

ANSI/APSP-7 2006



APSP

*The Association of
Pool & Spa Professionals™*



**American National Standard
for Suction Entrapment Avoidance
in Swimming Pools, Wading Pools, Spas,
Hot Tubs, and Catch Basins**



**ANSI
APSP-7 2006**

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For Suction Entrapment Avoidance in
Swimming Pools, Wading Pools, Spas, Hot Tubs, and Catch Basins

Sponsor

The Association of Pool and Spa Professionals

Approved September 11, 2006

American National Standards Institute, Inc.

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The Association of Pool and Spa Professionals, 2111 Eisenhower Avenue, Alexandria, VA 22314

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Foreword

(This Foreword is not part of American National Standard ANSI/ APSP-7 2006)

The ANSI/APSP-7 2006, *Standard for suction entrapment avoidance in swimming pools, wading pools, spas, hot tubs, and catch basins*, was approved by ANSI September 11, 2006, as a new standard.

The objective of this voluntary standard is to provide recommended minimum guidelines for suction entrapment avoidance in the design, equipment, operation, and installation of new and existing swimming pools, wading pools, spas, hot tubs, and catch basins for builders, installers, pool operators, and service professionals. It is intended to meet the needs for incorporation into national or regional building codes, and also for adoption by state and/or local municipalities as a local code or ordinance. It is understood that for the sake of applicability and enforceability, the style and format of the standard may need adjustment to meet code or ordinance style of the jurisdiction adopting this document.

The design recommendations and construction practices in this standard are based upon sound engineering principles, research, and field experience that, when applied properly, contribute to the delivery and installation of a safe product.

The words “safe” and “safety” are not absolutes. While the goals of this standard are to design and construct a safe, enjoyable product, it is recognized that risk factors cannot, as a practical matter, be reduced to zero in any human activity. This standard does not replace the need for good judgment and personal responsibility. In permitting use of the pool or spa by others, owners must consider the skill, attitude, training, and experience of the expected user.

As with any product, the specific recommendations for installation and use provided by the manufacturer should be carefully observed.

This standard was prepared by the APSP-7 Suction Entrapment Avoidance Standard Writing Committee of the Association of Pool and Spa Professionals (APSP) in accordance with American National Standards Institute (ANSI) *Essential Requirements: Due process requirements for American National Standards*.

Consensus approval was achieved by a ballot of the balanced ANSI Consensus Voting Body below and through an ANSI Public Review process. The ANSI Public Review provided an opportunity for additional input from industry, academia, regulatory agencies, safety experts, state code and health officials, and the public at large.

Suggestions for improvement of this standard should be sent to the Association of Pool and Spa Professionals, 2111 Eisenhower Avenue, Alexandria, VA 22314.

Inclusion in this list does not necessarily imply that the organization concurred with the submittal of the proposed standard to ANSI.

ANSI Consensus Voting Body

Consensus approval in accordance with ANSI procedures was achieved by ballot of the following ANSI consensus voting body. Inclusion in this list does not necessarily imply that the organization concurred with the submittal of the proposed standard to ANSI.

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Introduction

Suction entrapment has seen increased attention in the media and in legislative actions. Annual reported entrapment events to The Consumer Product Safety Commission (CPSC) are shown to be declining despite the increase of millions of residential and commercial pools.

Because the consumer and regulatory agencies may be unaware of the hazards associated with suction outlets in swimming pools and spas, APSP has pursued, since the early 1980s, the development of ANSI voluntary consensus standards for the United States that include new warnings and better-defined performance criteria for suction outlet entrapment as well as construction methods that decrease the chance of suction entrapment. In addition, the CPSC released its 1996 and 2005 “Guideline for Entrapment Hazards: Making Pools and Spas Safer.” APSP references other standards and government guidelines on suction entrapment avoidance.

Based upon a review of the reported cases of injury or death, solicitation of the industry, and through open forums on entrapment issues, 5 potential categories of hazards have been identified that are associated with suction outlets in a circulation system.

- Hair entrapment – Hair becomes knotted or snagged in an outlet cover.
- Limb entrapment – A limb sucked or inserted into an opening of a circulation outlet with a broken or missing cover in the pool resulting in a mechanical bind or swelling.
- Body suction entrapment – Suction applied to a large portion of the body or limbs resulting in an entrapment.

- Evisceration/disembowelment – Suction applied directly to the intestines through an unprotected sump or suction outlet with a missing or broken cover.
- Mechanical entrapment – Potential for jewelry, swimsuit, hair decorations, finger, toe or knuckle to be caught in an opening of an outlet or cover.

Complication arises from conflicting solutions for these different forms of entrapment. For example, the suction outlet cover that prevents limb entrapment can cause hair entrapment. This has become confusing for local building officials and even state regulatory agencies, because specific safety devices and/or piping configurations are often perceived as complete entrapment solutions when in fact, they may address one or more, but not all, of the hazards. These devices and/or piping systems are a critical part of a total solution, but future legislation, codes and standards must not be centered on a particular device or system. It must be noted that there is one overriding conclusion that is inescapable; there is no “back up” for a missing suction outlet cover. If any suction outlet cover is found to be damaged or missing, the pool/spa must be closed to bathers immediately.

Legislation, codes, and standards should be written to allow all valid engineering solutions based on performance criteria.

This standard was written to move toward performance-criteria for each identified hazard and allow state authorities to define clear codes for use by designers, builders, and inspectors.

ANSI/APSP-7 2006

Standard for Suction Entrapment Avoidance in Swimming Pools, Wading Pools, Spas, Hot Tubs, and Catch Basins

1 Scope

1.1 General. This standard covers design and performance criteria for circulation systems including components, devices, and related technology installed to protect against entrapment hazards in residential and public swimming pools, wading pools, spas, hot tubs, and catch basins, hereinafter referred to as “pools and spas.”

This standard applies to new and, when retrofitting, existing installations. (See Appendix B.)

1.2 Alternative methods. The provisions of this standard are not intended to prevent the use of any alternative material, system, or method of construction, provided any such alternative meets the intent and requirements of this standard and is approved by the authority having jurisdiction.

1.3 Exception. Commercial water parks and their associated suction systems are outside the scope of the standard.

2 Normative references

The following standards contain provisions that, through reference in this text, constitute provisions of this standard.

ANSI/ASME A112.19.8 1987 (reaffirmed 1996), *Suction fittings for swimming and wading pools, spas, hot tubs and whirlpool bathtub appliances.*¹

¹ American Society of Mechanical Engineers (ASME), 3 Park Avenue, 20th Floor, New York, NY 10016, (212) 591-8562, www.asme.org

ANSI/ASME A112.19.17-2002, *Manufactured safety vacuum release systems (SVRS) for residential and commercial swimming pool, spa, hot tub and wading pool suction systems.*²

ASTM F 2387-04, *Standard specification for manufactured safety vacuum release systems, swimming pools, spas and hot tubs.*³

IAPMO SPS-4 2000, *Special use suction fittings for swimming pools, spas and hot tubs (for suction side automatic swimming pool cleaners).*⁴

NFPA 70 – 2005, *National electrical code*, Article 680, Swimming pools, fountains, and similar installations.⁵

3 Definitions

3.1 alternative method: A substitute way of achieving the same goal or purpose.

