APSP-16 201X, Suction-Outlet Fitting Assemblies for Use in Pools, Spas, and Hot Tubs

Post APSP-16 Standard Writing Committee and APSP Technical Committee Review

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1 GENERAL

1.1 Scope

This standard establishes materials, testing, use, installation, and marking requirements for new or replacement *bather*-accessible Suction Outlet Fitting Assemblies (SOFAs), other than maintenance drains, that are designed to be *fully submerged* for use in any *pool*, which include, but are not limited to a swimming pool, hot tub, spa, portable spa, or non-portable wading pool, or other aquatic venue intended for swimming or recreational bathing. The term *pool* is used throughout this standard as an identifier for these bodies of water.

1.1.1 This standard becomes effective 18 months after adoption by US Consumer Product Safety Commission (CPSC).

1.1.2 SOFA components that were manufactured or installed before the effective date of this standard, and that meet APSP-16 2011, shall be considered in compliance with this standard.

1.1.3 **Service life.** Cover/grates and all other SOFA components shall be replaced at or before the end of their service life as stated by the manufacturer. Service life begins the month and year in which a SOFA component is installed with or without water.

1.1.4 ***Skimmers*** are excluded from the scope of this standard.

1.1.5 ***Vacuum connection covers*** are excluded from the scope of this standard. See the International Association of Plumbing and Mechanical Officials (IAPMO) SPS-4, Special Use suction fittings for Swimming Pools, Spas and Hot tubs for Suction-Side Automatic Swimming Pool Cleaners.

1.2 Suction Outlet Fitting Assembly types

1.2.1 **General purpose SOFAs:** A manufactured SOFA for transferring water from the pool directly or indirectly to a pump.

1.2.2 **Maintenance drain and fire suppression water source outlet**: A manufactured, restricted use fitting **used** only by pool maintenance personnel or fire suppression personnel ONLY at times when the pool is closed to *bathers*. Maintenance drains and fire suppression water source outlets are exempt from sections 5 and 6 of this standard. Any SOFA certified to this standard shall be permitted to serve this purpose.

1.2.3 **Self-contained spa SOFAs:** A manufactured, restricted use, SOFA that is distributed exclusively as a component of a self-contained factory-manufactured spa, where the *self-contains spa SOFA* has been further evaluated while installed in the spa at the time it is tested and certified in conformance with ANSI/UL 1563.

1.2.4 **Swim jet combination SOFAs:** A manufactured SOFA that merges a suction port(s) and discharge port(s) into as single assembly for use in a *single SOFA system* and/or a *multiple SOFA system*.

1.2.5 **Registered Design Professional SOFAs:** A field-built SOFA that is typically used for high flow rate systems found in large public pools and water park type recreation facilities. They shall be designed using only *sumps* that qualify as *unblockable.* The term *RDP SOFA* is used throughout this standard as an identifier for this type of SOFA.

1.2.6 **Venturi SOFAs**: A manufactured, restricted use, *blockable* SOFA distributed exclusively as a component of a water-driven suction system that returns all water from the Venturi SOFA to the pool without it passing through a pump.

1.3 Certifications

1.3.1 **Prohibited certifications.** Manufactured SOFAs and *RDP SOFAs* that are not evaluated to all applicable sections or fail any applicable requirement of this standard shall not be certified as meeting this standard.

1.3.2 Required testing and certification.

1.3.2.1 ***Manufactured*** **SOFAs** shall be tested by a laboratory in conformance with paragraph 1.3.4 and certified by an agency in conformance with paragraph 1.3.5.

1.3.2.2 ***RDP SOFAs*** shall be designed, installed, and certified in conformance with all applicable requirements of this standard by a *registered design professional* whose credentials are in conformance with the paragraph 1.3.6.

1.3.2.3 General Certificate of Conformity (GCC). *Manufacturers* and *registered design professionals* of SOFAs intended to enter commerce within the United States shall make available a General Certificate of Conformance (GCC) for each SOFA model as required by 16 CFR Part 1450.

1.3.3 Prohibited installations. *Pools* equipped with a SOFA(s) that does not result in an *individual suction system flow rating* equal to or greater than the pool's actual *individual suction system flow rate*, or pools with a SOFA(s) that was not installed in accordance with the SOFA specific instructions, including fasteners used with preexisting components, shall not be considered in conformance with this standard.

1.3.3.1 Replacement cover/grates for existing pools. *Cover/grate* shall only be installed on existing SOFA components if the replacement cover/grate *manufacturer* has designated the products as suitable for attachment to previously installed SOFA components. When used, the designation shall include how to identify compliant fastener attachment points and/or how to install the replacement cover/grate without using existing attachment points.

1.3.4 Testing laboratory accreditation. Laboratories shall be accredited to ISO 17025 by the International Laboratory Accreditation Cooperation (ILAC) signatory member and shall ensure all testing of *manufactured* SOFAs conform to this standard.

1.3.5 Certification agency accreditation. Certification bodies shall be accredited to ISO 17065 by an ILAC signatory member and shall provide certification of all *manufactured* SOFAs to this standard.

1.3.6 Registered design professional accreditation. Any individual who designs and certifies *RDP SOFAs* shall be registered or licensed to practice their design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the *pool* receiving the *RDP SOFA* is located.

1.3.7 Flow rating determination – ***manufactured*** **SOFAs.** The flow rating for each *manufactured* SOFA *configuration* shall be determined by the lowest passing flow rate obtained during any of the Type 1 hair tests, the Type 2 hair tests, and the *body-blocking element (BBE)* test, unless the SOFA manufacturer specifies a lower flow rate, which shall then be the maximum allowable flow rate for that SOFA.

1.3.7.1 Suction piping less than 16 inches from the SOFA mounting surface. The cover/grate shall be tested on each *SOFA configuration* in accordance with section 5 for all SOFA configurations where a suction pipe opening is less than 16 in. from the *finished surface of the pool*, as if measured with a string line representing the greatest distance Type 1 and Type 2 hair can travel into the cover and sump. Each of these SOFA configurations shall receive a flow rating.

1.3.7.2 Suction piping greater than 16 inches from the SOFA mounting surface. The *cover/grate* shall be tested on one SOFA *configuration* in accordance with section 5 for all SOFA *configurations* where all suction pipe openings are greater than 16 in. from the *finished surface of the pool*, as if measured with a string line representing the greatest distance Type 1 and Type 2 hair can travel into the cover and sump. The SOFA configuration tested shall be one using the largest pipe opening size specified for the *cover/grate* resulting in the highest flow potential.

1.3.8 Flow rating determination – *RDP SOFAs.* The *registered design professional* shall determine the SOFA's flow rating in accordance with section 3.9.

1.3.9 Water velocity limits. For purposes of suction safety, this standard provides SOFA configuration specific water velocity limits through

a *cover/grate* based on the SOFA tests of sections 5 and 6. These limits are expressed in gallons per minute (gpm), which can be converted directly into feet per second (fps) velocity units when desired. State and Local Codes may limit flow through a cover/grate based on water velocity (fps) rather than the marked flow rate (gpm) of the cover/grate. When this methodology is used, the resultant flow rating shall not exceed the cover/grate's SOFA specific flow rating in gallons per minute.

1.3.10 Table 1, Applicable Body Block Element – Calculation of Removal Force, referenced in ANSI/APSP – 16 2011 has been replaced with Equation 2 in section 6.4.

1.3.11 When values are stated in U.S. Customary units and in the International System of Units (SI), the values stated in U.S. Customary units shall be considered as the standard.

1.4 Related standards

Because the scope of this standard is directly related to suction fittings, it is important to mention that the fittings themselves represent only one portion of the suction entrapment scenario. Additional standards to be consulted to provide coverage for the various other potential hazards in swimming pools, wading pools, spas, and hot tubs and aquatic recreation facilities. These other standards include, but are not limited to, the following:

16 CFR Part 1450 Virginia Graeme Baker Pool and Spa Safety Act

ANSI/APSP-1 Standard for Public Swimming Pools

ANSI/APSP-2 Standard for Public Spas

ANSI/APSP-3 Standard for Permanently Installed Residential Spas

ANSI/APSP-4 Standard for Above-ground/On-Ground Residential Swimming Pools

ANSI/APSP-5 Standard for Residential In-Ground Swimming Pools

ANSI/APSP-6 Standard for Residential Portable Spas

ANSI/APSP-7 Standard for Suction Entrapment Avoidance

ANSI/APSP-8 Model Barrier Code for Residential Swimming Pools, Spas, and Hot Tubs

ANSI/APSP-9 Aquatic Recreation Facilities

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

ASTM F2387 Standard Specification for Manufactured Safety Vacuum Release Systems (SVRS) for Swimming Pools, Spas and Hot Tubs

UL 1563 Standard for Electric Spas, Equipment Assemblies, and Associated Equipment

1.5 Normative References

The following standards are referenced in this document. Unless otherwise specified, the latest edition in effect shall apply:

ANSI/APSP-1 Standard for Public Swimming Pools

ANSI/APSP-2 Standard for Public Spas

ANSI/APSP-3 Standard for Permanently Installed Residential Spas

ANSI/APSP-4 Standard for Above-ground/On-Ground Residential Swimming Pools

ANSI/APSP-5 Standard for Residential In-Ground Swimming Pools

ANSI/APSP-6 Standard for Residential Portable Spas

ANSI/APSP-7 Standard for Suction Entrapment Avoidance

ANSI/APSP-8 Model Barrier Code for Residential Swimming Pools, Spas, and Hot Tubs

ANSI/APSP-9 Aquatic Recreation Facilities

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

ASME B1.20.1 Pipe Threads, General Purpose (Inch)

ASTM D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

ASTM D638 Standard Test Method for Tensile Properties of Plastics

ASTM D1056 Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber

ASTM D1785 Standard for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

ASTM D2444 Standard Practice for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

ASTM D2466 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

ASTM F1498 Standard Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings

ASTM F2387, Standard Provisional Specification for Manufactured Safety Vacuum Release Systems (SVRS) for Swimming Pools, Spas, and Hot Tubs

ASTM G153 Standard Practice for Operating Carbon Arc Light Apparatus for Exposure of Non-Metallic Materials

ASTM G154 Standard Practices for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

ASTM G155 a Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

IAPMO/ANSI Z1033 Flexible PVC Hoses and Tubing for Pools, Hot Tubs, Spas, and Jetted Bathtubs

National Electrical Code, NFPA 70, Article 680 and Article 250.8.

UL 1439 Standard for Tests of Sharpness on Edges of Equipment

UL 1563 Standard for Electric Spas, Equipment Assemblies, and Associated Equipment

2 DEFINITIONS

Additional device or system designed to prevent suction entrapment: Equipment or arrangements of piping and equipment as defined by the Virginia Graeme Baker Pool and Spa Safety Act (VGBA). See section 9.4.

Accessible: A surface that can be touched by a *bather* when all components are installed per the *manufacturers* or *registered design professional's* instructions.

Anticlastic: Having opposing curvature in two perpendicular directions, as the surface of a saddle.

Anti-vortex: A term used to describe *cover/grates* that are designed to prevent an air-entraining vortex from forming between the *suction piping* and *pool* water's surface.

Aperture, small: A flow passage entrance into a *cover/grate*, or a flow passage entrance into a SOFA formed between a *cover/grate* and the *finished surface of the pool*, where the opening has two or more dimensions smaller than 1 in. (25 mm).

Aperture, large: A flow passage entrance into *a cover/grate*, or a flow passage entrance into a SOFA formed between a *cover/grate* and the *finished surface of the pool*, where the opening has only one dimension smaller than 1 in. (25 mm).

Applicable: A term used to limit the scope of a requirement based on a SOFA's Type, installation location, and any other attribute.

Bather: Any person entering a *pool* for any reason.

Blockable SOFA: A suction outlet fitting assembly with a *sump* that can be completely shadowed by the *body-blocking element (BBE)*.

Body blocking element (BBE): A simulated human torso as defined in paragraph 6.2.2.

Circulation system: The materials and equipment used to collect and return water to the *pool*.

Component: A part in a suction outlet fitting assembly (SOFA).

Cover/grate: The component of the SOFA that separates the *bather* from the *suction outlet*.

Direct-suction: A method for the transfer of water from a *pool* where the low pressure in the SOFA is produced by a piping arrangement that is connected between the SOFA *sump* to the inlet side of a pump, or pumps, such that the piping arrangement does not include a permanently open connection to atmosphere located above the overflow level of the pool.

Drain cover: A term used in the Virginia Graeme Baker Pool & Spa Safety Act (VGBA) to describe SOFAs.

Dual drain system: See *multiple SOFA system*.

Edge: The line of intersection between any two surfaces within a SOFA flow passage *aperture* with an intersecting angle greater than 180 degree, measured face to face, and having a transitional radius between the two faces of less than 0.75 in. (19 mm). Refer to Figure 1.

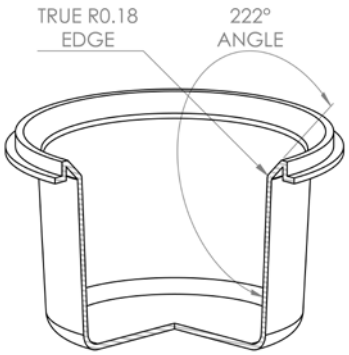


Figure 1: Edge

Existing: A *pool* previously installed and approved to open by the authority having jurisdiction.

Field-built sump: A *sump* formed in the structure of a pool in accordance with the *cover/grate* manufacturer's installation instructions, and for *RDP SOFAs,* in accordance with the certified plans of a *registered design professional*.

