U.S. CONSUMER PRODUCT SAFETY COMMISSION
WASHINGTON, D.C. 20207

December 15, 2003

Dear Colleague:

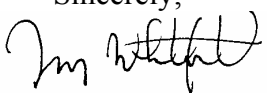
In January 1998, the U.S. Consumer Product Safety Commission (CPSC) released the document *Guidelines for Entrapment Hazards: Making Pools and Spas Safer* (guidelines). CPSC created these guidelines to help identify and eliminate dangerous entrapment hazards in swimming pools and spas. Since their release, CPSC staff has received comments and suggestions for updating the guidelines to reflect changes in codes and voluntary standards and operational considerations. The staff has now revised the guidelines document to address these comments and is interested in receiving your views, comments, and/or suggestions.

A copy of the *Draft Guidelines for Entrapment Hazards: Making Pools and Spas Safer* is enclosed for your review. The primary revision is to Guideline #1, for pools or spas with single drains, with or without skimmers. The staff has eliminated the option for locking valves in the open position for operational reasons. Additionally, pool and spa water depths are considered when recommending multiple drains and the installation of a back-up system to the multiple drain concept.

The goal of the guidelines is to promote greater safety awareness among those who purchase, install, maintain, and inspect public and residential pool and spa facilities, and to encourage owners and operators of existing facilities to retrofit those facilities so that potential entrapment hazards are removed. Your comments and suggestions on the draft guidelines will help us finalize the document for official release. Please forward any comments to my attention by February 18, 2004, or e-mail me at twhitfield@cpsc.gov. If you have any questions, please do not hesitate to call me at (301) 504-7548.

Please note that the revisions included in this draft document were prepared by the CPSC staff and have not been reviewed or approved by the Commission.

Sincerely,



Troy W. Whitfield
Directorate for Engineering Sciences

Enclosure

Draft Guidelines for Entrapment Hazards: Making Pools and Spas Safer

December 2003
U.S. Consumer Product Safety Commission
Washington, D.C. 20207

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1. INTRODUCTION

The *Guidelines for Entrapment Hazards: Making Pools and Spas Safer* (guidelines) provide safety information that will help identify and eliminate dangerous entrapment hazards in swimming pools, wading pools, spas, and hot tubs. They address the hazards of body entrapment, hair entrapment/entanglement, and evisceration/disembowelment. These guidelines are intended for use in building, maintaining, and upgrading public and private pools and spas. They are appropriate for use by parks and recreation personnel, public health organizations, equipment purchasers and installers, owners, inspection officials, and others who are responsible for pool and spa safety.

The guidelines are based on information provided to the U.S. Consumer Product Safety Commission (CPSC) by the National Spa & Pool Institute (NSPI), the National Swimming Pool Foundation (NSPF), swimming pool and spa equipment suppliers and maintenance firms, state health officials, and voluntary standards organizations. Several voluntary standards are currently in existence for pool and spa construction and equipment. These are referenced in Appendix A. These voluntary standards contain more technical requirements and specifications than CPSC's guidelines and are primarily intended for use by designers, builders, equipment installers, and manufacturers.

In these guidelines, the term "public pool and spa" refers to facilities intended for use by the public in such areas as parks, hotel/motel facilities, institutions, multiple family dwellings, resorts and recreational developments, and other areas of public use. The term "residential pool and/or spa" refers to a pool or spa located within the confines of a residential property and intended for the private use of the owner and/or the home's occupants. A glossary of other terms used in these guidelines and by pool professionals can be found in Appendix B.

These guidelines are recommendations; they are not intended as a CPSC standard or mandatory requirement. The CPSC originally issued these guidelines in January 1998. The revisions incorporated in this version of the guidelines reflect changes in codes and voluntary standards and operational considerations. The revisions focus on the development of performance standards for safety vacuum release systems (SVRS) and the recommendations found in Guideline #1. In the January 1998 guidelines, wading pools, pools, spas, and hot tubs were addressed without reference to water depth. In this revision, Guideline #1 makes a distinction between water depths of four feet and below, and depths above four feet.

The Commission believes that these guidelines can reduce the possibility of body entrapment, hair entrapment/entanglement, and evisceration, which can have life-threatening consequences. However, these guidelines do not contain all possible approaches for addressing the identified hazards.

2. WHY THE GUIDELINES WERE DEVELOPED

Although current codes and standards for pools and spas contain requirements to prevent evisceration, body entrapment, and hair entrapment/entanglement, incidents and deaths continue to occur. Since the release of the first edition of the guidelines, changes have been made in codes and new standards for safety vacuum release systems (SVRS) have been developed.

2.1 Pool and Spa Entrapment Injuries

Evisceration/Disembowelment

From January 1990 through October 2003, CPSC has reports of two incidents of evisceration/disembowelment. CPSC is not aware of any associated deaths, but the injuries are irreversible and have a devastating effect on the victim's future health and development (Ref. 1). These cases, in addition to cases prior to 1990, include incidents of young children sitting on and being 'sucked into' drain sumps with missing covers, and suffering rectal lacerations, and partial and nearly complete eviscerations.

The scenario leading to disembowelment typically involves a young child, 2 to 6 years old, who sits on an uncovered drain. The incidents occur primarily in public wading pools where a floor drain cover is broken or missing. Young children have direct access to the bottom drain in wading pools because of the shallow water. Generally, drains are equipped with either flat grates or dome-shaped covers. The domed shape helps to prevent sealing of the pipe opening by the body. However, if the grate or cover is unfastened, broken, or missing, the potential for an incident exists. When the child's buttocks cover the drain opening, the resulting suction force can eviscerate the child through the ruptured rectum. A small change in pressure is sufficient to cause such injury extremely quickly (Ref. 2).