3.2 anti-entrapment cover: See LISTED SUCTION OUTLET COVER/GRATE.

3.3 anti-vortex cover: An outlet cover designed to prevent air entrainment from the surface of the water. This term is no longer used to describe LISTED SUCTION OUTLET COVER/GRATE.

3.4 approved safety outlet cover: See LISTED SUCTION OUTLET COVER/GRATE.

3.5 branch piping: **1.** multiple suction outlet covers/grates: all pipe and fittings, including the tee, located between covers/grates and the single suction pipe feeding the pump or pumps. (See figure 1 and figures 4 – 10.) **2.** sumps in series: all pipe and fittings between the first sump and a

² ASME, previously listed

³ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428, (610)832-9500, www.astm.org

⁴ International Association of Plumbing and Mechanical Officials (IAPMO), 5001 E. Philadelphia St., Ontario, CA 91761, (909) 472-4100, www.iapmo.org

⁵ National Fire Protection Association (NFPA) 1 Batterymarch Park, Quincy, MA 02169-7471, (617) 770-3000, www.nfpa.org

required option of 5.9.1 through 5.9.3. (See figure 14.)

3.6 catch basin: A body of water supplied by gravity overflow from another pool. This is different from the terminology in storm water drainage.

3.7 catch pool: The pool at the discharge of a waterslide or similar aquatic facility.

3.8 CAUTION: Indicates a potentially hazardous situation that, if not avoided, could result in minor or moderate injury. It may also be used to alert against unsafe practices.

3.9 certified safety outlet cover: See LISTED SUCTION OUTLET COVER/GRATE.

3.10 check valve: A mechanical device in a pipe that permits the flow of water in one direction only.

3.11 DANGER: Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

3.12 debris removal system: A system comprised of a large opening suction outlet, large diameter pipe and a debris collection basket, typically located in the deck or the pump basket. Because of unique challenges passing debris through the drain cover and suction piping, these systems are designed specifically for debris removal and are commonly sold as kits with detailed installation requirements to address suction safety.

3.13 drain: an obsolete term for suction outlet, which is a fitting, fitting assembly, cover/grate, and related components that provide a localized low pressure area for the transfer of water from a swimming pool, wading pool, spa, or hot tub.

3.14 drawdown: Drawdown is the decrease of water level in a vented reservoir from the rest condition to operating condition.

3.15 equalizer line: **1.** A pipe with a listed suction outlet cover/grate located below the waterline and connected to the body of a skimmer to prevent air from being drawn into the pump if the water level drops below the skimmer weir. **2.** A

pipe connecting two bodies of water to equalize water levels.

3.16 feet of head: The resistance in a hydraulic system based on the equivalent to the height of a column of water that causes the same resistance (100 feet of head equals 43 pounds per square inch).

3.17 flow rate: The quantity of water flowing through a pipe within a specified time, such as the number of gallons flowing past a point in one minute; abbreviated as GPM or liters/minute, Lpm (1 GPM = 3.7854 L/min).

3.18 flow rating: The maximum allowable flow rate through a cover/grate.

3.19 GPD, GPH, GPM: Abbreviations for gallons per day, hour, and minute.

3.20 gutter: Overflow trough at the perimeter wall of a pool or at the bottom of a vanishing edge wall of a pool that is a component of the circulation system or flows to waste.

3.21 hydrostatic valve: A relief valve to allow rising groundwater to enter an empty pool to prevent flotation.

3.22 inches of mercury (in Hg): Traditional units of measuring pressure below atmospheric ("suction" or "vacuum") (1.0 inch Hg = 0.4912 psi). See psi.

3.23 inlet: See RETURN INLET.

3.24 listed/listing: The published certification by a nationally recognized testing laboratory that a device, system, or alternate method has been tested and certified to be in conformance with the full intent of a standard.

3.25 listed safety cover: See LISTED SUCTION OUTLET COVER/GRATE.

3.26 listed suction outlet cover/grate – Manufactured: A suction outlet cover/grate that has been tested, certified, and listed by a nationally recognized testing laboratory in accordance with the most recent edition of ANSI/ASME A112.19.8 *Suction fittings for swimming and wading pools, spas, hot tubs and whirlpool bathtub appliances.*

3.27 listed SVRS: A manufactured safety vacuum release system tested and certified by a nationally recognized testing laboratory in accordance with ANSI/ASME A112.19.17 or ASTM F 2387-04 cited in Normative References.

3.28 main drain: See DRAIN.

3.29 manifold: A branch pipe arrangement that connects several influent pipes into one chamber or pump or one chamber into several effluent pipes.

3.30 maximum allowable flow rate: See FLOW RATING, COVER/GRATE.

3.31 maximum pump capacity: The maximum flow capacity may be determined by one of the following methods:

- Simplified TDH Calculation (see definition); or
- The maximum flow possible by a pump(s) as indicated on the manufacturer’s pump curve.

Notice: The flow condition of this method will likely be outside the pump’s recommended operating range and shall be used only in the absence of a Simplified TDH Calculation.

3.32 maximum system flow rate: The flow resulting from the lowest possible total dynamic head (TDH) for a circulation system.

3.33 operating point: The condition at which the pump will operate. It is the intersection of the pump curve and system curve.

3.34 overflow pipe: See STANDPIPE.

3.35 overflow system: An outlet with flow across a fixed or movable weir and where there is a free surface interface with atmosphere.

3.36 parallel: A piping arrangement allowing flow through multiple paths.

3.37 properly: According to the manufacturers’ instructions or to workmanlike practices as taught in vocational schools.

3.38 psi: An abbreviation for pounds per square inch.

3.39 pump: A mechanical device, usually powered by an electric motor, that 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.

3.40 pump curve: Also called the pump performance curve. A graph that represents the pressure rise of a pump plotted against flow rate. See SYSTEM CURVE AND OPERATING POINT.

3.41 purpose: Where used, the phrase “tested and listed for the purpose” shall require the device, system, or alternative method to be tested and certified by a nationally recognized testing laboratory, or a licensed professional engineer, as performing the required function(s) in accordance with the referenced standard.

3.42 retrofit: The act of adding a component or accessory to the pool and spa that was not part of the original installation — for example, replacing a non-listed suction outlet cover/grate with one that is listed. See also 6.2.

3.43 return inlet: The aperture or fitting through which the water under pressure returns into the pool or spa.

3.44 safety drain cover: See LISTED SUCTION OUTLET COVER/GRATE.