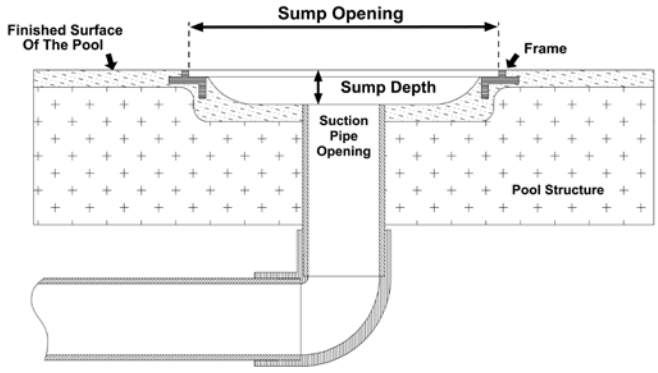


Figure 2: Field-built sump

Finished surface of the pool: The watertight interior surface that defines the plane used to measure the distance the *cover/grate* protrudes into the *pool,* depth of the *suction pipe(s)* opening, and the *suction port(s)* opening. Refer to Figure 2.

Fire suppression water source outlet: A SOFA used to transfer water from a *pool* to a fire hydrant, for purposes of using pool water to fight a fire after the pool is closed and confirmed to be clear of *bathers*.

Floor: The structure of a *pool,* where a SOFA is to be installed, that is sloped between 0 degrees and 45 degrees from horizontal.

Flow path length. The shortest distance water travels between the outer surface of any cover/grate aperture and the nearest edge of the *suction pipe* opening. Refer to Figure 3.

Flow path zone. *Manufacturer* specified minimum dimensions equal to or exceeding the *flow path length* boundary of the *sump* used during the SOFA specific test as described in section 5, Hair Entrapment Testing. Refer to Figure 3.

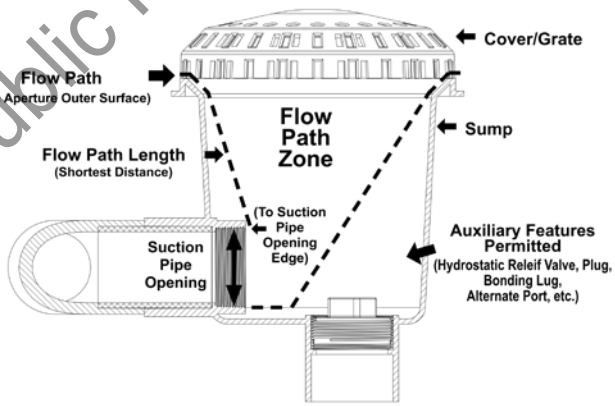


Figure 3: Flow path length and zone

Frame: A SOFA component that shall be structurally attached to the pool, to which a *cover/grate* is attached.

Fully submerged: A condition where all components of an assembly are inside the waterline perimeter and below the overflow water level of a *pool*.

Grate: An assembly, or panel with multiple openings in its surface. The term is not used in this standard to avoid confusion. See also *cover/grate*.

Indirect-suction: A method for the transfer of water from the *pool* to the inlet side of a pump(s) where the low pressure in the SOFA is produced by a difference in water levels between the *pool water's surface* and a separate water vessel that includes a permanent connection to atmosphere, the opening of which is located above the overflow level of the pool. e.g., gravity flow and vent systems.

Individual suction system: A *direct-suction* or *indirect-suction* system that connects one or more SOFAs to one or more pumps, the combination of which is used to determine the *maximum system flow rating* of the *individual suction system*.

Individual suction system flow rating: A calculation based on the quantity and type(s) of installed SOFA, where the rating is determined in accordance with the applicable paragraph 1.3.7 or 1.3.8.

Manufactured: When applied to a SOFA or SOFA *component*, indicates the routine commercial production of such item(s) that are evaluated for conformance to this standard in accordance with paragraph 1.3.2.1.

Main drain: A term used in VGBA to describe SOFAs.

Maintenance drain: A water outlet that is only used by maintenance personnel at times when the *pool* is closed and confirmed to be clear of *bathers*, to remove water from the *pool*.

Maximum system flow rate: The highest flow rate that is achievable by an *individual suction system* in accordance with ANSI/APSP/ICC-7.

Model number: The designation used to identify unique *SOFA configurations*.

Mud ring: See *frame*.

Multiple SOFA use only: Indicating that the referenced SOFA may be used only in conjunction with one or more additional SOFA serving an *individual suction system*.

Multiple SOFA system: Two or more SOFAs connected to an *individual suction system*.

Open area: The area available for water flow through or under a SOFA *cover/grate*, as measured parallel to the flow path at each opening. Refer to Figure 4.

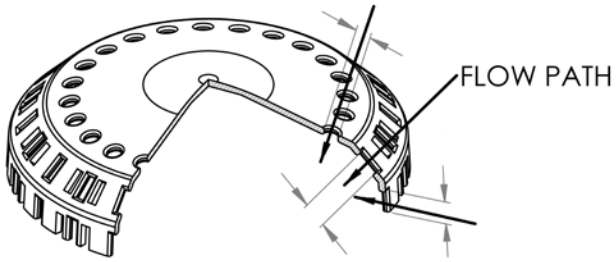


Figure 4: Measurement of open area

Operational day: One day of use of a pool by *bathers*.

Part number. The designation used to identify individual SOFA *component*s.

Pinch point: Any location within a SOFA *aperture* that enlarges upstream and downstream.

Permanent: Never changing, or not expected to change. e.g. piping below a *pool*.

Pool: Any outdoor or indoor structure intended for swimming or recreational *bathing*, including inground and onground structures, and includes hot tubs, spas, portable spas, infinity edge catch basins, slide and other amusement termination basins, and non-portable wading pools.

Pool owner: The person(s) recognized by the law as having the ultimate control over, and responsibility for the property on which a *pool* is located.

Product specifications: Information specific to a product, including, but not limited to model numbers, flow ratings, service life, SOFA type, etc., that is made available by the manufacturer or Registered Design Professional in advance of the product being sold and installed.

Q: Volumetric flow rate in cubic feet per second (ft^3/s).

Registered design professional: An individual who is registered or licensed to practice their design profession, as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.

Registered Design Professional (RDP) SOFAs: A SOFA designed and certified as conforming to all

applicable requirements of this standard by a *registered design professional* that is custom-made for a specific *pool* at the construction site, or custom-made for a specific *pool* at a facility not normally engaged in SOFA *manufacturing*.

Restricted use. A SOFA type that is only certified for used in a specific pool type, e.g., *self-contained factory-manufactured spa,* or that is distributed exclusively as a component of a *manufactured*, *individual suction system,* e.g., venturi SOFA.

Self-contained factory-manufactured spa: A spa that is certified in conformance with ANSI/UL 1563.

Self-contained spa SOFA: See paragraph 1.2.3.

Service life: The period of time between the installation of a component in a *pool*, with or without water at the time of installation, and the end of its useful life as specified in conformance with paragraph 3.1.1.

Shadow: That portion of a SOFA sump that is hidden by the *body-blocking element (BBE)* to a person viewing perpendicularly to the *mounting surface* of the SOFA sump.

Sharp edge: An edge that can cause a cut-type injury when contacted during normal use by a bather. Refer to UL 1439 Standard for Tests of Sharpness on Edges of Equipment.

Skimmer: A partially submerged *suction outlet* that is designed to remove water from the surface of a *pool*. Skimmers that are not *fully submerged* are not SOFAs; therefore, they are excluded from testing and certification to this standard.

SOFA configuration: A *manufacturer* or *registered design professional* specified assembly where any difference in mounting orientation (wall or floor), *suction pipe* opening size, or *suction pipe* opening orientation (horizontal or vertical exit from the *sump*) results in a different *SOFA model number*.

Suction outlet: Any appurtenance that provide a localized low-pressure area for the transfer of water from a *pool* to an *individual suction system*, e.g. SOFA, skimmer, gutter overflow, etc.

Suction outlet fitting assembly (SOFA): All components, including the *cover/grate*, used to attach a *cover/grate(s)* to the *finished surface of a pool* and to an *individual suction system*.

Suction pipe: A pipe used to convey water to an *individual suction system*.

Suction pipe opening: The inside diameter of suction pipe, suction port fitting, or other geometry through which water will flow exiting a sump.

Suction port: The portion of a SOFA *sump* used to connect the SOFA directly to the *suction pipe*.

Suction system flow rating: The maximum flow for which an *individual suction system* is permitted to operate while remaining in compliance with this standard.

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

Swim jet combination SOFA: A *manufactured* inlet/outlet SOFA that combines a *suction port(s)* and return port(s) into one suction outlet fitting assembly.

Total dynamic head (TDH): The total equivalent height that pool water is to be pumped, considering friction losses in the pipe. This term, along with flow rate, is used to specify the expected performance of a pool pump over its operating range, expressed as a curve plotted against head pressure versus flow rate.

Unblockable SOFA: A suction outlet fitting assembly with a *sump* opening size that cannot be completely *shadowed* by the *body blocking element (BBE)*.

Vacuum connection cover: A cover over a fitting in the wall of a *pool* intended to provide a hose connection point for suction-side cleaners.

Venturi SOFA: A *restricted use*, blockable SOFA distributed exclusively as a component of a water-driven suction system that returns all water to the pool without it passing through a pump.

Virginia Graeme Baker Pool & Spa Safety Act (VGBA): The federal law enacted by Congress and signed by the President on December 19, 2007. Designed to prevent suction entrapments in pools, the law became effective on December 19, 2008.

Wall: The structure of a *pool,* where a SOFA is to be installed, that is sloped more than 45 degrees and less than or equal to 90 degrees from horizontal.

3 DESIGN, MATERIALS, AND INSTALLATION REQUIREMENTS

SOFAs shall be designed and installed to reduce the potential for hair, body, finger and limb entrapment.

3.1 Physical design requirements and limitations

3.1.1 Service life designation. *Manufacturers* and *registered design professionals* shall state the installed service life in years for each SOFA component.

3.1.2 Protrusion. SOFAs shall be designed such that when installed, they do not protrude more than 2 in. (51 mm) from the *finished surface of the pool*.

3.1.3 Sharp edges. There shall be no *bather accessible* sharp edges, as defined by UL 1439 Standard for Tests of Sharpness on Edges of Equipment, on fully assembled SOFAs.

3.1.4 Accessible openings. All flow passage openings through and/or under *cover/grates* shall be designed and installed to reduce the potential for finger or limb entrapment. All *manufactured* SOFAs and all *RDP SOFAs,* shall be designed and installed in conformance with the requirements of section 7, finger and limb entrapment tests.

3.1.5 Fasteners. *Cover/grate manufacturers* shall provide all fasteners required for the proper installation of the SOFA in accordance with the *cover/grate* installation instructions.

3.1.5.1 Replacement cover/grates fasteners. *Cover/grate manufacturers* shall designate if and when a cover/grate is suitable for attachment to previously installed SOFA components. When the replacement cover designation is used, installation instructions shall address how the installer is to verify that the existing attachment points meet the manufacturer's requirements.

3.1.6 All threaded fasteners joining SOFA *components* that are *bather*-accessible shall comply with all requirements of this section.

3.1.7 Fasteners, excluding threaded inserts or anchors, shall be removable from the *sump* and any permanent SOFA *components*, including but not limited to, *frames*, *mud rings*, and support beams, for winterizing or replacement.

3.1.8 When threaded fasteners are used to secure SOFA *components*, machine screws with associated metallic inserts or self-tapping screws shall be permitted.

3.1.9 Metal screws shall be passivated stainless steel meeting ASTM 967 and UNS S31600 or SAE Type 316, or be made from equivalent corrosion resistant material. Metal threaded inserts shall be made from copper alloy C23000, C61400, C64700, C65100 or C65500 or equivalent corrosion resistant material.

3.1.10 Tool required. Fasteners shall not be removable without the use of a tool.

3.1.11 Service access. The use of adhesives or other attachment methods that prevent access to *suction piping* or SOFA *components* requiring periodic servicing is prohibited. *Manufacturer's* installation instructions shall provide this compliance information.

3.1.12 Suction piping connections. *Sumps* that connect directly to the *suction piping* shall have *suction ports* that attach by an end connection that is dimensionally in accordance with ASTM D 2466, by a threaded end connection in accordance with ASTM F 1498, or by flanges dimensionally in accordance with ASME B1.20.1.

3.1.13 Suction piping requirements for self-contained spa SOFAs. The *cover/grate manufacturer* shall specify the suction piping to be used. Flexible PVC hose shall conform to IAPMO/ANSI Z1033. Rigid PVC pipe specification shall conform to ASTM D 1785-Standard for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120. The *cover/grate manufacturer's* installation instructions shall provide this compliance information.

3.1.14 Metal component electrical bonding. SOFA components made of metal that will be exposed to *pool* water and that measure greater than 4 in. (100 mm) in any dimension shall provide a means for electrical bonding in conformance with the National Electrical Code,

NFPA 70, Article 680. The bonding connection and wire shall not be *bather*-accessible when the SOFA is fully assembled and installed in the *pool*. The bonding connection provided shall not be located within a SOFA *flow path zone* or where it may pose a hair entanglement/entrapment hazard, nor prevent service access to *suction piping*.

3.1.14.1 The bonding connection and associated bonding wire shall be considered non-*bather* accessible when it can not be touched by any portion of the "UL Articulate Probe" when evaluating the SOFA in accordance with section 7, Finger and Limb Entrapment testing.

3.2 SOFA configurations

3.2.1 Product identifier. Each SOFA *component* part shall be assigned a *part number* and each SOFA *configuration* shall be assigned a *model number*.