Body Entrapment

CPSC is aware of 73 cases of body entrapment, including 12 confirmed deaths, between January 1990 and October 2003. The deaths were the result of drowning after the body, or a limb, was held against the drain by the suction of the circulation pump (Ref. 1). The incidents occurred in both residential and public settings. Twenty-two incidents occurred at a home location, 30 in a public facility, and in 21 cases, the location was not specified. Thirty-eight of the incidents occurred in spas, hot tubs, or whirlpools, 31 incidents occurred in swimming pools and three occurred in a wading pool (one location was reported as 'unknown'). In one of the spa incidents, a 16-year-old girl became trapped on a 12" by 12" flat drain grate in a large public spa and died.

The reported incidents involved people ranging in age from 22 months to 89 years. Most

incidents were to older children (8 to 16 years of age); 77% were under the age of 15 years with a median age of 9 years. In some of the cases, it appears that the child was playing with the open drain, including inserting a hand or foot into the pipe, and then became trapped by the increased suction and resulting tissue swelling. There are potentially many different circumstances of design and maintenance that can produce the conditions for the hazard. Body entrapment cases can occur in either pools or spas. The scenarios suggest that any open drain, or any flat grating that the body can cover completely, coupled with a plumbing layout that allows an increase in suction to occur if the drain is blocked, presents this hazard. Depending upon the layout, a single bottom drain can become the sole inlet to the pump, and this condition becomes dangerous if there is an inadequate or missing drain cover.

Hair Entrapment/Entanglement

CPSC is aware of 40 reported incidents of hair entrapment or entanglement in pools, spas, and hot tubs between January 1990 and October 2003. Eleven of the incidents resulted in drowning deaths, as a result of hair becoming entangled in the drain grates. Thirty-six incidents occurred in spas, including hot tubs, and four occurred in a pool. The victims' ages were between 4 and 42, with a median age of 9 years – 92.5% were under the age of 15 (Ref. 1).

Typically, these incidents involve females with long, fine hair, who are underwater with their head near a suction inlet (drain). The water flow into the inlet sweeps the hair into and around the drain cover, and the hair becomes entangled in and around holes and protrusions in the cover. Entrapment occurs because of the tangling, and not necessarily because of strong suction forces.

Since about 1982, industry voluntary standards for pools, spas, and hot tubs require drain covers to be certified for use at a specified maximum flow rate. The design of a drain cover in association with the flow rate through it has been found to relate to the cover's ability to entrap hair. Large openings in the covers in combination with high flow rates can pull hair through the cover and cause entanglement in the turbulence behind the cover. Reduced flow rates and smaller holes in the drain cover can make entanglement less likely to occur. However, it can be difficult to determine actual flow rates in pools and custom-built spas, and thus to know if they are equipped with the proper fitting to prevent hair entanglement. Pools and spas built prior to 1982 were most likely fitted with flat grates. Drain fittings available on the market since 1982 are believed to be manufactured to provide hair entrapment/entanglement protection and, because of their domed shape, offer some protection against body entrapment.

Other/Unknown Cases

The CPSC is also aware of nine cases of drain entrapment occurring between January 1990 and October 2003 where the particular body part or object caught in the drain is unknown. Two of these cases resulted in death. There are also two reports of drain entrapment where

something being worn by the person became caught. In one case, a 43-year-old woman's necklace became caught. The other case involved a 21-year-old man's swim trunks.

2.2 Codes and Standards

Several voluntary standards currently in existence for swimming pool and spa construction and equipment are referenced in Appendix A. New ASTM International and American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI) standards regarding the performance of safety vacuum release systems (SVRS) have been developed. The National Electrical Code (NEC) has adopted language requiring an emergency shutoff switch within sight of a spa or hot tub (in public facilities only) to allow for easy removal of power from the circulation system (Ref. 3). Some state and/or local building codes may have adopted the requirements in these standards. Check with your local authorities to determine what the specific requirements are in your community. Many communities also require inspections of new and existing facilities before they are opened to the public or at the time of residential sale. These inspections involve the general pool filtration system (pumps, filters, and skimmers), drain covers and fencing, if required. Periodic inspections during the operating season of public facilities may also occur to ensure that the facility is properly operated and maintained according to local regulations.

While the voluntary standards primarily address new construction, these guidelines were developed to address potential entrapment hazards that currently exist with older pools and spas that were built prior to the effective date of the relevant standard.

The approach taken in the guidelines is to provide layers of protection to prevent entrapments from occurring. The layers of protection prescribe entrapment avoidance in new construction by suggesting multiple outlets to prevent sole source suction in combination with appropriate drain (pool outlet) covers. In addition, should outlets become blocked or if covers are broken or removed, atmospheric vent systems that relieve the entrapping suction, or safety vacuum release systems (SVRS) that respond to an increase in pump suction associated with entrapment and comply with ASME/ANSI A112.19.17 and/or ASTM International PS10-03 are strongly recommended, especially in older pools with single main drains.

3. EXPLANATION OF GUIDELINES FOR ADDRESSING POTENTIAL ENTRAPMENT HAZARDS

Guideline #1

If the pool, spa, or hot tub has a single drain, with or without a skimmer, take the following actions:

a. For water depths of four feet or less:
if conditions allow, rework the drain system to include either a minimum of two drains per pump or drain design configurations described in Section 3.1.2, and

strongly consider installation of a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected (e.g., a safety vacuum release system (SVRS[1]) or equivalent).

b. For water depths over four feet:
if conditions allow, rework the drain system to include either a minimum of two drains per pump or drain design configurations described in Section 3.1.2, and

consider installation of a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected (e.g., a safety vacuum release system (SVRS) or equivalent).

c. Where rework is not possible, ensure that:

- flow through the drain (outlet) grate does not exceed 1.5 feet per second (fps), and
- the drain (outlet) grate minimum diagonal dimension is 24 inches, and
- a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected (e.g., a safety vacuum release system (SVRS) or equivalent) is installed.

