ASME A112.19.8-2007

[Revision of ASME/ANSI A112.19.8M-1987 (R1996)]

Suction Fittings for Use in Swimming Pools, Wading Pools, Spas, and Hot Tubs

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Three Park Avenue • New York, NY 10016

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ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Interpretations are published on the ASME Web site under the Committee Pages at http://cstools.asme.org as they are issued.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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FOREWORD

The initial work on a standard for suction fittings was undertaken by a Committee of the International Association for Plumbing and Mechanical Officials (IAPMO). Their activity resulted in their Product Standard SPS-1 for suction fittings, which was used as a benchmark for the performance of such devices. At IAPMO's suggestion, the SPS-1 standard was offered to ASME for conversion into a national consensus standard. In order to undertake this challenge, a Task Group of A112 Panel 19 was formed to write this Standard.

The original edition of this Standard was approved by the American National Standards Institute (ANSI) on November 23, 1987.

Since the 1987 publication of this Standard, studies continued on the issues of hair test samples, hair entanglement, and pump analysis. Actual human tests have shown significant differences in the behavior of a full head of hair as compared to the previous specimen of only two ounces (approximately a half head of hair) that was concentrated on a 1 in. dowel, rather than distributed on a head that allows blockage of a larger area of a cover/grate.* Test procedures have been revised accordingly. This revision of the original Standard reflects the results of such studies and subsequent experience.

Work is ongoing on entrapment by swelling of skin on the downstream side of a cover/grate which can create a mechanical lock. Another aspect is the ability of skin to separate from the body and conform to the shape of the cover/grate. This can occur with high differential pressure commonly associated with small, single cover/grates connected to a single point, direct suction.

Research has shown the potential for body entrapment decreases when a seal cannot be formed over a suction outlet cover/grate. The use of large size cover/grates, or if a large size is not used, small suction outlets that do not mount flat and flush with the mounting surface are helpful in this regard. The hazard of body entrapment is primarily addressed by the proper selection of a large size outlet cover/grate, which is unblockable, or with the proper installation of more than one suction outlet spaced apart or positioned on different planes to prevent simultaneous blockage. Alternatively, body entrapment is inhibited through the use of indirect suction, such as gravity flow systems.

Accident summaries have shown the necessity for designing cover/grates so that they are held firmly in place over the suction outlet sump. When fasteners are used for this purpose, manufacturers are strongly encouraged to use captive screws and threaded inserts, or deep thread depths with sufficient receiving material. The use of self-tapping fasteners is discouraged where repeated inspection and/or service is likely, such as public and semi-public installations or where access to a hydrostatic valve is necessary. Any loose, degraded, broken, or missing cover/grate requires the immediate closing of the facility until the problem with the cover/grate is fully corrected.

Wherever possible, suction fittings should be tested with the end use product to confirm compliance with this Standard. For example, packaged spa systems should be tested to confirm compliance, including an evaluation of the foot well for body entrapment hazards associated with large adults. In this regard, the 1995 edition of ASME A112.19.7 covering whirlpool bathtub appliances was amended to integrate testing for suction fittings, which are used in such appliances; therefore, reference to whirlpool bathtubs within this Standard have been deleted.

The structural tests included in this Standard are intended to evaluate the integrity of the suction fitting, the suitability of the material(s) for the intended installation environment, and addressing the problem of broken suction cover/grates, which statistics show to be one of the leading causes of body and limb entrapments.

The potential for body entrapment is also addressed by the proper installation of more than one suction outlet. Sample installation procedures are found in the Uniform Swimming Pool, Spa and Hot Tub Code, published by the International Association of Plumbing and Mechanical Officials (IAPMO), 5001 East Philadelphia Street, Ontario, CA 91761. The standards for public and private swimming pools and spas published by the Association of Pool and Spa Professionals (APSP), 2111 Eisenhower Avenue, Alexandria, VA 22314, also provide similar guidance. See also ANSI/NSPI-1 Standard for Public Swimming Pools, ANSI/NSPI-2 Standard for Public Spas, ANSI/NSPI-3 Standard for Permanently Installed Residential Spas, ANSI/NSPI-4 Standard for Aboveground/Onground Residential Swimming Pools, ANSI/NSPI-5 Standard for Residential Inground Swimming Pools, and ANSI/NSPI-6 Standard for Residential Portable Spas. ASME has developed a standard (ASME A112.19.17) for safety vacuum release systems that should be investigated when evaluating the overall suction hazard potential of pools and spas and proper safety measures to be taken, as well as a similar standard by ASTM referenced as ASTM F 2387-04.

Suggestions for improvement of this Standard are welcome. They should be sent to The American Society of Mechanical Engineers; Attn: Secretary, A112 Standards Committee; Three Park Avenue; New York, NY 10016-5990.

ASME A112.19.8-2007 was approved by the American National Standards Institute on February 5, 2007.

* Throughout this Standard, the words "cover/grate" are used with the full meaning "suction fitting."

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Standardization of
Plumbing Materials and Equipment

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PROJECT TEAM 19.8 — SUCTION FITTINGS FOR WHIRLPOOLS, SPAS, AND HOT TUBS

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G. S. Duren, *Deputy Project Team Leader,* Code Compliance, Inc.
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Secretary, A112 Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the edition, the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal including any pertinent documentation. When appropriate, proposals should be submitted using the A112 Project Initiation Request Form.

Interpretations. Upon request, the A112 Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the A112 Standards Committee.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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Attending Committee Meetings. The A112 Standards Committee schedules meetings as needed, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the A112 Standards Committee. The A112 home page contains information on future meeting dates and locations.

SUCTION FITTINGS FOR USE IN SWIMMING POOLS, WADING POOLS, SPAS, AND HOT TUBS

1 GENERAL

1.1 Scope

1.1.1 General Requirements. This Standard establishes materials, testing, and marking requirements for suction fittings that are designed to be totally submerged for use in swimming pools, wading pools, spas, and hot tubs, as well as other aquatic facilities.

1.1.2 Definition. Suction fittings shall be defined as all components, including the sump and/or body, cover/grate, and hardware.

1.1.3 Compliance. Demonstration of compliance for this Standard is merely an indication that the product meets performance requirements and specifications contained in this Standard.

1.1.4 Revisions. The provisions of this Standard shall not be construed to prevent the use of any alternate material or method of construction provided any such alternate meets the full intent of the standard.

1.1.5 Exclusions

1.1.5.1 Skimmers shall be excluded from evaluation to this Standard.

1.1.5.2 Vacuum connection covers shall be excluded from evaluation to this Standard.

1.1.6 Types of Suction Fittings

1.1.6.1 General. A manufacturer or designer of any suction outlet cover/grate shall indicate under which Type the cover/grate is listed.

1.1.6.2 Field Fabricated Outlets. All nonmanufactured suction outlets constructed in the field with individual components shall be considered as "Field Fabricated Outlets."

1.1.6.3 Venturi Outlets. All venturi activated indirect-suction outlets or venturi activated debris collection systems shall be considered as "Venturi Outlets."

1.1.6.4 Swim Jet Combination Fittings. All swim jet combination fittings that combine suction and discharge into one housing, creating a high velocity, high volume stream of water to swim, jog, or walk against, as well as massage, shall be considered "Swim Jet Combination Fittings."

1.1.6.5 Submerged Suction Outlets. All other suction outlets for use in swimming pools, wading pools, spas, and hot tubs, as well as all other aquatic facilities, shall be considered as "Submerged Suction Outlets."

1.1.7 Single or Multiple Usage

1.1.7.1 Cover/grates that pass the body entrapment portion of this Standard as well as meeting all other requirements in this Standard shall be permanently marked "For Single or Multiple Drain Use," "For Single Drain Use," or "For Multiple Drain Use Only" at the manufacturer's option.

1.1.7.2 Cover/grates that fail the body entrapment portion of this Standard or any other requirements of this Standard may not be certified under this Standard.

1.2 Related Standards

Since 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. Several other standards, including but not limited to, ANSI/NSPI-1, -2, -3, -4, -5, -6, and -8, ANSI/IAF-9, as well as ASME A112.19.17, and ASTM F 2387-04, as outlined in para. 1.4, should be consulted so as to provide coverage for the various other aspects of this potential hazard in swimming pools, wading pools, spas, and hot tubs.

1.3 Units of Measurement

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 References

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

ANSI/IAF-9, Aquatic Recreation Facilities
ANSI/NSPI-1, Standard for Public Swimming Pools
ANSI/NSPI-2, Standard for Public Spas
ANSI/NSPI-3, Standard for Permanently Installed Residential Spas
ANSI/NSPI-4, Standard for Aboveground/Onground Residential Swimming Pools

ANSI/NSPI-5, Standard for Residential Inground Swimming Pools
ANSI/NSPI-6, Standard for Residential Portable Spas
ANSI/NSPI-8, Model Barrier Code for Residential Swimming Pools, Spas, and Hot Tubs

Publisher: Association of Pool and Spa Professionals (APSP) [formerly National Spa and Pool Institute (NSPI)], 2111 Eisenhower Avenue, Alexandria, VA 22314

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

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2300, Fairfield, NJ 07007-2300

ASTM D 2444, Standard Practice for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
ASTM D 2466-02, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM F 1498-2000, Standard Specification for Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings
ASTM F 2387-04, Standard Provisional Specification for Manufactured Safety Vacuum Release Systems (SVRS) for Swimming Pools, Spas and Hot Tubs
ASTM G 154, Standard Practices for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

Publisher: ASTM International (ASTM), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959

1.5 Definitions

anticlastic: having opposite curvatures, as the surface of a saddle.

anti-vortex: the term anti-vortex has been misused within the industry and largely misunderstood as somehow relating to entrapment prevention. Anti-vortex drain covers were designed to prevent an air-entraining vortex from forming. The term anti-vortex should not be construed to impart any protection and should no longer be referenced in this regard.

applicable body blocking element: a body blocking element that has a mandatory length to width ratio of 1.2777, a maximum size of 18 in. × 23 in. (457 mm × 584 mm), and a minimum size of 9 in. × 11.5 in. (229 mm × 292 mm). Its actual size for test purposes is the smallest size that will completely shadow the suction cover/grate being tested.

body blocking element: a flat, rectangular shape with radiused corners of approved foam and backing of the torso specimen measuring 18 in. × 23 in. (457 mm × 584 mm) with 4 in. (102 mm) corner radii.

body membrane: a rectangular inextensible isotropic sheet, for example, a 20 mil (0.5 mm) Vinyl sheet, in an 18 in. × 49 in. (457 mm × 1 245 mm) pattern with 4 in. (102 mm) corner radii.

complete system: comprising a pump, suction outlet (and possibly inlet), and connecting piping as specified by manufacturer. No other operating components or valves may be included. Safety devices, vents, suction vacuum release systems, etc., shall be used only as specified by the manufacturer. Nonoperating components such as drains are permitted.

cover: a fitting or device generally placed between the suction piping and the bather. Not used in this document to avoid confusion. See also *cover/grate*.