3.2.2 Head loss curve. Cover/grate manufacturers shall provide a legible head loss curve covering the full range of flow for each SOFA *model*. The curve shall plot the SOFA specific suction head loss in inches of mercury versus flow rate using data collected or confirmed in accordance with paragraph 5.4.5. The actual SOFA suction head loss curve shall be within a range of -3% to + 5% of the suction head or ± 5% of the flow rate, whichever is greater, indicated by the curve. The accuracy of the curve shall be verified at three points along the curve include the suction head loss at approximately 20, 50 and 100 percent of the SOFA's certified flow range. The head loss curve shall be accompanied by a description and/or illustration showing the approximate location the suction head was measured to aid pool designers calculating the total dynamic head (TDH) of a recirculation system.

3.2.3 *Cover/grates* used for multiple SOFA configurations. It shall be permissible to use a single *cover/grate* part(s) as a component of multiple SOFA*s*.

3.2.4 "Blockable" and "Unblockable" designations. SOFAs shall be categorized as *blockable* or u*nblockable,* as appropriate, by physical examination using the dimensions of the *body-blocking element (BBE)* of paragraph 6.2.2. If the sump opening can be completely shadowed by the *body-blocking element (BBE)* when viewed perpendicular to the *pool mounting surface* in which the SOFA is installed, it shall be categorized as *blockable;* those that cannot be completely shadowed shall be categorized as *unblockable*.

3.3 Cover/grate security, fasteners, and servicing instructions.

3.3.1 *Cover/grate manufacturers* shall provide installation instructions that detail the type of fasteners to be used and the recommended installation torque. Instructions shall also include a statement to start installation of screws by hand to ensure proper thread engagement and to prevent cross threading, and state the following: "DO NOT USE POWER TOOLS TO INSTALL FASTENERS".

3.3.2 Replacement *cover/grates* for *existing* pools. *Manufacturer's* of replacement *cover/grates* and other SOFA *components* intended for installation on *existing pools* with unknown sumps and *mud frames* shall provide replacement specific instructions for identifying when it is acceptable to attach the new *cover/grate* and how to confirm the attachment was successful.

3.3.3 For *cover/grates* where a portion of the flow path is formed by the *interior surface of the pool*, the *cover/grate manufacturer's* installation instructions shall provide a method for the installer to verify the actual installation conforms to section 7.3.

3.4 User maintenance instructions

All SOFA *types* shall be accompanied by user maintenance instructions containing all the information of this section that is applicable to the SOFA:

3.4.1 Field modifications. A statement that any field modification made to a SOFA not authorized by the manufacturer's installation instructions shall void the SOFA certification.

3.4.2 Configuration modifications. A statement that no modification shall be made to a SOFA structure or flow path unless the new configuration has been certified as new SOFA.

3.4.3 Service life. A statement that cover/grates and all other SOFA components shall be replaced at or before the end of their service life and that service life begins the month and year in which a SOFA component is installed with or without water.

3.4.4 Winterizing instructions. *Cover/grate manufacturers* shall provide instructions stating how to winterize *manufactured* SOFAs. *Registered design professionals* shall provide winterizing instructions stating how to winterize the *unblockable suction outlet cover/grate and sump* when the *pool* is in a location known to require winterizing.

3.4.5 Service instructions, including a list of the required tools.

3.4.6 A statement that the *cover/grate*, including fasteners, shall be observed for damage or tampering each *operational day*.

3.4.7 A statement that missing, broken, or cracked *cover/grates* shall be replaced before *bathers* are allowed to use the *pool*.

3.4.8 A statement that loose *cover/grates* and associated *components* shall be reattached before *bathers* are allowed to use the *pool*.

3.4.9 A statement indicating that SOFA *components* and fastener receptacles shall be clean and free of debris or obstructions during installation of *cover/grate* and fasteners.

3.4.10 Instructions shall indicate the proper alignment and assembly order of all SOFA *components*.

3.4.11 The statement “DO NOT USE POWER TOOLS TO INSTALL FASTENERS” and to start installation of screws by hand to ensure proper thread engagement and to prevent cross threading.

3.4.12 A statement indicating the requirement to hand-check *cover/grate* for snugness to the *sump/frame* after installation.

3.4.13 A statement indicating how to evaluate the integrity of SOFA *components*, including how to address color change, brittle components with chunks or pieces broken off, stripped screw holes, cracks, and if a *mud ring* is used, cracked or broken *interior finish of the pool* holding the *mud ring* in place.

3.4.14 A statement indicating that when any SOFA *component* is held in place by the *interior finish of the pool*, that surface shall be free of deterioration and voids.

3.4.15 Instructions for reinstallation or repair of damaged fasteners and corresponding receptacles either inserted, tapped, or self-threaded. Instructions shall include a description of the condition(s) indicating when it is necessary to remove the SOFA from service. Reinstallation and repair examples may include:

- Remove and replace SOFA *component*.
- Provide additional holes to receive fasteners in a different orientation.
- Instructions for drilling new holes, including conditions when and where it is appropriate, and how to confirm proper installation in conformance with the requirements of this standard.

3.5 Flow hazard related requirements and limitations

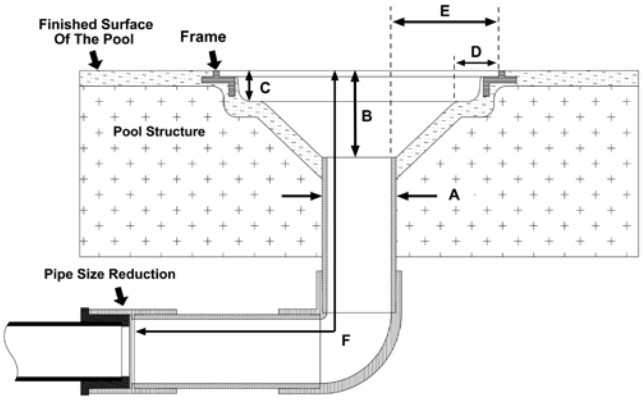
Sumps play an important role in addressing suction safety. Flowing water turbulence can twist and tangle hair in, under, and around the *cover/grate* and other SOFA *components*, including the *suction piping* itself. For this reason, the “Figure 2: Field-Built Sump” in the previous version of this standard has been revised and supplemented by Figures 3, 5 and 6.

Additionally, the standard now requires each SOFA *configuration* to be tested whenever a *suction pipe(s)* opening is positioned within reach of the hair used for certification testing. For SOFA configurations with all suction pipe openings positioned outside the reach of the test hair, the cover/grate only needs to be tested over a single, representative SOFA *sump* configuration with the highest flow potential.

3.5.1 Sump specifications. *Cover/grates* shall only be installed on *sump* configurations authorized by the *manufacturer’s* installation instructions resulting in a unique SOFA configuration, with a specific certified flow rating.

Manufactured or field-built sumps shall be permitted. Refer to Figures 2, 3, 5 and 6.

3.5.1.1 The *manufacturer's product specifications* and installation instructions, as appropriate, shall define each SOFA configuration and include the *flow path zone*, minimum suction pipe(s) opening depth below/behind the *finish surface of the pool*, pipe size, pipe orientation, and minimum suction pipe opening length before any reduction in pipe size. Refer to Figure 5 and 6.



A. Specified PVC Pipe Size
B. Minimum Sump Depth
C. Minimum Ledge Depth
D. Maximum Ledge Width
E. Minimum Pipe Offset
F. Minimum Length Before Reduction

Figure 5: Sump specifications

3.5.1.2 Flow path zone. The *manufacturer* shall specify the minimum flow path zone dimensions equal to or exceed the dimensions of the *sump* used during the SOFA specific test as described in section 5, Hair Entrapment Testing. The boundaries shall encompass the volume between cover/grate apertures and suction pipe(s) opening defined by the SOFA-specific flow path of 1.3.7.1. Refer to Figures 3, 4, 5 and 6.

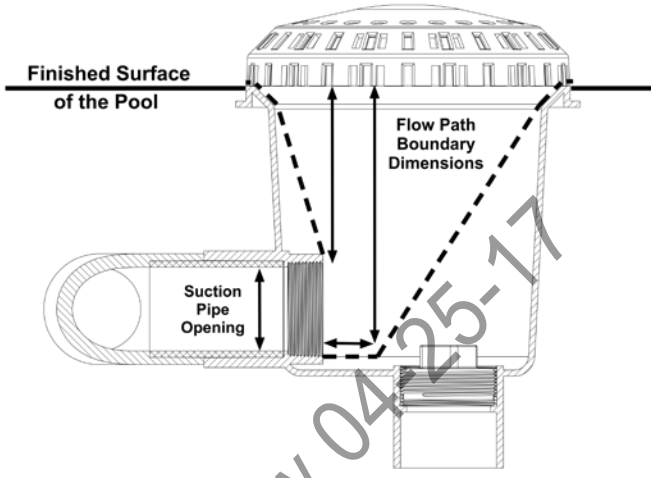


Figure 6: Flow path zone dimensions

3.6 Installation requirements and limitations

All applicable information and safety considerations provided in this section shall be included in the *manufacturer's product specifications* and/or installation instructions, as appropriate, to assist *pool* designers, installers, and owners in the proper selection, installation, operation, and maintenance of products certified to this standard.

3.6.1 Installation. All SOFAs shall be installed in accordance with the *manufacturer's* installation instructions, or for *RDP SOFAs,* in accordance with the *registered design professional's* engineering plans.

3.6.2 Field modifications. No modification shall be made to a SOFA structure or flow path unless the new configuration has been certified to the original SOFA.

3.6.3 Individual product flow ratings. This standard provides performance-based flow ratings for all SOFA(s). These flow limits are designed to prevent suction entrapment.

3.6.3.1 Compliance with this standard requires that these SOFA-*configuration* specific flow ratings NOT be exceeded at any time the pool is open to *bathers*.

3.6.3.2 Compliance with this standard requires selecting and installing a SOFA, or combination of SOFAs, such that the resulting *individual suction system flow rating* is greater than

the pumping system's *maximum system flow rate*.

It is also important to state that skimmers, gutters, and other overflow systems may not always be operational and could divert all the pump(s) flow through the SOFA suction system, therefore the flow capacity of these systems shall not be included when evaluating an *individual suction system* flow rating.

3.6.4 Installed suction system flow ratings

3.6.4.1 Pools with multiple, Blockable SOFAs. The flow rating of the set shall be determined by combining the flow rating of all SOFAs, minus the flow rating of one. If the flow ratings of all SOFAs are not equal, subtract the flow rating of the SOFA with the highest flow rating.

3.6.4.2 Existing pools with a single, *blockable* SOFA. The flow rating is the flow rating of the SOFA, when also installed in conjunction with an *additional device or system designed to prevent suction entrapment*, where the additional device or systems is of a type listed in section 9.4. A single, *blockable* SOFA in a system that does not also include one of the additional devices or systems shall result in a flow rating of zero.

3.6.4.3 Pools with single, or multiple *unblockable* SOFAs. The flow rating shall be determined by combining the flow rating of all SOFAs.

3.6.5 Protrusion. *Cover/grates*, when installed, shall not protrude more than 2 in. (51 mm) from the *finished surface of the pool* in which the SOFA is installed.

3.6.6 Pool surface types. *Manufacturer's product specifications* and installation instructions shall state the type of pool surfaces for which the SOFA is intended, e.g. concrete, vinyl lined, or composite pools.

3.6.7 SOFAs shall not be located on seats or the backrests for seats.

3.7 SOFA specific specifications and instructions

3.7.1 *Cover/grates* marked "Blockable" – for use in new pools. *Blockable SOFAs* shall be installed in a *multiple SOFA system* only.

3.7.1.1 *Multiple SOFA system* spacing for new pools. When used in multiple-outlet systems, *cover/grates* marked *blockable* shall be arranged such that the two outermost *sumps/frames* shall have a minimum separation of three feet, measured center-to-center. If they are to be installed closer than three feet center-to-center, they shall be located on two different planes, i.e., one SOFA shall be located on the pool floor, and one shall be located on a vertical wall, or one SOFA shall be located on each of two separate walls.

3.7.2 Cover/grates marked *blockable* – for use in existing pools. Cover/grates marked *blockable* installed in *existing* pools with *single SOFA systems* shall also be installed in conjunction with an *additional device or system designed to prevent suction entrapment*, where the additional device or systems is of a type listed in section 9.4.

3.7.3 *Unblockable* SOFAs. *Cover/grates* marked *unblockable* are permitted for use in *multiple SOFA systems*, and *single SOFA systems* when authorized by the *cover/grate manufacturer*.

3.8 Self-contained spa SOFA instructions

The *cover/grate* manufacturer shall provide *product specifications* and installation instructions stating:

3.8.1 *Self-contained spa SOFAs* shall be used only in self-contained factory-manufactured spas tested and certified in accordance with ANSI/UL 1563.

3.8.2 *Self-contained spa SOFAs* shall be installed into the body or shell of the spa at the time that the spa is manufactured.

3.8.3 At least two *self-contained spa SOFAs* shall be piped so that water is drawn through them simultaneously through a common line to the related pump(s). The use of valves or fittings capable of isolating one *self-contained spa SOFA* from any other on the common line to the related pump is prohibited.

3.8.4 Self-contained spa SOFAs shall be connected to a tee leading to the pump utilizing

only the SOFA manufacturer's specified size(s) of PVC hose or pipe.

3.8.5 The maximum hose length difference between any *self-contained spa SOFA* and the tee leading to the pump shall not exceed 13 feet (3.96 m).