NOTE: *Effluent system designs that do not create an entrapping suction at the main drain are acceptable. Tests should be conducted to verify entrapment does not occur.*

[1] ***The device should meet the performance requirements of the ASTM International PS10-03 and/or ASME/ANSI A112.19.17 standard referenced in Appendix A.***

3.1 Information on Guideline #1

If local conditions permit, rework the drain system to include a minimum of two drains per pump.

Rationale: Where the water depth is four feet or less, young children can easily access the drain in wading pools, spas, and hot tubs because of the shallow water depth of these pools. Young children may be attracted to the drain cover itself or the feel of water flow through the drain. If the drain cover is a flat grate (8 inches or less in diameter), missing, broken, or not an anti-entrapment or anti-vortex cover (dome-shaped), the potential for an entrapment or disembowelment injury exists. Where water depths are greater than four feet, access is not as easy, but the potential for an entrapment still exists.

Information: There are several approaches to reworking the drain system. These include the use of multiple drains or channels, the use of a larger suction area, and gravity feed or vent stacks. These are discussed below:

3.1.1 Multiple Drains

Your pool maintenance professional may recommend completely reworking the suction drain system. This may involve a major construction effort around the drain section of the pool and could involve providing a second suction drain or a larger suction area to prevent entrapment by an existing single drain configuration. **This option should be strongly considered in the case of wading pools, spas, and hot tubs because of the ease with which young children have access to the drain cover.** Additionally, a channel type drain could be installed in such a way as to prevent the ability to "trap off" or block the main drain.

The principle behind installing a multiple drain system is to prevent a single drain opening from becoming the sole inlet to the suction side of the pump. By providing an additional drain, a blockage created by someone at one drain does not interfere with flow through the second drain. The installation of at least one additional drain effectively divides the suction between the drains, provided the piping is the same diameter and the "tee" is placed midway between the drains (See Figure 1). With the pump's ability to draw water from the unblocked drain, flow to the pump would remain unchanged. Therefore, there would be no increase in suction at the pump and no

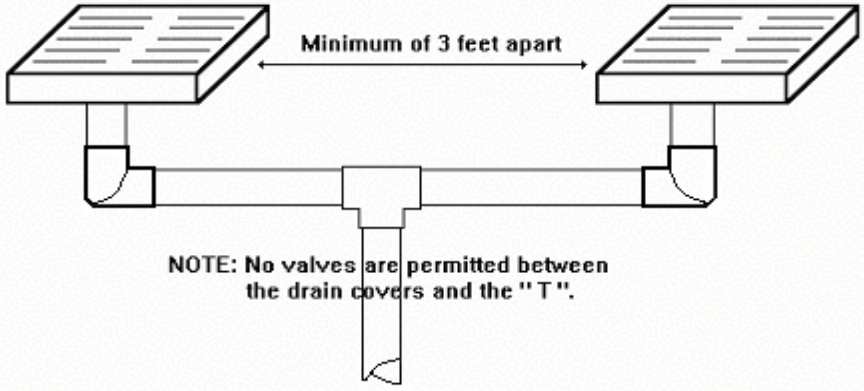

Figure 1. Dual Drain System

entrapment forces created in the blocked drain.

The state of North Carolina currently requires a minimum of two main drains per pump in the construction of new wading pools and is requiring that existing wading pools be retrofitted to meet a two outlet per pump minimum requirement. The state is accepting a single drain and skimmer line combination as long as neither can be isolated. A point of contact for further information on the implementation and success of this requirement is:

James Hayes of the *N.C. Department of Environmental Health and Natural Resources,* (919) 733-9933.

The effective use of a skimmer line as the second suction or suction relief source for the pump should the main drain become blocked has not yet been established. It is theorized that the skimmer line will provide flow to the pump, thus preventing an entrapment at the main drain. However, depending on pipe sizes and flow status of the skimmer, there may not be enough relief provided by the skimmer line to release an entrapment at the main drain. By design, pool skimmer lines collect surface debris and are therefore expected to clog, or experience reduced flow. A complete blockage of the skimmer system leaves the main drain as a sole source of suction for the pump – an undesired condition.

3.1.2 Channel Systems

Alternatively, a channel type drain could be installed in such a way as to prevent the "trapping off" or blockage of the main drain (Figure 2). The channel, possibly retrofitted onto either or both sides of a 12" x 12" grate, would provide a larger surface area to maintain the desired flow without creating an entrapment hazard since it would be difficult to completely seal or trap off. Also providing a larger surface area are drain covers whose diagonal measurement is at least 24 inches, whether 18” x 18” or 6” x 24”. These measurements provide drain (outlet) covers that should be large enough to prevent a body seal and thus body entrapment. CPSC is aware of a limited number of facilities that incorporate these kinds of designs. In some cases, the grating incorporates a "snap out" feature that also addresses the hazard associated with hair entrapment.

