC Pipe unsupported in the ground or installed in soil conditions that have – or are still – settling, may be fractured by stress and will leak. All PVC pipe should be supported by installing in a non-crushable material such as sand, or even cement casing.

Installing PVC pipelines where a subsequent subcontractor is going to come and overlay them with hardcore material to support a concrete deck is prone to damage if a compator is used. Always pressure test the lines BEFORE they are covered up! Attach a label to the pipeline where it terminates, so that it is visible to your customer, and indicates that if a subsequent problem arises, it's NOT your fault!

Here is a typical example of a test label

WATER CIRCULATION PROBLEMS WITHIN THE POOL (MISTAKES MADE BY BUILDERS)

For adequate filtration, the filter must be capable of removing the filterable contaminates as rapidly as they enter the pool without unduly restricting the water's circulation, AND the system must provide a circulation pattern which quickly brings the contaminants into the skimmer box and the filter from all areas of the pool.

When the filtering system is operating and there is no wind, the circulation pattern of the surface water can be seen on the surface. If this is not apparent, several floating tennis balls will soon show the effect and the presence of 'dead' areas where there is little or no water movement.

If the designed circulation pattern planned for the pool is not known or is not effective, draw a sketch of the pool to scale as best you can, without exaggerating any dimension and mark the position of the skimmer box and all outlets.

Draw a curved arrow from each pool outlet to the skimmer box to represent the flow of water in a wide circular fashion. Usually, the simplest overall flow of water will predominate in the pool resulting in an overall clockwise or anti-clockwise movement around the perimeter, or two or three smaller circulating movements in harmony with one another may occur.

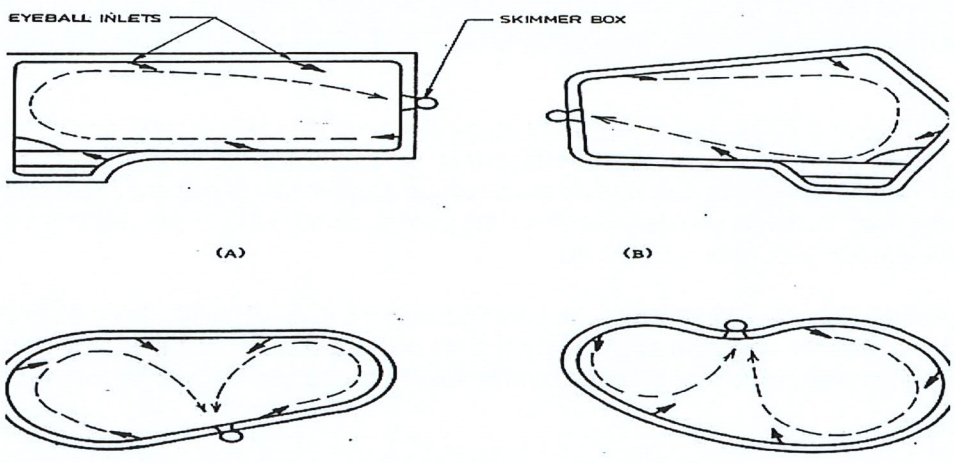
You will need to draw several flow patterns to determine the simplest and most efficient flow pattern.

Having done this, you should manipulate and position the eyeball outlets in the directions displayed in your sketch and run the pump to see if the water flows accordingly. If not, return to the sketchboard or re-direct the outlets by trial and error.

Low filter pressure or circulation can also be a sign of other filter problems in the pool. For example the filter media itself is clogged and requires changing, or the filter needs backwashing.

Common media used for filtration includes sand which should be changed approximately every 5 years, glass which should be changed around every 10 years or activated filter media which can last as long as the filter itself.

EXAMPLES OF PREFERRED CIRCULATION PATTERNS (SINGLE SKIMMER POOLS)



FILTRATION TANK - MULTIPORT VALVE PROBLEMS

Fault	Possible Causes	Remedy
Air bubbles in return line Air in filter tank when system is "off" Skimmer Strainer Basket "pops"	Leak in suction line	Repair/replace line
MPV (Multiport valve) is stiff	Damaged seal or lack of Lubrication grease	Repair/replace Valve
Valve Leaks Pool losing water	Damaged Seal Valve Stem may need to Be tightened	Repair/replace if tightening does not stop leak
Water is draining to waste while filter is running	MPV Gasket is worn	Replace spider gasket

PROBLEMS WITH AUTOMATIC CHLORINATION DISPENSERS, AUTOMATIC CLEANING DEVICES, AUTOMATIC pH CONTROLLERS, AND SALTWATER CHLORINATORS

TIP - REGULAR MAINTENANCE WILL AVOID PREMATURE BREAKDOWNS!