3.8.6 The suction pipe size between *self-contained spa* SOFAs shall be specified for each SOFA model.

3.9 Requirements for RDP SOFAs

3.9.1 *RDP SOFAs* shall be rated by the body entrapment test of section 6, or the following formulas, which shall yield the maximum allowable flow, Q, through the *cover/grate*. All calculations involve the open area of the *cover/grate* only.

3.9.2 Entrapping Force Criterion for Q

Equation 1

$$Q = a_R \sqrt{\frac{F}{C \frac{p}{2} a_B}}$$

where:

a_B = largest area of the *cover/grate* flow path openings in ft^2, that can be *shadowed* by the *body blocking element (BBE)*.

a_R = area of the cover/grate flow path openings, in ft^2, that remains unblocked

C = flow coefficient based on the design of the flow path openings in the *cover/grate*. It shall be based upon the actual loss coefficient of the *cover/grate* or representative sample from laboratory test data, unless otherwise demonstrated by calculation or test.

F = 120 lbf (534 N)

Q = limiting flow rate in ft^3/s based on the allowable entrapping force

ρ = density of water.

3.9.2.1 Maximum rating, ft^3/s. The maximum flow rating of the SOFA in cubic feet per second is Q.

3.9.2.2 Maximum rating, gal/min. The maximum flow rating of the *cover/grate* in gallons per minute is Q multiplied by 7.48 gal/ft^3 multiplied by 60 s/min.

3.9.3 Water velocity limit through *cover/grate*. *RDP SOFAs* are limited to a flow velocity of 1.5 ft/sec (0.46 m/s) through any remaining *cover/grate aperture not shadowed by the body blocking element of Figure 17*, unless rated at a lower flow rate by a *registered design professional*.

3.9.4 Control of flow through cover/grate. *RDP SOFAs* shall have a *sump* below or behind the *cover/grate* of a design provided by a *registered design professional* documented to control flow through the open area of the *cover/grate* such that the design does not exceed the water velocity limits of paragraph 3.9.3. Refer to Figures 2, 3, 5 and 6.

3.9.5 Certification report. The design of *RDP SOFAs* shall be specified by a *registered design professional* in plans acceptable to the *authority having jurisdiction* (AHJ) for the specific *pool* and a written report addressed to the *pool owner*. The plans and report shall fully address the considerations used during SOFA certification and shall address all applicable requirements of sections/paragraphs 1.2.5, 1.3, 3.1, 3.3 through 3.6, 3.6.4.3, 4.2 through 4.8, 4.10, 7, 8.5, 9.2, 9.3 through 9.7 as well as features particular to the specific site.

4 PHYSICAL TESTING

4.1 General

4.1.1 Test Conditions. All tests shall be conducted at an air and water temperature of 73.4 °F ± 3 °F (23 °C ± 2 °C).

4.1.2 Test Procedure. For the tests covered in this section a minimum of six cover/grates shall be tested in each test condition, unless otherwise stated. If the parts are made in different mold cavities, representative samples shall be taken from different mold cavities.

4.1.3 Test fixture. The SOFA shall be installed in a rigid fixture that can support the *cover/grate* in a manner simulating the actual installation.

4.1.4 Conditioning. All specimens shall be kept at a temperature of 73.4 °F ± 3 °F (23 °C ± 2 °C) for at least 24 hours before testing.

4.1.5 Crack detection. After each physical test, the cover/grate shall be washed, rinsed with potable water, and dried prior to application of ink. After inking, the cover/grate shall be visually inspected in accordance with paragraph 4.1.7.

4.1.6 Inking procedure. The exposed surfaces of the *cover/grate*, as if installed in a *pool*, shall be rubbed with a sponge and a 50% solution of potable water and water-soluble contrasting color ink after the unit has been washed and dried. The ink shall be rinsed from the surface with potable water, and the *cover/grate* allowed to air dry before inspection.

4.1.7 Inspection method. The exposed surfaces of the cover/grate, as if installed in a *pool*, shall be inspected for defects without the use of visual aids, except for corrective lenses, from between 1 ft. and 2 ft. (305 mm and 610 mm). The light source shall be equivalent to an illuminance near the surface to be inspected of 150 fc ± 50 fc (1615 lx ± 540 lx).

4.1.8 Performance requirement. The fitting shall be free from cracks as determined by inspection in accordance with paragraph 4.1.7. The presence of seams, flow lines, and knit lines shall be permitted and shall not be considered to be cracks.

4.2 Ultraviolet light exposure test

Polymeric materials, including fiberglass reinforced plastics, used for the manufacture of *cover/grates* and other SOFA *components* that may be exposed to direct sunlight when installed in a *pool* shall meet the requirements of this section.

Either of two test methods shall be utilized to test for ultraviolet light degradation testing. Test Method 1 is suited for products small enough to fit into an ultraviolet (UV) test chamber, while Test Method 2 is suitable for all products.

If Test Method 1 is used, then the ultraviolet test and the structural tests are performed on fully assembled SOFAs.

If Test Method 2 is used, then the ultraviolet test is performed on two sets of “dog bone” samples molded per ASTM D 638 from the same resin as the *cover/grate*. Set A is not exposed to UV light. Set B is exposed to UV light. In addition, all the applicable structural tests described in sections 4.3 through 4.8 are also performed on the as-sold samples. The performance requirements for those tests, however, shall be adjusted per paragraph 4.2.2.3.

Sumps and other SOFA *components* that are not exposed to direct sunlight when fully assembled and installed, per the *cover/grate* manufacturer's installation instructions, shall not be required to meet the requirements of this section.

4.2.1 Test method 1. Twelve new *cover/grates* shall be exposed to ultraviolet light and water spray in accordance with 4.2.1.1, 4.2.1.2 4.2.1.3, or 4.2.1.4 and 4.2.1.5 through 4.2.1.7:

4.2.1.1 720 hr. of twin enclosed carbon-arc (ASTM G 153, Table X1.1 Cycle 1 except the Black Panel Temperature shall be 50 °C), or;

4.2.1.2 720 hr. of twin enclosed carbon-arc (ASTM G 153, a programmed cycle of 20 minutes consisting of a 17-minute light exposure and a 3-minute exposure to water spray with light shall be used with a black-panel temperature of 63 ± 3 °C), or;

4.2.1.3 1,000 hr. of xenon-arc (ASTM G 155, Table X3.1 Cycle 1 except the Black Panel Temperature should be 50 °C), or;

4.2.1.4 750 hr. of fluorescent (ASTM G 154, Table X 2.1 Cycle 1 except the 8-hour UV shall be at a Black Panel Temperature of 50 °C and the 4-hour condensation Black Panel Temperature shall be 40 °C).

4.2.1.5 Cover/grates shall be mounted inside the test apparatus, with surfaces of the *cover/grate* that will be exposed after installation in a *pool* facing the UV lamps, and positioned so they receive exposure approximating a fully assembled SOFA. After the exposure test, the cover/grates shall be removed from the test apparatus and rejected if signs of deterioration such as cracking

or crazing appear. Discoloration shall not be cause for rejection. The UV exposed samples shall then be retained under ambient temperature of 73.4 °F ± 3 °F (23 °C ± 2 °C) for not less than 16 hours, and not more than 96 hours, before being subjected to the following tests:

- Floor-Mounted Fitting Load and Deformation Test
- Wall-Mounted Fitting Load and Deformation Test
- Point Load to Excess Test
- Shear Load Test
- Pressure Differential and Point Impact Test
- Pull Load Test

4.2.1.6 The intensification factor K shall be 1.0 for UV Test Method 1.

4.2.1.7 Performance requirement. *Cover/grates* that were subject to the UV Test Method 1 shall comply with all *applicable* performance requirements of the structural integrity tests in sections 4.3 through 4.8.

4.2.2 Test method 2. Specimens of the component polymeric materials shall be exposed to ultraviolet light in accordance with the options specified in paragraphs 4.2.1.1, 4.2.1.2, 4.2.1.3, or 4.2.1.4, and then to the tests specified in paragraphs 4.2.2.1 and 4.2.2.2. For Test Method 2, K is derived from paragraph 4.2.2.3.

4.2.2.1 Tensile strength. Specimens of non-exposed material (A) and UV-exposed material (B) shall be evaluated for tensile strength as described in the Standard Test Method for Tensile Properties of Plastics, ANSI/ASTM D 638 (ISO 527-2) using Type 1 specimens of 0.125 in. ± 0.02 in. (3.2 mm ± 0.4 mm) thickness and testing speed of 0.2 in./min ± 0.05 in./min (5.1 mm/min ± 1.3mm/min). The tensile strength is to be that value recorded at the yield point, if the material yields, or the value at the break point if the material breaks.

4.2.2.2 Impact. Specimens of non-exposed material (A) and UV-exposed material (B) shall be evaluated for impact strength as described in Method A of the Standard Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials, ASTM D 256 or ISO 180, using a 0.125-in. (3.2-mm) thick specimen.

4.2.2.3 Performance requirement. Samples of the material shall retain at least 70% of the non-exposed value when the tests indicated in 4.2.2.1 and 4.2.2.2 are performed. An intensification factor K shall be defined as the inverse of the lowest retained proportion of the non-exposed value when the tests in paragraphs 4.2.2.1 and 4.2.2.2 are performed. The structural integrity tests described in sections 4.3 through 4.8 shall be conducted using non-UV exposed *cover/grates* attached to a SOFA at loadings equal to the base values multiplied by the intensification factor, K. For example, if 80% of the tensile strength is retained in paragraph 4.2.2.1, and 85% of the Izod unit energy measured in paragraph 4.2.2.2 is retained, then K =1/0.80 = 1.25.

4.3 Floor-mounted SOFA load and deformation test

This test applies only to SOFAs intended for installation on the *floor*. Six *cover/grates* attached to a SOFA shall be tested at four locations. A point load machine readable to, at a minimum, 5 lbf (22 N) increments, and that is equipped with a steel tup of 2 in. (51 mm) minimum diameter, with a 2 in. ± 0.5 in (51 mm ± 13 mm) radius nose. A skin pad consisting of a 0.25 in. (6.35 mm) thick buna-n rubber pad of Shore A durometer 60 ± 5 hardness shall be placed between the tup and the *cover/grate* being tested.

4.3.1 Test method. *Cover/grates* shall be from section 4.2.1 or new covers if Test method 2 from section 4.2.2 are used and tested as described in 4.3.1.1 through 4.3.1.3.

4.3.1.1 Each SOFA shall be mounted on a horizontal plane.

4.3.1.2 The steel tup and pad shall apply a vertical load at a total of four different locations on the *cover/grate*; two points midway between the center and edge at two points between stiffeners, if any, and at two points furthest from any support element.

4.3.1.3 Using the tup and a 2 in. (51 mm) diameter skin pad on the face of the tup, and a tup speed of 0.20 in./min to 0.25 in./min (5.1 mm/min to 6.4 mm/min), apply a load at each of the above

locations until 300 lbf × K ± 10 lbf (1334 N × K ± 44 N) is reached.

4.3.2 Performance requirement. *Cover/grates* and their SOFA support components shall not crack, or lose any material from the fitting, exclusive of plating or finish coatings.

4.4 Wall-mounted SOFA load and deformation test

This test applies to *cover/grates* intended for installation on a *wall*. Six *cover/grates* shall be tested and they shall be those from section 4.2.1 or new covers if Test method 2 from section 4.2.2 are used.

4.4.1 Test method. The tests described in section 4.3.1 shall be performed with a load of 150 lbf. × K ± 5 lbf (667 N × K ± 22 N).

4.4.2 Performance requirement. The test specimens shall meet the performance requirements of section 4.3.2.

4.5 Point load to excess test

The *cover/grates* to be tested shall be the six previously tested in sections 4.3 or 4.4, as applicable, with loads applied in accordance with section 4.3.

4.5.1 Test method. The test equipment set-up and *cover/grate* mounting shall be as described in section 4.3. The SOFAs shall be subjected to loading at a tup speed of 0.20 in./min to 0.25 in./min (5.1 mm/min to 6.4 mm/min) until the tup protrudes through the *cover/grate*, or until a value of 600 lbf × K ± 10 lbf (2669 N × K ± 44 N) is reached.

4.5.2 Performance requirement. *Cover/grates* shall not sustain loss of any material from the fitting, exclusive of plating or finish. Permanent deformation shall not be considered a failure.

4.6 Shear load test on the horizontal edge of wall mounted cover/grate.

This test shall be applied to any *cover/grate* that protrudes 0.5 inch (13 mm) or more from the *finished surface of the pool* wall when installed per the *manufacturer's* installation instructions. The six *cover/grates* to be tested shall be from section 4.2.1 or new covers if Test method 2 from section 4.2.2 are used.

4.6.1 Test method. Each *cover/grate* shall be attached to a SOFA that is mounted in a manner simulating an actual installation as closely as possible. The loads transferred from the *cover/grate* to the rest of the SOFA and thence to the foundation shall represent the load paths of an actual installation.

4.6.1.1 The *cover/grates* shall be tested by the application of a 150 lbf × K ± 5 lbf (667 N × K ± 22 N) test load applied 30 degrees from the mounting plane.

4.6.1.2 The test load shall be applied by a steel plate that is 1/2 in. × 2 in. × 2 in. (12 mm × 51 mm × 51 mm), that is covered on its face with a 2 in. × 2 in. (51 mm × 51 mm) skin pad, as defined in section 4.3.

4.6.1.3 The six *cover/grates* shall be tested using the point load apparatus described in section 4.3.

4.6.1.4 Three *cover/grates* shall be tested with the load placed directly in line with the fasteners.

4.6.1.5 Three *cover/grates* shall be tested with the load midway between fasteners, when used.

4.6.2 Performance requirement. The *cover/grate* shall remain in place and not crack, or lose any material exclusive of plating or finish.