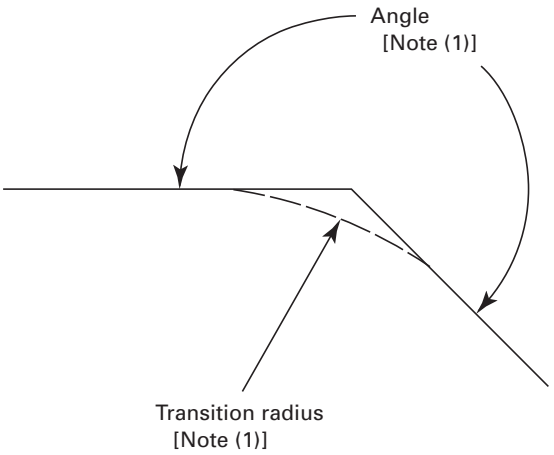
cover/grate: covering fitting or assembly that separates the bather from the suction sump or piping, sometimes referred to as a "grate" or a "cover."

dual blockage: a condition existing when a body membrane is placed to cover one suction outlet completely and any portion of the second suction outlet connected to the same individual suction system.

dual outlets: two suction outlets connected to an individual suction system but separated by a body membrane as a minimum.

edge: the line of intersection between any two surfaces with an intersecting angle greater than 180 deg, measured face to face (see Fig. 1), and having a transitional radius between the two faces of less than 0.75 in. (19 mm).

Fig. 1 Finger Probe "Edge"



NOTE:
(1) A transition is considered an "edge" when the angle is greater than 180 deg, and the transition radius is less than 0.75 in. (19 mm).

field fabricated: when applied to suction outlet hardware, shall indicate the use or design of conventional building materials or products, or of custom fabrication (e.g., weldments) to create specialized suction outlets.

grate: a fitting, assembly, or panel with multiple openings in its surface. Not used in this Standard to avoid confusion. See also *cover/grate*.

indirect-suction: a localized area of low pressure for the transfer of water from a swimming pool, wading pool, spa, or hot tub by any means not to include suction created by the inlet side of a pump or turbine (e.g., gravity flow systems where the low pressure under a cover/grate is produced by a difference in water levels).

individual suction system: a single suction system piping arrangement that connects one or more suction outlets to one or more pumps or gravity flow reservoirs.

manufactured: when applied to fittings, fitting assemblies, cover/grates, or related devices indicates the routine commercial production of such item(s) for the purpose of providing suction outlet hardware for swimming pools, wading pools, spas, and hot tubs.

multiple drain use only: indicating that the referenced suction outlet may not be used as the single sole source for water to a pump suction system.

multiple outlets: outlets when applied to suction outlets shall mean two or more suction outlets connected to an individual suction system.

operating component: any component or part that can have its functionality changed.

pinch point: any location inside the assembled suction fitting where an aperture enlarges upstream and downstream.

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

registered design professional: an individual who is registered or licensed to practice their respective 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.

single blockage: condition existing when a body membrane is placed to cover one suction outlet completely.

single drain use: indicating that the referenced suction outlet may be used as the single sole source for water to a pump suction system.

single or multiple drain use: indicating that the referenced suction outlet may be used as either the single sole source for water to a pump suction system, or may be used in conjunction with additional suction outlets to a pump suction system.

skin pad: skin-like cushion consisting of $\frac{1}{4}$ in. (6.35 mm) thick Buna-N rubber, Shore A durometer 60 ± 5.

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

swim jet combination fitting: a fitting that combines suction and discharge into one housing, creating a high velocity, high volume stream of water to swim, jog, or walk, as well as massage.

torso specimen: an 18 in. × 23 in. (457 mm × 584 mm) rectangular form with 4 in. (102 mm) radiused corners representing the flat portion of the 99th percentile adult male body (Mandatory Appendix I).

venturi outlets: venturi activated indirect-suction cover/grates or venturi activated debris collection systems.

2 FITTING DESIGN, ASSEMBLY, AND MATERIAL REQUIREMENTS

2.1 General Requirements

2.1.1 When fasteners are used, the suction fitting shall be designed so that tools are required for disassembly. Standard slotted screws shall not be permitted for affixing cover/grates to the suction fitting body. Fasteners shall have a corrosion resistance to the intended environment equivalent to grade 316 stainless steel as a minimum.

2.1.1.1 Threaded fasteners shall be sized to provide a minimum of three threads of engagement.

2.1.1.2 Sumps intended to receive fasteners shall be designed for fifteen secure insertion, tightening, and removal cycles of the fasteners without stripping. The design shall inhibit inadvertent cross-threading.

2.1.1.3 Sumps intended for use with self-tapping screws (those not having threaded inserts) shall be designed and constructed to accommodate redrilling for insertion of a threaded insert in a stripped hole to accept the original size fastener.

2.1.1.4 If threaded inserts are used, they shall be chosen to preclude any corrosive or chemical reaction with screws provided for the sump by the manufacturer.

2.1.1.5 Both self-tapping screws and machine screws with associated threaded inserts shall be permitted.

2.1.1.6 The strength of the fastening system shall conform to the requirements of this Standard.

2.1.2 Suction fitting assemblies that connect directly to the circulation piping shall attach by a PVC end connection in accordance with ASTM D 2466, or by a threaded end connection in accordance with ASTM F 1498.

2.1.3 There shall be no accessible sharp edges to constitute a hazard with fully assembled suction fittings.

2.1.4 Suction fittings shall not protrude from the installed surface more than 2 in. (51 mm).

2.2 Fitting Exposure

When polymeric material is used for the manufacture of suction fitting components they shall be tested as described in para. 3.2 and be rated for service life in accordance with para. 7.1.1(b)(5).

2.3 Specific Design Requirements

2.3.1 Field Fabricated Outlets. Field fabricated outlets are intended as but not limited to a single suction outlet and are limited to 1.5 ft/sec (0.46 m/s) of flow through the open area of the cover/grate unless rated at a lower flow rate by the Registered Design Professional. They shall be of such a size that the 18 in. × 23 in. (457 mm × 584 mm) body blocking element will not cause a differential pressure that could cause body entrapment as defined below. They are further governed by the stipulations of Mandatory Appendix II.

2.3.1.1 Suction Outlet Cover/Grates. Suction outlet cover/grates that cannot be completely covered by the 18 in. × 23 in. (457 mm × 584 mm) body blocking element may be rated by 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.

2.3.1.2 Entrapping Force Criterion for *Q*

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

where

a_B = largest area of the openings in ft^2, that can be blocked by the torso specimen in the most demanding position

a_R = area of the openings in ft^2 that remains unblocked

a_T = total area of the openings in ft^2 in the cover/grate

C = flow coefficient based on the design of the openings in the cover/grate. It shall be taken at 2.1 unless otherwise demonstrated by calculation or test.

F = allowable lifting load that can be exerted by a conscious entrapped person. It is taken at 120 lbf (534 N), about half the weight of the 99th percentile male whose weight is already entirely balanced by buoyancy.

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

ρ = mass density of water

$$= \frac{62.4 \text{ lb/ft}^3}{32.16 \text{ ft/sec}^2} = 1.940 \text{ slugs/ft}^3$$

2.3.1.3 Maximum Rating, ft^3/sec. The maximum rating of the cover/grate in cubic feet per second is Q.

2.3.1.4 Maximum Rating, gal/min. The maximum rating of the cover/grate in gallons per minute is Q multiplied by 7.48 gal/ft^3 multiplied by 60 sec/min.

2.3.1.5 Alternate Test. As an alternate to para. 2.3.1.2, the Body Entrapment Test of section 5 may be performed.

2.3.1.6 Sump. Field fabricated outlets shall have a sump below or behind the cover/grate of the design specified by the Registered Design Professional to control flow through the open area of the cover/grate.

