

## **DESIGN AND CONSTRUCTION OF SWIMMING POOLS**

### **I. PURPOSE**

This Information Bulletin establishes consistent and uniform requirements for the design and construction of swimming pools, based on the State and City requirements. Currently, the provisions for the design and construction of swimming pools are regulated as follows:

- C The State provisions for Public Swimming Pools are found in California Building Code (CBC) Chapter 31B of Division I, which includes Sections 3101B through 3137B and Division III, which includes Sections 3160B and 3161B.
- C The State provisions for Private Swimming Pools are found in CBC Sections 3150B through 3156B.
- C Los Angeles Municipal Code (LAMC) Sections 91.6109 and 91.8118 shall apply to all pools, unless otherwise stated in this Information Bulletin.

*Note: All of the provisions regarding swimming pool design and construction are found in the Los Angeles Building Code (LABC). The Plumbing Code requirements for swimming pools are found in LAMC Section 94.1700 which adopts by reference the "Uniform Swimming Pool, Spa and Hot Tub Code."*

### **II. DEFINITIONS**

For the purpose of this Information Bulletin and for enforcement purposes, the following terms shall apply when a permit is issued.

1. **Pool:** Any constructed or prefabricated structure which contains water, used for swimming or recreational bathing, includes in-ground and above-ground pools and includes, but need not be limited to hot tubs, portable and non-portable spas, and wading pools.
2. **Private Swimming Pool (Private Pool):** Any pool, permanent or portable, which is intended for noncommercial use accessory to a single-family dwelling and available only to the family of the household and their guests.
3. **Public Swimming Pool (Public Pool):** Any pool other than a private pool.
4. **Pool Enclosure:** A fence and gate complying with all requirements of LABC Sections 91.3118B and 91.3152B and Section IV below and the walls of a building which serves as part of the enclosure around the pool.

### III. POOL - GENERAL REQUIREMENTS

#### 1. Permit Requirements

- a. **Public Pools:** Separate Building, Electrical, Plumbing and Mechanical permits shall be obtained for all public pools which services more than two-family dwellings. A Combined Building-Mechanical permit shall be obtained for public pools which service a two-family dwelling (LABC Section 91.107.2.2).
- b. **Private Pool:** Combined Building-Mechanical permit shall be obtained to construct private pools (LABC Section 91.107.2.2).
- c. **Exceptions:** Neither building nor combined building-mechanical permits are required for the following pools:
  1. Swimming, bathing and wading pools less than 24 inches in depth and having a surface area of less than 250 square feet. (LABC Section 91.106.2, Item 8.)
  2. Hot tubs or spas with locking safety cover that comply with American Society for Testing Materials - Emergency Performance Specification ASTM ES 13-89 and accessory to a single-family dwelling. (LABC Section 3154B, Item 2.)
  3. Prefabricated swimming pools accessory to a Group R, Division 3 Occupancy in which the pool walls are entirely above the adjacent grade and if the capacity does not exceed 5,000 gallons. (UBC Section 106.2, Item 11)
- d. **Grading and Mechanical Permits:** A mechanical permit shall be obtained for any additional gas or electrical outlets installed for any of the exceptions outlined in item c above. A grading permit shall be required for excavations when the pool requires a building permit or combined Building-Mechanical permit and the lot is located in a grading hillside area.

#### 2. Plan Requirements

- a. **Number of Plans:** Two sets of plans and one set of calculations is required for all pools at the time of permit issuance. Each set of plans shall include a fully dimensioned plot plan, which shows the location of the pool, pool enclosure, and all accessory equipment and their setbacks to all adjacent buildings, property lines, and slopes.

**Exception:** Only one set of plans and no calculations are required, when there is a valid City of Los Angeles Standard Plan for the swimming pool on file with the Department.

- b. **Signatures on Plans:** Plans and calculations shall be signed and stamped by a California

registered engineer or licensed architect.

- c. **Expansive or Uncertified Fill Soils:** Plans shall indicate “Expansive Soil” or “Uncertified Fill Soil” and shall comply with Subsection 5 of this Section III, Structural Design criteria, when applicable.
- d. **Notes on Plans:** Plans shall include the following notes:
  2. No ground water shall be above any portion of the pool construction.
  3. All surface water shall drain away from the pool.
  4. Electrical inspection shall approve grounding of reinforcing, plumbing and conduit prior to the approval of reinforcing steel for pouring of concrete or gunite.
  5. The noise level from the pool equipment located less than 10 feet from a property line of an adjoining property, shall not exceed ambient noise level by more than five decibels.
  6. Continuous inspection is required for shotcrete/gunite pools.

3. **Location of Swimming Pools** The swimming pools shall be located as follows:

- a. **Zoning Code Requirements:** All pools shall comply with the use and location requirements of the Zoning Code. Pools shall not be located in any required yard in which fences more than 3½ feet in height are prohibited. (LAMC Section 12.21.C1.g). Public pools are not allowed in certain zones. The location of a pool constructed on lots containing residential buildings shall comply with any additional regulation imposed by an ordinance “Q” or “T” condition or any other zoning regulations.
- b. **Building Code Requirements:** The setback requirements for swimming pools from the bottom of ascending slopes and the top of descending slopes shall be H/4 and H/6, respectively, where H is the height of the slope, as defined in LABC Section 91.1806.5.4.
- c. **Glazing in Hazardous Locations:** Glazing in walls of a building and fences used as the barrier for swimming pools and spas shall comply with the requirements of LABC Section 91.2406 when all of the following conditions are present:
  - The bottom edge of the glazing is less than 60 inches above the pool side of the glazing.
  - The glazing is less than 5 feet from swimming pool or spa water’s edge.

4. **Special Requirements for Public Pools**

- a. **Public Pool Deck:** All public pools shall provide a continuous, unobstructed, minimum four-foot-wide slip-resistant non-abrasive (walking or lounging) deck area of concrete or like material flush with the top of the pool shell wall and extending completely around the pool. The deck shall be measured from the pool side edge of the coping lip. The deck shall extend four feet on both sides and rear of any diving board or slide and their appurtenances. Note: There are exceptions and additional requirements in LABC Section 91.3113B.1.

- b. **Los Angeles County Health:** All plans to construct public pools, except for those public pools serving two- or three-family dwellings, shall be approved by the Los Angeles County Health Services Department prior to issuance of the building permit.