4.7 Pressure differential and point impact test

The *cover/grates* to be tested in this section shall be the six previously tested in section 4.6.

4.7.1 Test method. Each *cover/grate* shall be mounted in a manner simulating an actual installation as closely as possible. The loads transferred from the *cover/grate* to the rest of the SOFA and thence to the foundation shall represent the load paths of an actual installation. Pressure or vacuum may be used to develop the differential pressure that is required, the magnitude of which is determined by the value of K.

4.7.1.1 The *cover/grate* shall be covered with a 20-mil (0.5 mm) plastic material or other suitable material.

4.7.1.2 The *cover/grate* shall be subjected to an external differential pressure of 28.5 inHg × K ± 1 inHg (724 mmHg × K ± 25 mmHg) differential pressure within 60 s ± 5 s.

4.7.1.3 The differential pressure shall be sustained for 5 min ± 10 s.

4.7.1.4 The vacuum or pressure shall be removed from the system, the plastic film shall be removed, and the *cover/grate* shall be impacted at 15 ft-lbf × K (20.3 J × K) using the test method in ASTM D 2444, with a 5 lbm. (2.3 kg) steel tup, 2 in. (51 mm) minimum diameter with a 2 in. ± 1/2 in. (51 mm ± 13 mm) radius nose.

4.7.1.5 The tup shall be dropped onto the center of the fitting from 3 ft. × K (914 mm × K).

4.7.1.6 The *cover/grate* shall again be subjected to the 28.5 inHg × K ± 1 inHg (724 mmHg × K ± 25 mmHg) differential pressure within 60 s ± 5 s.

4.7.1.7 The differential pressure shall be sustained for an additional 5 min ± 10 s.

4.7.1.8 Remove the sample from the test fixture, and then apply water-soluble contrasting ink in accordance with paragraphs 4.1.5 through 4.1.8.

4.7.1.9 The components shall then be inspected for cracks, breaks, or fractures in accordance with paragraph 4.1.7.

4.7.2 Performance requirement

4.7.2.1 The *cover/grate* shall remain in place after the test procedures in paragraphs 4.7.1.1 through 4.7.1.7.

4.7.2.2 The components shall not permanently deform, crack, or lose any material from the fitting, exclusive of plating or finish.

4.8 Pull load test

Pull Load Testing shall be required of all *cover/grates* with openings with at least two dimensions of 0.375 in. (9.53 mm) or greater. The *cover/grates* to be tested shall be the six previously tested in section 4.7.

4.8.1 Test method. The *cover/grate* shall be installed on a SOFA per the manufacturer's installation instructions. A total force of 150 lbf × K ± 5 lbf (667 N × K ± 22 N) shall be applied to the underside of the *cover/grate*, and perpendicular to the mounting surface, in locations that will approximate the load bearing points available to a *bather's* finger(s). The test shall be conducted once adjacent to fasteners, and conducted once midway between adjacent fasteners. The test apparatus used shall apply an equal load to each bearing location.

4.8.2 Performance requirement

4.8.2.1 The *cover/grate* shall withstand a 150 lbf × K (667 N × K) pulling force.

4.8.2.2 Distortion under load shall not compromise the fastener(s), loosen the *cover/grate*, or cause permanent deformation exceeding 0.03 in. (0.76 mm). Metal *cover/grates* are exempt from the deformation requirements.

4.8.2.3 The *cover/grate* shall be free from cracks as determined by inspection in accordance with paragraph 4.1.7.

4.9 Mold stress relief distortion

4.9.1 One sample, non-UV exposed *cover/grate*, assembled with any other SOFA component(s) **as intended for shipping and distribution**, shall be placed in a full draft circulating air oven maintained at a uniform temperature of 140 °F ± 3 °F (60 °C ± 2 °C). The sample shall remain in the oven for 7 hrs. and then be allowed to return to room temperature before being assembled and installed in the *SOFA mounting surface*.

4.9.2 This sample shall be used for the Hair Entrapment Tests, section 5, and Body Entrapment Tests, section 6.

4.10 Threaded fastener test

Each female thread or thread receptacle shall be tested to the maximum torque specified by the manufacturer.

4.10.1 The test shall be performed 15 times.

4.10.2 A torque-limiting driver shall be used.

4.10.3 The test shall be performed on a SOFA assembled per the manufacturer's instructions.

4.10.4 The screws shall be removed manually and started manually each time.

4.10.5 The screws and receptacle shall be at a temperature of 73.4 °F ± 3 °F (23 °C ± 2 °C).

4.10.6 The use of multiple screws shall be permitted to complete this test.

4.10.7 **Performance Requirement.** The female receptacle shall not strip or crack, and the fastener head shall not cause cracking of the *cover/grate*. Threaded inserts shall not strip, twist, or pull out of the SOFA component.

5 HAIR ENTRAPMENT TESTING

The objective of this section is to measure the removal force of hair that may be drawn into a SOFA and manufacturer specified *suction pipe* opening.

5.1 General

5.1.1 Hair drawn into or onto suction fittings shall not prevent the escape of a *bather* in accordance with the performance requirements of section 5.10.

5.1.2 Hair entrapment tests are not required for *RDP SOFAs* certified by a *registered design professional* in conformance with section 3.10.

5.2 Hair specimens

Two types of hair shall be used in this test. Separate tests shall be run with each hair type.

5.2.1 **Type 1, (skull).** A full head of natural, fine, straight, blond European, human hair with cuticle on hair stems, 16 in. (406 mm) in length, weighing 5.5 oz. ± 0.5 oz. (155 g ± 15 g), shall be firmly affixed to a simulated skull with a head circumference of 22.8" ± 1", a head length of 7.9" ± ½", and a head breadth of 6.2" ± ½" in a manner approximating the normal distribution of hair. The completed assembly shall weigh between 1 pound and 2 pounds when submerged at the test depth. An anchoring point shall be provided near the neck of the simulated skull. Hair shall be trimmed evenly to a length of 16 inches (406 mm) ± ¼ inch (6 mm), measured from the top of the skull, after being attached to the simulated skull.

5.2.2 **Type 2, (ponytail).** Natural, medium-to-fine, light-brown colored human hair weighing 2 oz. ± 0.11 oz. (57 g ± 3 g) and having a length of 16 in. (406 mm) shall be affixed to a 1 in. (25 mm) diameter by 12 in. (305 mm) or longer wooden dowel, as may be required to properly place the hair sample for testing. Consideration shall be given to the buoyancy of the portion of the wooden dowel more than 12" (305 mm) in determining the removal force. A method for attaching a scale shall be provided on the opposite end of the dowel. Hair shall be trimmed evenly to a length of 16 inches (406 mm) +/- ¼ inch (6 mm) measured from hair attachment end of the dowel.

5.3 Test tank

5.3.1 **Water temperature.** During all tests, the water shall be at a temperature at 90 °F ± 10 °F (32°C ± 6 °C)

5.3.2 **Water depth.** During all tests and with water flowing, the minimum water level of the tank shall be above the shallowest *cover/grate* flow passages such that the hair test assembly, up to and including the pull mechanism attachment point of the skull or ponytail, is at least 2 in. below the water level. Refer to Figure 7.

5.3.3 **Water currents.** Influences of water currents shall be virtually absent in the test tank, as evidenced by the suspension of the hair sample in the water 2 in. above the center of the SOFA for 30 seconds with the pumping system running at the maximum anticipated, or actual, passing flow rate. Hair movement away from a vertical plumb line shall be observed and any deviation shall not exceed 1 in. (25 mm) during this time. Refer to Figure 7.

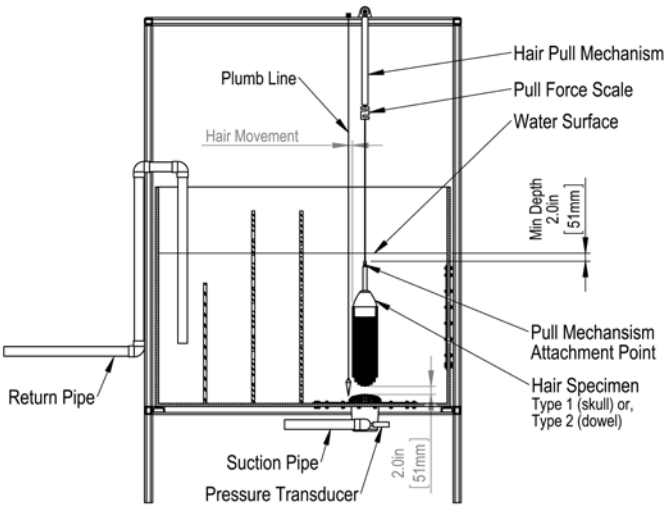


Figure 7: Water and test equipment

5.3.4 The test tank for evaluation of the SOFA for the hair entrapment test shall comply with Figures 8 and 9. The baffle plates shall be constructed as shown in Figures 10 and 11.

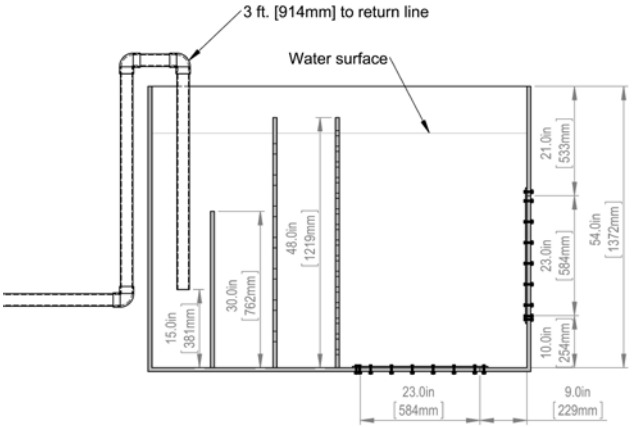


Figure 8: Test tank side view

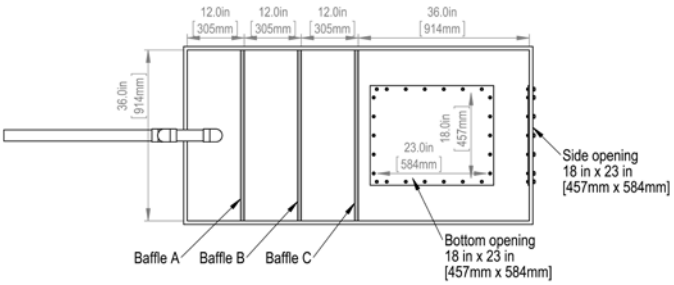


Figure 9: Test tank top view

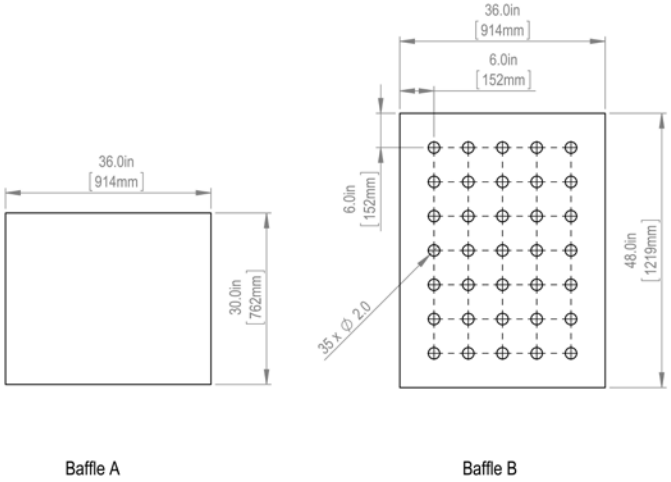


Figure 10: Test tank baffles A and B

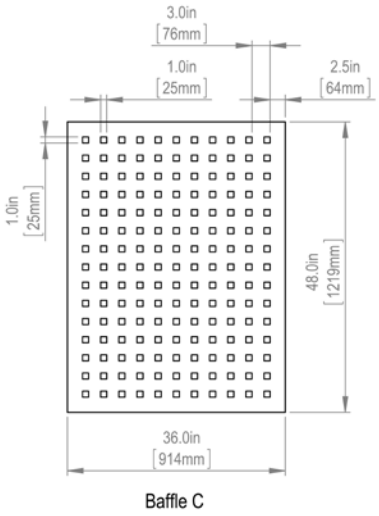


Figure 11: Test tank baffle C

5.3.5 Alternate test tanks

5.3.5.1 The same tank as described in paragraph 5.3.4, with Baffle C, bottom, sides, and only the one end where the fittings are tested may be used by inserting the tank into a larger body of water so that the submerged depth of the simulated SOFA mounting surface is the same as in paragraph 5.3.2.

5.3.5.2 The volume of the water in this larger body of water shall substitute for the return line piping depicted in Figures 7, 8 and 9.

5.3.5.3 Any other body of water may be used if the body of water provides equivalent test results

as intended by this standard.

5.4 Test equipment.

5.4.1 Pump flow. The pump shall be capable of producing a flow rate at least 25% greater than the *cover/grate* manufacturer's anticipated rating of the SOFA *configuration*.

5.4.2 Flow measurement. A flow meter with an accuracy of ±3% at the anticipated SOFA *configuration* rating shall be installed in the piping system in accordance with the flow meter manufacturer's installation instructions.

5.4.3 Flow control. A valve shall be used to adjust the test flow rate. Altering the speed of the pump motor shall not be use to vary the test flow rate.

5.4.4 Pump suction. The suction source for the hair and body entrapment tests shall be a pumping system that is capable of producing the required volumetric flow rate, and a suction head of at least 26.0 inHg, measured as close as practicable to the SOFA in accordance with paragraph 5.4.5, when the *suction piping* is completely blocked after the discharge is throttled to deliver the test flow rate. Refer to Figures 7 and 12.