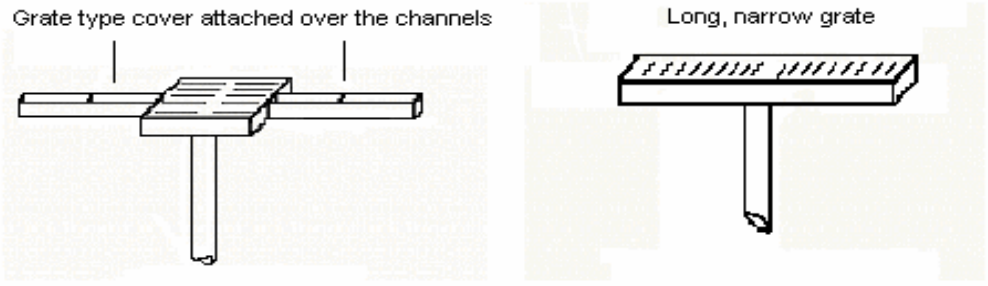

Figure 2. Alternate Drain Configurations

3.1.3 Assessment of Multiple Drain and Channel Systems

A multiple drain, channel system, or large drain cover (diagonal greater than 24 inches) can greatly reduce the likelihood of body entrapment and subsequent drowning. In tests conducted by the National Swimming Pool Foundation (NSPF) on a multiple drain system similar to that shown in Fig. 1, results indicated that no suction force was available to entrap a user if the user's body covered one drain (Ref. 4). The lack of an appreciable suction force in a functioning multiple drain configuration would reduce the likelihood of body entrapment. The presence of multiple drains may also reduce the likelihood of hair entrapment incidents due to the lower flow rates through the drains resulting in less pull of hair into or against the drain cover. The use of drain covers that have been approved for the drain's exit flow and passed tests against entrapment of hair will also influence the effectiveness of multiple drains against hair entrapment.

The effectiveness of these proposals against disembowelment injuries is not as clearly understood because of the lack of data surrounding the pressure differential and the duration of exposure to the available suction required to cause such injury. The disembowelment injuries are believed to occur "almost instantaneously" at a small pressure differential. Whether that small differential is present in a multiple drain system has not yet been established. The incorporation of a channel or 24" diagonal drain cover, which cannot be completely sealed by a single person, may be the best approach in preventing disembowelment injuries since the child would not be subjected to the full suction of the pump.

3.1.4 Gravity Feed and Vent Stack Systems

One system, currently in use in Florida, is a gravity feed system. The system is based on pressure equalization, water seeking an equal level, between the pool or spa and the collection tank. A separate tank collects water from the pool or spa by means of gravity and the suction pumps then draw water from the tank rather than the pool or spa (Figure 3). This method of circulating, filtering, and/or heating and jetting the pool or spa water removes the direct suction from the main drains and skimmers and applies it to the tank, which is not occupied. Water flow through the suction outlet(s) is regulated by atmospheric pressure 'pushing' the water into the collector tank until equilibrium is reached. This type of system will not produce sufficient forces at the outlet(s) to present a hazard. A point of contact for further information on the implementation of this system is:

Robert S. Pryor of the *Florida Department of Health,* (850) 245-4444 x2369

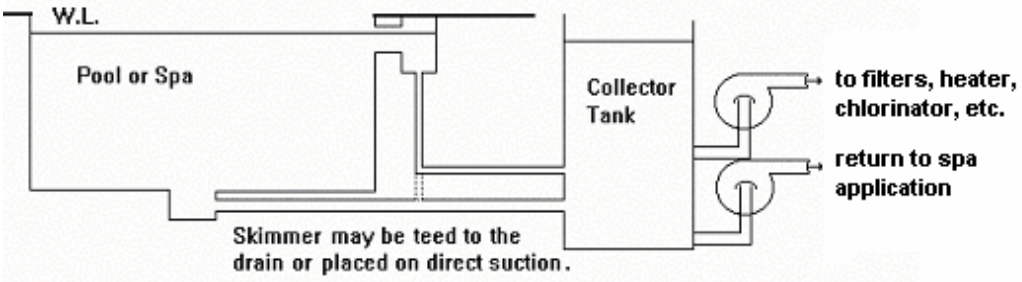

Figure 3. Gravity feed system - Direct Suction removed from Main Drain.

The use of a vent stack or stacks may remove suction from the main drain or skimmer in case a blockage should occur. The stack would be connected to the main suction line between the outlet drain and the pump and would be open to the atmosphere (Figure 4). Similar to the principle behind the gravity feed system; the vent stack will fill with water to a level equal to that of the pool. Should the outlet in a single main drain circulation system become clogged or obstructed, the pump begins to draw on the water from the vent stack until air is introduced to the system and the suction is broken. A point of contact for further information on the implementation of atmospheric vents is:

Carvin DiGiovanni, of the *National Spa and Pool Institute,* (703) 838-0083

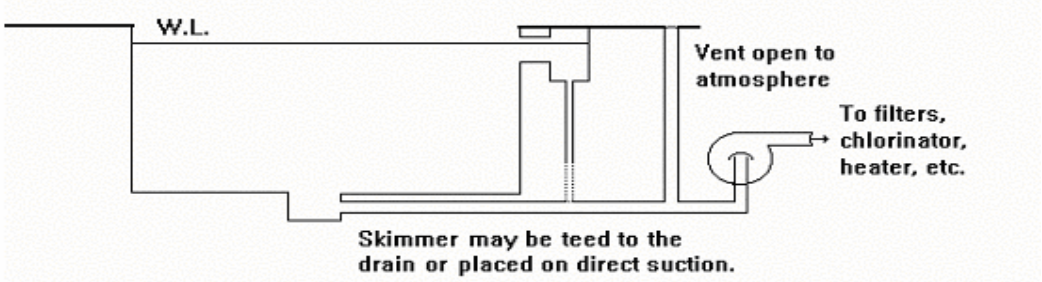

Figure 4. Vent System to relieve Main Drain Suction

3.1.5 Assessment of Gravity Feed and Vent Stack Systems

The use of these gravity systems may reduce the likelihood of suction entrapment because direct suction at the main drain has been removed. Some concerns have been raised surrounding the ability to keep vent stack systems clean of algae, other biological contaminants, and obstructions. On a simple design as shown in Figure 4, there is no indication if the vent stack system were to become blocked. Should the vent become obstructed, the safety system would be

rendered ineffective unless procedures are in place to regularly test and maintain the system. There are additional concerns regarding manufactured vent systems versus field-fabricated units. The design and operation of the vent could be dependent on the depth of the pool or spa being protected and location of the vent unless specific design conditions were used to make the vent system function correctly regardless of pool depth and vent location. Consideration must be given to the length and location of the vent pipe so that the vent is not drained (introducing air into the system) with each start up of the pump. Manufactured vent pipe designs exist that are independent of the pool depth. The effectiveness of either of these proposals against disembowelment injuries is not known because of the lack of data surrounding the pressure differential required to cause such an injury.

