TECHNICAL PAPER

CIRCULATION SYSTEMS FOR DOMESTIC SWIMMING POOLS.

There has to be an international understanding of certain words when producing any paper such as this. The word “REGULATION” means that there is a national law and is associated with the word “MUST”. The word “RECOMMENDED” means that there is no legal requirement but this is the EUSA suggested best way of working and is associated with the word “SHOULD”.

DOMESTIC SWIMMING POOL CIRCULATION SYSTEMS

GENERAL

1. Without the size of the pool, the design bather loading and the turnover requirements the circulation system cannot be properly designed.

2. The circulation system in any swimming pool is designed to move the water from the pool tank for passage through filtration, heating and treatment systems and returning it to the pool tank. This is achieved by a circulation pump and a pipework system between the pool the pump, and the various ancillary systems.

3. The circulation system should also be designed to maximise the efficiency of water removal from the pool and distribution of water back into the pool. Its design will be influenced by the filtration type and design, the relative position of the pool to the plant room, to safety and to cost.

4. A good circulation system will ensure the greatest possible mixing of the water in the pool tank to ensure the distribution of chemical treatment and heat, ensuring fine debris is kept in suspension for the maximum period, and that there are no “dead areas” where water movement in minimal or zero.

5. Domestic Pools must have a turnover of between 4 – 8 hours.

6. There are also guides for the safe bathing load in relation to the pool water surface area and in general this can be averaged a 3m²/bather.

WATER VELOCITY

7. It is essential that any circulation system should be also correctly hydraulically designed. The sizing of the pipework used in the system must take into account the head loss of the system, the flow rate and the water velocity.

8. Additionally the selection of the circulation pump to achieve the flow and filtration rates should be such that the velocities are achieved in the mid range of the pumps published performance curve. Sufficient valving arrangements should be incorporated into the pipework design to allow for adjustment of the flow after installation.

9. Flow rates are to be such that the safety of the bathers is not put at risk. Every effort must be made to ensure that body or hair entrapment cannot occur. To that end the following maximum flow rates are recommended:

    a. Suction over outlet grilles: 0.5 m/sec.
    b. Suction pipework: 1.2 m/sec.
    c. Return water pipework 2 m/sec.

FLOW FITTINGS

10. All flow fittings should be made of suitable, non-corroding material, and the design flow rate for each type of fitting published. Where they incorporate grilles and gaps these should not exceed 8 mm as a safety precaution to prevent entrapment of fingers etc.

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SURFACE WATER REMOVAL

11. Water can be taken off the surface by one of two of two methods;

    a. Firstly by a continuous channel, which is fitted at the top of the pool wall, and which is around the perimeter of the pool and at the same level as the water in the pool and surrounding bather area. This is known as an OVERFLOW pool.

    b. Secondly by a number of outlets built into the top of the pool wall known as surface water skimmer outlets. The water level of the pool will be approximately 150 to 200 mm from the top of the pool wall and half way up the mouth of the skimmers. This is known as a SKIMMER pool.

12. It is well known that the majority of pollution in pool water is found in the top 75mm and therefore good surface water removal is essential to the efficient filtration and treatment of the water.

13. With a SKIMMER pool the volume of water removed from the pool via the skimmers should be 70 % of the circulation rate the remainder being removed from the low level outlets. With an OVERFLOW pool the ratio should be 75 – 25.

14. **Overflow Systems** In order for this system to operate correctly the water must flow continuously from the pool into the surround channel. This can only be achieved if the total volume of water in the system is greater than the volume of pool tank. Therefore there must be a balance, or compensation, volume of water in the system and this is usually held in tank designed for that purpose. The circulation pump will suck water from the balance tank and return it to the pool tank causing it to overflow. Water runs from the channel, under gravity, back to the balance tank.

15. Water should flow over the top of the pool into the channel over the whole perimeter when the pool is in use and over 90% of the perimeter when it is not in use. Consequently the final finish of the top edge of the pool wall must no deviate more than +/- 2 mm over 25m.