Each type of these automatic devices will have operating problems specific to that particular model. Some manufacturers include in the instruction booklet for the device, a 'troubleshooting' guide. You should be familiar with its contents and consult it when necessary. It is not possible to list all the likely problems that may arise with every device on the market as this would be too lengthy and time consuming. If the 'troubleshooting' guide does not help, consult the repair or service agent for the product.

CHLORINE DISPENSERS AND AUTOMATIC CHLORINATORS.

Most of these will only provide for the average chlorine demand. It must be remembered that the chlorine demand will vary according to the bather load and weather conditions.

It is essential, therefore, that regular testing be carried out, and that additional chlorine be added when necessary or the chlorinator output levels be changed.. However, some auto chlorinators with sensing probes do measure chlorine levels and adjust the flow of chlorine accordingly.

Automatic Cleaning Devices (Suction Driven or Robotic Cleaners);
These are not completely trouble-free and therefore not as automatic in their operation as some sales brochures would lead us to believe. Regular cleaning and maintenance as well as untangling of hose lines which have become coiled and knotted is often required on some suction units.

To remove the tendency of plastic hose lines to return to the coil formation in which they were packed and transported, it is recommended that the hose be laid out in a straight line on the ground exposed to the heat of the sun for several days before being placed into service. Changing the configuration of the hose lengths regularly is also recommended.

Certain types of automatic pool sweeps need to be plumbed properly and require a booster pump operating off an electrical timer independent of the one controlling the filter pump. This will allow the booster pump to cut in after the filter pump starts and to shut down before it stops to ensure sufficient water flow to prevent the seals in the booster pump deteriorating from heat. A debris and sediment from the pool sides and bottom are swept into a pile near the main drain, a large efficient filtering system is required.

Flip hoses sweep heavier debris into a long pile on the pool floor and move this around. The ratio of the volume of water sucked through the skimmer box opening to the main drain opening should be approximately 25% skimmer and 75% main drain. The lighter material is kept in suspension by the flip hoses and the filter should be capable of removing this.

Suction driven automatic vacuum cleaners, relying as they do on the suction pressure of the filter pump for their movement and cleaning action, consequently, place a higher load on the pump. The suction head or pressure that the pump can draw has a maximum value after which the pump starts to cavitate, i.e. works inefficiently, and may cause the motor to overheat and burn out. Cavitation causes a form of corrosion to the impeller of the pump and results in air bubbles being discharged from the pool outlets.

As the filtering system gradually becomes clogged with dirt, some of the suction power of the pump is used in and dirt as water is drawn through the skimmer basket, lint basket and filter media.

The accumulation of debris may cause such an increased load on the pump that it starts to cavitate. This should be checked frequently. First, remove all debris from the skimmer box and re-start the pump. If cavitation still persists, it is time to clean out the lint basket and possibly backwash or clean the filter tank.

Robotic cleaners should be removed from the swimming pool when they are not in use to prolong their life. Cords should be periodically straightened and kept carefully when stored to avoid tangling and coiling. If the cleaner stops, check the basket, entrapment area and tracks or wheels to make sure it is clear from debris. Follow the manufacturer's instructions for any other error diagnosis.

Automatic pH Controllers.
These are usually preset on installation using a reference solution to give the required pH level. Those controllers injecting liquid acid into the pool inject only a very small quantity at any one time and this becomes diluted many hundreds of times before coming in contact with a swimmer. Common problems with any of these units can usually be traced back to poor installation or the liquid or gas containers not being refilled regularly.
Probes should be replaced, and the unit recalibrated on an annual basis.
Is it imperative that the water is manually balanced before installing a new unit or calibrating the dosing to ensure the unit works correctly.

Saltwater Chlorinators.
The most common reason for a salt chlorinator to stop producing chlorine is low salt in the water. Test the salt and ensure it is in range for the manufacturers recommended operating levels. This is usually around 4000-5000 ppm.

The electrodes in the salt 'cell' are usually replaced every 3-5 years. If these show white calcium build up or erosion in the plates it needs to be cleaned or replaced.

If no lights are showing on the head unit a fuse can be blown. For any other issues, such as a faulty display or timer not holding the correct settings, consult a service technician.

In concrete, marble or plaster these are installed after the water chemistry of the pool has stabilised.

With marble finish pools, a large amount of calcium is emitted from the marble during the first one or two months. This continually upsets the water chemistry of the pool and the installation of the saltwater chlorinator should not be undertaken until the pool water is correctly balanced. Some builders think this is more than one year after initial filling.