Installation of a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected (e.g., a safety vacuum release system (SVRS)[2], or equivalent).

Rationale: Given the resources required to reconstruct the drain system, a secondary system that works with existing configurations may be desirable until the time and funds are available to make permanent renovations. In some cases, environmental conditions might exist that preclude the renovation of a drain system. Having a back-up system in place to monitor the function of the drain(s) and respond to abnormal conditions provides an additional layer of protection to help prevent the occurrence of entrapments.

Information: A secondary back-up system may consist of a proper drain cover [with an ASME/ANSI A112.19.8M rating (Appendix A), a large area grate (preferably one with a diagonal measurement of at least 24 inches) and/or some type of channeling too large to be sealed by a human body]; a sensing device that detects an increased suction associated with blockage and relieves the entrapping suction, or any combination of these. SVRS devices are available that can sense a small increase in suction at the inlet to the pump and shut off the power to the pump, or simply introduce air into the suction line, effectively removing the suction at the drain. Standards developed by ASTM International and ASME address the operation and performance of these devices under entrapment conditions.

Another form of intervention required by the National Electrical Code (NEC) is an emergency cut-off switch in the line-of-sight of a spa, not less than 5 feet from the spa, that would allow a person to cut the power to the pump(s) in a life-threatening situation. ***NOTE*****:** *A cut-off switch should not be considered in lieu of the solutions previously discussed and should only be considered as a solution to be used in combination with any of the alternatives previously mentioned, since a second party would need to be present to activate the switch*.

[2] The device should meet the performance requirements of the ASTM International PS10-03 and/or ASME/ANSI A112.19.17 standard referenced in Appendix A.

Assessment: In the case of entrapment, the removal of the suction in the line can relieve the forces causing the entrapment, and therefore make rescue possible. For this reason, installation of a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected should be considered. It should be noted however, that if a check valve is installed on the suction side of the circulation system to prevent the backflow of water, it may also prevent the relief of the suction and the vacuum forces may remain in place and impede rescue efforts. Therefore, installation of a check valve between the main drain and the inlet to the pump is not recommended in new construction. Presence of a check valve in existing pools and spas may render an SVRS device ineffective.

In the case of disembowelment, the amount of time between sensing the restricted flow, the shutdown of the pump(s) or the relief of the suction, and the ultimate relief of the suction forces at the source of the blockage may not be fast enough to eliminate all disembowelment injuries. The CPSC does believe, however, that injuries will be prevented because a child playing in the vicinity of the open drain fitting is likely to interrupt the flow and activate the release system before completely sealing the fitting. Further, CPSC believes that an SVRS, while not a substitute for proper drain covers required in the voluntary standards, is a reasonable system to have in place in the event of improper maintenance or tampering with the drain cover.

For existing pools and spas with water depths of four feet or less, a secondary back-up system should be installed where a single drain exists or a drain can become single upon activation of valves. While multiple drains or an alternate drain configuration providing entrapment avoidance are preferable solutions, it is recognized that a pool/spa owner is more likely to install a back-up system rather than structurally renovate the pool/spa. Regardless of the number of outlet drains provided, because of the shallow depths of wading pools, spas, and hot tubs, and the easy access to their suction outlets, the installation of a back-up system that monitors the function of drain outlet/circulation system should be seriously considered.

For existing pools and spas with water depths over four feet, a back-up system should be installed where a single drain exists or a drain can become single upon activation of valves and rework is not possible. While access to the suction outlets in deeper pools is less likely, the potential for a broken or missing cover(s) and subsequent entrapment still exists.

For deeper pools where rework or new construction has provided multiple suction outlets, back-up systems should still be considered for installation. The system provides protection should multiple drains become blocked for any reason.

Where rework is not possible, along with the installation of a back-up system to monitor the drain function, the flow through the outlet grate should be limited to 1.5 fps (feet per second) and serious consideration given to the installation of a large outlet grate (diagonal measure of 24 inches or more) or cover that cannot be sealed by the body and meets the ASME/ANSI A112.19.8M requirements. Studies by NSPF have shown that by reducing the flow through the grate, hair

entanglement/entrapment and body entrapment incidents are less likely to occur. By providing an outlet grate with a large diagonal measurement, body entrapment incidents are less likely to occur due to the inability of the body to completely seal such an area.

Because the activation of a manually-operated emergency cut-off switch requires the presence of at least one other person when the incident occurs, this solution is not a satisfactory substitute for the other secondary solutions mentioned, although it is desirable in tandem with some other solution.

Guideline #2:

If the drain cover does not display the appropriate markings for maximum flow rate and labeling that indicate it has been tested to the ASME/ANSI voluntary standard, shut down the pump and replace the cover.

3.2 Information on Guideline #2

Rationale: An improper outlet cover can increase the likelihood of hair entanglement or entrapment. Covers are tested and rated for flow rates to prevent hair entrapment incidents from occurring. Flow rates in excess of the cover's rated flow can pull hair through the cover and create tangling behind the cover, which can lead to entrapment. A qualified pool professional must determine if the flow rate through the fitting is adequately matched to the actual flow rate of the spa, hot tub, or pool. If not, changes must be made to achieve this match.