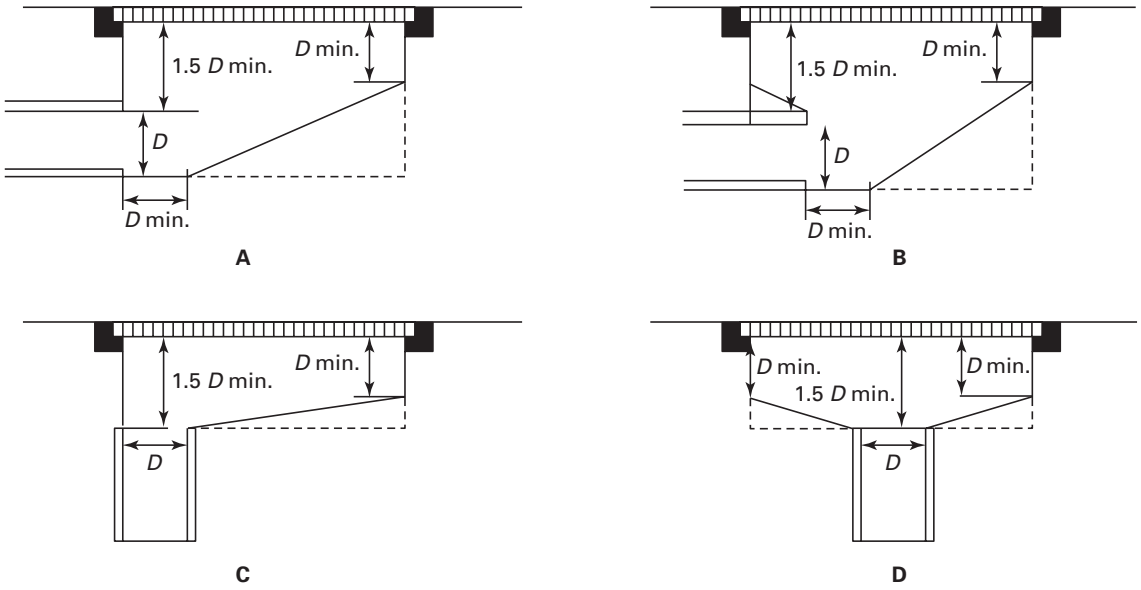
2.3.1.7 Design. The design of field fabricated outlets shall be further specified by a Registered Design Professional so as to fully address the considerations of cover/grate loadings, durability, hair, finger and limb entrapment issues, cover/grate secondary layer of protection, related sump design, as well as features particular to the site.

2.3.2 Venturi Outlets. Venturi outlets are outlets that are venturi activated through indirect suction through a single cover/grate generally designed for debris collection. Those that do not connect directly to the circulation piping must have the manufacturer's recommended sump below or behind the outlet cover/grate. They are further governed by the stipulations of Mandatory Appendix II.

2.3.3 Swim Jet Combination Fittings. Swim jet combination fittings are fittings that combine suction and discharge into one housing and may be used as single inlets/outlets. They shall connect directly to the circulation piping by a PVC end connection in accordance with ASTM D 2466, or by a threaded end connection in accordance with ASTM F 1498. They are further governed by the stipulations of Mandatory Appendix II.

2.3.4 Submerged Suction Outlets. Submerged suction outlets are manufactured cover/grate assemblies that may or may not connect directly to the circulation piping. Those that do not connect directly to the circulation piping must have either the manufacturer's recommended sump below or behind the outlet cover/grate, or a field built sump of the design specified by the manufacturer to control flow through the open area of the cover/grate. Alternatively, a sump built in accordance with Fig. 2 shall be permitted. They are further governed by the stipulations of Mandatory Appendix II.

Fig. 2 Field Built Sump



GENERAL NOTES:
(a) D = inside diameter of pipe.
(b) All dimensions shown are minimums.
(c) A broken line (_ _ _) indicates suggested sump configuration.

3 PHYSICAL TESTING

3.1 General

3.1.1 Certification. All testing and any certification of products to this Standard shall be conducted by a nationally recognized testing laboratory, except for field fabrication suction outlets which shall be certified in accordance with para. 2.3.1.7.

3.1.2 Conditions for Tests and Evaluation. All tests shall be conducted at laboratory room temperature of 73.4°F ± 3°F (23°C ± 2°C) unless specified otherwise herein.

3.1.3 Test Procedure. For the tests covered in section 3, a minimum of six suction fittings 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 for a total of six. Testing shall be performed immediately after conditioning, as described in para. 3.1.5.

3.1.4 Test Fixture. The fitting(s) shall be installed in a rigid fixture that is capable of supporting the fitting(s) in a manner similar to the actual installation.

3.1.5 Conditioning. All specimens shall be submerged in water at a temperature of 73.4°F ± 3°F (23°C ± 2°C) for at least 2 hr before testing.

3.1.6 Crack Detection. After each physical test, the unit shall be washed in a standard liquid detergent solution, rinsed with clear water and dried prior to application of ink as specified in para. 3.1.6.1. After inking, the unit shall be visually inspected in accordance with para. 3.1.6.2. To hasten drying, the surface of the unit shall be permitted to be wiped with a clean chamois leather or a clean absorbent lint-free material for this test only.

NOTE: Standard liquid detergent shall consist of (by volume)
(a) Monsanto TKPP, 8.00%
(b) Sterox NJ, 7.00%
(c) Stepan SXS, 8.00%
(d) Butyl Cellosolve, 1.5%
(e) Water, 75.5%

3.1.6.1 Inking Procedure. The entire finished surface of the fitting shall be rubbed with a sponge and a 50% solution of tap water and water-soluble contrasting color ink after the unit has been washed and dried as described in para. 3.1.6. The ink shall be rinsed from the surface and then dried before inspection.

3.1.6.2 Method of Inspection of the Fitting Surface. The surface of the fitting shall be inspected with the unaided eye for defects from a distance of between 1 ft and 2 ft (305 mm and 610 mm). The light source shall be equivalent to an illumination intensity near the surface to be inspected of 150 fc ± 50 fc (1615 lx ± 540 lx).

3.1.7 Performance Requirement. The fitting shall be free from cracks. The presence of seams, flow lines, and knit lines within suction fittings shall be permitted and shall not be considered as cracks. No failures shall occur.

3.2 Ultraviolet Light Exposure Test

Twelve new fittings shall be exposed to ultraviolet light and water spray in accordance with ASTM G 154,

using the Common Exposure condition, Cycle 3, found in Table X2.1 of ASTM G 154 for a period of 750 hr.

Manufactured sumps and other fitting components that are not exposed when fully assembled and installed according to the manufacturer's instruction shall not be required to be included in the Ultraviolet Light Exposure Test.

Where cover/grates are larger than the largest size parts that will fit in the test apparatus, representative sections of the cover/grate shall be tested in order to comply with the intent of para. 3.2.2.

3.2.1 Test Method. Specimens shall be mounted inside the test apparatus, with exposed surfaces of the specimens facing the UV lamps and positioned so they receive exposure approximating a fully assembled and installed cover/grate fitting. After the exposure test, the specimens 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. They shall then be retained under conditions of ambient room temperature and atmospheric pressure for not less than 16 hr and not more than 96 hr before being subjected to the following tests: Deflection Tests, Point Load to Protrusion Test, Shear Load Test, Vacuum and Point Impact Test, and Pull Load Test.

The exposed specimen shall be permitted to be transported from one laboratory to another via express shipment, provided time requirements are met.

3.2.2 Performance Requirement. All samples shall comply with all performance requirements of the structural integrity tests.

3.3 Vertical Load and Deformation Test

Six fittings intended for installation in the floor or wall shall be tested. They shall be those from the Ultraviolet Light Exposure Test (see para. 3.2).

A point load machine readable to, at a minimum, 5 lbf (22 N) increments and that is equipped with a 2 in. (51 mm) minimum diameter steel tup with a 2 in. ± ½ in. (51 mm ± 13 mm) radius nose and a tup speed of 0.20 in./min to 0.25 in./min (5.1 mm/min to 6.4 mm/min) shall be used.

3.3.1 Test Method. Using the tup and a 2 in. (51 mm) diameter "Skin Pad" on the face of the tup, and tup speed described in para. 3.3, the six fittings shall be mounted in a horizontal plane and tested. The "Skin Pad" is a ¼ in. (6.35 mm) thick Buna-N rubber pad of Shore A durometer 60 ± 5 hardness. The tup and pad shall be centered

(a) on the fitting face
(b) at two points midway between the center and edge
(c) at two points between stiffeners, if any
(d) at two points furthest from any support post

A load is applied at each of the above locations until 300 lbf ± 10 lbf (1 334 N ± 44 N) is reached.

3.3.2 Performance Requirement. Suction fittings shall not permanently deform, crack, or lose any material from the fitting, exclusive of plating or finish.

3.4 Horizontal Load and Deformation Test

Fittings to be tested shall be the six as previously tested in para. 3.3. This test is identical to the Vertical Test except that the load is 150 lbf ± 5 lbf (667 N ± 22 N). This applies only to fittings intended for and marked "Wall Only" or "Wall or Floor."

3.5 Point Load to Excess Test

Fittings to be tested shall be the six as previously tested in paras. 3.3 and 3.4, loaded in the same manner.

3.5.1 Test Method. The test equipment to be used shall be the same and positioned as described in para. 3.3, with "Skin Pad". The units shall be subjected to additional loading, with a load 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 ± 10 lbf (2 669 N ± 44 N) is reached.

3.5.2 Performance Requirement. Suction fittings shall not sustain loss of any material from the fitting, exclusive of plating or finish upon protrusion or when a value of 600 lbf ± 10 lbf (2 669 N ± 44 N) is reached. Permanent deformation shall not be considered a failure.

3.6 Shear Load Test

Six fittings shall be tested. They shall be those from the Ultraviolet Light Exposure Test (para. 3.2). This test shall be applied to all fittings that protrude ½ in. (13 mm) or more from the mounting plane.

3.6.1 Test Method. The fitting shall be tested by the application of a 150 lbf ± 5 lbf (667 N ± 22 N) test load applied 30 deg from the mounting plane by a loading face 2 in.^{2} (645 mm^2) covered with a 2 in. × 2 in. (51 mm × 51 mm) "Skin Pad" on its face. The six fittings shall be tested using the point load machine described in para. 3.3. Three fittings shall be tested with fasteners directly in line with the load to test the fastener's strength, and three shall be tested with the load midway between fasteners for general strength.

3.6.2 Performance Requirement. The cover/grate shall remain in place. The fitting shall not permanently deform, crack, or lose any material exclusive of plating and finish.

3.7 Vacuum and Point Impact Test

The same six fittings used in the Shear Load Test (para. 3.6) shall be tested.