## 5. Structural Design

- a. **General Structural Design Requirements:** The pool shall be designed in accordance with the latest code requirements and the following:

1. Pneumatically applied mortar (shotcrete) pools shall be designed, tested, and inspected in conformance with LABC Section 91.1924. The exception noted in Item 12 of LABC Section 91.1705 shall not be used for the construction of swimming pools.
2. Gunite may be used for structural purposes, provided it conforms to all applicable requirements of this information bulletin and shall require continuous inspection as required for shotcrete per LABC Section 91.1924.11. The design and placement of rebar in gunite pools shall be the same as that specified for shotcrete construction in LABC Section 91.1924.
3. Minimum concrete compressive strength,  $f'_c$ , for shotcrete or gunite, shall be 2500 psi.
4. When casting against the earth, the reinforcing steel in gunite or shotcrete pools shall have a minimum cover of three inches. (LABC Section 91.1907.7.1)

- b. **Wall Design:** Pool walls shall be designed in accordance with the latest code requirements and the following:

1. Pool walls shall be designed for earth pressures as specified in LABC Section 91.1611.6, or designed for expansive soil as specified herein.
2. Hydrostatic pressure shall be used in an outward direction as a design criterion where concrete is not deposited against natural undisturbed earth or approved compacted fill.
3. Minimum required reinforcing steel in either direction shall be 1/10 of one percent of the wall cross-sectional area with a maximum spacing of 18 inches.

- c. **Pools in Expansive Soil:** The following minimum construction requirements will be required for all swimming pools located in expansive soil:

1. All pools shall be provided with a concrete or equally impervious deck sloping away from the pool with a minimum width of four feet and having a lip extending six inches below the bottom of the deck at its outer edge. All joints in the deck and coping shall have approved permanent resilient waterproof seals. The coping shall be set

in a solid bed of mortar.

**Exception:** The impervious deck may be omitted, provided the pool is designed for lateral earth pressure of  $P = 62.4H + P(s)$ ; and the bond beam has a thickness of not less than 12 inches and is reinforced with a minimum of three No. 4 bars in each face. The soil around the pool shall slope away from the pool to prevent ponding; or a drainage system shall be provided to collect surface water.

2. To determine the lateral earth pressure on the pool walls, the following formula shall be used:

$$P = 45H + P(s), \text{ where:}$$

P = lateral pressure in pounds per square foot.

H = vertical distance in feet below the ground surface.

P(s) = lateral pressure due to any superimposed surcharge.

3. The design of bond beams and the thickness and amount of reinforcing steel in the bottom of pools shall be given special consideration. Bond beams shall have a minimum of four No. 3 bars.

- d. **Pools in Uncertified Fill Soils:** The Department may issue permits for “floating type” swimming pools when the following conditions are complied with:

1. A favorable recommendation from a soils engineer based upon findings in the field relative to the materials making up the fill, the density, containment, drainage factors, and additional conditions which may affect the pool structure or its foundation is submitted and approved by the Department.
2. The pool is designed under the assumption that it receives vertical support from the soil lying under the pool bottom. The limits of the supporting soil shall be below a line drawn around the perimeter of the pool and located on the bottom of the pool where a line sloping at 33 degrees with the horizontal is tangent to the pool bottom.
3. Pool walls shall be designed assuming no support from the surrounding soil as well as a 30 pounds per square foot equivalent fluid pressure acting inward.
4. The owner shall be made aware that without a favorable soil test of the fill material the only positive method to guard against settlement and possible cracking is to extend the foundation into natural ground. Therefore the owner shall record a covenant and agreement with the County Recorder acknowledging that he/she understands that settlement and cracking may occur. The covenant and agreement shall be approved by Grading Section prior to being recorded.
5. All water connections including both inlet and outlet shall be flexible in nature so that some differential settlement between pool and utilities may take place without

causing leaks.

6. The design engineer shall attest to the capability of the soil to support the pool.

#### **IV. POOL ENCLOSURE**

1. **Permit Requirements:** A separate permit to construct the pool enclosure is required, if any portion of the enclosure is constructed of masonry or concrete higher than 3.5 feet per Section 106.2 of the Los Angeles Building Code.
2. **Plans:** When a separate permit is required for the construction of the pool enclosure, then the plan shall require a plot plan to show the location of the pool enclosure and all buildings, pools and setback requirements. The plans shall include construction details that complies with the requirements of this information bulletin.
3. **Private Pools:** All private pools shall provide a pool enclosure. To comply with the intent and the spirit of LABC Sections 91.6109 and 91.3151B, all new pool enclosures shall be a minimum of 5 feet in height and shall comply with the construction requirements of this section.

**Exception:** Portions of a building may be used as part of the pool enclosure, provided:

1. Doors, with direct access to the swimming pool from the home, shall be equipped with complying "Exit Alarm,"
  2. Doors (garage doors), with direct access to the swimming pool from accessory buildings, shall be equipped with a self-closing, self-latching device with a release mechanism placed no lower than 54 inches above the floor.
4. **Public Pools:** All public pools shall provide a pool enclosure a minimum of 5 feet in height, which complies with the requirements of LABC Section 91.3118B and with the fence construction requirements of this section.
  5. **Construction Material:** The fence shall use one of the following approved construction materials: wood, masonry, concrete, corrosion-resistant sheet metal or chain link fence. A fence shall be maintained in good repair and shall be kept vertical, uniform and structurally sound per LAMC Section 12.21A9. The pool fence shall be structurally designed to resist minimum lateral loads due to wind and seismic loads per LABC Sections 91.1609 and 91.1610.
  6. **Construction Requirements:** The fence shall meet all of the following requirements.
    - a. The minimum fence height is measured on the side of the fence which faces away from the swimming pool as depicted in Figures 31B-4 and 31B-5 of the code for both public and private pools.
    - b. The maximum vertical clearance from the ground to the bottom of the fence shall be limited

to two inches, measured on the side of the fence which faces away from the swimming pool.

- c. The outside surface of a fence shall be free of protrusions, cavities, or other physical characteristics that would serve as handholds or footholds, which renders the fence easily climbable.
- d. Maximum mesh size for chain link fences shall be the same as required by public pool enclosures of LABC Section 91.3118B. A chain link fence may be used provided the openings are not greater than  $1\frac{3}{4}$  inches measured horizontally. The wire shall not be less than 11 gauge.
- e. Gaps or voids in the fence shall not allow the passage of a sphere equal to or greater than 4 inches in diameter.
- f. Where the fence is composed of horizontal and vertical members and the distance between the tops of the horizontal members is less than 48 inches, the horizontal members shall be located on the swimming pool side of the fence. Spacing between vertical members shall not exceed  $1\frac{3}{4}$  inches. Where there are decorative cutouts within vertical members, spacing within cutouts shall not exceed  $\frac{3}{4}$  inches in width.
- g. Where the fence is composed of horizontal and vertical members and the distance between the tops of the horizontal members is 48 inches or more, spacing between vertical members shall not exceed 4 inches. Where there are decorative cutouts within vertical members, spacing within the cutouts shall not exceed  $\frac{3}{4}$  inches in width.
- h. Where the fence is composed of diagonal members, such as a lattice fence, the maximum opening formed by the diagonal members shall be no more than  $1\frac{3}{4}$  inches.

## 7. Gates

- a. **Construction of Gates:** The construction material and method of construction for gates shall comply with Subsection 5 and 6 above.
- b. **Private Pools:** All access gates through the enclosure shall open away from the swimming pool and shall be self-closing with a self-latching device placed no lower than 60 inches above the ground.