Information: Installers, owners, maintenance personnel, and inspectors should ensure that drain covers are manufactured and installed according to the latest specifications set forth by the ASME/ANSI A112.19.8M voluntary standard (Appendix A) for suction fittings. The standard requires that the cover material be tested for structural integrity. The cover also must be tested for hair entrapment/entanglement potential and is required to display a flow value in gallons per minute (GPM) that indicates the maximum flow rate for which the cover has been approved. The use of a cover under conditions where the maximum allowable flow rate is exceeded can lead to entrapment hazards. Portable spas (including hot tubs) manufactured after 1982 are likely to have drain suction fittings that are appropriately sized for the flow rate.

Spas built on site may not have controls to guarantee that the suction cover is correctly matched with the pump to provide a rated flow appropriate for that cover. One possible solution would be to provide a flow control valve that qualified pool maintenance professionals could set during installation to assure that the rated flow for the drain cover is not exceeded. During regular maintenance, the flow can be checked, and adjusted as necessary. Should a pump need to be replaced, the flow can again be determined and adjusted as needed.

Assessment: A pool professional should inspect spas or hot tubs that were manufactured prior to 1982, or if there is a question about the drain cover currently installed. Anti-vortex covers (dome-shaped covers) were developed to protect against air entering the circulation system due to swirling behind the covers. An added benefit of these covers appears to be the ability to address entrapment hazards when installed properly. Because of their water flow design and shape the anti-vortex covers seem to be more difficult to seal with the body than are flat grates. The pool professional should determine if the covers meet the safety requirements outlined in the appropriate ASME/ANSI and ANSI/NSPI standards (Appendix A).

More information on the ASME/ANSI standard and the testing procedures can be obtained by contacting:

Perry Miekle, *ASME/ANSI Subcommittee*, (925) 757-0836.

Information on the ANSI/NSPI standard can be obtained from:

Carvin DiGiovanni, *National Spa and Pool Institute*, (703) 838-0083.

Guideline #3

Develop a comprehensive maintenance program for each facility. A checklist is provided on page 17 to help implement this program. The maintenance program should address the following:

a. If the drain cover or grate is cracked or broken or missing, immediately shut down the pump(s) and replace the grate or cover.

b. The covers should be anchored in accordance with the manufacturer's specifications and supplied parts (e.g., non-corrosive fasteners).

c. The practice of color coding or labeling plumbing and equipment should be incorporated into all facilities. The most important aspect of a labeling/coding program is to provide the location, identification, and marking of the On/Off switch for the circulation pump(s).

3.3 Information on Guideline #3

Rationale: Inadequate maintenance of equipment and drain covers can lead to entrapment injuries. Because the safety of swimming pools, wading pools, and spas depends on good

inspection and maintenance, the manufacturer's maintenance instructions and recommended inspection schedules should be strictly followed. Generally, all equipment, skimmers, and drain covers should be inspected frequently for corrosion, deterioration, missing or broken parts, or any other potential hazards. In case of emergency, a clearly labeled and accessible On/Off switch for the circulation pumps may make the difference between entrapment and rescue.

Information: The frequency of thorough inspections will depend on the type of equipment to be inspected and the amount of its use. Inspectors should give special attention to moving parts, components that can be expected to wear, and drain covers. Trained personnel should conduct all inspections. Some manufacturers supply checklists for general and/or detailed inspections with their maintenance instructions. These should be used. A general checklist that may be used as a guide for frequent routine inspections of swimming facilities is included in these guidelines.

When installed and secured in accordance with the manufacturer's instructions, no fasteners used to affix drain covers should loosen or be removable without the use of tools. In addition, all fasteners should be corrosion resistant and should minimize the likelihood of corrosion to the materials they connect.

Public pool equipment rooms may color code or label the plumbing according to local code requirements. The coding or labeling can be helpful during maintenance procedures or during times of urgency, especially to those not familiar with the equipment. The On/Off switch for the circulation pumps should be clearly marked. The ability to provide assistance to an entrapped victim depends on the ability to quickly remove the suction force.

Assessment: Inspections alone do not constitute a comprehensive maintenance program. All hazards or defects identified during inspections should be repaired promptly before opening the facility to the public. All repairs and replacements of equipment parts should be completed in accordance with the manufacturer's instructions.

A summary of these guidelines as well as a checklist to help identify potential entrapment hazards is provided on the following pages. It is suggested that these pages be prominently posted as a constant reminder to the pool staff to regularly check for potentially hazardous conditions. The checklist in these guidelines addresses potential entrapment hazards, but is not intended to provide a complete safety evaluation of equipment design and layout. Complete documentation of all maintenance inspections and repairs should be retained, including the manufacturer's maintenance instructions and any checklists used. A record of any accidents and injuries reported to have occurred at the facility should also be maintained. This will help identify potential hazards or dangerous features that warrant attention.

4. GUIDELINES FOR ADDRESSING POTENTIAL ENTRAPMENT HAZARDS

Guideline #1

If the pool, spa, or hot tub has a single drain, with or without a skimmer, consider taking the following actions:

a. ***For water depths of four feet or less, if conditions allow, rework the drain system to include either a minimum of two drains per pump or drain design configurations described in Section 3.1.2, and strongly consider the installation of a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected (e.g., a safety vacuum release system (SVRS)[3], or equivalent).***

b. ***For water depths over four feet, if conditions allow, rework the drain system to include either a minimum of two drains per pump or drain design configurations described in Section 3.1.2, and consider installation of a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected (e.g., a safety vacuum release system (SVRS) or equivalent).***

c. ***Where rework is not possible, ensure that:***
   - flow through the drain (outlet) grate does not exceed 1.5 feet per second (fps), and
   - the outlet grate minimum diagonal dimension is 24 inches, and
   - a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected (e.g., a safety vacuum release system (SVRS) or equivalent) is installed.