3.7.1 Test Method

(a) The fitting to be tested shall be mounted on a horizontal surface and covered with a 20 mil (0.5 mm) plastic material or other suitable material. The fitting

outlet shall be connected to a vacuum system and it shall be subjected to a 28.5 in. Hg (724 mm Hg) vacuum within 60 sec ± 5 sec. The vacuum shall be sustained for 5 min ± 10 sec.

(b) The vacuum shall be removed, the plastic film shall be removed, and the fitting shall be impacted at 15 ft-lbf (20.3 J) using the test method in ASTM D 2444, with a 5 lb (2.3 kg) steel tup, 2 in. (51 mm) minimum diameter with a 2 in. ± ½ in. (51 mm ± 13 mm) radius nose. The 5 lb (2.3 kg) tup shall be dropped from a distance of 3 ft (0.9 m) aligned with the center of the fitting.

(c) The fitting shall be again covered with the plastic film and again the 28.5 in. Hg (724 mm Hg) vacuum shall be applied within 60 sec ± 5 sec. The vacuum shall be sustained for an additional 5 min ± 10 sec.

(d) After removal from the test fixture, water-soluble contrasting ink shall be applied in accordance with paras. 3.1.6 and 3.1.6.1 and the fitting shall be inspected for cracks, breaks, or fractures in accordance with para. 3.1.6.2.

3.7.2 Performance Requirement. The cover/grate shall remain in place after the test procedures in paras. 3.7.1(a) through (d). The fitting shall not permanently deform, crack, or lose any material from the fitting exclusive of plating and finish.

3.8 Pull Load Test

Pull Load Testing shall be required of all fittings with openings of 0.375 in. (9.53 mm) or more affording a finger grip. The measurements shall be done on the anticlastic surface when required for the hair test, para. 4.1.5.7. The same six fittings used in the Vacuum and Point Impact Test (see para. 3.7) shall be tested.

3.8.1 Test Method. The cover/grate shall be tested by the application of a 150 lbf ± 5 lbf (667 N ± 22 N) test load to the underside of the cover/grate assembly and perpendicular to the mounting surface that will approximate the load bearing points available to a bather's three fingers directly adjacent to fasteners, and midway between fasteners when the fitting is installed in accordance with the manufacturer's instructions.

3.8.2 Performance Requirement. The cover/grate shall withstand a 150 lbf (667 N) pulling force. Distortion under load shall not compromise the fastener(s), loosen the cover/grate, permanently deform, or crack the fitting.

4 HAIR ENTRAPMENT

4.1 General

4.1.1 Impedance. Hair drawn into or on suction fittings shall not impede the escape of a bather.

4.1.2 Sample Types. Two types of hair shall be used in this test and separate tests shall be run with each type.

4.1.2.1 Type 1. A full head of natural, fine, straight, blond European, human hair with cuticle on hair stems, 16 in. (406 mm) in length [5.5 oz ± 0.5 oz (155 g ± 15 g)], shall be firmly affixed in a manner approximating the normal distribution of hair with "hook and loop" to a Professional Wig Display Mannequin, Model No. FMH-#1SC, or equivalent, properly weighted to achieve neutral buoyancy under the water. A scale anchoring point shall be provided near the "neck" of the "skull". A fresh sample of hair shall be used for each fitting tested or when tangles in the hair cannot be removed. Hair shall be trimmed evenly.

4.1.2.2 Type 2. Natural, medium to fine, straight, 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) wooden dowel. A method for attaching a scale shall be provided on the opposite end of the dowel. A fresh sample of hair shall be used for each fitting tested or when tangles in the hair cannot be removed. Hair shall be trimmed evenly.

4.1.3 Suction Fitting. Only one new suction fitting shall be required to be tested.

4.1.4 Field Fabricated Outlets. For field fabricated outlets, hair entrapment tests are not required, but velocity through cover/grate openings shall not exceed 1.5 ft/sec (4.675 gpm/in.^{2}) of open area.

4.1.5 Test Equipment

4.1.5.1 Test Tank. The test tank for evaluation of suction fittings for the hair entrapment test shall be in accordance with Figs. 4, 5, and 6. The baffle plates shall be constructed as shown in Fig. 7 and be positioned as shown in Figs. 4 and 5.

4.1.5.2 Pump. A properly grounded pump capable of producing a flow rate of at least 25% greater than the fitting manufacturer's recommended rating of the fitting shall be used. A rate of flow meter with an accuracy of ±3% at the anticipated cover rating shall be installed in the piping system.

4.1.5.3 Pump Inlet. The pump inlet shall be connected to the 16 in. (406 mm) length of Schedule 40 plastic pipe using pipe lengths and adapters as necessary.

4.1.5.4 Scale. A scale accurate within 0.1 lbf (0.45 N) at a tension of 5 lbf (22 N) shall be used to determine pounds of pull against the entrapment.

4.1.5.5 Test Fixture. The hair entrapment test fixture shall be comprised of the test tank (Figs. 4 through 7), the mechanical appurtenances, and the pull mechanism (Fig. 3 and related notes).

4.1.5.6 Mounting Surface. For assemblies where all flow passages are provided by the manufactured

Fig. 3 Test Tank Pull Mechanism

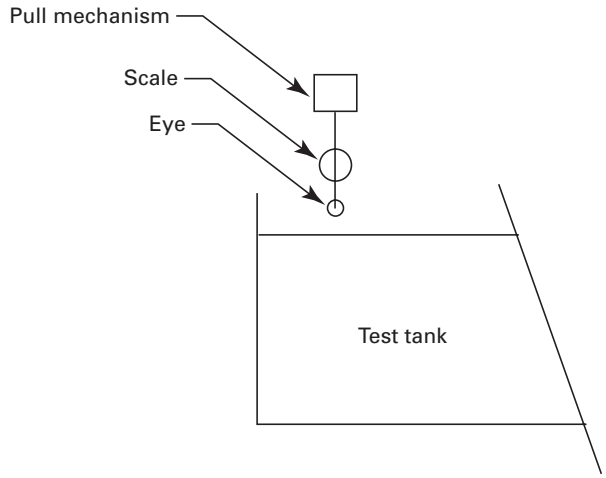


Fig. 4 Test Tank Side View

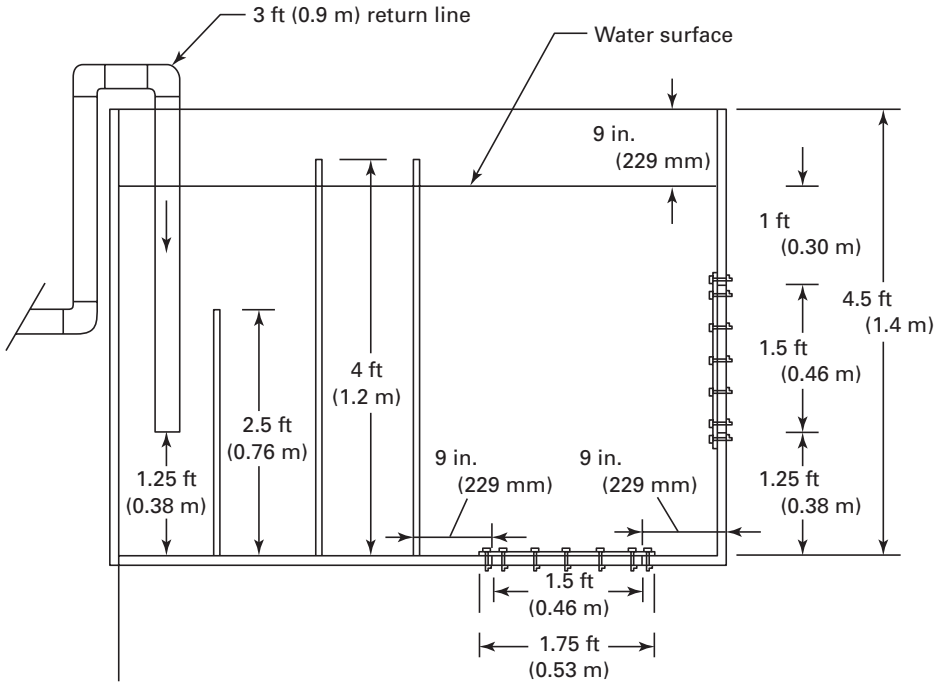
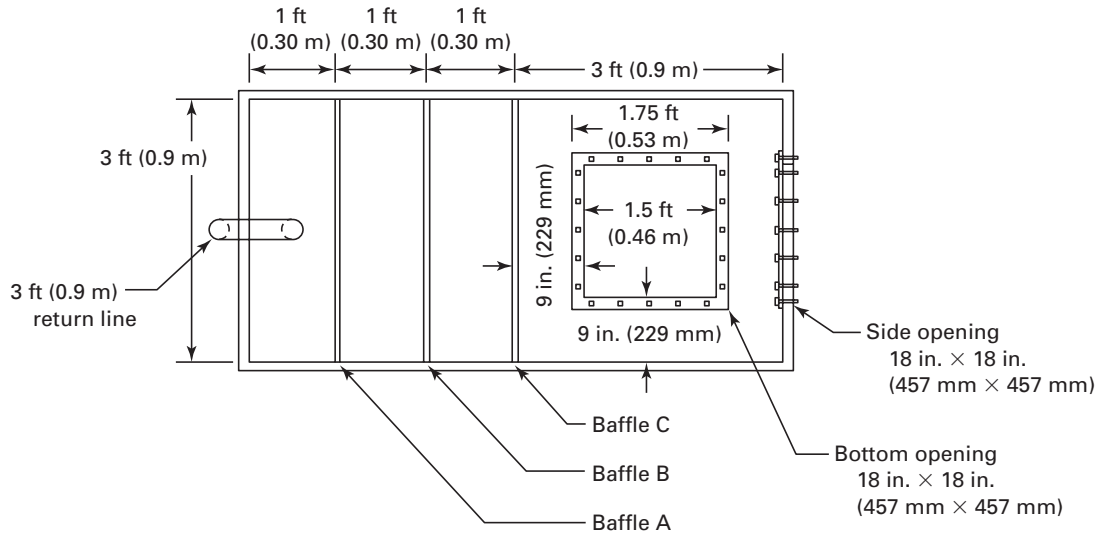


Fig. 5 Test Tank Top View



components, the mounting surface of Fig. 6 shall be planar.