3.45 safety vacuum release system (SVRS): A system capable of providing vacuum release at a suction outlet in case of a high vacuum occurrence due to a suction outlet flow blockage. Methods may include, but are not necessarily limited to, venting the suction line to atmosphere and/or turning off the circulation pump, or reversing the circulation flow.

3.46 simplified TDH calculation: A method of determining the maximum system flow rate using hydraulic calculations based on the lowest possible total dynamic head (TDH) for a circulation system. For example, using the shortest distance between the pool and the pump, omitting the calculations

for fittings/valves, and using the best performance ratings for filters and heaters.

3.47 single outlet, alternative suction systems:

A single listed suction outlet cover/grate and an alternative suction system, including a venturi-driven system, turbine driven system, or any other mechanical means of circulating water without the use of a pump.

3.48 skimmer: A device installed in the wall of a body of water that permits the removal of floating debris and surface water.

3.49 standpipe: Vertical outlet pipe with open top end to control liquid level. OVERFLOW PIPE.

3.50 suction outlet: The term Suction Outlet shall indicate a fitting, fitting assembly, cover/grate, and related components that provide a localized low pressure area for the transfer of water from a swimming pool, wading pool, spa, or hot tub. See also LISTED SUCTION OUTLET COVER/GRATE.

3.51 suction system piping: All piping on the suction side of the system between the pool and the pump.

3.52 sump: The vessel between the suction outlet cover/grate and suction outlet piping. This may be manufactured or field built.

3.53 sumps in series: An arrangement of outlets such that effluent of one sump is influent to another sump. It is commonly used in piping submerged suction outlet(s) to skimmer body(s).

3.54 surface crazing: A network of fine cracks in the surface of a plastic part, such as a cover, grate, or ring.

3.55 swim jet systems with hydrotherapy combination fitting: Combination fitting or fittings that incorporate(s) a suction outlet and inlet designed to move a large volume of water at high velocity in a single direction.

3.56 system curve: A graph that shows the pressure difference required to induce flow through the entire piping system. It is plotted against flow rate.

3.57 TDH: See TOTAL DYNAMIC HEAD.

3.58 tee: A fitting in the shape of a “T” used to connect pipes. The “branch” is perpendicular to the two “run” connections.

3.59 testing: For the purposes of this standard “testing” shall mean the physical activity of performing an evaluation in accordance with the procedures and protocols defined by this standard and/or a referenced standard.

3.60 total dynamic head (TDH): The sum of all resistances in a complete operating system. See FEET OF HEAD.

3.61 vacuum: A condition in which the pressure inside an outlet or suction pipe is lower than atmospheric pressure.

3.62 vanishing edge: A design feature incorporated into a pool wall wherein the water flows over the wall (edge) into a catch gutter or catch pool creating the illusion that the water vanishes.

3.63 vented reservoir: A receptacle or container incorporated as part of a circulation system that is vented to atmosphere and receives water from the pool/spa or water feature by force of gravity, from which the pump draws its water supply. Systems including vented reservoirs are commonly referred to as gravity flow systems, gravity feed systems or gravity drainage systems. Vented reservoirs include but are not limited to the following: catch pools or catch basins, surge tanks, collector tanks, skimmers open to atmosphere, atmospheric vent pipe tees, gutters, overflow gutters, or perimeter gutter systems.

3.64 wall vacuum fitting: A fitting in the wall of a pool intended to provide a point of connection of suction for suction side cleaners.

3.65 WARNING: Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

3.66 water velocity: The speed at which water flows through a pipe, expressed in feet per second (meters per second).

4 General requirements for suction entrapment avoidance systems and components

4.1 Codes. Pools and spas covered by this standard shall be constructed and operated to comply with all local, state, and federal codes governing safety and environmental regulations.

4.2 Electrical components. All associated electrical components installed in and/or adjacent to the circulation system shall comply with the requirements of the *National Electrical Code*, Article 680, Swimming pools, fountains, and similar installations, or the latest revision and any state or local codes.

4.3 DANGER. There is no backup for a missing or damaged suction outlet cover/grate. If any cover/grate is found to be damaged or missing, the pool or spa shall be immediately closed to bathers.

4.4 Water velocity. Water velocity in field-fabricated piping is based on the maximum system flow rate (see 4.4.1). Maximum water velocity in branch suction piping (shown as bold lines in figures 1 – 14) shall be limited to 6 feet per second (fps) (1.829 mps) when one of a pair is blocked. In normal operation then, the branch suction piping velocity is 3 feet per second (0.914 mps). All other suction piping velocities shall be 6 fps (1.829 mps) for public pools or 8 fps (2.438 mps) for residential pools (shown as thin lines in figures 1 through 14).

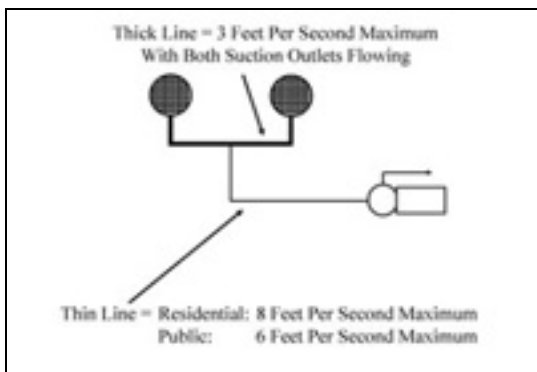


Figure 1 – Pipe velocity

NOTE – In figure 1, each separate line leading to the suction line should be sized to handle the pump's flow at 6 feet per second.

4.4.1 Maximum system flow rate. The maximum system flow rate shall be determined by one of the following:

- TDH calculation for the circulation system of each pump; or
- Simplified TDH calculation (see definition); or
- The maximum flow capacity of the new or replacement pump, which shall be limited by the criteria of 4.4.

4.5 Listed suction outlet(s). Suction outlet covers/grates shall be tested and listed by a nationally recognized testing laboratory as conforming to the most recent edition of ASME/ANSI A112.19.8 and include a permanently marked flow rating tested to prevent hair entrapment. They are not governed by the velocity limitations of 4.4 and 4.6.

4.5.1 Field built sumps. Field built sumps shall be built so that the opening of the suction pipe will be no closer than 1.5 times its inside diameter from the bottom of the listed suction outlet cover/grate.

4.6 Minimum flow rating for each cover/grate. When used, submerged suction outlet arrangements shall be single unblockable, dual, or three-or-more as defined below. All shall be in the same body of water for the purposes of 4.6.1 and 4.6.2.

Table 1 – Flow rating for covers/grates

Number of covers/grates per system	Minimum flow rating of each cover/grate % maximum system flow rate
1	100%
2	100%
3	66.7%
4	50%
5	40%
6	33.3%

4.6.1 Single or dual outlets. The flow rating for each listed cover/grate shall be greater than the maximum system flow as determined in accordance with 4.4.1.