Note: *Effluent system designs that do not create an entrapping vacuum at the main drain are acceptable. Tests should be conducted to verify entrapment does not occur.*

Guideline #2:

If the drain cover does not display the appropriate markings for maximum flow rate and labeling that indicate it has been tested to the ASME/ANSI voluntary standard, shut down the pump and replace the cover.

Guideline #3

Develop a comprehensive maintenance program for each facility. A checklist is provided on page 17 to help implement this program. The maintenance program should address the following:

a. ***If the drain cover or grate is cracked or broken, immediately shut down the pump(s) and replace the grate or cover.***
b. ***The covers should be anchored in accordance with the manufacturer's specifications and supplied parts (e.g., non-corrosive fasteners).***
c. ***The practice of color coding or labeling plumbing and equipment should be incorporated into all facilities. The most important aspect of a labeling/coding program is to provide the location, identification, and marking of the On/Off switch for the circulation pump(s).***

[3] ***The device should meet the performance requirements of the ASTM International PS10-03 and/or ASME/ANSI A112.19.17 standard found in Appendix A.***

5. POOL AND SPA ENTRAPMENT HAZARDS CHECKLIST

Pool Name:	Date:
	Completed by:
	Pool Builder:

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 & wading pools)
- ☐ Suction drain covers firmly and properly affixed using manufacturer's recommended parts
- ☐ Proper return covers installed (main & wading pools)
- ☐ Skimmers checked (baskets, weirs, lids & flow adjustors) for blockage
- ☐ All skimmer throats checked for blockage (main & 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 Checklist

- ☐ Main drain, vacuum, inlet covers and/or fittings in place, secured and unbroken (**hourly**) (main & wading pools)
- ☐ Skimmers checked (baskets, weirs, lids & flow adjustors) for blockage (**hourly)** (main & wading pools)
- ☐ 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

6. REFERENCES

1. CPSC Memorandum to Troy Whitfield, "Drain Entrapment in Spas, Swimming Pools and Wading Pools from January 1990 through October 2003," Natalie Marcy, EPHA, November 5, 2003.

2. CPSC Memorandum to Ronald L. Medford, "Assessment of the Pool Pump Cutoff Device Presented by David Stingl," Roy W. Deppa, P.E., Suad Nakamura, PhD., and William Rowe, March 12, 1996.

3. National Fire Protection Association Inc., National Electrical Code 2002, Article 680 – Swimming Pools, Fountains, and Similar Installations, August 2, 2001.

4. National Swimming Pool Foundation, Dual Main Drain Suction Entrapment, Hair Entrapment/Entanglement Test Report, William N. Rowley, Ph.D., P.E. and Glen H. Egstrom, Ph.D., June 1997.

Appendix A
Applicable Standards

Standard: **Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, Hot Tubs and Whirlpool Bathtub Appliances - ASME/ANSI A112.19.8M.**

Standard: **Manufactured Safety Vacuum Release Systems (SVRS) for Residential and Commercial Swimming Pool, Spa, Hot Tub and Wading Pool Suction Systems - ASME/ANSI A112.19.17.**

Sponsored and Published by:
The American Society of Mechanical Engineers
United Engineering Center
345 East 47th Street
New York NY 10017
www.asme.org

Standard:**The following are American National Standards for Pools and Spas;**
ANSI/NSPI-1-1991 Standard for Public Swimming Pools
ANSI/NSPI-2-1992 Standard for Public Spas
ANSI/NSPI-3-1992 Standard for Permanently Installed Residential Spas
ANSI/NSPI-4-1992 Standard for Aboveground/onground Residential Swimming Pools
ANSI/NSPI-5-1995 Standard for Residential Swimming Pools
ANSI/NSPI-6-1992 Standard for Residential Portable Spas
NSPI-7 Workmanship Standards for Swimming Pools and Spas
ANSI/NSPI-8-1996 Model Barrier Code for Residential Swimming Pools, Spas and Hot Tubs
BSR/NSPI/WWA-9 Standard for Aquatic Recreation Facilities (In Progress)
BSR/NSPI-10 Standard for Public Swimspas (In Progress)
BSR/NSPI-11 Standard for Residential Swimspas (In Progress)

Sponsor:
National Spa and Pool Institute
2111 Eisenhower Avenue
Alexandria VA 22314
(703) 838-0083
www.nspi.org

Standard: **Standard for Electric Spas, Equipment Assemblies, and Associated Equipment, UL 1563.**

Sponsor:
Underwriters Laboratories Inc.
1655 Scott Boulevard
Santa Clara CA 95050
(408) 985-2400
www.ul.com

Standard: **Standard Provisional Specification for Manufactured Safety Vacuum Release Systems (SVRS) for Swimming Pools, Spas and Hot Tubs – ASTM PS10-03**

Sponsor:
ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428
www.astm.org

Standard: **National Electrical Code 2002, Article 680 – Swimming Pools, Fountains, and Similar Installations**

Sponsor:
National Fire Protection Association Inc.
One Batterymarch Park
Quincy, MA 02269
www.nfpa.org

Appendix B
GLOSSARY

ANSI

American National Standards Institute.

ASME

American Society of Mechanical Engineers.

Anti-Entrapment Cover

A drain fitting designed to prevent entrapment, typically dome-shaped to reduce the likelihood of creating a body seal.

Anti-Vortex Cover

A drain fitting designed to prevent the circular or swirling motion of water that tends to form a vacuum or suction at the center and draws the body or hair into the drain pipe.

Backflow

The backing up of water through a pipe in the direction opposite to normal flow.

Ball Valve

A simple non-return valve consisting of a ball resting on a cylindrical seat within a liquid passageway.

Blower (Air)

An electrical device that produces a continuous rush of air to create the optimal bubbling effect in a spa, hot tub or whirl-pool. It is usually plumbed in with the hydrotherapy jets or to a separate bubbler ring.