“Driveway Gates” shall no longer be permitted as part of the pool enclosure. “Driveway Gates” are those gates across driveways. The Department may approve the use of “Driveway Gates” on a case-by-case modification, provided the following conditions are met:

- The driveway gate shall be equipped with an electric gate operating device that is approved by a recognized electrical testing agency.
- The electric gate operating devices shall be provided with a safety mechanism to interrupt and recycle the device, should the gate become blocked.

- The electric gate operating devices shall be provided with a time delay closing device, which is set and maintained to activate a maximum of 20 seconds after the gate has been opened.
- No manual control or override mechanism shall be installed on or in connection with the gate operating device.
- The driveway gate shall open outward away from the pool or the gate shall have a self-latching device, lockable hardware or padlock.

c. **Public Pools:** All gates shall be equipped with self-closing and self latching devices. The self-latching device shall be designed to keep the gate securely closed. Gates shall open outward away from the pool. Hand activated gate opening hardware shall be located at least 42 inches above the deck or walkway. All public pools shall provide a five-foot high pool enclosure, which complies with the requirements of LABC Section 91.3118B and with the fence construction requirements of Subsection 6 of Section IV.

8. **Exit Alarm for Private Pool:** The term “Exit Alarm” shall mean (as per LABC Section 91.3150B) an approved device that makes audible, continuous alarm sounds when any door that permits access from the residence to the pool area, and is without any intervening enclosure, is opened or is left ajar. Exit alarms may be battery operated or may be connected to the electrical wiring of the building.

All exit alarms shall be permanently attached to the door at a minimum of height of 54 inches above the floor. Exit alarms shall not be permitted when they are attached to the door in a manner where it may be easily removed without the use of tools. The use of “Velcro Alarms” shall not be allowed. “Velcro Alarms” are those exit alarms attached to the door by use of velcro or self-adhesive.

**Exception:** Exit alarms need not be required when the following conditions are met:

1. Doors providing direct access from a building to the swimming pool are equipped with self-closing, self-latching devices with a release mechanism placed no lower than 54 inches above the floor, or
2. The pool is equipped with an approved safety pool cover which is manually or power-operated and meets all of the performance standards of the American Society for Testing and Materials (ASTM F 1346-91)

## V. POOL EQUIPMENT

1. **Pool Equipment:** Plans shall show location of all pool equipment. Every pool shall be equipped with an approved filter unit and drain. The location of pool equipment shall require an additional inspection and approval by the Noise Enforcement Inspector, when the pool equipment is located less than 10 feet from a property line of an adjoining property. The fee for the additional inspection shall be charged and collected when the swimming pool permit is issued.

## 2. Pool Drainage

- a. **General Requirements.** Pool drainage (outlet) shall comply with the requirements of the Chapter 3 of the Uniform Swimming Pool Spa and Hot Tub Code and the following requirements. Outlets less than 12 inches across shall be covered with anti-entrapment grates that cannot be removed except with a use of tools. Slots or openings in the grates or similar protective devices shall not exceed ½ inch in the smallest dimension and shall be of a shape, area and arrangement that would prevent physical entrapment and would not pose any suction hazard to bathers.
- b. **Private pools:** Each new pool or spa shall have a minimum of two circulation drains per pump. The drains or outlets shall be hydraulically balanced and symmetrically plumbed through one or more “T” fittings, and separated by a distance at least three feet in any dimension between drains. Any backup safety system shall meet the standards as published in the “Guidelines for Entrapment Hazards: Making Pools and Spas Safer,” Publication Number 363, January 1998, United States Consumer Products Safety Commission. This document may be downloaded from the following website: <http://www.cpsc.gov/cpsc/pub/pubs/363.pdf>
- c. **Public pools:** Waste water from periodic draining of the pool or spa for maintenance purpose shall be discharged into the sanitary sewer.

3. **Deck Drainage:** Decks built around the pools shall not drain into the sanitary sewer. Drainage may be conducted to street (storm drain) via non-erosive device.

## VI. EXISTING POOLS

1. **Maintenance of Pool Enclosure:** An existing pool enclosure or fence nonconforming to height and not less than 4½ feet in height, may be maintained to enclose a swimming pool existing in a required yard prior to June 1, 1956. [LAMC Section 12.22.C20.f(8)] Existing pool (fence) enclosures, which are 4½ feet in height and which comply with all other current fence construction requirements of Subsections 5, 6 and 7 of Section IV above, shall be allowed to continue to exist under the nonconforming rights of the LABC Section 91.8103.
2. **Repair or Replacement of Existing Pool Enclosure:** If repair is required for the existing legal 4½ feet high fence, then the fence shall comply with all fence construction requirements and may maintain the 4½ feet fence height. If the fence does not comply with all the fence construction requirements of Subsections 5, 6 and 7 of Section IV above, then the fence shall be made to comply with Subsection 4 of Section IV for Public Pools or Subsection 3 of Section IV for Private Pools.
3. **Adding Pool or Spa to a Lot with an Existing Spa or Pool:** Notwithstanding any other provisions of the municipal code to the contrary, if there exists a legal 4½ feet high fence around the existing private pool or spa and a new private pool or spa is constructed on the same lot, then a five-foot high pool enclosure, constructed per Subsections 5, 6 and 7 of Section IV above, shall

be constructed immediately around the new pool or spa, **or** the pool enclosure shall comply with the following after January 1, 2002:

- a. All private pools and spas on the lot shall be isolated from the home by a five-foot high fence that meets all the requirements of LABC Section 91.3152B and Subsections 5, 6 and 7 of Section IV, or
- b. Maintenance of the legal 4½ feet high fence (LABC Section 91.6109) around both private pool and spa is permitted provided the construction of the existing fence complies with above Subsections 5, 6 and 7 of Section IV requirements and one of the following for the new pool or spa is provided:
  1. Approved safety pool cover that complies with ASTM Standard F 1346-91 (LABC Section 91.3150B) for a pool and/or locking safety cover that complies with ASTM-ES 13-89 for a spa, or
  2. Approved exit alarm per Subsection 8 of Section IV on all doors from the home to the pool or spa, or if other buildings are part of the pool enclosure, then the doors providing direct access from the building (garage) to the private pool shall be equipped with a self-closing, self-latching device with a release mechanism placed no lower than 54 inches above the floor.

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# **Guidelines for Entrapment Hazards: Making Pools and Spas Safer**

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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, pool and spa owners, inspection officials, code officials, and others who are responsible for pool and spa safety.

The guidelines are based on information assembled by the U.S. Consumer Product Safety Commission (CPSC) from many sources, including the Association of Pool and Spa Professionals (APSP) [formerly, National Spa and 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. There are several voluntary standards 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, manufacturers, and code officials.

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 can be found in Appendix B.