5.4.5 SOFA suction. The suction head shall be measured with a pressure transducer or sensing device with an operating range appropriate for the test and with a minimum accuracy of 1% full scale. The elevation of the pressure sensor diaphragm or strain gauge above or below the water level of the test tank, as measured during the test shall be recorded, and the value shall be adjusted as required to correct for positive or negative water column. The maximum suction head reading (corrected for elevation) shall be recorded.

5.4.6 Hair pull mechanism. A pull mechanism with an anchoring point located directly above the area of the SOFA being tested, such that during any test, the hair specimen will be pulled vertically towards the surface of the water. It shall be capable of maintain a consistent speed of 5 in/s ± 0.25 in/s (127 mm/s ± 6 mm/s) when pulling either the Type 1, (skull) or Type 2 (ponytail) hair specimen. Refer to Figure 7.

5.4.7 Pull force measurement. A scale accurate to ±0.1 lbf (0.45 N) at a tension of 5 lbf (22 N) shall be used to measure the hair removal force.

5.5 SOFA mounting surfaces

5.5.1 The SOFA, including a *cover/grate*, as conditioned in accordance with paragraph 4.9.1 and the *sump* to be tested, shall be installed in accordance with the manufacturer's installation instructions on the SOFA *mounting surface*, with a surface area of sufficient size such that the BBE does not touch a mounting surface edge, or associated mounting hardware. Refer to Figure 12.

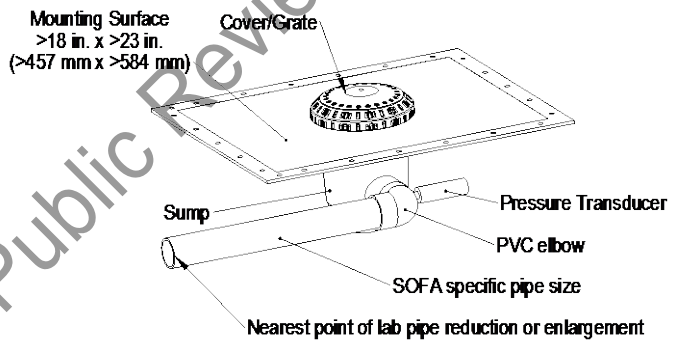


Figure 12: SOFA mounting surface

5.5.2 For assemblies where all flow passages are provided by *manufactured* SOFA *components*, the SOFA *mounting surface* of Figure 12 shall be planar and represent actual field practices, with smooth surfaces immediately adjoining the top edge of the frame or sump, or as specified by the manufacturer, in accordance with their installation instructions.

5.5.3 For assemblies where a portion of the flow passage is the *finished surface of the pool* and is not controlled by the *cover/grate* manufacturer, the SOFA *mounting surface* shall represent field imperfections that may produce a hair entrapment hazard. The nominally square planar mounting surface shall be distorted to an anticlastic surface such that one corner is 2 in. (51 mm) away from a plane defined by the other three corners of a 48 in. × 48 in. (122 mm × 122 mm) square as shown in Figure 13. A convenient means shall support three of the corners in a plane with 1 in. (25 mm) clearance from the nearby surface of the frame, then force the fourth corner 2

in. (51 mm) from the plane of the first three. Supports shall be localized, and 1.5 in. (38 mm) from the edges of the mounting surface. The test specimen shall be firmly attached to the anticlastic surface in a field installation manner as specified by the *cover/grate* manufacturer.

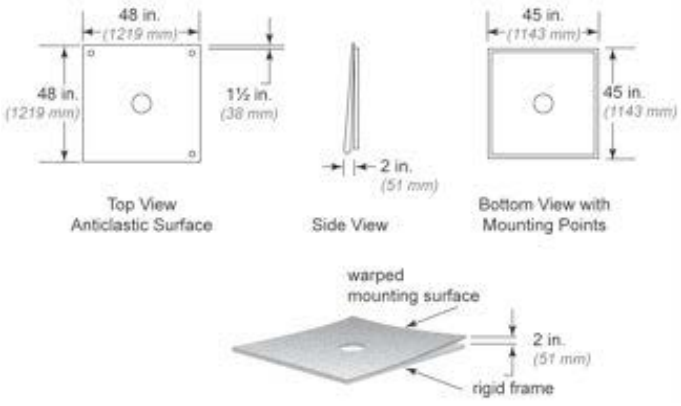


Figure 13: Anticlastic mounting surface

5.6 Self-contained spa SOFA mounting surface, test position, and piping

5.6.1 *Self-contained spa SOFAs* shall be installed in pairs on the *SOFA mounting surface* using 14 ft. ± 1 ft. (4267 mm ± 305 mm) of flexible PVC hose in accordance with Figure 14.

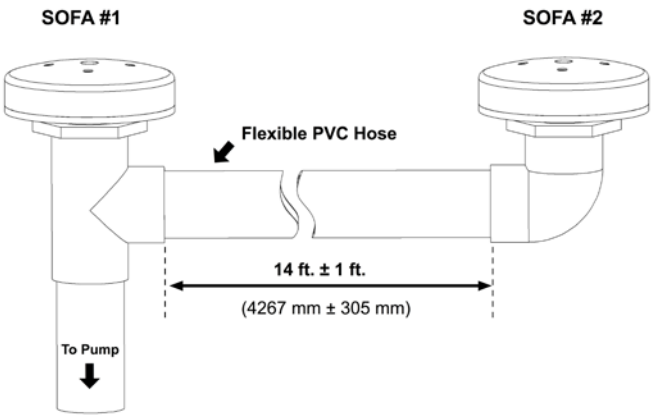


Figure 14: Self-contained spa SOFA

5.6.2 When more than one size of hose/pipe is specified by the *self-contained spa SOFA manufacturer's product specifications* or installation instructions, each size of hose shall be tested.

5.6.3 SOFA #1, shown in Figure 14, shall be tested for hair entrapment in accordance with sections 5.8 through 5.10.

5.7 SOFA sump and piping configurations for hair testing.

5.7.1 Sump dimensions. Manufacturers shall provide the test lab with the dimensions of the sump to be used during each SOFA model test. Refer to Figures 3, 5 and 6.

5.7.1.1 Flow path length. The lab shall measure and document the minimum flow path length for each SOFA model for purposes of determining the hair test scope of either 5.7.2 or 5.7.3. Refer to Figure 3.

5.7.1.2 The flow path length shall be measured using a string line from the entrance of the nearest aperture to the closest *suction pipe* opening to identify the shortest distance Type 1 or Type 2 hair can travel from the *cover/grate* to a suction pipe opening.

5.7.2 Flow path length less than 16 inches. Each SOFA *model* shall be tested at the minimum *cover/grate manufacturer*-specified distance from the top of the *pipe opening* to the *finished surface of the pool t*o simulate actual installations. These SOFA models shall be tested with a 90-degree elbow of the same size as the *suction pipe* opening, installed as close to the *sump* as practical. All *suction pipe* openings shall be challenged as part of Type 1 and Type 2 hair tests.

5.7.3 Flow path length greater than 16 inches. Only the SOFA configuration with the largest manufacturer specified suction pipe opening size and suction pipe quantity, the configuration of which results in the highest flow potential for the c*over/grate,* shall require Type 1 and Type 2 hair tests.

5.8 SOFA test positions

5.8.1 For SOFAs intended for floor-mounted installations, the SOFA *mounting surface* shall be horizontal.

5.8.2 For SOFAs intended for wall-mounted installations, the SOFA *mounting surface*

shall be vertical.

5.8.3 SOFAs intended for either wall or floor-mounted installations shall be tested with the SOFA *mounting surface* configured in both vertical and horizontal positions.

5.8.4 For SOFAs intended for wall-mounted installation that have a *cover/grate* flow-path pattern that is not uniform, the *cover/grate* shall be tested in two clock positions that represent the essential geometric differences that may affect the hair removal force. Refer to Figures 15 and 16.

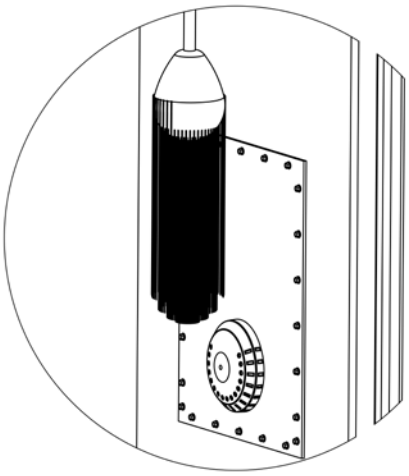


Figure 15: Flow path down

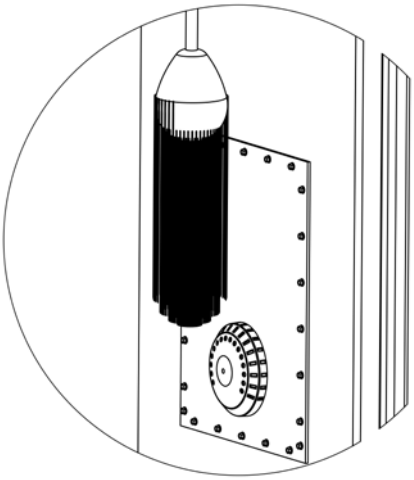


Figure 16: Flow path up

5.9 Hair test procedure

5.9.1 **Starting flow rate.** The manufacturer shall specify the starting test flow rate for each SOFA *configurations* to be tested.

5.9.2 **Pull mechanism verification.** Prior to energizing the test pump, the pull mechanism shall be verified to ensure consistent speed when pulling a 2 lbm (8.9 N) and a 10 lbm (44 N) weight. For each test weight, the speed of the pull shall be 5 inches per second ± 0.25 inches per second (127 mm/s ± 6 mm/s). Refer to Figure 7.

5.9.3 Test hair preparation and maintenance.

5.9.3.1 Prior to use, the hair shall be cleaned in a solution of 10% by volume of sodium alpha olefin sulfonate (AOS), and potable water. The hair test sample shall be rinsed in potable water after cleaning.

5.9.3.2 The hair shall be submerged in the test tank water for a minimum of 2 minutes prior to use.

5.9.3.3 New hair shall be conditioned by performing ten test pulls prior to recording the hair removal force.

5.9.3.4 Hair samples shall be cleaned before first use and after every ten pulls.

5.9.3.5 A fresh sample of hair shall be used when tangles in the hair cannot be removed by combing.

5.9.4 **Hair Test Starting Position**

5.9.4.1 **Wall-mounted SOFA.** The free end of the hair shall be in front of and 2 inches (51 mm) above the SOFA, as illustrated in Figures 15 and 16.

5.9.4.2 **Floor-mounted SOFA.** The free end of the hair shall be placed 2 in. (51 mm) above the area of the SOFA to be evaluated, as illustrated in Figure 7.

5.9.5 The hair test shall then be uniformly moved closer to the suction portions of the fitting, as illustrated in Figure 17.

5.9.6 The ends of the hair shall be fed into the SOFA in the direction of the intake flow.

5.9.7 The hair shall be continuously fed into the SOFA while moving the skull or ponytail in a sweeping motion.

5.9.8 The magnitude of the sweeping motion shall be reduced with each pass of the skull or ponytail.

5.9.9 The hair shall be moved toward the SOFA over a period of 30 seconds ±5 seconds.

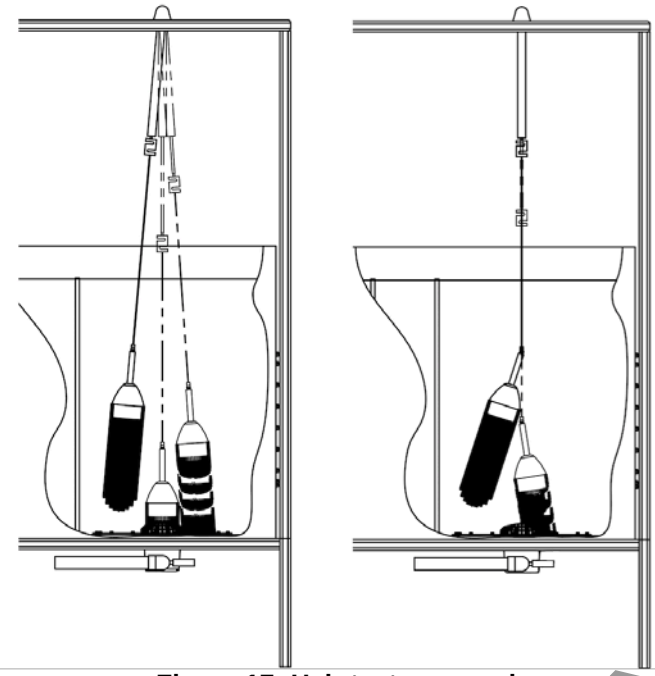


Figure 17: Hair test approach

5.9.10 The skull or ponytail end shall be held against the *cover/grate* for 30 seconds ± 5 seconds.

5.9.11 The skull or ponytail shall then be released and allowed to float or remain free for 30 seconds ± 5 seconds.

5.9.12 In testing any SOFA which is not entirely symmetric, or those mounted on an anticlastic surface, testing shall start with the free end of the hair at least 2 in. (51 mm) from any portion of the fitting.

5.9.13 Hair entrapment tests for SOFAs with a flow path length less than 16 inches; each SOFA *configuration* shall be tested, including each suction port combination for *manufactured sumps* with multiple *suction ports* and/or *suction pipe* opening sizes. Hair entrapment tests for SOFAs with a flow path length greater than 16 inches; the SOFA *configuration* that results in the highest flow potential shall be tested.