4.6.2 Three or more outlets. For a system with three or more covers/grates, the sum of the flow ratings shall be at least twice the maximum system flow rate as determined in accordance with 4.4.1, or alternatively see table 1.

Example: Two (2) 100 GPM cover/grates and one (1) 60 GPM cover/grate would have an allowable maximum system flow rate of 130 GPM $((100 + 100 + 60) / 2 = 130)$.

4.6.3 Warning: When using table 1 with covers/grates of different flow ratings on the same system, the lowest flow rating shall be used in calculating.

Example: With two (2) cover/grates rated at 100 GPM, and one (1) rated at 80 GPM, the allowable maximum system flow rate is 120 GPM $(80 / .667 = 120)$. (The higher rated cover/grates are not considered.)

4.7 Dual cover/grate separation. Two covers/grates shall be separated by a minimum of 3 feet (914 mm) measured from center to center of suction pipes, (see figures 4, 5, 6, 8, 9, and 10) or located on two (2) different planes; i.e., one (1) on the bottom and one (1) on the vertical wall, or one (1) each on two (2) separate vertical walls. (See figures 7 and 14.)

4.8 Skimmers. Skimmers shall be vented to atmosphere through openings in the lid, or through a separate vent pipe, designed in accordance with 7.2, or incorporate an equalizer line. (See figure 3.)

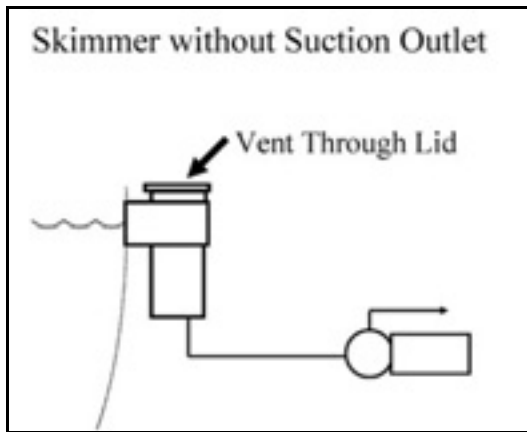


Figure 2 – Skimmer, vent through lid

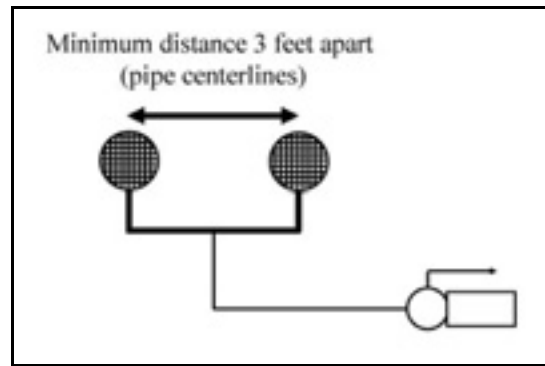


Figure 4 – Dual outlets in parallel to one pump

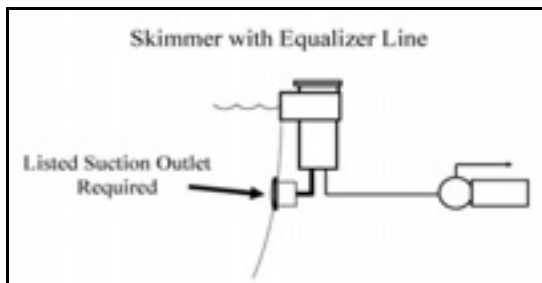


Figure 3 – Skimmer with equalizer

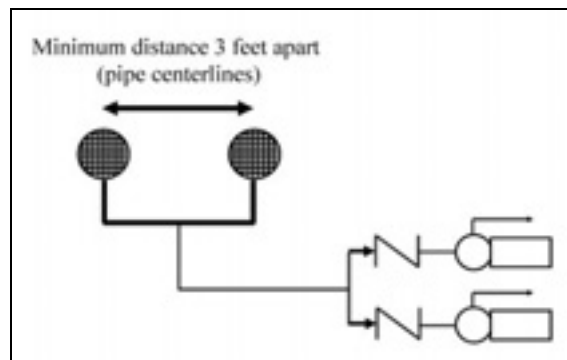


Figure 5 – Dual outlets in parallel to dual pumps in parallel

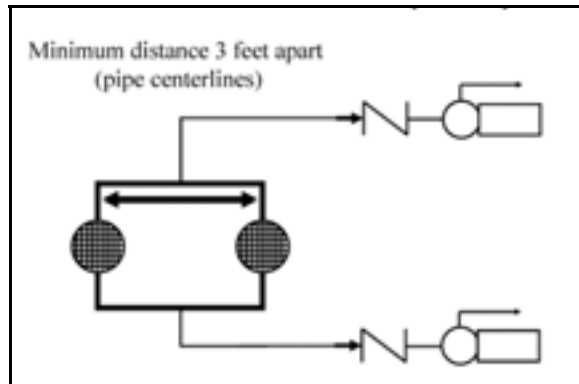


Figure 6 – Parallel dual outlets to two pumps

4.8.1 Skimmer equalizer lines. Skimmer equalizer lines, when used, shall be located on the wall with the center no more than 18 inches (457 mm) below the maximum operating level. It shall be protected by a listed suction outlet cover/grate with a flow rating equal to the maximum system flow divided by the number of skimmers when piped through a common suction line, or the maximum flow rating of the skimmer, whichever is greater. (See figure 3.)

4.9 Wall vacuum fitting(s). When used, vacuum cleaner fitting(s) shall be located in an accessible position(s) at least 6 inches (152 mm) and no greater than 18 inches (457 mm) below the water level and the self closing, self latching fitting shall comply with IAPMO SPS 4 – *Special use suction fitting for swimming pools, spas and hot tubs (for suction side automatic swimming pool cleaners)*. In addition, the vacuum piping shall be equipped with a valve to remain in the closed position when not in use.

5 New construction

5.1 General. Methods to avoid entrapment in circulation systems, swim jet systems, alternative suction systems, and debris removal systems are shown in 5.2 through 5.10.

5.2 Submerged suction outlets are optional. Fully submerged suction outlets (main drains) are not required in pools and spas. Surface skimming or overflow systems shall be permitted to provide 100 percent of the required system flow.