These guidelines are recommendations; they are not intended as a CPSC standard or mandatory federal 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 other operational considerations. The revisions primarily pertain to the recommendations found in Guideline #1 and focus on the development of performance standards for safety vacuum release systems (SVRS) and alternative methods for avoiding entrapment.

The Commission believes that following 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 body entrapment, hair entrapment/entanglement, and evisceration, 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 SVRS have been developed.

### **2.1 Pool and Spa Entrapment Injuries**

#### **Body Entrapment**

CPSC is aware of 74 cases of body entrapment, including 13 confirmed deaths, between January 1990 and August 2004. 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 residential location, and 31 at a public facility. In 21 cases, the location was not specified. Thirty-nine 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% of the victims 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 this hazard, which 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 configuration that allows a strong suction force to persist if the drain is blocked, can present this hazard. Drain covers available on the market since 1982 generally have a domed shape, which may offer some protection against body entrapment. Depending upon the plumbing configuration and pool maintenance conditions, a single bottom drain can serve as the sole water inlet to the pump. This condition becomes dangerous if there is an inadequate or missing drain cover.

#### **Hair Entrapment/Entanglement**

CPSC is aware of 43 incidents of hair entrapment or entanglement in pools, spas, and hot tubs between January 1990 and August 2004. Twelve of the incidents resulted in drowning deaths, as a result of hair becoming entangled in the drain grates. Thirty-eight incidents occurred in spas, including hot tubs, and five 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 outlet (drain). The water flow into the drain sweeps the hair into and around the drain cover, and the hair becomes entangled in and around holes and protrusions on both sides of the cover. Entrapment occurs because of the tangling and not necessarily because of strong suction forces, although the suction forces initially draw the hair into the drain cover.

Since about 1982, industry voluntary standards for pools, spas, and hot tubs require drain

covers to be certified. The certification includes a maximum flow rate, in gallons per minute (GPM), which should never be exceeded, as this increases the possibility for hair entrapment/entanglement. 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. Drain covers available on the market since 1982 are supposed to conform to a standard that provides hair entrapment/entanglement protection.

### **Evisceration/Disembowelment**

From January 1990 through August 2004, 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).

### **Other/Unknown Cases**

The CPSC is aware of 11 other cases of drain entrapment occurring between January 1990 and August 2004; two of these cases resulted in death. In nine cases, the particular body part or object caught in the drain is unknown. There are two reports of drain entrapment where something being worn by the person became caught, neither resulted in death. 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 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). The International Code Council (ICC), a nonprofit organization established in 1994 to develop a single set of comprehensive national construction codes, has also begun to address aspects of pool safety in its International Building Code (IBC) and International Residential Code (IRC). The creators of the ICC are the Building Officials and Code Administrators International, Inc. (BOCA), the International Conference of Building Officials (ICBO), and the Southern Building Code Congress International, Inc. (SBCCI), three

nonprofit organizations responsible for the development of three separate sets of regional model codes used throughout the United States.

Some state and/or local building codes may have adopted requirements found 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 be required 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 also address potential entrapment hazards that may exist with older pools and spas that were built prior to the effective date of the relevant standard.

### **2.3 CPSC Guidelines**

The approach taken in the guidelines is to present various options to attain “layers of protection” against entrapment in all pools and spas. The options available depend on whether entrapment hazards are being addressed in new construction or an existing facility. Entrapment hazards can be addressed in new construction by several options, including alternative gutter or overflow circulation systems that eliminate the main drain altogether, or the use of multiple main drains to prevent sole source suction in combination with appropriate drain (pool outlet) covers. Options for existing pools include reconfiguring the circulation system to include multiple main drains with proper drain covers, installing SVRS that respond to an increase in pump suction associated with entrapment and remove the suction forces, or other technology capable of recognizing a potentially hazardous situation such as a sudden increase in pump suction or missing drain cover(s) and responding to remove or prevent the hazard (hereafter referred to as “other technology”).

Due to the “human element” involved in the care and maintenance of pools and spas, it is strongly recommended that consideration be given to including an additional and final layer of protection in all pools and spas that use submerged suction outlets, to relieve an entrapping suction force should outlets become blocked or if covers are broken or removed. Options for new construction include, but are not limited to, a properly designed atmospheric vent system, SVRS, or other technology. For existing facilities, options include the installation of an SVRS or other technology. This is especially important in wading pools and older pools with single main drains.

### 3. GUIDELINES FOR ADDRESSING POTENTIAL ENTRAPMENT HAZARDS

#### *Guideline #1*

**For new construction that includes fully submerged suction outlets, a minimum of two outlets per pump, with pipe centers at least 3 feet apart, is one approach to reduce the likelihood of entrapment. Outlet covers listed and approved in accordance with ASME/ANSI A112.19.8 performance requirements are recommended.**

*The use of alternative designs is another recommended option, such as 18" x 23"<sup>1</sup> or larger covers, long channels that cannot be blocked by the body, gravity feed systems, atmospheric vent systems, or engineered, tested, and approved designs that prevent entrapment hazards from occurring, including designs that do not include fully submerged suction outlets (see Appendix B).*

*Due to care and maintenance concerns associated with circulation systems that include suction outlets and covers, consideration should be given to the installation of a back-up system that relieves entrapping suction and/or shuts down the pump when a blockage is detected [e.g., an SVRS\*] or other technology, in case unanticipated conditions arise that may present an entrapment hazard. Tests should be conducted to verify entrapment does not occur.*

**If an existing pool, spa, or hot tub has a single suction outlet, with or without a skimmer, the following actions are recommended:**

*If conditions allow, rework the suction (drain) system to include either a minimum of two drains per pump with ASME/ANSI A112.19.8 listed covers or drain design configurations that prevent a seal from occurring (large aspect cover), and consider installing a secondary back-up system that relieves the entrapping suction and/or shuts down the pump should an unanticipated condition arise and a blockage occur [e.g., an SVRS\*] or other technology, or*

*Where rework is not possible or practical, ensure that:*

- *an ASME/ANSI A112.19.8 listed cover is in place,*
- *flow through the drain (outlet) grate does not exceed 1.5 feet per second (fps), and*
- *a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected [e.g., an SVRS\*] or other technology is installed.*

**For wading pools that include a fully submerged suction outlet(s), install multiple drains with ASME/ANSI A112.19.8 tested covers and an SVRS\* back-up system or other technology due to the shallow depth of water and easy access to the pool drains. Alternative designs that prevent entrapment hazards from occurring are also acceptable as noted above under new construction.**

\* The device should meet the performance requirements of the ASTM International F2387 and/or ASME/ANSI A112.19.17 standard referenced in Appendix A.

<sup>1</sup> This aspect ratio is currently being considered by the ASME/ANSI A112.19.8 project team and relates to the torso size of a 99<sup>th</sup> percentile male, age 20-65, weighing 244 pounds.