4.1.5.7 Test Procedure. For assemblies where a portion of the flow passage is the pool surface and is not controlled by the suction outlet manufacturer, the test mounting surface shall represent field imperfections that may produce a hair entrapment hazard. The nominally planar mounting surface shall be distorted to an anticlastic (warped or saddle-shaped) surface such that one corner is 2 in. (51 mm) away from a plane defined by the other three corners of a 48 in.^{2} (310 cm^2) square as shown in Fig. 8. A convenient means shall support three of the corners in a plane with not less than 1 in. (25 mm) clearance from any nearby surface. 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 manufacturer.

4.1.6 Alternate Test Tank

4.1.6.1 Depth of Tank. The same tank as described in para. 4.1.5.1, with baffles, bottom, sides, and only the one end where the fittings are tested may be used by the insertion of the tank into a larger body of water so that the submerged depth of the tank is the same as in para. 4.2.3.

4.1.6.2 Water Volume. The volume of the water in this larger body of water shall substitute for the return line piping depicted in Figs. 4 and 5.

4.1.6.3 Alternate Test Pool. Any other body of water may be used provided the body of water provides equivalent test results as intended by this Standard.

4.1.6.4 Water Currents. Influences of water currents shall be virtually absent in the test pool as evidenced by the suspension of the hair sample in the tank for 30 sec and noting its deviation from a vertical plumb line hung at a distance from the nonflowing test specimen of four times the least dimension of the test cover/grate. The deviation shall not exceed 1 in. (25 mm) during this time.

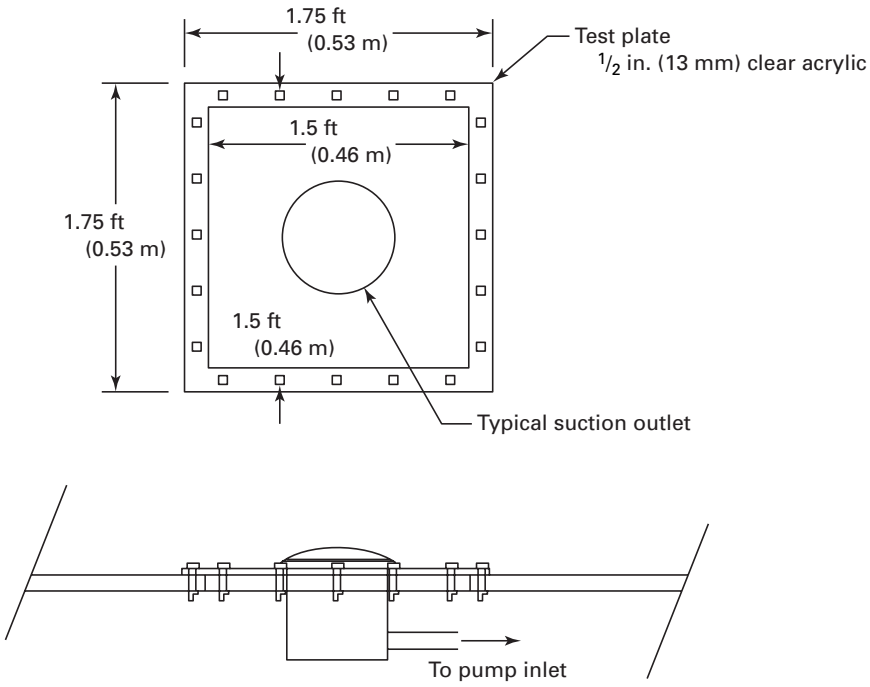
4.2 Test Method

4.2.1 Testing requirements shall be in accordance with paras. 4.1.3 and 4.1.4.

4.2.2 The suction fitting including the sump to be tested (see Fig. 6) shall be installed in accordance with manufacturer's installation instructions on the test drain mounting surface. For suction fittings intended for wall installation, the test mounting surface shall be placed in the vertical position, and for suction fittings intended to be installed only in the floor installation, the test mounting surface shall be placed in the horizontal position. Suction fittings intended for installation in either the wall or floor position shall be tested in both positions. For fittings tested in the vertical position, if the pattern of the cover/grate is not uniform, it shall be tested in two positions, representing the essential geometric differences. The fitting shall be connected to a 90 deg elbow the same size of the fitting outlet and as close to the suction fitting as possible with a minimum of 16 in. (406 mm) of straight Schedule 40 plastic pipe the same size as the fitting socket connected to the 90 deg elbow.

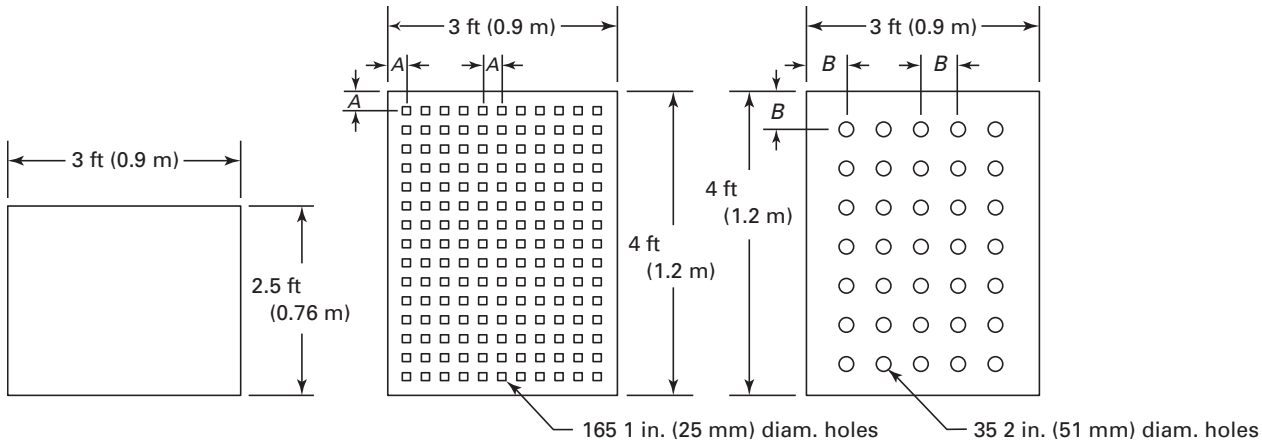
4.2.3 The tank shall be filled with water at a temperature at 90°F ± 10°F (32°C ± 6°C) to a depth of 12 in. ± ½ in. (305 mm ± 13 mm) above the top edge of the

Fig. 6 Test Tank Mounting Plate



Typical Mounting of Suction Outlet on Removable 21 in. × 21 in. (533 mm × 533 mm) Test Plate

Fig. 7 Test Tank Baffles



Baffle A | **Baffle B** [Note (1)] | **Baffle C** [Note (2)]

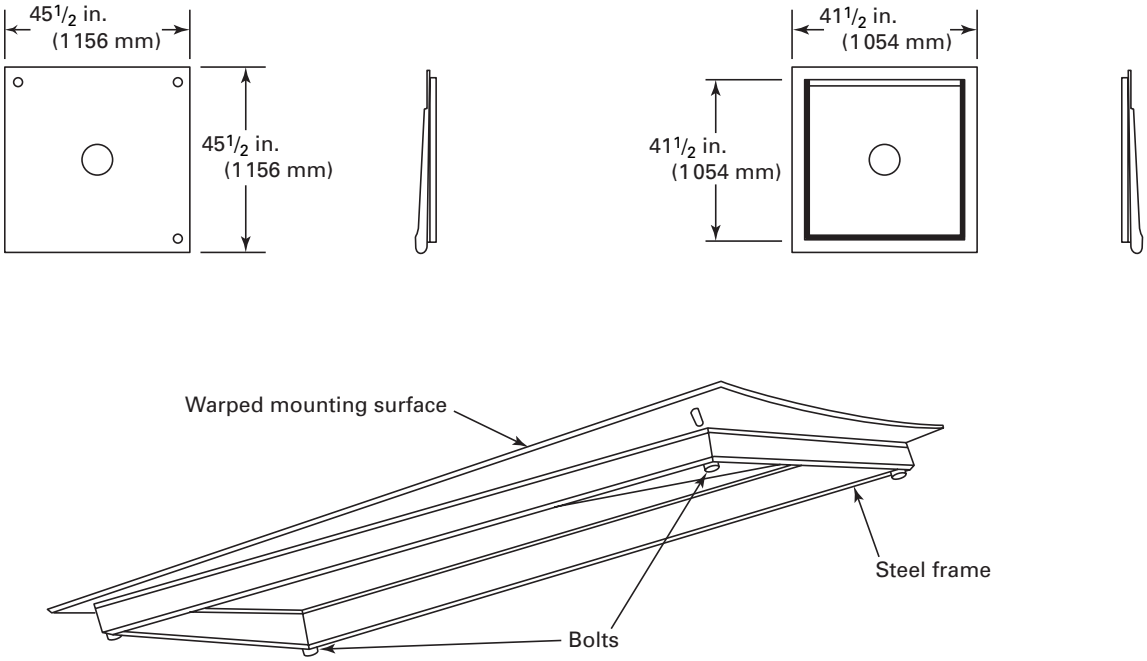
GENERAL NOTE: Baffles made of ½ in. (13 mm) clear acrylic.

NOTES:

(1) A = 3 in. (76 mm)

(2) B = 6 in. (152 mm)

Fig. 8 Anticlastic Mounting Surface (Typical)



cover/grate, or to a depth in accordance with the manufacturer's instructions for swim jet combination fittings.