Some saltwater chlorinator manufacturers recommend a minimum period of six weeks after the marble finish is applied. Daily testing and adjustment of the pH is essential during this period as well as a check on Total Alkalinity to ensure proper pool water balance. If this not able to be regularly monitored, it is better to delay the commissioning of the salt chlorinator.

Saltwater chlorinators do not necessarily cause problems in a concrete plastered pool, but they will accelerate the occurrence of problems which would have happened in any case, the most likely two being the rusting of the structural steel due to inadequate concrete cover (a pool construction problem), and the scaling of a marble finish, due to the calcium emission discussed above, and the water chemistry being unbalanced.

Unless the pool customer is prepared to "take ownership" of the pool chemistry during the vital first months (and up to a year) it is not advisable to commission the chlorinator until the plaster has fully stabilised.

In fiberglass, ceramic composite or vinyl lined pool it is generally safe to install a salt chlorinator immediately after the pool has been commissioned.

Ozone Generation Devices

These are gradually becoming more commonly found in home swimming pools, so you may be called on to service an Ozone Device in your pool industry career, so here are a few details of what an Ozone Device does.

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The production of Ozone (Chemical designation O^3) is generated in two basic forms: UV (ultra-Violet Light), and CD (Corona Discharge Light). UV Light is typically generated in a fluorescent tube at a wavelength of between 100 and 254 nm (nm = Newton Meters). At 185 nm "ozone" is produced, while at the upper wavelength "Germicidal: light is created

Ozone is a very powerful and useful Oxidant (far more powerful than Chlorine) - which is why there have been restrictions and controls on its use in Public Swimming pools in some countries. Accordingly, Ozone has an (incorrect) bad reputation in some countries (USA Particularly).

The New Zealand Government Health Department publication "Treatment processes: Disinfection (Of potable water)" lists in paragraph 15.2.3 Nature of the Disinfectant the three effective power as:

1st ozone – 2nd chlorine dioxide – 3rd chlorine – 4th chloramines (very weak)

https://www.health.govt.nz/system/files/documents/publications/dwg-chapter-15-treatment-processes-disinfection-jun19.pdf

Home swimming pool Ozone generation units designed specifically for home pools are therefore low power devices that are very suitable for this purpose. Unlike Chlorine (which kills only about 65% of bacteria and germs), Ozone will kill 100% of contaminant bacteria and viruses (viri).

Ozone is highly "reactive" (i.e. it will attack other molecules and destroy them) and destroys microorganisms on contact. It is effective against common bacteria found in home pools that Chlorine does not affect, like Cryptosporidium and Guardia, and even Staphylococcus Aureus (aka MRSA) – nasty germs that will make affected children very grumpy and ill for several weeks. (Not unlike Influenza) Even Covid-19 will be destroyed by Ozone.

Technically speaking, Ozone Molecules present in home swimming pool water will attack every other molecule it encounters: including Chlorine. So the two disinfectant systems should never be used at the same time.

Some "Ozone Generation Machines" combine both UV and CD, but both types rely on the generation of ultra-violet light to react with, and destroy Oxygen molecules (O^2) by splitting them into unstable O^1 molecules. These molecules will seek out and join up with O2 to for the O3 Ozone molecule. These have a short life-time of between 2 and 5 hours before shedding off the third

ANCILLARY ELECTRICAL EQUIPMENT;

(Note: We recommend you familiarise yourself with the latest NZ standards here https://www.standards.govt.nz/news-and-updates/electrical-wiring-rules-updated/)

Electricity is necessary for the operation of any swimming pool, both for the lighting of the pool area and the operation of the filter. However, it must be remembered that water and electricity form a lethal combination. Electrical accessories must be properly installed by a licensed electrician and in the Authorised Zone (usually Zone Two or greater). A suitable weatherproof power outlet should be provided for the electrical equipment. Operating a filter with an extension lead trailing from the nearest window is both inconvenient and dangerous. Similarly, general lighting in the pool area should be permanently installed.

Underwater lights are of the extra low voltage type. These usually operate on 12 volts DC (Direct Current – as opposed to AC Alternating Current), which is supplied by a step-down transformer mounted in a convenient position away from the pool. This type of light is considerably safer than the earlier 240-volt types. If you encounter a pool that is fitted with 240-volt lights which were installed some years ago, it is advisable to remove these and up-date the installation to comply with present day safety requirements.