### 3.1 Information on Guideline #1

#### *For new construction:*

*For new construction that includes fully submerged suction outlets, a minimum of two outlets per pump with covers listed and approved in accordance with ASME/ANSI A112.19.8 performance requirements is recommended.*

**Rationale:** Providing multiple outlets from the pool to the suction side of the pump allows flow to continue to the pump and reduces the likelihood of an entrapping suction being generated when a body blocks one of the outlets.

*The use of alternative designs is another recommended option, such as 18" x 23" or larger covers, long channels that cannot be blocked by the body, gravity feed systems, atmospheric vent systems, or engineered, tested, and approved designs that prevent entrapment hazards from occurring, including designs that do not include fully submerged suction outlets.*

**Rationale:** Providing large aspect drain covers or channel type drains that cannot be covered by the body eliminates the potential for a suction entrapment to occur since the water will always have the ability to flow around the body and through the cover. Gravity feed systems remove direct pump suction from the pool by providing a second tank (known as a collector or surge tank – see Appendix C) from which the pump will draw. As the pump removes water from the tank, water from the pool will flow into and replenish the tank due to atmospheric pressure on the surface of the pool. A properly designed atmospheric vent system will introduce air into the pump suction line in the event an outlet is blocked, thus removing the entrapping suction and releasing the victim. Removing submerged drains and relying on an overflow or gutter system to circulate the pool water and strategically placing the water returns throughout the pool to ensure proper chemical circulation completely removes the entrapment hazard.

*Due to care and maintenance concerns associated with circulation systems that include suction outlets and covers, consideration should be given to the installation of a back-up system that relieves entrapping suction and/or shuts down the pump when a blockage is detected [e.g., an SVRS] or other technology in case unanticipated conditions arise that may present an entrapment hazard. Tests should be conducted to verify entrapment does not occur.*

**Rationale:** With options that include submerged outlets, consideration should be given to the installation of a back-up system that relieves entrapping suction and/or shuts down the pump when a blockage is detected [e.g., an SVRS] or other technology in case unanticipated conditions arise that may present an entrapment hazard. Data indicates that entrapment tends to occur where the wrong cover is used, missing or broken covers exist, and in some instances, a lack of proper maintenance procedures has left multiple drain configurations inoperative. There is also the potential for inadvertently blocking or disabling drains in a multi-drain system, which can present an unseen entrapment hazard to users.

#### *In existing pools, spas, and/or hot tubs:*

*If an existing pool, spa, or hot tub has a single suction outlet, with or without a skimmer, the following actions are recommended:*

*if conditions allow, rework the suction (drain) system to include either a minimum of two drains per pump with ASME/ANSI A112.19.8 listed covers or drain design configurations that prevent a seal from occurring (large aspect cover), and consider installing a secondary back-up system that relieves the entrapping suction and/or shuts down the pump should an unanticipated condition arise and a blockage occur [e.g., an SVRS] or other technology, or*

*Where rework is not possible or practical, ensure that:*

- an ASME/ANSI A112.19.8 listed cover is in place*
- flow through the drain (outlet) grate does not exceed 1.5 feet per second (fps), and*
- a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected [e.g., an SVRS] or other technology is installed.*

**Rationale:** Providing multiple outlets from the pool to the suction side of the pump allows flow to continue to the pump and reduces the likelihood of an entrapping suction being generated when a body blocks one of the outlets. Large aspect covers (e.g., 18" x 23"), long channels that cannot be blocked by the body, conversion to a gravity feed/collector tank system, or an engineered, tested and approved design that prevents entrapment hazards from occurring, including designs that remove a fully submerged suction outlet, are also acceptable.

While multiple drains or an alternate drain configuration providing entrapment avoidance are preferable solutions, it is recognized that rework may not always be a practical solution and a pool/spa owner may choose to install a back-up system rather than structurally renovate the pool/spa. As explained previously, consideration should be given to the installation of a back-up system that relieves entrapping suction and/or shuts down the pump when a blockage is detected (e.g., an SVRS) or other technology capable of recognizing a potentially hazardous situation in case unanticipated conditions arise that may present an entrapment hazard. This is especially important in wading pools and older pools with single main drains. Given the resources required to reconstruct the drain system and the difficulty in modifying a vinyl liner (complete replacement may be required) or altering a fiberglass shell, a secondary system that works with existing configurations may be desirable until time and funds are available to make permanent renovations. In some cases, environmental conditions might exist that preclude the renovation of a drain system. The inclusion of a back-up system 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.

### ***Wading Pools:***

*For wading pools that include a fully submerged suction outlet(s), install multiple drains with ASME/ANSI A112.19.8 tested covers and an SVRS back-up system or other technology due to*

*the shallow depth of water and easy access to the pool drains. Alternative designs that prevent entrapment hazards from occurring are also acceptable (as noted under new construction).*

**Rationale:** 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 to prevent the entrainment of air into the suction line), 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.

***Additional Entrapment Avoidance Information:***

There are several approaches available if a pool owner chooses to rework the drain system. These include the use of multiple drains or channels, the use of a larger suction area, a gravity fed circulation system, or atmospheric vents included in the circulation system. These options are discussed in greater detail in Appendix B.

First and foremost, a proper drain cover [with an ASME/ANSI A112.19.8 rating to address hair entrapment (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] should be installed. Additionally, a sensing device that detects an increased suction associated with blockage and relieves the entrapping suction should be considered, especially in the case of a single drain. 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.

In the case of body entrapment, the removal of the suction in the line between the pump and a blocked outlet 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 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. The presence of a check valve in existing pools and spas may render an SVRS device ineffective. The manufacturer's installation instructions should be consulted prior to the installation of the SVRS (or other technology) device. For new construction where a check valve is necessary due to elevation differences, the circulation system design should include considerations for entrapment avoidance.

In the case of evisceration/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 may 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 or other technology, 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.

**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 safety back-up system that monitors the function of drain outlet/circulation systems and relieves suction forces in the event of entrapment should be **seriously considered**.

For existing pools and spas where water depths are over four feet, a back-up system should be installed where a single drain currently exists, or a drain can become single upon activation of valves or as result of poor maintenance, 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, install a back-up system to monitor the drain function. In addition, the flow through the outlet grate should be limited to 1.5 feet per second (fps) 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 A112.19.8 requirements (for hair entrapment). 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.

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 person would need to be present to activate the switch.*

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**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.***

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**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 can 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 should be made to achieve this match.

**Additional 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 A112.19.8 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 the quality and inspection 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 ensure 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.

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).

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### ***Guideline #3***

***Develop a comprehensive maintenance program for each facility. A checklist is provided in Section 5. to help implement this program. The maintenance program should address the following to avoid entrapment hazards:***

- a. If the drain cover or grate is cracked, 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-corroding 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).*
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### **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.

**Additional 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. For hair entrapment, or entanglement, the ability to remove the victim depends on how quickly the hair can be removed, pulled, or cut from the outlet cover. With this in mind, a pair of scissors or a knife located in a First Aid kit or in close proximity to the outlet cover area (lifeguard stand, equipment room, office, etc.) should be considered.