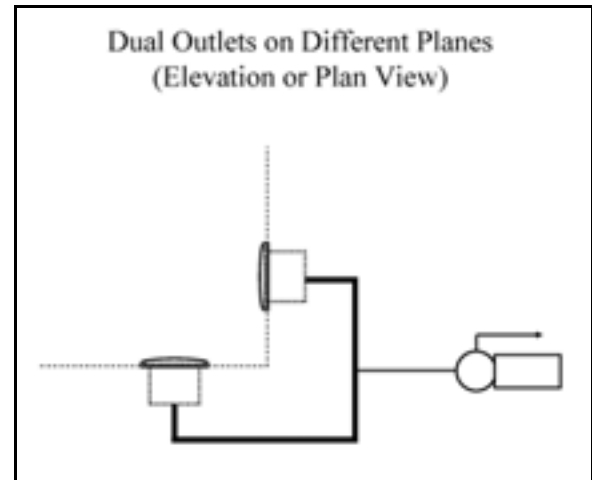


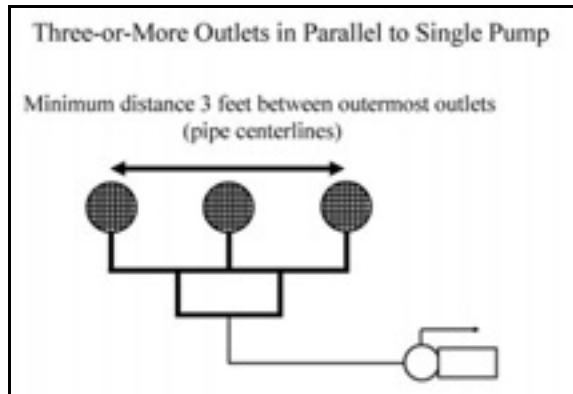
Figure 7 – Dual outlets on different planes

5.3 Dual outlets. Dual-outlets, i.e., two listed suction outlets, are piped to a single, common suction line to the pump(s). The tee feeding from the common line between the suction outlets, to the pump(s) shall be located approximately midway between the outlets with flow out of the branch of the tee. See figures 4, 5, 6, and 7.

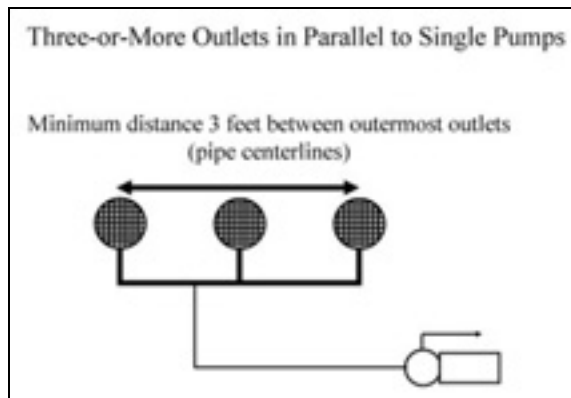
5.3.1 The flow rating of each cover/grate shall be at least equal to the system's maximum flow rate.

5.3.2 Dual outlet separation. Dual outlets shall be separated by a minimum of 3 feet (914 mm) measured from center to center of the suction pipes (see figures 4, 5, and 6) or located on two (2) different planes, i.e., one (1) on the bottom and one (1) on the vertical wall, or one (1) each on two (2) separate vertical walls. (See figures 7 and 14.)

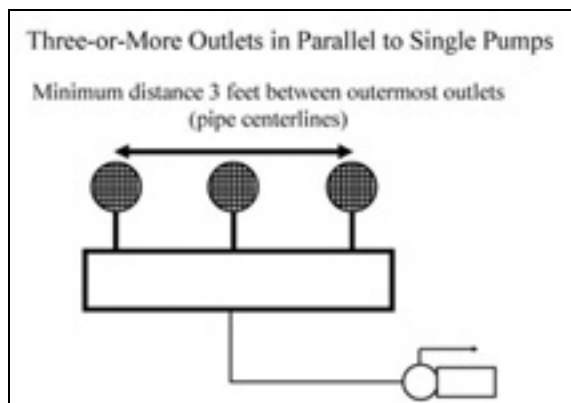
5.4 Three-or-more outlets. Three or more listed suction outlets are piped in parallel. Two of the outlets shall be piped with the tee feeding the suction line to the pump(s) located approximately midway between the two outlets. The additional outlet(s) shall be permitted when piped according to figures 8, 9, or 10.



**Figure 8 – Three or more outlets in parallel
Symmetric piping**



**Figure 9 – Three or more outlets in parallel
Eccentrically tapped piping**



**Figure 10 – Three or more outlets in parallel
Looped piping**

5.4.1 For three or more outlets, the sum of the ratings of the cover/grates shall be at least twice the maximum system flow rate.

5.4.2 Three-or-more outlets are subject to the separation requirement only on the most widely spaced of the group. See figures 8, 9, or 10.

5.5 Single unblockable suction outlet

5.5.1 Single channel outlet. A single listed channel outlet shall be considered acceptable if the size of the perforated area is 3 inches (76 mm) or greater in width and 31 inches (787 mm) or greater in length. (See figures 11 and 12.)

5.5.2 Single unblockable outlet. (See figure 13.) Single unblockable covers shall be of any size and shape such that a representation of the torso of the 99 percentile adult male cannot sufficiently block it to the extent that it creates a body suction entrapment hazard. The torso is represented as a rectangle 18 inches x 23 inches (457 mm x 584 mm) with corners of radius 4 inches (102 mm).

5.6 Single outlet swim jet system. Single outlet swim jet systems consist of a combination fitting that incorporates a suction outlet and inlet in a single housing that is designed to move a large volume of water at high velocity in a single direction. Such systems shall be tested and listed by a nationally recognized testing laboratory as conforming to the most recent edition of ASME/ANSI A112.19.8 and include a permanently marked Flow Rating tested to prevent hair entrapment. They are not governed by the velocity limitations of 4.4.

5.7 Single outlet – alternative suction system. Single outlet–alternative suction systems consist of a single listed suction outlet cover/grate utilizing a venturi-driven system for circulating water. Such systems shall be tested and listed by a nationally recognized testing laboratory as conforming to the most recent edition of ASME/ANSI A112.19.17 and ASTM F 2387-04.

5.8 Gravity flow systems. Flow from a pool or spa to a vented reservoir (see definition) may be partially or fully submerged.

5.8.1 Pumps shall take suction from a vented reservoir rather than directly from the submerged suction outlets.

5.8.2 The vent interface with atmosphere shall be designed or modified to inhibit blockage or infestation and shall be clearly identified to discourage tampering, unless the vented reservoir is an integral part of the swimming pool such as a gutter or catch pool.

5.8.3 The vented reservoir shall be sized to accommodate pump start-up surge unless rated by the manufacturer.

5.8.4 When a manufactured reservoir is used, the connection of submerged suction outlets to the vented reservoir shall be placed in accordance with manufacturer's instructions to limit the drawdown.

5.8.5 Pipe shall be sized to provide the required flow at this drawdown.

5.8.6 Fully submerged gravity outlet(s). Fully submerged outlets in a gravity system shall be in accordance with 5.3, 5.4, or 5.5 and shall have a listed cover/grate(s) in accordance with 4.6.

5.8.7 Partially submerged gravity outlet. Partially submerged gravity outlets shall have a listed cover/grate in accordance with 4.6. **Exception:** Skimmers are not required to have a Listed cover/grate in accordance with 4.6.