4.2.4 Prior to energizing the test pump, the pull mechanism shall be verified to ensure a consistent speed when pulling weights from 2 lbf to 10 lbf (8.9 N to 44 N). Within that range of test weights the speed of the pull shall be 5 in./sec ± 0.25 in./sec (127 mm/sec ± 6 mm/sec).

4.2.5 The test pump shall be activated and the flow shall be regulated to 10 gpm (38 L/min) less than the fitting manufacturer's recommended gpm flow rate. If the fitting rating is not known, this test shall be started at 25 gpm (95 L/min). The fitting manufacturer may specify the starting test flow rate for each fitting to be tested.

4.2.6 Prior to use, the hair shall be cleaned in a 10% volume of Sodium Alpha Olefin Sulfonate (AOS) and water. After cleaning thoroughly, rinse in potable water. Hair samples shall be cleaned after every ten pulls. Dry hair shall be saturated for a minimum of 2 min in the test tank. When saturated, the hair shall be placed on the dowel/human skull and attached to the piston. When testing on a vertical fitting, the free end of the hair shall be placed approximately 12 in. (305 mm) in front of the suction fitting, 2 in. (51 mm) above the face of the fitting, as illustrated in Fig. 9.

4.2.7 In both tests the hair shall be slowly moved closer to the suction portions of the fitting and the ends of the hair shall be fed into the fitting in the direction of the intake flow as illustrated in Fig. 9. The hair shall be continually fed into the fitting while moving the skull or dowel from side-to-side in a sweeping motion. The magnitude of the sweeping motion shall be reduced with each pass of the skull or dowel. The hair shall be fed into the fitting over a period of 60 sec ± 5 sec. Then the skull or dowel end shall be held against the fitting for 30 sec ± 5 sec. The skull or dowel shall then be released and allowed to float or remain free for 30 sec ± 5 sec.

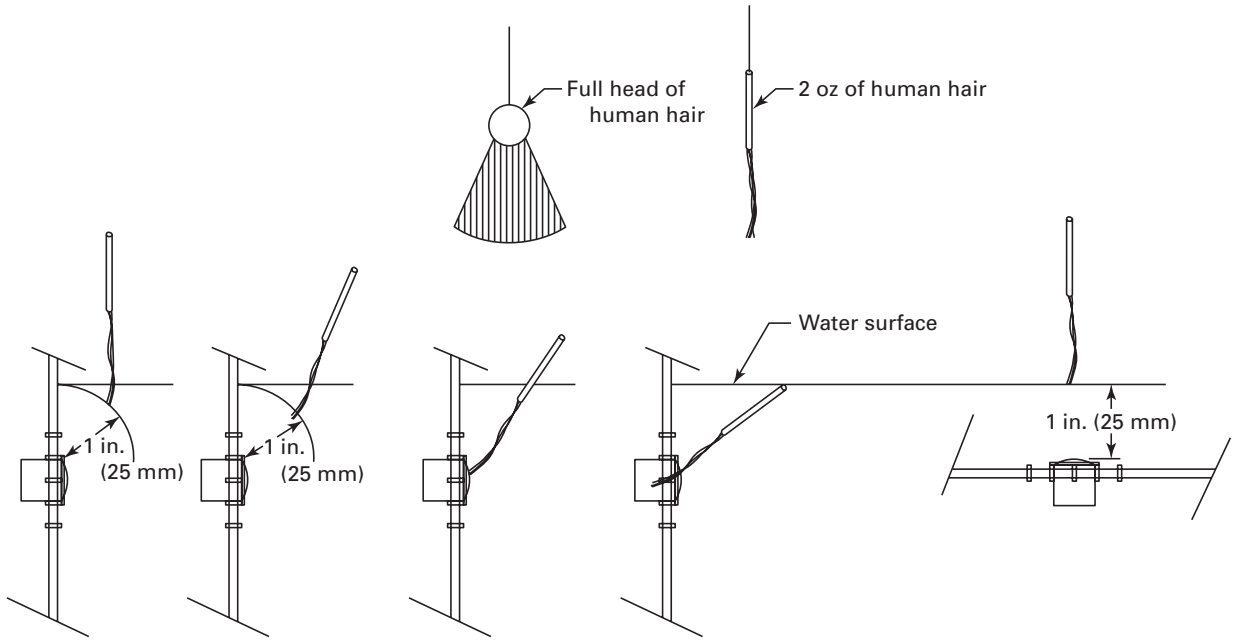
4.2.7.1 If testing a horizontal fitting, testing shall start with the end of the hair 2 in. (51 mm) above the fitting in a similar sweeping motion.

4.2.7.2 In testing any fitting which is not entirely symmetric, or those mounted on an anticlastic surface, testing shall start with the end of the hair 2 in. (51 mm) from all representative locations around the fitting.

4.2.8 The flow rate shall be increased in 5 gpm (19 L/min) increments ±3% and ten tests shall be performed at each flow rate. Brush hair prior to each test to keep tangle-free.

4.2.8.1 With the test pump still operating, the amount of force necessary to free the hair from the fitting shall be measured. The skull or dowel shall be attached to the scale and the scale shall be zeroed and then pulled in a vertical orientation away from the fitting by activating the hair removal mechanism. The force of the entrapment shall be measured and recorded. A sample

Fig. 9 Hair Test Diagrams



GENERAL NOTE: Showing 2 oz hair test. Same to be performed with full head of hair.

reporting form for recording the data is provided in Nonmandatory Appendix A.

4.2.8.2 Where a failure is determined with a specific 5 gpm (19 L/min) increase, the unit shall be permitted to be retested in 1 gpm (3.8 L/min) increments up to the point of the previous failure in order to determine the rating under this section.

4.3 Performance Requirement

A pull of 5 lbf (22 N) or greater on any one of the ten tests, 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 one failure in ten pulls occurs, repeat the test ten more times. All additional tests shall pass before moving to the next value. The highest passing flow rate shall be divided by 1.25 to determine the maximum allowable rating of the suction fitting unless the manufacturer has set a lower flow rate which then shall be the rating of this fitting.

5 BODY ENTRAPMENT

5.1 General

5.1.1 Design and Installation. Suction fittings shall be designed and installed so as to reduce the potential for body entrapment. The potential for body entrapment is addressed by the proper selection of the size of outlet cover/grate or the proper installation of more than one suction outlet.

5.1.2 Fittings

5.1.2.1 Body Entrapment Test shall apply to all fittings and suction outlets covered under this Standard. For manufactured fittings only one new fitting shall be required to be tested.

5.1.2.2 Suction outlet cover/grates that can not be completely covered by the 18 in. × 23 in. (457 mm × 584 mm) body blocking element may be rated by either the test procedures called for in this section or by calculation in accordance with para. 2.3.1.

5.1.3 Test Equipment. A torso specimen is defined as a rectangular form representing the flat portion of the 99th percentile adult male body (Mandatory Appendix I). Representing this form for test purposes is the body block element that is an 18 in. × 23 in. × 2 in. (457 mm × 584 mm × 51 mm) section of foam identified as "Closed Cell 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." It shall be mounted against an 18 in. × 23 in. × $^{3}/_{4}$ in. (457 mm × 584 mm × 19 mm) waterproofed plywood backing, with the skin side away from the plywood, with an eyebolt, hitching ring, or equivalent at the centroid as shown in Figs. 10 and 11. The specimen

Fig. 10 Body Block Element

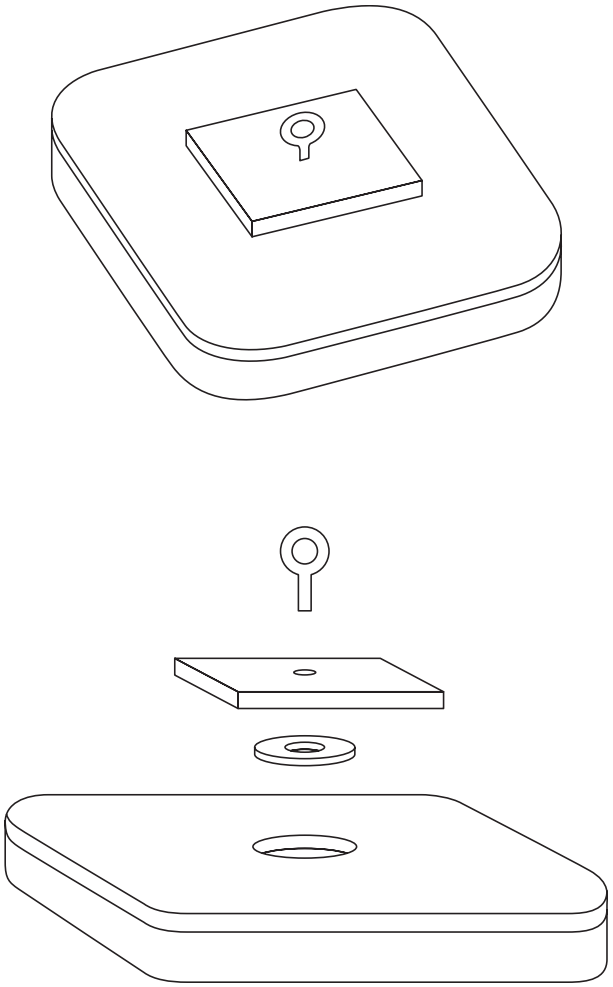
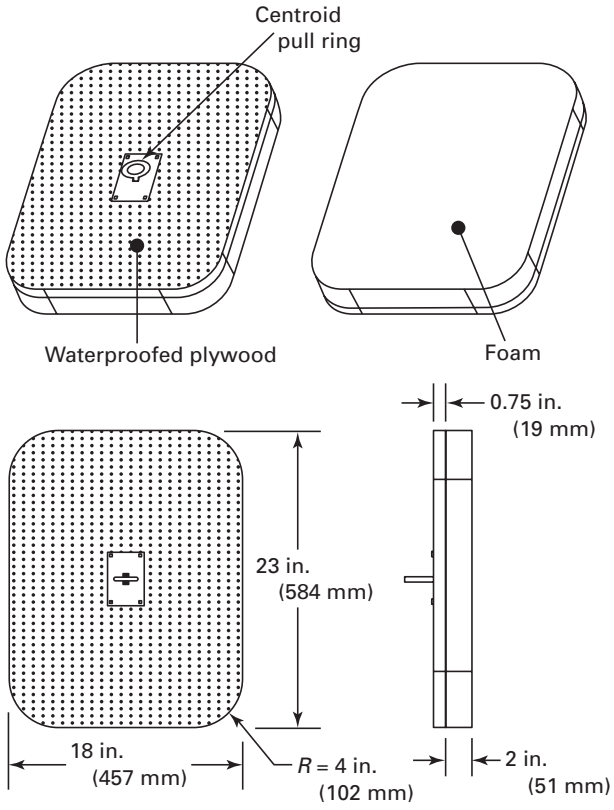


Fig. 11 Body Block Element Dimensions



shall be ballasted to neutral buoyancy, within 0.7 lbf (3.1 N), at the test depth.