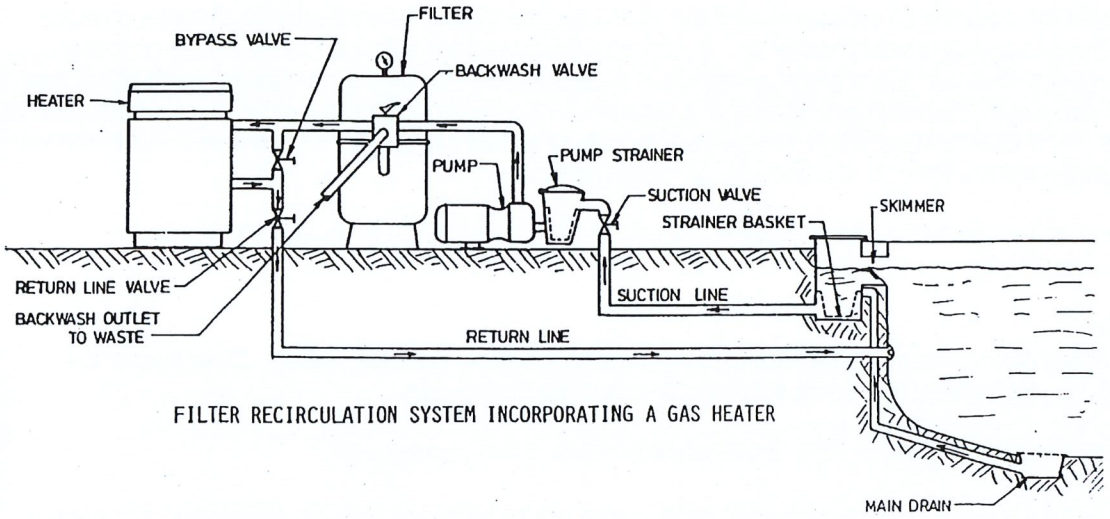
If you have any doubts about the safety of any of your pool's electrical installations, you should consult an electrician without delay.

Due to "voltage leak" from in-line electrical chlorinators, particular attention should be paid to earthing and bonding of any metal in contact with the pool water to the house earth or to an earth rod provided near the pool, and to the installation of lights near a pool.

FAULTS WITH POOL HEATERS.

Experience has shown that 90% of the complaints about properly installed heaters not coming on properly (i.e. Firing Up) - have nothing to do with the heater itself. Usually something has happened to reduce water flow through the heater. The protective switches on the heater (Pressure testing flow switch) will operate to protect it. Check the flow through the unit to ensure that sufficient water pressure or flow exists to activate the safety switch.

See below for a typical filter recirculation system incorporating a gas heater.



FILTER RECIRCULATION SYSTEM INCORPORATING A GAS HEATER

PROBLEMS WITH MAINTAINING AN ADEQUATE WATER LEVEL IN THE POOL;

WATER LOSS

A loss of water denoted by a drop in the pool level is due to three main causes, namely high bather use (splash-out), transpiration/evaporation or one or more leaks in the pool system.

Transpiration/Evaporation is dependent on the area of the pool water surface and the prevailing weather conditions, namely wind and humidity. In dry hot summer periods, you can expect the pool water level to drop one or more centimeters in a week, and even more so during high wind periods.

A pool cover will reduce evaporation if water is a scarce commodity.

Common places to look for leaks:
Concrete pools: All fittings that protrude through the pool wall are suspect, as PVC fittings and concrete do not bond well, a further material (usually semi-flexible Expocrete?) is used as an in-fill material. This can deteriorate over time. Items to check for leaks are:

Main Drain
Hydrostatic Relief Valve/Drain
Skimmer(s)
Underwater lights
Return Eyeballs
Underground pipelines

Cracks in the pool structure? Unlikely, but without knowing the quality of the structure (or the type of structure: i.e. Old Gunite pools, modern Shotcrete, Cement Block, Plastered chicken wire shells etc.) it pays to consider this.

Fibreglass pools:
As a one-piece moulded product, there is a very low possibility of the shell itself leaking unless the Gel Coat has been damaged, either mechanically or by Cobalt erosion. (Cobalt Erosion is possible when pools manufactured without being "cooked" in an oven to cure for 48 hours after spraying-up often incorporated Cobalt as an accelerator to "cure" the pool. This system is not widely used currently, so this generally only applies to New Zealand-manufactured fiberglass pools more than twenty years old, although manufacture of these pools has expanded in New Zealand in the past decade.

Other than the shell, check the same items as for Concrete pools (above)

Vinyl Liner Pools:
The first place to look is for any cut or hole in the liner. Mechanical damage (cuts, holes poked by sharp objects) is usually the only source of leaks in relatively new pools and can be patched underwater in a similar colour as the liner.