5.8.7.1 WARNING!

Unprotected overflow pipe (standpipe) outlets, another way to hold a minimum water level, pose a risk to bathers and shall not be used in pools and spas intended to be bather accessible.

5.9 Outlet sumps in series. Two manufactured sumps or field-fabricated sumps, with listed suction outlet covers/grates, piped in series, are typically intended for debris removal. Between the debris suction outlet and the pump, there shall be one of the options listed in 5.9.1., 5.9.2., or 5.9.3 (see figure 14). The manufacturer of such debris removal systems shall test and approve for the purpose at least one of these.

5.9.1 One (1) additional suction outlet with listed suction outlet cover/grate located a



Figure 11 – Single unblockable channel outlet to single pump

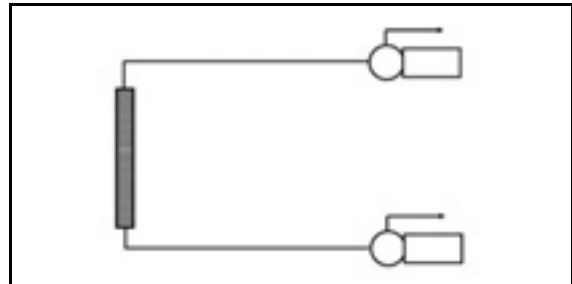


Figure 12 – Single unblockable channel outlet to two pumps

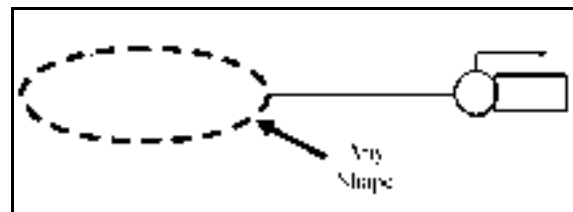


Figure 13 – Large unblockable outlet of any shape to single pump

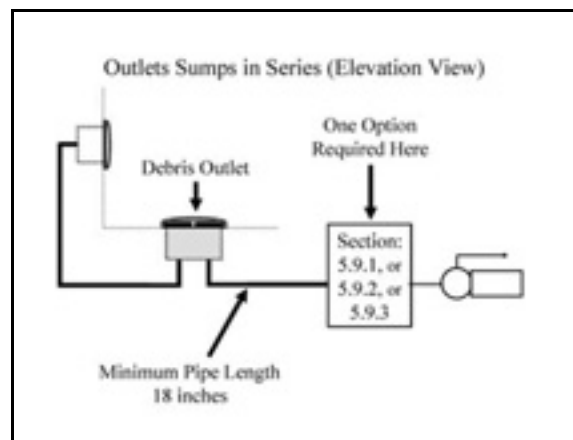


Figure 14 – Sumps in series

minimum of 18 inches (457 mm) from the tee in the suction line to the pump(s); or

5.9.2 Engineered vent system in accordance with 7.2; or

5.9.3 Listed manufactured SVRS in accordance with 7.1.

5.10 Other means. See 1.2.

6 Existing pools and spas

DANGER! To avoid serious injury or death, close the pool or spa to bathers if any suction outlet cover/grate is missing, broken, or inoperative.

6.1 Periodic evaluation, testing, and maintenance. Covers/grates and suction entrapment avoidance systems and related components shall be evaluated, maintained, and replaced by a person licensed or qualified in accordance with applicable manufacturer's instructions and local law.

6.1.1 Maximum flow rate of an existing system. To determine if system flow is compatible with the existing cover(s)/grate(s) flow rates, use one of the procedures of Appendix B, "Field checklist for identifying suction entrapment hazards."

6.2 Retrofitting suction system piping or outlets. When retrofitting, the retrofit installations shall be permitted to utilize a portion of the existing facility and add or replace other elements. The retrofit shall be in accordance with applicable sections of this standard.

6.3 Existing installations - Single outlets. When retrofitting existing installations with a single suction outlet that is not listed and approved for use as a single suction outlet, the existing suction outlet shall be retrofitted with either a listed single unblockable suction outlet or a listed suction outlet cover/grate and at least one of the following shall be added in accordance with 6.1.1.

- One or more additional listed suction outlet cover/grate located in accordance with 5.3; or
- Convert suction outlet to return inlet by changing the piping, provided the system piping and skimmer(s) shall be capable of handling the full system flow, in accordance with Section 5; or
- Gravity flow system in accordance with Section 5.8; or
- Engineered vent system in accordance with 7.2; or
- Listed manufactured SVRS in accordance with 7.1; or
- Permanently disable the single outlet, provided the system piping and skimmer(s) shall be capable of handling the circulation and distribution requirements.

6.4 Existing skimmer equalizer lines. Existing equalizer lines, when used, shall be retrofitted to comply with 4.8.1.

6.5 Existing single outlet piped through skimmer. A single suction outlet piped through a skimmer and deeper than 18 inches (457 mm) shall comply with 6.3.

6.6 Existing installation - Two or more outlets. When retrofitting existing installations with two or more suction outlets that are not listed, each shall be retrofitted with a listed cover/grate in accordance with 4.6 and Section 5.

7 Vacuum release systems

Vacuum release systems are methods, devices, and piping configurations that respond to a blockage of a single suction outlet by —

- releasing the vacuum by turning off the pump; or
- drawing water out of a vent tube to allow air into the suction system; or

- mechanically operating valves to reverse flow through the suction outlet(s); or
- opening a valve to atmosphere to cause the pump to lose prime.

NOTE: All vacuum release systems shall be tested on a single suction outlet with a listed safety cover in place. These devices/systems are not considered “backup” systems as there is no known suction vacuum release system that will completely protect against four of the five known hazards and presenting vacuum release systems as “backup” systems would promote a false sense of security among the users of these devices/systems.

7.1 Listed manufactured SVRS. Safety vacuum release systems, mechanical or electromechanical, venting or non-venting, shall be tested, certified, and listed for the purpose by a nationally recognized testing laboratory as conforming to ANSI/ASME A112.19.17 – Manufactured safety vacuum release systems (SVRS) for residential and commercial swimming pool, spa, hot tub and wading pool suction systems, or ASTM F 2387-04 *Standard specification for manufactured safety vacuum release systems (SVRS) for swimming pools, spas, and hot tubs.*

NOTICE: Operating conditions. Systems are tested for operation, in accordance with current standards, at room temperature. For substantially varying environmental conditions, including freezing, heat, salt spray, and humidity, confirm suitability with the SVRS manufacturer prior to installation and use.

CAUTION: Incompatible configurations. Some suction vacuum release systems may be incompatible with certain system configurations. The designer or installer shall confirm suitability with the SVRS manufacturer prior to installation and use. Incompatible configurations may include check valves, two or more suction outlets, hydrostatic relief valves, skimmers, solar systems, elevated or submerged pump suction, multilevel bodies of water, and water features.