Corners of the applicable body blocking element as well as the body blocking element shall be radiused with a radii of 22% of the width dimension.

5.2 Test Method

5.2.1 With the outlet flowing at the smaller of the maximum flow specified by the manufacturer or designer or as determined in para. 4.3, the 18 in. × 23 in. (457 mm × 584 mm) body block element, concentrically loaded, shall be placed on the cover/grate with an applied force of 120 lbf (534 N) and in such a position as to be centered or cover the largest area of the cover/grate.

5.2.1.1 For purposes of calculating the maximum allowable release force, the smallest blocking element that will completely shadow the suction outlet cover/grate being tested shall be referred to as the applicable body blocking element.

5.2.1.2 Applicable body blocking elements may range in size from the 18 in. × 23 in. (457 mm × 584 mm) size down to a minimum dimension of 9 in. × 11.5 in. (229 mm × 292 mm).

5.2.2 Swim jet combination fittings shall be tested by placing the body blocking element fully against and centered on the fixture face plate with a force of 120 lbf (534 N).

5.3 Performance Requirement

5.3.1 Under these test conditions, to pass the Body Entrapment Test, the maximum allowable removal force (in pounds), immediately after the 120 lbf (534 N) applied force is released, shall be based on the following calculation using the width of the smallest applicable body blocking element. This maximum shall not be exceeded in three consecutive tests.

NOTE: See Table 1 for computation of the maximum removal force.

Table 1 Applicable Body Block Element — Calculation of Removal Force

Bather	Min. Width Blocking Element to Shadow Tested Cover	Blocking Element Length = 1.2777 × Width	Basis is Child Width	Ratio of Element Width to Child Width	Ratio Cubed	Times Child Weight = 30 lb	One-Half Weight	Maximum Removal Effort No.
99th percentile male	**18**	23.0	9	2.00	8.00	240	120	**120**
	17.5	22.4	9	1.94	7.35	221	110	**110**
	17	21.7	9	1.89	6.74	202	101	**101**
	16.5	21.1	9	1.83	6.16	185	92	**92**
	16	20.4	9	1.78	5.62	169	84	**84**
	15.5	19.8	9	1.72	5.11	153	77	**77**
	15	19.2	9	1.67	4.63	139	69	**69**
	14.5	18.5	9	1.61	4.18	125	63	**63**
	14	17.9	9	1.56	3.76	113	56	**56**
	13.5	17.2	9	1.50	3.38	101	51	**51**
	13	16.6	9	1.44	3.01	90	45	**45**
	12.5	16.0	9	1.39	2.68	80	40	**40**
	12	15.3	9	1.33	2.37	71	36	**36**
	11.5	14.7	9	1.28	2.09	63	31	**31**
	11	14.1	9	1.22	1.83	55	27	**27**
	10.5	13.4	9	1.17	1.59	48	24	**24**
	10	12.8	9	1.11	1.37	41	21	**21**
	9.5	12.1	9	1.06	1.19	35	18	**18**
3 year old child	**9**	11.5	9	1.00	1.00	30	15	**15**

GENERAL NOTES:

(a) All dimensions in inches (1 in. = 25.4 mm).

(b) This Table calculates the maximum removal effort that shall be required to remove the body blocking element from the cover/grate being tested as based on the width of the applicable body blocking element. Intermediate values may be calculated using the formula

$$(\text{width}/9)^3 \times 15$$

Example: $10.7/9 = 1.188$; $1.188^3 = 1.68$; 1.68 multiplied by 15 = 25.2 lbf

5.3.2 Where a failure is determined at the tested flow rate as specified in para. 5.2.1, the unit shall be allowed to be tested in 5 gpm (19 L/min) decreases until the unit passes. The unit shall then be permitted to be retested in 1 gpm (3.8 L/min) increments up to the point of the previous failure in order to determine its rating under this section.

6 FINGER AND LIMB ENTRAPMENT

6.1 General

6.1.1 Design and Installation. Suction fittings shall be designed and installed so as to reduce the potential for digit or limb entrapment.

6.1.1.1 When fully assembled, suction fittings shall not have any accessible opening that allows the passage of the 1 in. (25 mm) cylindrical end of the UL Articulate Probe.

6.1.2 Small Aperture. A small aperture is an opening with two or more dimensions smaller than 1 in. (25 mm) (see Fig. 12).

6.1.3 Large Aperture. A large aperture is an opening with only one dimension smaller than 1 in. (25 mm) (see Fig. 12).

6.1.4 Suction Outlet Testing

6.1.4.1 All suction outlets covered under this Standard shall be subjected to the following test.

6.1.4.2 Finger Entrapment Tests shall be conducted on one new suction fitting from each mold cavity.

6.1.5 Conditions for Tests. Tests shall be conducted at room temperature using new dry fittings.

6.1.6 Conditions Using UL Articulate Probe. Tests shall be conducted with the UL Articulate Probe in accordance with Figs. 1, 12, 13, 14, and 15.

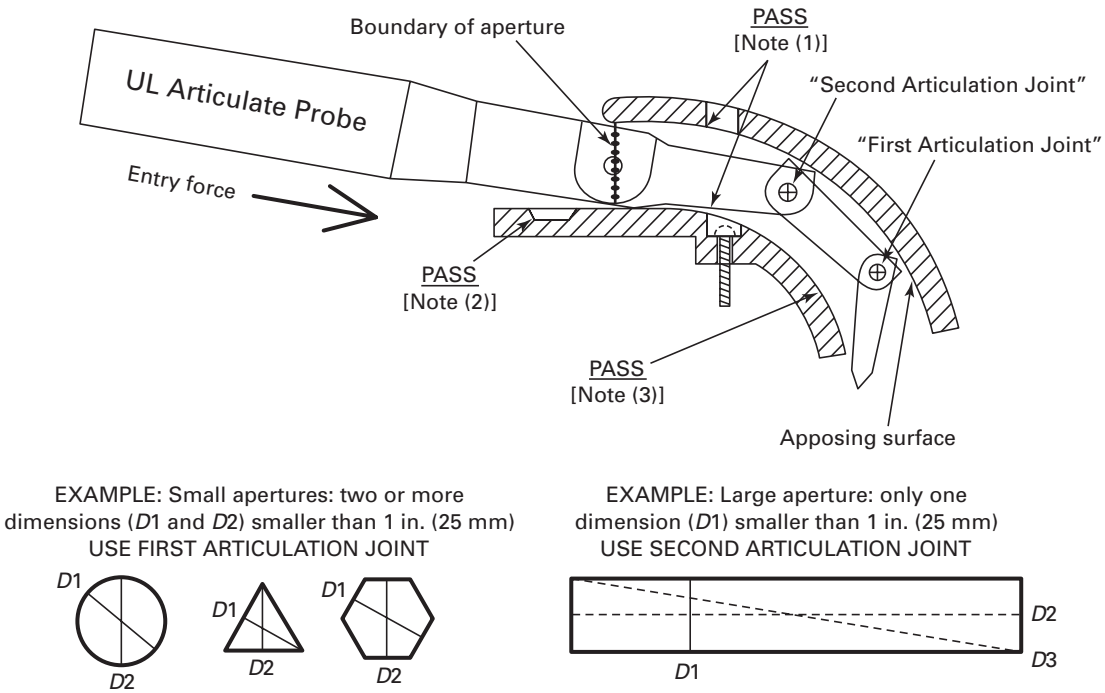
6.2 Test Method

Each aperture on the assembled suction fitting shall be subjected to the insertion of both ends of an UL Articulate Probe. Using 3 lbf (12 N) ±5%, the Articulate Probe shall be urged through all exposed apertures of the assembled suction fitting.

6.3 Performance Requirement

A small or large aperture is permitted when the 1 in. (25 mm) cylindrical end of the UL Articulate Probe cannot be made to penetrate through to the inside surface of the aperture and as follows:

Fig. 12 Finger Probe — Finger and Limb Entrapment Test



NOTES:
(1) "Edges" inside aperture are less than 0.311 in. (7.9 mm) wide and there are no protrusions above the aperture surface.
(2) An "edge" wider than 0.311 in. (7.9 mm) but it is outside the aperture.
(3) Transitional radius > 0.79 in. (19 mm).