5.9.14 The area of the *cover/grate* adjacent to each *suction port* shall be challenged with the Type 1 (skull) and Type 2 (ponytail) hair specimens.

5.9.15 The scale shall be reset to zero prior to each pull test, if applicable.

5.9.16 The flow rate shall be increased in 5 gpm (19 L/min) increments.

5.9.17 Ten tests shall be performed at each flow rate.

5.9.18 The hair shall be combed or brushed before each test until it is free of tangles.

5.9.19 The amount of force necessary to free the hair from the fitting shall be measured with the test pump(s) operating.

5.9.20 The skull or ponytail shall be attached to the scale and the scale shall be zeroed while the skull or ponytail is fully immersed in the test tank water.

5.9.21 The skull or ponytail shall be pulled vertically away from the fitting by activating the hair removal mechanism. The removal force and suction head shall be measured and recorded.

5.9.22 Where a failure is determined with a specific 5 gpm (19 L/min) increase, the SOFA shall be permitted to be retested in 1 gpm (3.8 L/min) increments up to the point of the previous failure.

5.10 Hair test performance requirement

5.10.1 A pull of 5 lbf (22 N), or greater, on any one of the ten pulls, including the equalized weight of the saturated test apparatus, shall be deemed a failure, and the flow rate in gpm at failure shall be recorded. If only one failure in ten pulls occurs, repeat the test, with ten more pulls. If no failures occur in the second set of ten pulls, move to the next higher flow rate. The flow rate, pull force, and suction head of each passing set of tests used to determine the SOFA flow rating shall be recorded and reported.

5.10.2 The maximum allowable certified flow rating shall be the lower of either the highest passing flow rate for any of a SOFAs suction ports,

divided by 1.25, the body blocking flow rate determined in section 6 or any lower flow rating specified by the *cover/grate manufacturer.*

6 BODY ENTRAPMENT TESTING

The objective of this section is to measure the removal force of a body that might be held against a cover/grate by the suction force of a pump.

6.1 General

6.1.1 The body entrapment test shall apply to all manufactured *cover/grates* certified under this standard.

6.1.1.1 *RDP SOFAs* shall be certified in accordance with either section 3.9 or section 6.

6.1.2 Only one *cover/grate* is required to be tested.

6.1.3 *Self-contained spa SOFAs* shall be tested for conformance with section 6 using a single-outlet configuration on a SOFA *mounting surface* in accordance with section 5.5 and the body entrapment test shall not be performed using the configuration of paragraph 5.6.1.

6.2 Body entrapment test equipment.

Tests shall be performed using the equipment specified in paragraphs 6.2.1 through 6.2.8.

6.2.1 A test tank in accordance with section 5.3.

6.2.2 **Body blocking element (BBE).** The *body-blocking element (BBE)* shall be constructed of 2-inch (51 mm) thick closed-cell nitrile butadiene rubber/(poly) vinyl chloride (NBR/PVC) foam with a compression deflection value of 1.5 psi to 3.0 psi (10 kPa to 21 kPa) at 25% deflection, as measured in accordance with ASTM D 1056-00. The foam shall be mounted to a 3⁄4 in. (19 mm) waterproofed plywood backing, with the skin side of the foam facing away from the plywood. The vertical corners of the *body-blocking element (BBE)* shall have a radius of 4 inches. Refer to Figure 18.

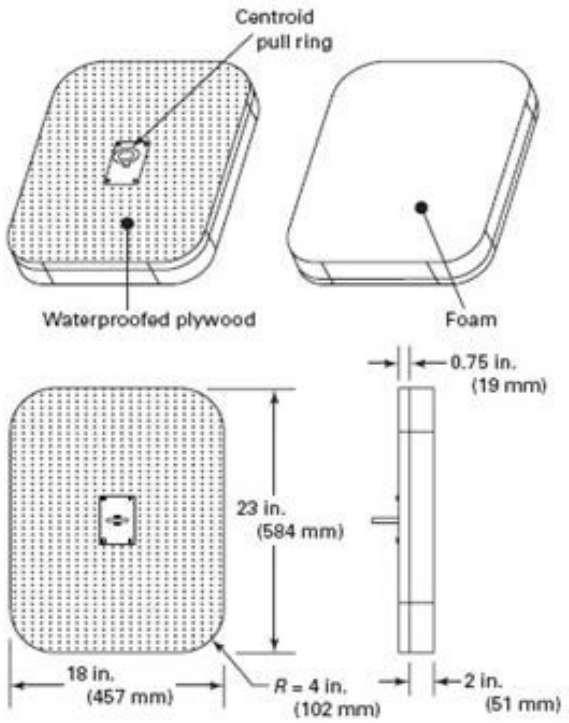


Figure 18: Body blocking element (BBE)

6.2.3 **BBE attachment.** An eyebolt, or equivalent device located at the centroid of the *body blocking element (BBE)*, shall be used to attach the *body-blocking element (BBE)* to the push/pull actuator as shown in Figure 18.

6.2.4 **Push/pull actuator.** An apparatus that can apply 120 lbf (534 N) vertically downward and upward on the *body-blocking element (BBE)*, release the downward force within 2 seconds, then apply the upward force required to remove the *body-blocking element (BBE)* from the *cover/grate*.

6.2.5 **Push/pull force measurement.** A scale accurate within 0.5 lbf (2.2 N) at a compression/tension of 120 lbf (534 N) shall be used to measure the BBE removal force.

6.2.6 **SOFA test configuration.** The *cover/grate* shall be installed on and tested with the SOFA configuration of section 5 that provided the highest flow rating.

6.2.6.1 For SOFA's certified for wall only applications, the testing of section 6 may be performed in either the vertical or horizontal orientation. When a *cover/grate* certified for walls only is to be tested in the wall mounted position, the push/pull actuator performance requirements

of paragraph 6.2.5 shall be met except the push/pull forces shall be applied horizontally.

6.2.7 Pumping system. Shall be in accordance with paragraph 5.4.4.

6.2.8 The *body-blocking element (BBE)* shall be ballasted to neutral buoyancy within 0.7 lbf (3.1 N) at the test depth, and the buoyancy shall be reported.

6.3 Body entrapment test procedure.

6.3.1 With the *cover/grate* installed on the SOFA configured in accordance with paragraph 6.2.6 and with the pumping system operating in conformance with paragraph 6.2.7, the *body-blocking element (BBE)* shall be centered over the *cover/grate* and oriented to block the largest possible open area of the *cover/grate*.

6.3.2 A force of 120 lbf (534 N) shall be applied through the eyebolt, or equivalent, to fully seat the *body-blocking element (BBE)* on the *cover/grate*.

6.3.3 The applied force shall be removed from the *body-blocking element (BBE)* within 2 seconds.

6.3.4 Within 2 seconds after removal of the applied force, the push/pull actuator shall begin to lift the *body-blocking element (BBE)* from the *cover/grate*.

6.3.5 The maximum force required to remove the *body-blocking element (BBE)* from the *cover/grate* shall be recorded as the removal force.

6.4 Body entrapment test performance requirement

6.4.1 Under these test conditions, the removal force shall not exceed the value specified by the equation:

Equation 2:

$$F_{max} = \left(\frac{W_{derived}}{9}\right)^3 15$$

where:

$\mathbf{F_{max}}$ = the maximum permissible removal force in pounds.

$\mathbf{W_{derived}}$ = the minimum width in inches of a rectangular shape whose length is 1.28 times the width, with corners of radius 22% of the width dimension, which completely shadows the openings of the *cover/grate*, and shall in no case be smaller than 9 in. nor larger than 18 in.

6.4.2 The maximum permissible removal force shall not be exceeded in three consecutive tests.

6.4.3 Where a failure is determined at the tested flow rate as specified in section 6.3, it is permitted to test the *cover/grate* in 5 gpm (19 L/min) decrements until it passes. Then it is permitted to retest the *cover/grate* in 1 gpm (3.8 L/min) increments up to the point of failure to determine the SOFA rating under section 6.

- The maximum removal force, test flow rate, and maximum suction head shall be recorded and reported for the three passing tests.

7 FINGER AND LIMB ENTRAPMENT TESTING

The objective of this section is to evaluate cover/grate for geometry that might entrap a finger or limb.

7.1 General

7.1.1 The finger and limb entrapment test of this section shall apply to all SOFA types.

7.1.2 Finger entrapment tests shall be conducted on one new *cover/grate*.

7.1.3 When fully assembled, SOFAs shall not have any accessible opening that allows the passage of the 1 in. (25 mm) cylindrical end of the UL articulated probe.

7.1.4 Finger entrapment tests shall be conducted on each SOFA configuration capable of altering the size of any *cover/grate* aperture opening, e.g., *cover/grates* certified in accordance with paragraph 5.5.3.

7.1.5 Tests shall be conducted at 73.4 °F ± 3°F (23 °C ± 2 °C) using a new dry SOFA.

7.1.6 Tests shall be conducted with the "UL Articulated Probe" in accordance with Figures 19, 20, 21 and 22.

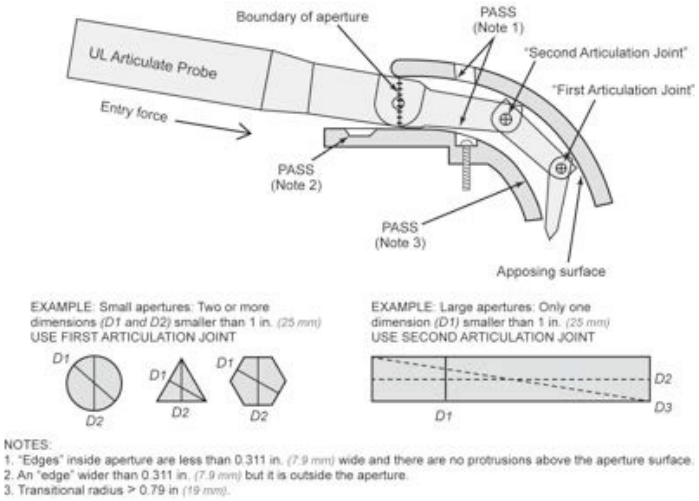


Figure 19: Finger probe test

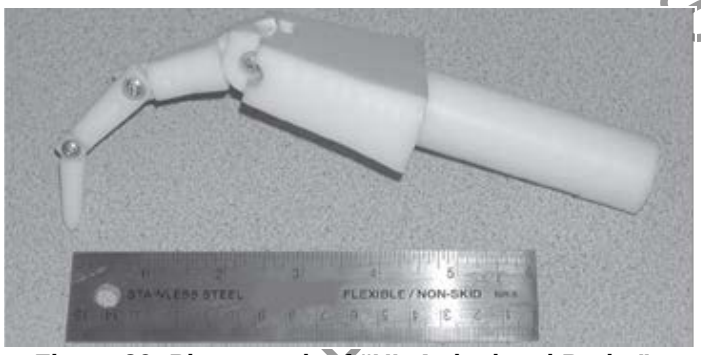


Figure 20: Photograph of "UL Articulated Probe"

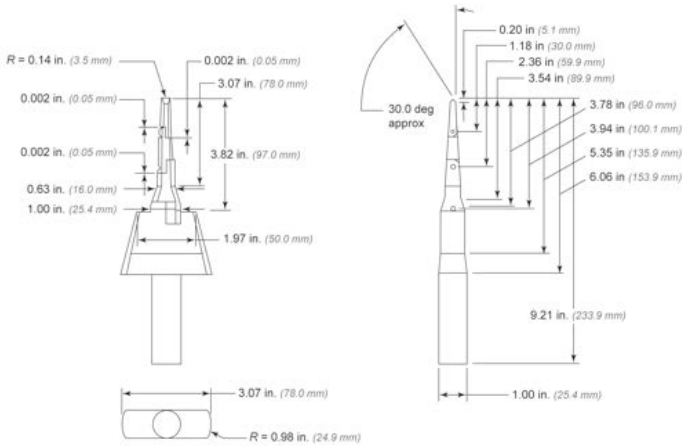


Figure 21: Finger probe dimensions

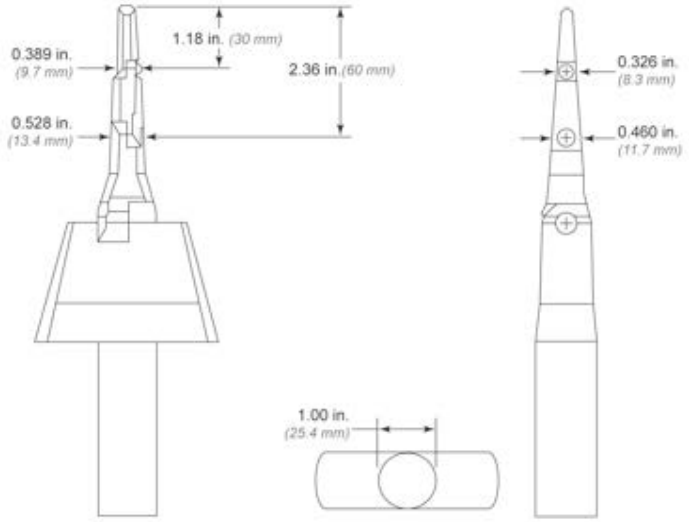


Figure 22: Finger probe knuckle dimensions

7.2 Finger and limb test procedure

7.2.1 Each flow passage aperture of the *cover/grate* when installed on the SOFA shall be subjected to the insertion of both ends of a "UL Articulated Probe".