Small holes may develop if the pool is >20 years old, and the PVC Liner has become brittle due to chlorine-induced de-plasticising and may be caused by a pool cleaner (or mechanical damage) and will look "black" like a spot that can't be removed by brushing. The useful lifetime of a vinyl liner is determined by the original gauge – earlier .42 mm or 1990's onwards .577 mm South African liners lasting an average of 17.5 years while the more recent introduction of Australian .75 mm liners in the 2000's should last 15+ years in a salt chlorinated pool, or 25+ years in an Ozone pool before a loss of plasticization makes them brittle and due for replacement.

Other than the liner, check the same items as for Concrete pools (above) except the Hydro drain which is not commonly fitted to vinyl liner pools.

Underground pipelines:
A leak in the pool system results in a much faster loss of water than that caused by evaporation. Detection of the exact location of the leak is a trial-and-error process if the leak is not readily obvious.

1. Look for a wet area of surrounding ground. This could indicate a leak in the nearby pool.

2. Digging of test holes around the pool or near to buried suction and return pipelines may be necessary, but always proceed carefully to ***avoid rupturing buried pipes or electrical fittings***.

3. ***Turn off the power*** at the main switchboard to ensure safety before you start work. Look for increasing signs of moisture to point you in the right direction. Check there is no bypass at the backwash valve.

4. One way to determine if water loss is due to a pool leak or transpiration/evaporation, is to fill a bucket of the pool water and stand it near the poolside. Mark the water level of both pool and bucket. (NOT with an indelible Marker Pen, as you may not be able to remove it from the pool wall, which will upset the owners) Monitor the levels over the next dry-weather days. They should be equal. If the pool level is lower, and the bucket NOT lower, it is an indication that the pool is actually leaking, not losing water through the surface.

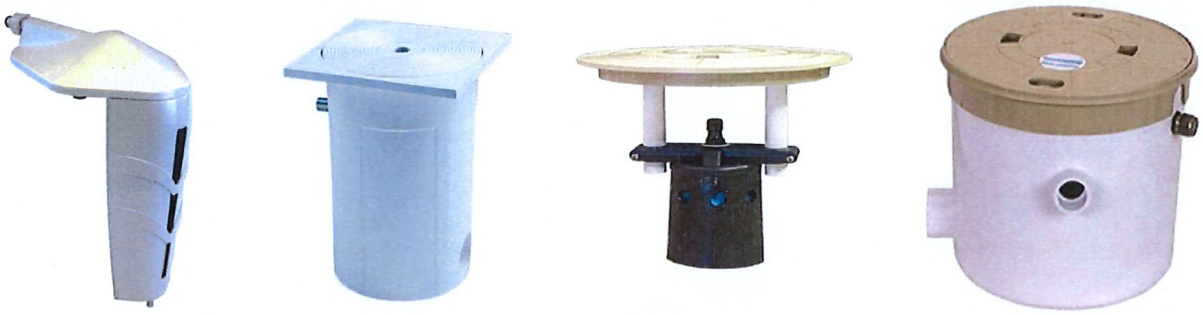
5. Once the problem is located, you will have to decide if you have enough knowledge and ability to repair the problem or if you should call in an expert pool builder.

If the pool is under warranty, contact the pool builder to investigate and repair the suspected leak, but make sure you have observed the rate of loss of water first (so many centimeters drop in the water level per hour or day depending on the size of the leak). This information will assist the builder in his investigations.

PREVENTION OF THE POOL FLOODING or EMPTYING

Rainfall will cause the pool to overflow if there is not an overflow mechanism built into the pool.

Commercially available self-leveling devices such as the Austral Water Levelers, Pool Sentry and Waterco Pool-Water Leveler and other imported variants are available for home swimming pools, although these are mainly devised to "add water" to pools that are in need due to evaporation and transpiration, nor flooding.



The system attached to the skimmer lid (above) connects to a Garden Hose to keep the pool topped up,

The easy answer for the DIY person is to make a simple hose attachment device that fits through the back of the Skimmer at the desired water level and lets the extra-high pool water flow away by gravity.

This simple system works when the pool is being built is by adapting a length of 20 mm rigid pipe into the pool wall or skimmer at the desired water level. The invert (opposite end) of this pipe at the outlet end is then positioned at a suitable lower point to encourage gravity discharge. Ensure that no portion of the pipe run-off is any higher than the pool outlet, as this will negate the effect of gravity and the outlet flow.

The same problem exists in existing fiberglass and vinyl-lined pools, and in concrete pools already built, and can be overcome by drilling a hole inside the skimmer box at - or slightly higher than - the desired maximum water level height. This usually can only be done by removal of the coping leading to the back of the skimmer box to allow the connection of a surface spoon drain or buried pipe to dispose of the overflow water.

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