

Inlet and outlet safety

The dangers arising from pool inlets and outlets are not new. For example there is a history of horrific accidents which show how the potential risks of entrapment of hair or a body in a pool outlet can result in significant internal injuries or drowning. This danger is particularly great in the following situations:

- Pools with a single pool bottom outlet, connected directly to the pump, readily accessed and small in size so that a bather can easily block it with their body. This type of installation is most frequently seen in older pools or in poorly specified or incorrectly designed pools;
- Pools where water velocities in the vicinity of the pool outlet are in excess of those recommended and have the potential to draw a body to it or draw hair through it where it entangles and prevents withdrawal;
- Pools with two or more outlets where corrosion or scale formation in an outlet line has caused an increase in velocity in another. Following good practice guidelines for water balance and chemical dosing will prevent this;
- Pools where the outlet cover is not secured safely;
- Pools where the outlet cover has insufficient strength to withstand the load of say a bather jumping into the pool onto the cover whereon it collapses trapping the bather. This can happen to some outlet covers that over time become brittle due to the action of ultra violet light and/or pool chemicals.

WHAT CAN BE DONE? A GUIDE TO MINIMISING THE RISK

There is a CEN European standard for the safety of water inlets and outlets in swimming pools available from BSI. The relevant sections are:

- BS EN 13451: 2001 swimming pool equipment part 1 – general safety requirements and test methods.
- BS EN 13451: 2001 swimming pool equipment part 3 – additional specific requirements and test methods for pool fittings for water treatment purposes.

Inlets

It is critical for safety that inlets should be strong enough to withstand any likely impact, and be fixed securely. Apertures in inlets should not exceed a gap of 8.00mm to avoid entrapment. Inlets should not form a protrusion hazard in the pool or have sharp edges or corners that could cause injury. Inlets should be arranged to ensure that each takes its required proportion of flow. There should be enough inlets to ensure that the velocity of water entering the pool does not exceed 1.5 to 2.0m/sec, and perhaps as low as 0.5m/sec in shallow water or sensitive areas (steps or teaching points) where turbulence may be a problem. Certain feature fittings such as spa massage jets, inlets in fast flowing channels will, to achieve their effect, exceed these figures.

Outlets

Where and what?

Pool outlets are used for the circulation of water from the pool to the filtration system. They can also be used for the sampling points for automatic controls, pool vacuum points and as the water source for features such as jets, waterfalls and slides.

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Water velocity

Water velocity through the outlet should be a maximum of 0.5m/sec.

Although this should have been considered at the design stage of the pool it is possible to calculate the velocity by using the following formula:

$$\text{Velocity (m/sec)} = \frac{\text{Circulation (m}^3\text{/hr)}}{\text{Area (m}^2\text{)} \times 3600}$$

It should be noted that the free open area of the grille depends on the size and type of apertures and the space between the apertures. For example, the free open grille area may vary between 30 – 60% of the total surface area of the grille.

Alternatively, there are instruments that can be used to measure the rate of flow.

Size of apertures in grilles

To prevent the entrapment of fingers and toes apertures in outlet grilles should not allow an 8mm-diameter probe to pass. This is a recognised test used in many national and international standards, such as those of Germany and America. It is the dimension used in the approved “CEN Standard for Children’s Play Equipment” based on anthropometric data. It is the Standard used in the proposed European Safety Standard for Swimming Pool Equipment, which has recently been published for consultation in all European Countries.

It is the recommended dimension in the guidance entitled “The Management of Health and Safety in Swimming Pools” recently published by the Health and Safety Commission and Sport England. It is the recommended dimension in the National Pool Water Treatment Advisory Group’s publication, “Swimming Pool Water” and is the dimension given in all of the Institute’s training programmes and information sources.

Vacuum prevention

There are a number of ways in which to reduce the risk of a vacuum forming in a suction line when an outlet becomes blocked or covered. These include:

- Number of outlets: At least two, preferably more outlets, should be fitted to each suction line. The outlets should be fitted 2 – 3 metres apart or as remote from each other as possible to prevent a bather’s body being able to cover both outlets completely at the same time. This ensures that should part of, or all of one outlet become covered then the second or other outlets are able to take the full flow, thus preventing a vacuum forming and risk of entrapment over the pool outlet.

- Size of outlets: Outlets are also safer if the size of the grille or outlet cover is such that it is difficult, if not impossible, for a bather to cover it completely with their body.

OUTLET DESIGN AND INSTALLATION

Outlets fitted to sumps

Outlet covers should cover a sump connecting to the outlet pipe, rather than simply covering the end of the outlet pipe. The area of the cover should typically be 6 to 10 times greater than the area of the pipe, although a suction velocity not exceeding 0.5m/sec must be the determining factor.

The advantage with sump outlets is that:

- i) The surface area of the grille is increased which increases the size of the free area and thus reduces the velocity through the grille;
- ii) It becomes more difficult for a bather to cover the entire grille;
- iii) The sump allows the pumped water to flow slowly and evenly through the grille, helping to prevent the creation of dangerous currents and hair entangling vortices.

In an existing pool with a single outlet it may be possible to:

- Fit two or more outlets to the suction line sufficiently large or spaced so that a bather cannot block them.
- Fit a large sump with a cover to the one line of sufficient size to ensure a bather cannot block it with their body.
- Fit an anti-vortex cover sized and designed to ensure a bather cannot block it with their body.
- Make sure that the pump cannot draw just from the bottom outlet.