Inspections alone do not constitute a comprehensive safety and maintenance program. Personnel conducting the inspections (pool operators, lifeguards, etc.) should also be made aware of the potential for entrapment hazards and the procedures necessary to perform a rescue. 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 incidents 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. SUMMARY OF GUIDELINES #1, #2, and #3

##### *Guideline #1*

**For new construction that includes fully submerged suction outlets, a minimum of two outlets per pump, with pipe centers at least 3 feet apart, is one approach to reduce the likelihood of entrapment. Outlet covers listed and approved in accordance with ASME/ANSI A112.19.8 performance requirements are recommended.**

*The use of alternative designs is another recommended option, such as 18" x 23"<sup>1</sup> or larger covers, long channels that cannot be blocked by the body, gravity feed systems, atmospheric vent systems, or engineered, tested, and approved designs that prevent entrapment hazards from occurring, including designs that do not include fully submerged suction outlets (see Appendix B).*

*Due to care and maintenance concerns associated with circulation systems that include suction outlets and covers, consideration should be given to the installation of a back-up system that relieves entrapping suction and/or shuts down the pump when a blockage is detected [e.g., an SVRS\*] or other technology in case unanticipated conditions arise that may present an entrapment hazard. Tests should be conducted to verify entrapment does not occur.*

**If an existing pool, spa, or hot tub has a single suction outlet, with or without a skimmer, the following actions are recommended:**

*if conditions allow, rework the suction (drain) system to include either a minimum of two drains per pump with ASME/ANSI A112.19.8 listed covers or drain design configurations that prevent a seal from occurring (large aspect cover), and consider installing a secondary back-up system that relieves the entrapping suction and/or shuts down the pump should an unanticipated condition arise and a blockage occurs [e.g., an SVRS\*] or other technology, or*

*Where rework is not possible or practical, ensure that:*

- an ASME/ANSI A112.19.8 listed cover is in place
- flow through the drain (outlet) grate does not exceed 1.5 feet per second (fps), and
- a secondary back-up system that relieves the entrapping suction and/or shuts down the pump when a blockage is detected [e.g., an SVRS\*] or other technology is installed.

**For wading pools that include a fully submerged suction outlet(s), install multiple drains with ASME/ANSI A112.19.8 tested covers and an SVRS\* back-up system or other technology due to the shallow depth of water and easy access to the pool drains. Alternative designs that prevent entrapment hazards from occurring are also acceptable as noted above under new construction.**

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\* The device should meet the performance requirements of the ASTM International F2387 and/or ASME/ANSI A112.19.17 standard referenced in Appendix A.

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<sup>1</sup> This aspect ratio is currently being considered by the ASME/ANSI A112.19.8 project team and relates to the torso size of a 99<sup>th</sup> percentile male, age 20-65, weighing 244 pounds.

##### **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 in Section 5. to help implement this program. The maintenance program should address the following:*

- a. If the drain cover or grate is cracked, 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-corroding 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).*

## 5. POOL AND SPA ENTRAPMENT HAZARDS CHECKLIST

Pool Name:	Date:
	Completed by:
	Pool Builder:
<b>Items to be Checked in Filter Room and Pool Before Filling and After Periodic Maintenance and Cleaning Procedures</b>	
<input type="checkbox"/> Proper suction drain covers installed and inspected for breakage (main & wading pools – covers should be labeled in accordance with ASME/ANSI A112.19.8)	
<input type="checkbox"/> Suction drain covers firmly and properly affixed using manufacturer's recommended parts <input type="checkbox"/> If applicable, SVRS or other device tested and operational according to the manufacturer's instructions	
<input type="checkbox"/> Proper return covers installed (main & wading pools)	
<input type="checkbox"/> Skimmers checked (baskets, weirs, lids & flow adjustors) for blockage	
<input type="checkbox"/> All skimmer throats checked for blockage (main & wading pools)	
<input type="checkbox"/> All valves and filter lines labeled and functional	
<input type="checkbox"/> Vacuum covers or fittings in place (if applicable)	
<input type="checkbox"/> Location of the On/Off switch to circulation pump clearly and conspicuously identified	
<input type="checkbox"/> On/Off switch to circulation pump clearly and conspicuously labeled	
<b>Daily Checklist</b>	
<input type="checkbox"/> Main drain, vacuum, inlet covers and/or fittings in place, secured and unbroken ( <b>hourly</b> ) (main & wading pools)	
<input type="checkbox"/> Skimmers checked (baskets, weirs, lids & flow adjustors) for blockage ( <b>hourly</b> ) (main & wading pools)	
<input type="checkbox"/> Warning/alert signs in place around the pool with emergency instructions and phone numbers	
<input type="checkbox"/> On/Off switch to pump clearly and conspicuously 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. Addendum October 6, 2004.
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 A112.19.8.**

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-1-2003 Standard for Public Swimming Pools**

**ANSI/NSPI-2-1999 Standard for Public Spas**

**ANSI/NSPI-3-1999 Standard for Permanently Installed Residential Spas**

**ANSI/NSPI-4-1992 Standard for Aboveground/Onground Residential Swimming Pools**

**ANSI/NSPI-5-2003 Standard for Residential Swimming Pools**

**ANSI/NSPI-6-1999 Standard for Residential Portable Spas**

**NSPI-7 Standard Entrapment Avoidance for Pool, Spa and Hot Tub Circulation System (In Progress)**

**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:  
**Association of Pool and Spa Professionals (APSP) formerly,  
National Spa and Pool Institute  
2111 Eisenhower Avenue  
Alexandria VA 22314  
(703) 838-0083  
www.theapsp.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 Specification for Manufactured Safety Vacuum Release Systems (SVRS) for Swimming Pools, Spas and Hot Tubs – ASTM International F2387.**

Sponsor:  
**ASTM International**  
**100 Barr Harbor Drive**  
**West Conshohocken, PA 19428**  
[www.astm.org](http://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](http://www.nfpa.org)

**Code: International Building Code (IBC)**  
**International Residential Code (IRC)**

Sponsor:  
**International Code Council (ICC)**  
**5203 Leesburg Pike**  
**Suite 600**  
**Falls Church VA 22041**  
[www.iccsafe.org](http://www.iccsafe.org)

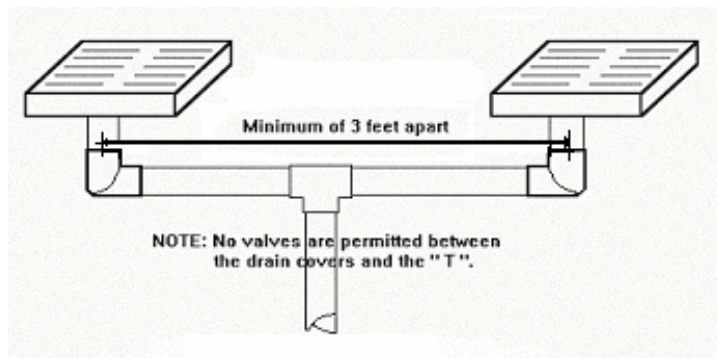
# **Appendix B**

## **General Entrapment Avoidance Information**

## B.1 Multiple Drains

Your pool maintenance professional may recommend completely reworking the suction outlet (drain) system. This may involve a major construction effort around the drain section of the pool and could involve providing two or more suction drains 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 substantial entrapping forces created in the blocked drain. The main supposition in this configuration is that both drains are properly plumbed, maintained, and free from any debris behind the cover that may reduce flow on one leg of the configuration.