Centrifugal Pump

A pump consisting of an impeller fixed on a rotating shaft and enclosed in a casing or volute and having an inlet and a discharge connection. The rotating impeller creates pressure in the water by the velocity derived from the centrifugal force.

Check Valve

A mechanical device in a pipe that permits the flow of water or air in one direction only.

Diverter Valve

A plumbing fitting used to change the direction or redirect the flow of water. Some diverter valves are used on pool/spa combinations to allow the use of the spa and then switch the flow back to the pool. This valve may also be referred to as an Ortega valve, a brand name.

Drain

This term usually refers to a plumbing fitting installed on the suction side of the deepest part of the pool, spa or hot tub. Main drains do not drain the pool, spa or hot tub, as a sink drain, but rather connect to the pump to allow for circulation and filtration.

Effluent

The water that flows out of a pool, filter, pump, or other device.

Filter

A device that removes undissolved or suspended particles from water by recirculating the water through a porous substance (a filter medium or element). The three types of filters used in pools and spas are sand, cartridge and D.E. (diatomaceous earth).

Flow Rate

The quantity of water flowing past a designated point within a specified time, such as the number of gallons flowing past a point in one minute - abbreviated as GPM.

fps

An abbreviation for feet per second.

GPD

An abbreviation for gallons per day.

GPH

An abbreviation for gallons per hour.

GPM

An abbreviation for gallons per minute.

Gunite

A mixture of cement and sand sprayed onto contoured and supported surfaces to build a pool. Gunite is mixed and pumped to the site dry, and water is added at the point of application. Plaster is usually applied over the gunite.

Gutter

An overflow trough at the edge of the pool through which floating debris, oil, and other "lighter-than-water" things flow. Pools with gutters usually do not have skimmers.

Hot Tub

A spa constructed of wood with sides and bottom formed separately and joined together by hoops, bands or rods.

Hydrojet

A fitting in the pool or spa on the water return line from the equipment that blends or mixes air and water, creating a high-velocity, turbulent stream of air-enriched water.

Influent

The water entering the pool, pump, filter or other piece of equipment. Water entering the pump is called the influent, while water exiting the pump is called the effluent.

Inlet

A fitting in the pool or spa on the water return line from the equipment where water returns to the pool.

Main Drain

A term usually referring to a plumbing fitting installed on the suction side of the pump in pools, spas and hot tubs. Sometimes referred to as the drain, it is normally located in the deepest part of the pool, spa or hot tub. It does not drain the pool, spa or hot tub, as a sink drain, but rather connects to the pump to allow for circulation and filtration.

Manifold

A branch pipe arrangement that connects several input pipes into one chamber or pump or one chamber onto several output pipes.

Multiport Valve

Also referred to as a rotary-type backwash valve, this valve can replace as many as six regular gate valves. Water from the pump can be diverted for various pool related functions, such as draining, backwashing, bypassing the filter for maximum circulation, normal filtration, filtering before draining, or the valve may be closed by simply turning the handle. (NOTE: The pump must be off before setting the valve position.)

NSPF

National Swimming Pool Foundation**.**

NSPI

National Spa and Pool Institute.

psi

An abbreviation for pounds per square inch.

Pump

A mechanical device, usually powered by an electric motor, which causes hydraulic flow and pressure for the purpose of filtration, heating and circulation of pool and spa water. Typically a centrifugal pump is used for pools, spas and hot tubs.

Pump Capacity

The volume of liquid a pump is capable of moving during a specific period of time. This is usually specified in GPM.

Pump Curve

Also called the pump performance curve. A graph that represents a pump's water flow capacity at any given resistance.

Rate of Flow

The quantity of water flowing past a designated point within a specified time, such as the number of gallons flowing past a point in one minute (abbreviated as GPM).

Shotcrete

A mixture of cement and sand sprayed onto contoured and supported surfaces to build a pool or spa. Shotcrete is premixed and pumped wet to the construction site. Plaster is usually applied over the shotcrete.

Skimmer

A device installed through the wall of a pool or spa that is connected to the suction line of the pump that draws water and floating debris in the water flow from the surface without causing much flow restriction.

Skimmer Basket

A removable, slotted basket or strainer placed in the skimmer on the suction side of the pump, which is designed to trap floating debris in the water flow from the surface without causing much flow restriction.

Spa

A warm water reservoir permanently installed with hydromassage jets that are constructed out of concrete (gunite, shotcrete, etc.). Spas may or may not be attached to a pool.

Suction Outlet

The aperture or fitting through which the water under negative pressure is drawn from the pool or spa.

Sump

The lowest point in a circulation system, usually consisting of a reservoir, where water is drained.

SVRS

Safety Vacuum Release System – Device that senses an increase in pump suction and responds by relieving the potentially entrapping suction.

Tee

A plumbing fitting in the shape of a "T" used to connect pipes.

Turnover

Also called turnover rate. The period of time (usually in hours) required to circulate a volume of water equal to the volume of water contained in the pool or spa. Pool capacity in gallons, divided by pump flow rate in gallons per minute (gpm), divided by 60 minutes in one hour, will give the number of hours for one turnover.

Vacuum

This term can be used to define any number of devices that use suction (negative pressure) to collect dirt from the bottom and sides of a pool or spa. Most common is a vacuum head with wheels that attaches to a telescoping pole and is connected to the suction line usually via the opening in the skimmer. It must be moved about by a person, and debris is collected in the skimmer basket or filter.

Weir

Also called skimmer weir - Part of a skimmer that adjust automatically to small changes in water level to assure a continuous flow of water to the skimmer. The small floating

"door" on the side of the skimmer that faces the water over which water flows on its way to the skimmer. The weir also prevents debris from floating back into the pool after the pump shuts off.