Securely fixed outlet covers

The cover must be designed and installed to be secure. There must be sufficient number of fixings to ensure the cover remains in the frame, for instance should one fixing be removed or become dislodged, the cover should not pivot on a single anchor. The fixing devices should be tamper proof and provide adequate security against deliberate or unintentional actions.

Anti-vortex covers

Anti-vortex covers for the purpose of outlet safety are large domed fibreglass or plastic covers fitted to outlets in the pool where the water flow is mainly around the perimeter in a gap between the cover and the pool floor. The gap between the cover and the pool must be <8.0mm. The preceding requirements of size, security of the cover and velocity of flow still apply. The disadvantage with this type of cover is that they protrude above the pool base, which may pose a hazard in shallow water areas.

Deck level return

When planning a new pool or specifying a spa pool or in a major refurbishment of a pool the preferred design is for a deck level circulation system. In this form of system 80 - 100% of the flow from the pool is over the edge of the pool via a perimeter grille over a drainage channel from where it travels to a balance tank and then on to the main circulation system. The use of pool outlets is minimal so reducing the hazard.

OTHER ISSUES TO CONSIDER

Corrosion and scale

In older pools with two or more outlets, corrosion or scale formation in one of the outlet lines may cause an increase in pressure in the other. If both outlet lines are affected then the pool water velocity in the vicinity of the outlet may have increased considerably from the design velocity. It is therefore of considerable importance that the pool water is maintained according to the guidelines of the ISRM as practised on our education and training programmes and as contained within the publication "Swimming Pool Water: Treatment and Quality Standards".

Emergency shut down

An emergency stop button in the vicinity of the pool, or an effective, emergency action response, to shut down the circulation pumps, and associated equipment, in the event of an emergency should be considered.

Outlet covers – regular checks to be made

Pool outlet accidents can come about through a number of causes, design, operation, supervision, maintenance, misadventure or a number of these. For this reason and because circumstances can change regular frequent checks need to be carried out.

It is essential that outlet covers are firmly secured in place ideally with a special tool and be strong enough to resist any impact, such as bathers jumping onto them. They must also be strong enough to resist the pressure of suction forces that may be applied to them in the event of them becoming blocked or covered.

Regular checks to ensure the integrity of the cover should be made. Visually check the outlet cover is in place on a daily basis prior to bathing commencing, and dive down to inspect the cover on a regular basis. These inspections should form part of the general safety checks that are carried out, such as of pool alarm systems and other emergency equipment.

Bathing must not take place where an outlet cover is missing, loose or is damaged in any way.

Supervision

Outlets, inlets and water features all pose potential risks and whilst a number of measures can be put in place to reduce the risk, there is no substitute for

trained and competent staff. Outlets seem to have a dangerous fascination for children. Awareness of the risks involved should form part of the Centre's Normal Operating Procedures. Action to be taken in the event of an emergency associated with a pool outlet should be covered under the Centre's Emergency Action Plans. Good supervision and trained and competent staff do not happen by accident. Regular and rigorous training on a continual basis as required in the Royal Life Saving Society's National Pool Lifeguard (7th Edition) Qualification is essential for professional lifeguards supervising unprogrammed swimming. And the RLSS (UK) Rescue Test for the Teaching and Coaching of Swimming for Teachers and Coaches providing supervision in conjunction with their instructional role in programmed swimming.

Hair entrapment

There is a test to show if hair entrapment is a hazard with a pool outlet. The test is however designed to show safety in design and should be conducted on a test rig. The main design considerations to prevent entrapment are:

- Flow less than 0.5 m/sec
- Sump outlet and not a direct connection
- Grille apertures of <8.0 mm
- Outlet covers should be secured firmly in place.

WHAT SHOULD I DO NOW?

Carry out a risk assessment

Identify how many outlets you have.

If you have more than one, risks from the outlets are minimised.

Are the outlets fitted with suitable covers to prevent the risk of entrapment, of sufficient strength and secured firmly in place?

If not change them.

If you have only one outlet, how big is the cover?

If it is large and unable to be covered by a single bather then again the risk is reduced.

If the outlet cover is small and able to be covered by a single bather then the risk is potentially great. In this case it may be necessary to seek expert advice in order to safely carry out further tests. Under no circumstances should untrained staff carry out tests or examinations that put themselves or others at risk.

What is the flow rate through the outlet?

If the flow rate is more than 0.5 m/sec then seek specialist help on how to reduce this.

Is the outlet positioned in shallow water, or in water of a depth to which bathers may easily be able to dive and fitted to the pool without a sump connection?

If so it may be necessary to carry out a 'hair entrapment test'. Basically this involves placing a length of human hair over the outlet to see whether it becomes entrapped. However care needs to be taken to ensure that this test is again carried out safely by trained competent staff.

Further information:

If you decide you have a problem then:

- If the problem is serious and poses a risk to health, close the pool.
- Call in the engineer or installers of your pool to seek their advice.

Build outlet safety into your safety procedures for the pool and into all staff training.

Testing - ISRM Consultants can carry out a full safety audit for your pool including the full range of tests identified above. For further information contact ISRM Consultants on 01509 226474.