7.1.1 Check valves with listed manufactured suction vacuum release systems. Installer shall refer to the manufacturers’ installation instructions.

ASME A112.19.17 does not allow use of SVRS in systems with any check valves or hydrostatic valves.

ASTM F 2387-04 allows check valves only under special conditions on the pressure side of the pump. See the standard for details.

7.2 Engineered vent systems









7.2.1 Suction lines vented to the atmosphere shall be designed and certified by a licensed professional engineer whose specifications include but are not limited to maximum flow rates, pipe size(s), listed cover/grate make and model, depth of vent connection, and maximum equivalent distance from suction outlet to vent connection.

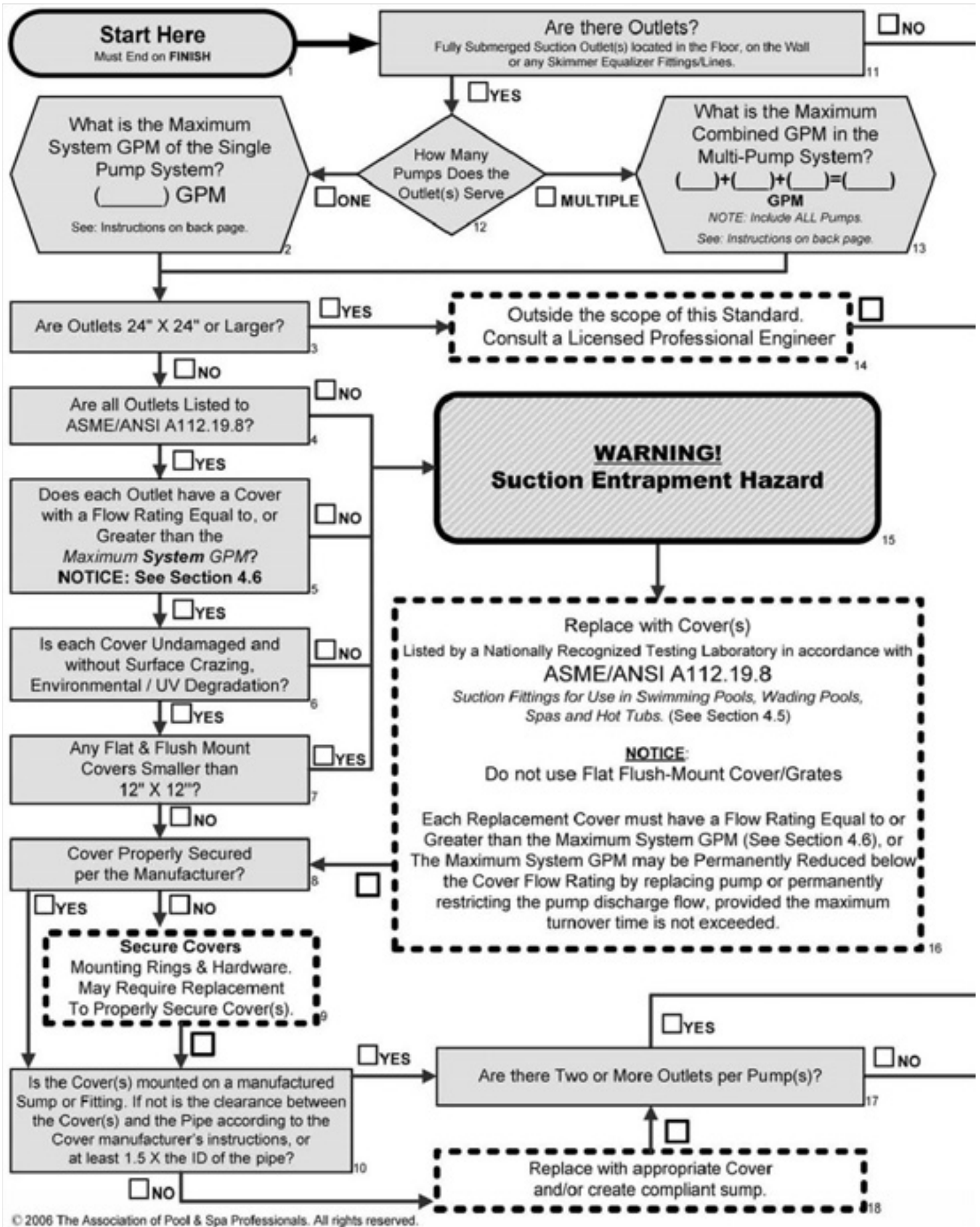
7.2.2 Engineered vent systems shall be designed to perform such that when the suction outlet is completely blocked, the vacuum shall decay to the level present at the suction outlet prior to the suction outlet blockage within an elapsed time of 4.5 seconds.

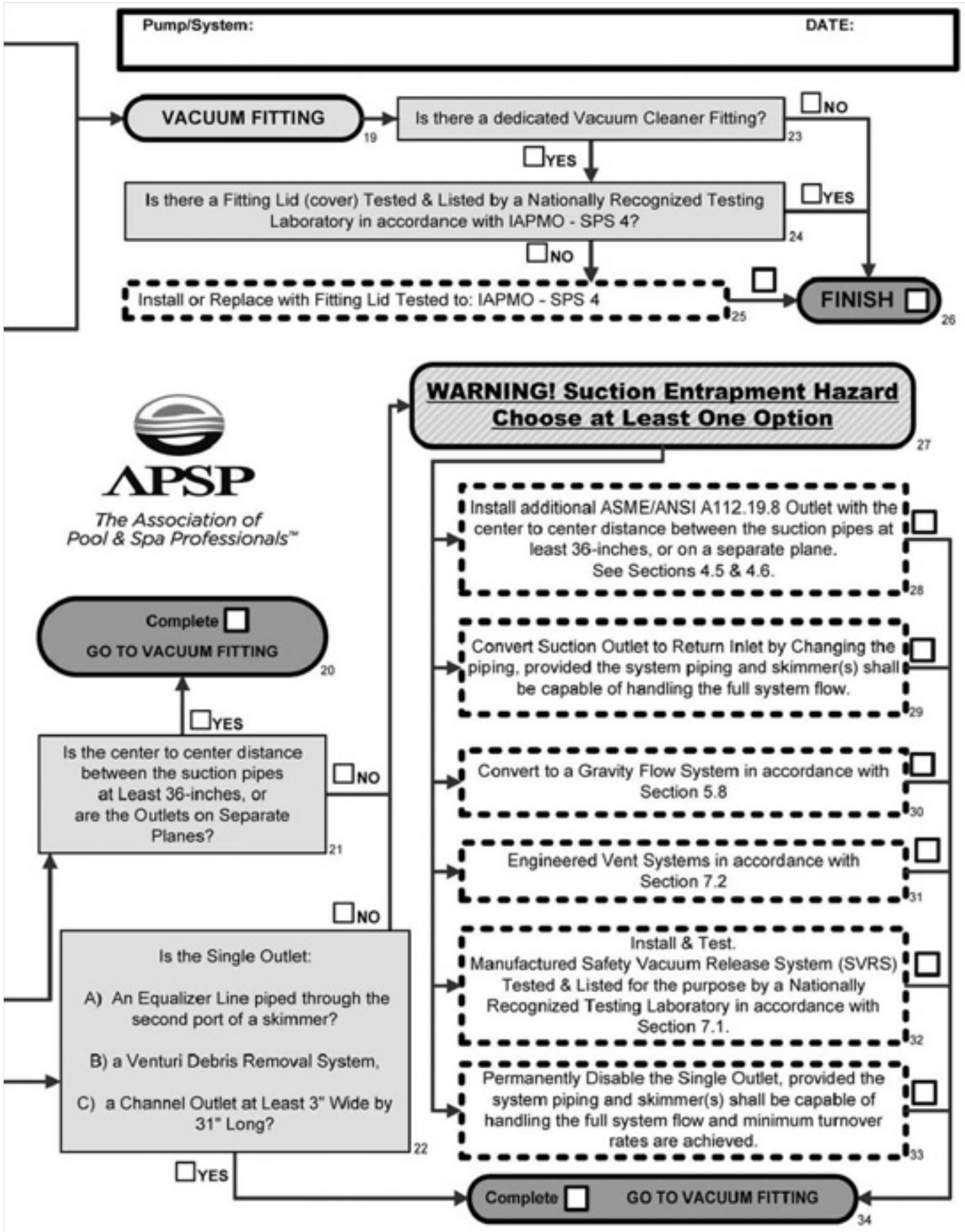
7.2.3 The vent line interface with atmosphere shall terminate with a fitting designed or modified to inhibit blockage or infestation and shall be clearly identified to discourage tampering.