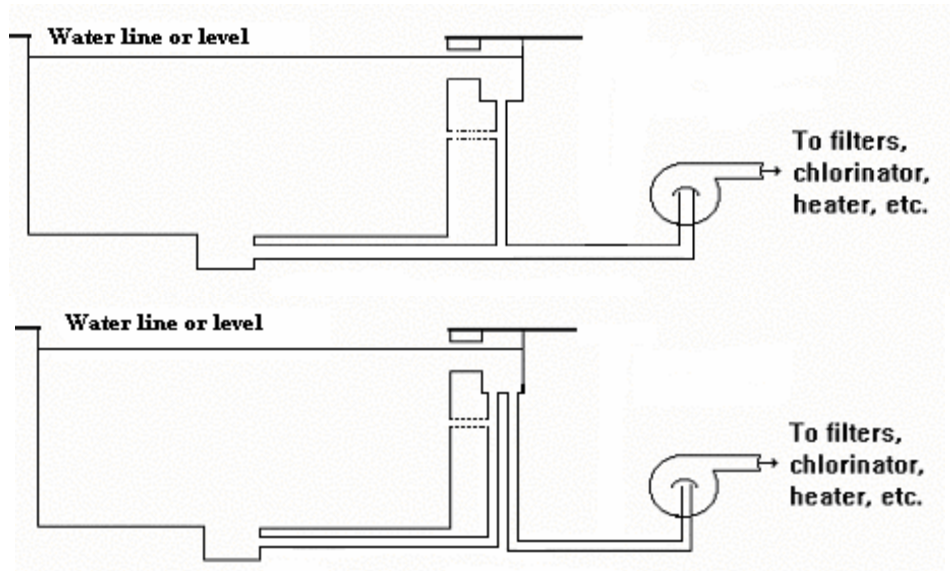
**Figure 1. Dual Drain System**

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 has accepted a single drain and skimmer line combination as long as neither can be isolated. However, beginning in April 2006, the state will be requiring both a safety vacuum release system (SVRS) and an anti-entrapment drain cover on all remaining single-drain pools. 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) 715-0924.

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, but this depends on the plumbing configuration (See Figure 2). Some plumbing configurations may provide better entrapment prevention by removing direct suction from 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.



**Figure 2. Skimmer Line Plumbing Options**  
 (Note: an equalizer line may or may not be present on the skimmer)

## B.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 3). 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. Providing a large drain cover, similar to 18" x 23", or one whose diagonal measurement is at least 24 inches (18" x 18" or 6' x 24"), can also reduce the likelihood of entrapment. These measurements provide drain (outlet) covers that should be large enough to prevent a body seal and thus body entrapment (based on the 99<sup>th</sup> percentile, 20-65 year-old male). 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 3. Alternate Drain Configurations**

## B.3 Assessment of Multiple Drain and Channel Systems

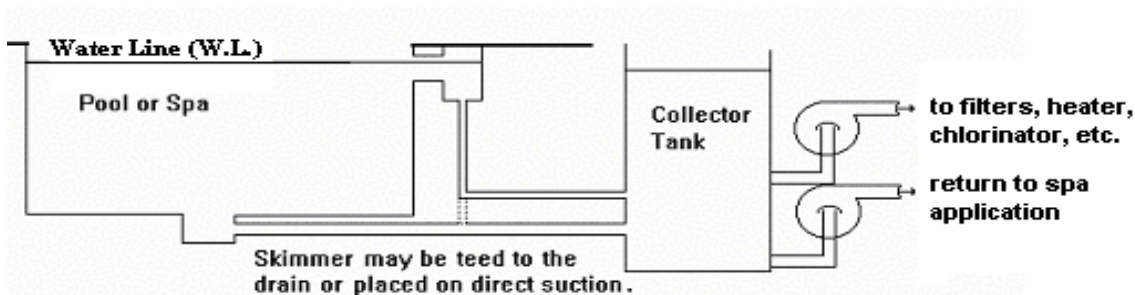
A multiple drain system, channel drain system, or large drain cover (diagonal greater than 24 inches) can greatly reduce the likelihood of body entrapment and subsequent drowning. In tests conducted by the National Swimming Pool Foundation (NSPF) on a multiple drain system similar to that shown in Figure 1, results indicated that no significant 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 listed 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" minimal-diagonal-measurement 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.

#### B.4 Gravity Feed and Vent 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, or surge, tank. The tank collects water from the pool or spa and the suction side of the pump(s) then draws water from the tank rather than the pool or spa (Figure 4). 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

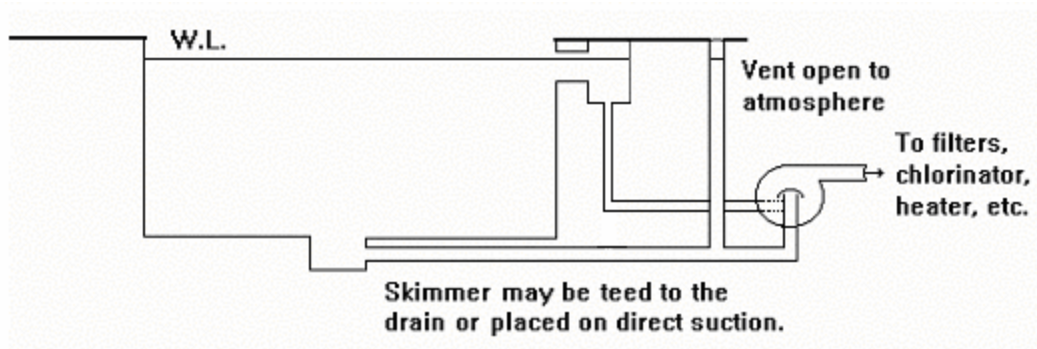


**Figure 4. Gravity Feed System – Direct Suction Removed from the Pool**

The use of an atmospheric vent may remove suction from the main drain or skimmer in case a blockage should occur. The vent would be connected to the main suction line between the outlet drain and the pump and would be open to the atmosphere (Figure 5). Similar to the principle behind the gravity feed system, the vent pipe 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 pipe until air is introduced into the circulation system and the suction is

broken (the pump loses prime). A point of contact for further information on the implementation of atmospheric vents is:

Carvin DiGiovanni, of the *Association of Pool and Spa Professionals*, (703) 838-0083