16. The balance tank is most conveniently located close to the pool although it can be remote from it. However it is essential that the water running into the balance tank can flow unrestricted under gravity (approximately 0.45 m/s) and therefore the connection pipes between the channel and the balance tank are correctly sized. The size of the balance tank should be commensurate with the use of the pool but should be large enough to accept the bathing design load entering the pool in one go, any wave surge due to water aerobics or water features, and a margin for safety. It should be fitted with an overflow which should discharge at a point where is can be seen so as to alert operatives to the problem. It should have access hatches to allow for cleaning and also any national legislation regarding working in confined spaces. The internal finish of the tank must be easily cleaned so as to prevent the build up of solids, bacteria etc.

17. The size of the channel must be such that it is of sufficient size to accept a volume equal to 50mm depth of water from the pool and the internal finish can be easily applied and cleaned. It is covered by a grid which can accept the flow of water over it and has gaps between the grids of no more than 8mm to prevent entrapment. The grid must be easily removed by maintenance staff for cleaning but not easily removed by the pool owners.

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LOW LEVEL OUTLETS

18. Where low level or floor outlets are fitted they should be positioned to ensure the greatest safety for the bathers. The velocity over the grilles must be as per the recommendation to reduce or eliminate the risk of hair and body entrapment.

19. This can be achieved by double outlets coupled together on the same suction line so that if one is covered the suction will default to the other. Additional safety can be achieved by placing the outlets 1.5 to 2 metres apart.

20. Where low level wall outlets are preferred, mainly due to water depths the same criteria should apply. In these cases the provision of a recess in the floor for a submersible pump will ease emptying and cleaning of the pool tank.

RETURN WATER INLETS

21. Water returning to the pool tank under pressure will assist the general movement of water in the pool. The position of the inlets should be designed with this in mind. The number of inlets should be sufficient to take 100% of the design flow rate. However the velocity of the water through each individual inlet must be such as not to disrupt swimming, especially competition.
22. In the domestic pool return water velocity must not exceed 2.5m/sec.

23. Care must be taken when positioning return water inlets in the floor of a pool to ensure that the fittings do not pose a hazard to swimmers and bathers on foot.

VACUUM POINTS

24. Where it is necessary to have dedicated vacuum point they shall be fitted below water level and have a sealed plug for fitting when not in use. The water velocity through these points is, of necessity, much greater than through the other outlets. It is most important that pool operators are aware of the potential risk if these vacuum points are not covered and the isolating valve in the plant room is left open.

PIPEWORK

25. The pipework used in any circulation system should be sized to take the design flow rate and to compensate for any frictional head losses. The material should be non-corroding and in general terms suitable for the head pressure in the system and the flow rates should not exceed 3m/sec.

26. Pipework and fittings used in swimming pools are generally used in other fluid applications; they must be suitable for the application and be covered by national “NORMS”.

27. When used underground the pipework must be compatible with this environment. Pipework, when not encased in concrete underground should be a minimum of 450mm below ground level and laid on and covered with a non-compactable material for protection.

28. All pipe runs must be supported by dedicated supports or clips every 1 to 1.5 metres. It is not acceptable to rely on items of equipment for support.

29. **Pressure Testing** All underground pipework must be pressure tested for soundness before backfilling and a certificate issued as proof. This should be done by hydraulic testing to a minimum

pressure of 1 to 1.5 Bar. The maximum pressure, when used, should be equivalent to 1.5 times the shut off pressure of the pump.

30. **Branches** Where pipe are split into branches, in particular with multiple skimmer outlets and returns, the branch pipes must be sized so that they can take the full proportion of their part of the flow.

31. **Valves** Valves must be fitted within the circulation pipe design not only for changing the direction of water flow but also for isolating various items of equipment within the system so that they can easily be removed for maintenance or repair. They must be suitable for their application and be in accordance with National "Norms".

PUMPS

32. Once the flow rate has been set and the head losses calculated the pump selection can be made from the pump performance curves.