Appendix A – Symbols

Symbols

<u>Bold Lines</u>	Branch Piping 3 fps Maximum With All Suction Outlets Flowing	<u>Thin Lines</u>	Suction Line Piping 8 fps residential 6 fps public
	Outlet Cover/Grate		Outlet Cover/Grate with Sump
	Check Valve		Debris Outlet with Sump
	Pump		Channel Outlet
	Skimmer		Large Unblockable Outlet





Finding the Maximum Flow Rate of an Existing System

When an accurate flow meter is not installed

Preparation:

1. Open all valves to their full open position for pool or spa circulation.
2. Remove Eye-ball fittings from Return Inlets (if applicable)
3. Clean Skimmer and Pump Baskets
4. Backwash or Clean Filter

Method 1: Measure using a 5 gallon Bucket and stopwatch

1. If necessary, using known 1 gallon or smaller containers, fill a 5 gallon bucket with exactly 5 gallons of water and mark a line on the inside of the bucket at the water level
2. Turn on pump and operate until it is running with a full prime
3. Using the backwash valve or waste valve and stopwatch record seconds required to fill the 5 gallon bucket to the line previously established.
4. Divide 60 by the number of seconds established above and multiply the result by 5. This will give you the maximum possible GPM of the system.
5. Repeat Test several times to verify results

EXAMPLE: If it takes 10 seconds to fill a 5 gallon bucket,
the GPM flow rate would be:
(60 seconds per minute / 10 seconds) x 5 gallons = 30
Gallons per Minute

Method 3: Use the maximum pump flow rate specified by the manufacturer.

Gravity Flow Calculation

$$\text{Flow (gpm)} = \sqrt{\frac{1786 \times [D(\text{inch})]^5 \times H(\text{inch})}{L(\text{inch})}}$$

Example: Gravity flow through 2" IPS Schedule 40 PVC pipe with inside diameter 2.067" with 32.0 feet of pipe and 2 elbows of equivalent length of 6.0 feet. The top of the pipe opening into the collector tank is 8" below pool water level.

The flow (Q) in gpm is

$$Q = \sqrt{\frac{1786 \times 2.067^5 \times 8}{[32 + (2 \times 6)] \times 12}}$$

$$Q = 31.95 \text{ gpm}$$

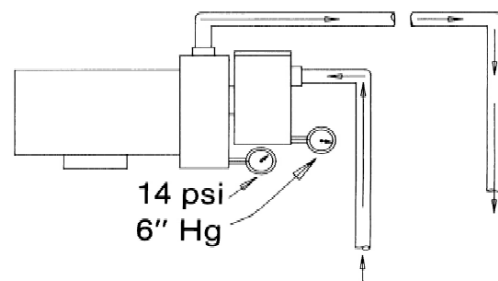
Method 2: Calculate using pressure and vacuum gage readings (see figure 1)

1. Install a vacuum gage as close to the bottom of the strainer basket as possible
 2. Install a pressure gage as close to the pump discharge as possible
- NOTE:** It may be necessary to use a 1/2" NPT x Barb fitting with a short section of plastic tubing connected to a gage if gages cannot be screwed into drain holes provided in pump.
3. Multiply Vacuum reading by 1.13 and record reading
 4. Multiply Pressure reading by 2.31 and record reading
 5. Add results of step 3 and 4 together to get the approximate Total Dynamic Head (TDH) in feet of water
 6. Using the published curve for the pump find the Total Dynamic Head calculated above on the vertical axis and read the flow rate on the horizontal axis
 7. This will give you the maximum flow rate within approximately 10%

Pressure Head: Gage PSI x 2.31 = Feet of Water

Suction Head: Gage "Hg x 1.13 = Feet of Water

EXAMPLE: If the Pressure Gage reads 14 PSI and the Vacuum Gage reads 6" Inches of mercury (Hg) the approximate Total Dynamic Head (TDH) of the system would be 39.12 feet



When inspecting existing installations, the **maximum possible flow rate of the suction system** must be determined as explained in this checklist and in ANSI/APSP-7 *Standard for Suction Entrapment Avoidance in Swimming Pools, Wading Pools, Spas, Hot Tubs, and Catch Basins.*

Appendix C – Warning – Drowning hazard

WARNING

Drowning Hazard



Avoid Drain Covers



Avoid Body Entrapment



Avoid Evisceration



Avoid Hair Entanglement



Avoid Finger Entrapment

- **Never play or swim near drains or suction fittings. Your body or hair may be trapped causing permanent injury or drowning.**
- **Never enter the pool or spa if a suction fitting or drain cover is loose, broken, or missing.**
- **Immediately notify the pool/spa owner or operator if you find a drain cover loose, broken or missing.**

For further information contact The Association of Pool and Spa Professionals.

Visit the U.S. Consumer Product Safety Commission website to read their entrapment guidelines at:
www.cpsc.gov/cpscpub/pubs/363.pdf

IMPORTANT SAFETY NOTE: If you choose to display this warning device as a sign, please make sure that it conforms to ANSI/NEMA Z535.4-2002 Standard for Product Safety Signs and Labels, or latest revision.



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