**Figure 5. Vent System to Relieve Main Drain Suction**

### **B.5 Assessment of Gravity Feed and Vent Stack Systems**

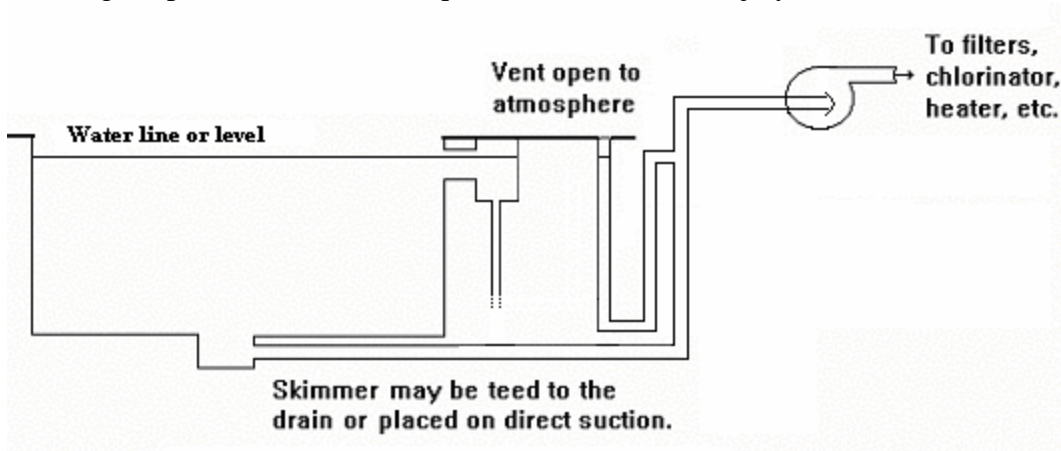
The use of these gravity systems may reduce the likelihood of suction entrapment because direct suction at the main drain has been removed. The collector tank (or surge tank) is generally located near the equipment and is covered, but remains open to atmosphere. If a blockage occurs at the drain, water will be drawn from the tank until air is introduced into the suction line, but no direct suction is ever applied to the main drain.

Earlier concerns surrounding the ability to keep atmospheric vent systems clean of algae and other biological contaminants have been addressed through observation. An ASTM International voluntary standards task group is currently developing minimum requirements for field-fabricated vent pipes. The performance of the vent, the ability to prevent obstructions from occurring within the vent, and a test procedure are being addressed. 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 the vent location, 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.

To address concern about residual suction effects (water pressure) that may continue to hold an entrapped victim on the drain, even after the initial pump suction has been relieved, the 'hydraulically balanced' concept for a vent system has been discussed (See Figure 6) during ASTM International voluntary standards task group meetings. In the event of a blockage at the main drain, air would be drawn through the vent and into the suction line, effectively breaking the suction of the pump. The principle of this design is that the remaining water column in the drain line would be nearly equal in height to that in the pool, thus equalizing the pressure at the main drain and allowing a user to readily remove himself from the drain.

The extent to which the water pressure in a pool will hold a user to the main drain with an atmospheric vent line installed as illustrated in Figure 5 has not yet been established. Systems such as Figure 5 are currently installed in Florida and CPSC is not aware of any reported incidents.

Manufactured vent pipe designs exist that are independent of the pool depth. The effectiveness of either of these vent pipe designs against disembowelment injuries is not known because of the lack of data surrounding the pressure differential required to cause such an injury.



**Figure 6. Hydraulically Balanced Vent System**

# **Appendix C**

## **GLOSSARY**

**ANSI**

American National Standards Institute.

**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.

**APSP**

Association of Pool and Spa Professionals, formerly the National Spa and Pool Institute.

**ASME**

American Society of Mechanical Engineers.

**Atmospheric vent**

Pipe teed to the suction side of the circulation system and open to the atmosphere at the opposite end. The pipe is full of water equal to the same height as the pool and drains when a blockage occurs at the main drain; thus introducing air into the suction line.

**Backflow**

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

**Centrifugal Pump**

A pump to circulate water using an impeller fixed on a rotating shaft having an inlet and a discharge connection. The rotating impeller creates centrifugal force causing flow (suction) into the pump and pressure exiting the pump.

**Check Valve**

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

**Collector Tank**

A water storage vessel within the pool circulation system used to collect water displaced by bathers. The pool circulation pump draws water from this tank, thus removing direct suction from the pool. Also referred to as a Reservoir, Surge Tank or Surge Pit.

**Drain**

This term usually refers to a plumbing fitting installed on the suction side of the pump in 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.

**Equalizer**

A pipe line below the pool water surface, usually on the side wall, connected to the body of a skimmer that prevents air from being drawn into the pump. The pipe line can also be used between two pools/spas to equalize water levels.

**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.

### **Gravity Feed**

Circulation of water based on pressure equalization, water seeking an equal level, between a pool or spa and a collection or surge, tank. Flow is initiated, under gravity, due to atmospheric pressure and a difference in water height between the pool and surge tank created by the suction side of the pump drawing water from the tank rather than the pool or spa.

### **Gutter**

An overflow trough in the perimeter wall of a pool that is a component of the circulation system or flows to waste.

### **Hot Tub/Spa**

A warm water reservoir, manufactured from prefabricated materials at a factory with hydromassage jets. A portable hot tub/spa may be constructed of acrylic thermoplastic or fiberglass surrounded by within a cabinet of wood, wood alternative or thermoplastic. All the control, water heating, water circulating equipment are contained within the unit.

### **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.

### **in Hg**

Unit of measure for vacuum – Inches of Mercury

### **Inlet**

A fitting in the pool or spa on the water return line from the equipment where water returns to the pool; also known as a return.

### **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.

**NSPF**

National Swimming Pool Foundation.

**NSPI**

National Spa and Pool Institute (see APSP).

**psi**

An abbreviation for pounds per square inch, typically used to define a level of water or air pressure.

**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.

**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).

**Reservoir**

See Collector Tank

**Skimmer**

A device installed through the wall of a pool or spa at the water surface 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, constructed out of concrete (gunite, shotcrete, etc.) with hydromassage jets. Spas may or may not be attached to a pool. Heating and circulation equipment are not an integral part of the product. (See hot tub)

**Suction Outlet**

Any 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.

**Surge Tank (Surge Pit)**

See Collector Tank

**SVRS**

Safety Vacuum Release System – Device that senses an increase in pump suction and responds by removing power to the pump(s) and/or relieving the potentially entrapping suction.

**System Flow**

See Turnover

**Tee**

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

**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.

**Vacuum**

1). 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 or brushes that attaches to a telescoping pole and is connected to the suction line with a hose 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. 2). The reduction of atmospheric pressure within a pipe, tank, pump, or other vessel. Vacuum is measured in inches of mercury (in. Hg).

**Water Velocity (piping)**

The speed at which the water flows between two specified points, measured in feet per second (fps).

**Weir**

Also called skimmer weir – the part of a skimmer that adjusts 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.