7.2.2 The finger probe shall be inserted with a force of 3 lbf ± 0.15 lbf (12 N ± 0.6 N)

7.3 Finger and limb test performance requirement

7.3.1 A small or large aperture is permitted when the 1 in. (25 mm) cylindrical end of the "UL

Articulated Probe" cannot be made to penetrate through to the inside surface of the aperture and as follows:

7.3.1.1 Small apertures shall be permitted when the centerline of the first articulation joint, located 1.18 in. (30 mm) from the point end of the "UL Articulated Probe", cannot be made to pass beyond an *edge* or *pinch point* that is located inside the aperture being tested. Refer to Figures 19, 20, 21 and 22.

7.3.1.2 *Edges* and *pinch points* shall be permitted within the small aperture and within range of the first articulated joint in accordance with Figure 19 if they are less than 0.311 in. (7.9 mm) wide, measured parallel to the aperture opening.

7.3.1.3 *Edges* and *pinch points* created by molding lines, engraved text, and symbols shall be permitted within the small aperture provided they do not exceed a height of 0.025 in. (0.64 mm).

7.3.1.4 Large aperture(s) shall be permitted if the centerline of the second articulation joint, located 2.36 in. (59.9 mm) from the point end of the "UL Articulated Probe", cannot be made to pass beyond an apposed *edge* or *pinch point* that is located inside the aperture being tested. Refer to Figures 19, 20, 21 and 22.

8 PRODUCT MARKINGS

8.1 *Cover/grate* markings visible when installed

All *manufactured cover/grates* shall include markings permanently legible and located on an exposed surface that is readily visible after installation. The text font size shall be at least 0.08-in. (2.03 mm) tall and shall include the following:

8.1.1 The name, trade name or trademark of the manufacturer.

8.1.2 A distinctive part number.

8.1.3 The type of service, "Blockable" or "Unblockable" as appropriate.

8.1.4 The manufacturer specified service life in years, e.g., "Life # Years" where "#" is years.

8.1.5 "VGBA ####", where #### indicates the year this standard was approved by the American National Standards Institute.

8.1.6 Certification agency conformity markings.

8.1.7 Cover/grate flow ratings.

8.1.7.1 Single flow rating. Cover/grates with only one set of flow ratings shall be marked "Wall ### GPM", and/or "Floor ### GPM", or "Wall/Floor ### GPM as appropriate, where ### is the flow rating in GPM as certified in accordance with paragraph 1.3.7.

8.1.7.2 Multiple flow ratings. Cover/grates with multiple sets of flow ratings shall be marked "For Flow Ratings See Instructions" or all flow ratings shall be marked on the cover/grate in accordance with paragraph 8.1.7.1 such that flow ratings are adjacent or otherwise associated with the SOFA *model number*.

8.1.8 Self-contained spa SOFA cover/grates shall be marked with "For Use in Self-Contained Factory-Manufactured Spas Only".

8.2 *Cover/grate* markings not visible when installed

All *manufactured cover/grate* markings shall be permanently legible and located on any surface that is readily visible before or after installation. The markings shall include the following:

8.2.1 The date of manufacture, or period of manufacture not exceeding one month.

8.3 Markings on *manufactured* sumps and *mud* frames

All *manufactured sump* and *mud frame* markings shall be permanently legible and located on any surface that is readily visible after the part has been installed in the pool. These marking shall be permitted to be hidden when the *cover/grate* is installed. The text font size shall be at least 0.08-in. (2.03 mm) tall for all markings except it is permissible for the text on standard injection molding date indicators to be smaller.

8.3.1 The name, trade name, or trademark of the manufacturer.

8.3.2 A distinctive part number.

8.3.3 The manufacturer specified service life in years, e.g., “Life # Years” where “#” is years.

8.3.4 The date of manufacture, or period of manufacture not exceeding one month.

8.4 Installation information label

8.4.1 Each manufactured *cover/grate* shall be packaged with a label made from materials designed to exceed the service life of the *cover/grate*, and of sufficient size and format to be legibly filled-in by the installer at the time the *cover/grate* is installed. The manufacturer shall prefill-in the information required by paragraphs 8.4.1.1 through 8.4.1.4.

Instructions shall be provided with the label requiring the *cover/grate* installer to fill-in the balance of the information required by paragraphs 8.4.1.5 to 8.4.1.7 before giving the label to the pool owner. The label instructions shall request it be permanently posted as near as feasible to the pump control, and that a copy of this information be given to the pool owner, to be kept with other important pool related documents.

8.4.1.1 Manufacturers name.

8.4.1.2 *Cover/grate* part number.

8.4.1.3 Service life of the *cover/grate.*

8.4.1.4 The certified *Cover/grate* flow rating(s), as they are permanently marked in accordance with paragraph 8.1.7.1, when applicable.

8.4.1.5 The certified flow rating specific to the SOFA configuration and installed orientation, i.e., wall or floor, for co*ver/grates* permanently marked “For Flow Ratings See Instructions”.

8.4.1.6 Location of the installed SOFA, such that it can be successfully identified in the future.

8.4.1.7 The date the *cover/grate* was installed in the pool, where the month and year indicators on the label are easily activated in the field.

8.5 Equivalent markings for RDP SOFA

8.5.1 The registered design professional that certifies an *RDP SOFA* shall either apply the applicable markings to the SOFA in conformance with sections 8.1 through 8.3 and provide an information label in conformance with section 8.4, or the equivalent information shall be posted on a permanently mounted sign, that is adjacent to the pool circulation pump(s). When posting adjacent the pump(s) is not feasible, the sign shall be posted in the equipment area and indicate which pump(s) to which the SOFA(s) is installed. The minimum text size of the sign lettering shall be 0.33 in. tall.

9 INSTRUCTIONS

Each product certified to this standard shall be provided with installation instructions, user-maintenance instructions, and important safety instructions. Installation instructions shall only include SOFA configurations that have been certified in accordance with section 1.3.

9.1 Installation instructions for all manufactured SOFAs

9.1.1 The installation instructions shall include all information required by section 3 that is applicable to product for which these instructions are intended.

9.2 Installation instructions for RDP SOFA

9.2.1 Registered design professionals who certify and supervise the installation of an *RDP SOFA* shall not be required to provide installation instructions. Those that do not supervise the installation shall provide installation instructions applicable to the specific SOFA in accordance with paragraph 9.1.1.

9.3 General Certificate of Conformity (GCC)

9.3.1 The SOFA manufacturer shall provide a “General Certificate of Conformity (GCC)” with each SOFA, or instructions how to secure this information via electronic means. The GCC shall include the following information, which was current at the time this standard was approved, however *manufacturers and registered design professionals* shall consult CPSC.gov for

current GCC requirements.

9.3.1.1 Identification of the product covered by this certificate: Describe the SOFA covered by this certification in enough detail to match the certificate to each product it covers and no others.

9.3.1.2 Citation to VGBA to which this product is being certified: The certificate must identify the Virginia Graeme Baker Pool and Spa Safety Act, the consumer product safety rule that is applicable to SOFAs.

9.3.1.3 Identification of the U.S. importer or domestic manufacturer certifying compliance of the product: Provide the name, full mailing address, and telephone number of the importer or U.S. domestic manufacturer certifying the product.

9.3.1.4 Contact information for the individual maintaining records of test results: Provide the name, full mailing address, e-mail address, and telephone number of the person maintaining test records in support of the certification.

9.3.1.5 Date and place where this product was manufactured: For the date(s) when the product was manufactured, provide at least the month and year. For the place of manufacture provide at least the city (or administrative region) and country where the product was manufactured or finally assembled. If the same manufacturer operates more than one location in the same city, provide the street address of the factory.

9.3.1.6 Provide the date(s) and place when the product was tested for compliance with this standard: Provide the location(s) of the testing and the date(s) of the test(s) or test report(s) on which certification is being based.

9.3.1.7 Identification of any third-party laboratory on who's testing the certificate depends.

9.4 VGBA devices and systems designed to prevent suction entrapment.

9.4.1 For cover/grates marked *blockable* the *cover/grate* manufacturer's installation instructions shall include a statement that the SOFAs be installed ONLY in *multiple SOFA systems,* or the manufacturer's instructions shall state that the installer shall include one or more of the following devices or systems designed to prevent suction entrapment:

9.4.1.1 SAFETY VACUUM RELEASE SYSTEM- A system that ceases operation of the pump, reverses the circulation flow, or otherwise releases the vacuum in a circulation system when a blockage is detected, that has been tested by an independent third party and found to conform to ASME/ANSI standard A112.19.17 or ASTM standard F2387.

9.4.1.2 SUCTION-LIMITING VENT SYSTEM- A circulation system that incorporates a tamper- resistant atmospheric vent that is hydraulically located between the suction outlet and the circulation pump, which allows air to enter the circulation system and release the vacuum within the system when the suction outlet is blocked and the circulation pump is operating.

9.4.1.3 GRAVITY DRAINAGE SYSTEM- A powered circulation system, which utilizes a collector tank hydraulically located between the pump and the suction outlet that is filled by the gravitationally induced flow of water from the suction outlet, and is vented to the atmosphere by a tamper-resistant opening.

9.4.1.4 AUTOMATIC PUMP SHUT-OFF SYSTEM- A system that is designed to sense blockage of the suction fitting and then turn-off the power to the pump, and subsequently release the vacuum in the circulation system when a blockage is detected.

9.4.1.5 DRAIN DISABLEMENT- A device or system that permanently stops the flow of water from a SOFA.

9.4.1.6 OTHER SYSTEMS- Any other system determined by the Consumer Product Safety Commission to be equally effective as, or better than, the systems described in paragraphs 9.4.1.1 through 9.4.1.5 above, at preventing or eliminating the risk of injury or death associated with pool drainage systems.

9.5 User maintenance Instructions

The *manufacturers* and *registered design*

professionals responsible for any product certified to this standard shall provide user maintenance instructions that shall include all applicable information in section 3.4.

9.6 Important Safety Instructions

The important safety instructions shall be separated in format from the other instructions and shall appear before the user-maintenance instructions specified in section 3.4. The important safety instructions shall be in the exact words specified or shall be in equally definitive terms. No substitution shall be made for the words "WARNING" and "DANGER." The first and last items specified in the important safety instructions shall be first and last, respectively. Other precautionary items considered appropriate by the manufacturer may be included. The letter size in the important safety instructions shall be as follows:

- Uppercase letters shall be no less than 1/12 inch (2.1 mm) high;
- Lowercase letters shall be no less than 1/16 inch (1.6 mm) high; and
- The phrases "IMPORTANT SAFETY INSTRUCTIONS," "READ, UNDERSTAND, AND FOLLOW ALL WARNINGS AND INSTRUCTIONS," and "SAVE THESE INSTRUCTIONS " shall be in letters no less than 3/16 inch (4.8 mm) high.

9.7 Statements for all SOFA instructions

9.7.1 The statement "When installing and using this equipment, basic safety precautions shall always be followed, including the following: IMPORTANT SAFETY INSTRUCTIONS".

9.7.2 READ, FOLLOW, AND UNDERSTAND ALL INSTRUCTIONS AND WARNINGS.

9.7.3 Any modification that increases the flow rate of the circulation system shall require re-evaluation of the *cover/grate* and *sump* to ensure that the flow rating of the Suction Outlet Fitting Assembly (SOFA) is not exceeded.

9.7.4 Missing, broken, or cracked cover/grates, sumps, mud-frames, or any other SOFA component shall be replaced before *bathers* are allowed to use the pool.

9.7.5 Loose cover/grates shall be reattached before *bathers* are allowed to use the pool.

9.7.6 SAVE THESE INSTRUCTIONS

9.8 Removal Tags for cover/grate packaging

Each *manufactured cover/grate* shall include with a removal tag or affixed label stating the following:

9.8.1 "READ, FOLLOW, AND UNDERSTAND ALL INSTRUCTIONS AND WARNINGS"

9.8.2 This VGBA Suction outlet has an installation specific flow rating and this product SHALL NOT be installed on a pumping system that is capable of exceeding this limit, which varies based on the number and location of installed suction outlets. READ and FOLLOW the section of the included installation instructions explaining how to calculate the suction system flow ratings and that of the installed pumping system.

9.8.3 For *cover/grates* marked *blockable*

The *cover/grate manufacturer* shall include at least one of the following statements, or a combination of these statements:

9.8.3.1 "WARNING! This is a BLOCKABLE VGBA Suction Outlet that must ONLY be installed in a multiple VGBA Suction Outlet system"

9.8.3.2 "WARNING! This is a BLOCKABLE VGBA Suction Outlet that must ONLY be installed in a suction system that also includes one or more of the following devices or systems designed to prevent suction entrapment." The cover/grate manufacturer shall then list one or more of the devices or systems of section 9.4 and/or a specific product(s) of the type listed in section 9. The list may also include the option of installing one, or more additional VGBA Suction Outlets.

9.8.4 For *cover/grates* marked *unblockable* the *cover/grate manufacturer* shall include at least one of the following statements.

9.8.4.1 “This is an UNBLOCKABLE VGBA Suction Outlet that may be installed as the sole source of water for a single suction outlet.”

9.8.4.2 “This is an UNBLOCKABE VGBA Suction Outlet that must ONLY be installed in a multiple VGBA Suction Outlet System.”

9.8.4.3 This is an UNBLOCKALBE VGBA Suction Outlet that must ONLY be installed in a suction system that also includes one or more of the following devices or systems designed to prevent suction entrapment.” The cover/grate manufacturer shall then list one or more of the devices or systems of section 9.4 and/or a specific product(s) of the type listed. The list may also include the option of installing one, or more additional VGBA Suction Outlets.

9.8.5 “THIS (TAG/LABEL) IS TO BE REMOVED BY THE INSTALLER ONLY”