Fig. 13 Finger Probe

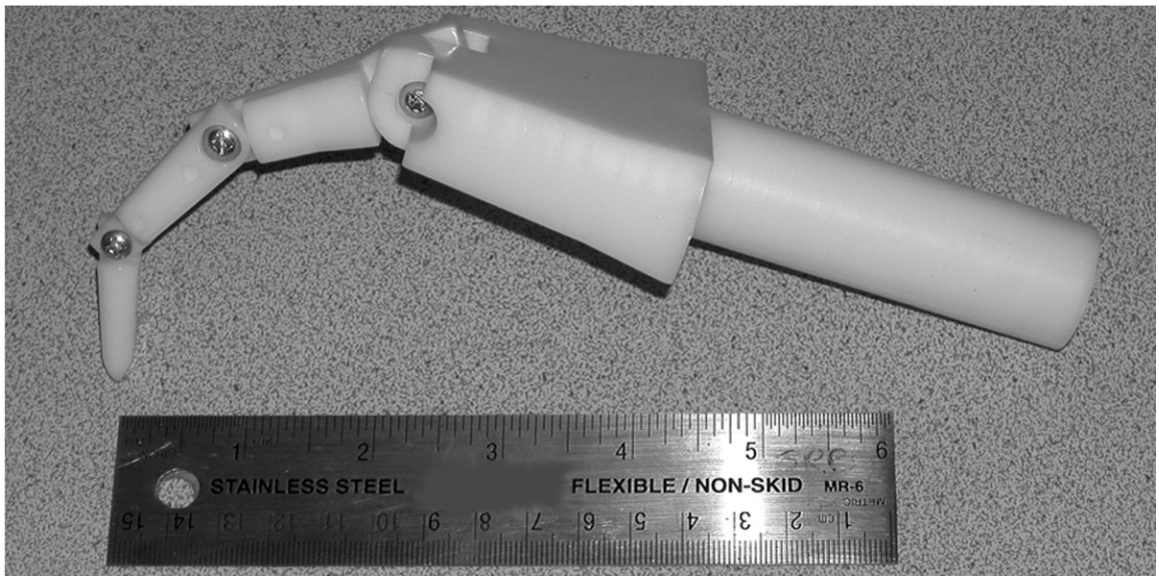


Fig. 14 Finger Probe Dimensions

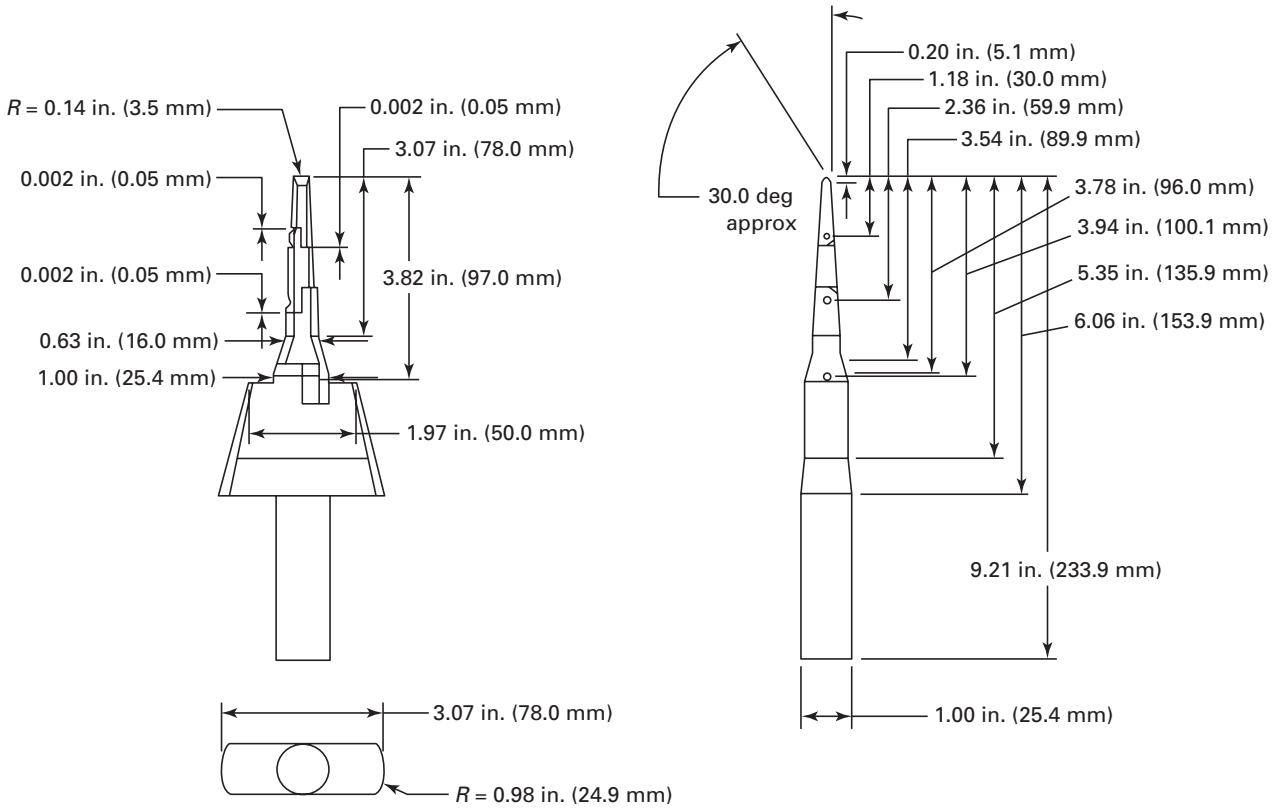
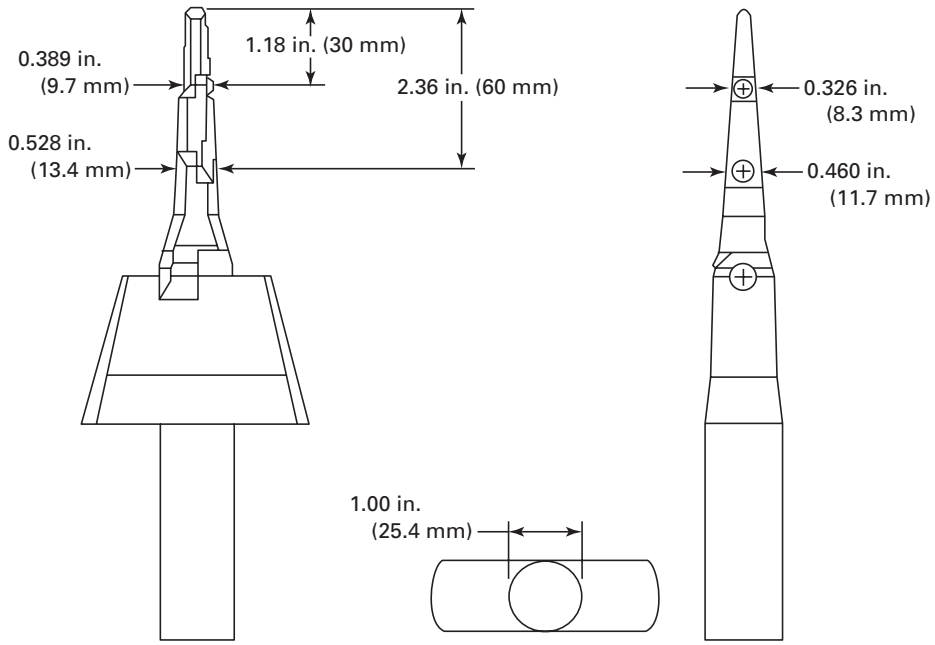


Fig. 15 Finger Probe Knuckle Dimensions



(a) 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 Articulate Probe, cannot be made to pass beyond an edge or pinch point that is located inside the aperture being tested. (See Fig. 1.)

(b) Large aperture(s) shall be permitted when the centerline of the second articulation joint, located 2.36 in. (59.9 mm) from the point end of the UL Articulate Probe, cannot be made to pass beyond an apposed edge or pinch point that is located inside the aperture being tested. (See Fig. 12.)

(c) Edges and pinch points shall be permitted within the aperture and within range of the first articulate joint in accordance with Fig. 12 if they are less than 0.311 in. (7.9 mm) wide, measured parallel to the aperture opening.

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

7 PACKAGING AND INSTALLATION INSTRUCTIONS

7.1 Marking of Suction Fittings

7.1.1 The fitting shall be permanently marked as follows in a manner that is visible in the installed position and where the text is no smaller than 10 pt (font size 0.1–in. tall):

(a) The following are examples of two typical markings:

EXAMPLE (with Logo):

2007
For Multiple Drain Use Only
108 GPM — Swim Jet
Life: 7 Years
Wall Only
Quantum 1563-W

EXAMPLE (without Logo):
ASME A112.19.8-2007
For Single Drain Use
108 GPM — Submerged
Life: 7 Years
Floor Only
Quantum 1563-G

(b) The positioning or arrangement of these markings shall be in the following sequence:

(1) the designation "ASME A112.19.8," or the ASME A112.19.8 logo followed by the year of the Standard, such as "2007" or "07."

(2) the statement "For Single or Multiple Drain Use," "For Single Drain Use," or "For Multiple Drain Use Only."

(3) the lesser of the maximum flow rate in gpm as determined in accordance with para. 2.3.1.4, 4.3, or 5.3.2.

(4) the "Type" of the fitting in accordance with para. 1.1.6.

(5) fitting components shall be marked "Life: X Years" where the manufacturer indicates the appropriate installed life in years. Individual components may be marked with unique life spans.

(6) installation position — "Wall Only," or "Floor Only," or "Wall or Floor" if allowed in both positions.

(7) manufacturer's name or registered trademark.

(8) model designation.

7.1.2 As an alternate to marking field fabricated outlets, the owner of the facility where these fittings will be installed shall be advised in writing by the Registered Design Professional the information called for in paras. 7.1.1(b)(1) through (8).

7.2 Packaging of Suction Fittings

7.2.1 The packaging and installation instructions for manufactured fittings shall contain

(a) information on installation and service including

(1) type designation in accordance with para. 1.1.6, including any requirement for multiple outlets required per pump

(2) instructions not to locate suction outlets on seating areas or on the backrests for such seating areas

(3) instructions stating that when two or more suction fittings are used on a common suction line they shall be separated by a minimum of 3 ft (91.44 cm), or if any are located closer they shall be located on two different planes (i.e., one on the bottom and one on the vertical wall, or one each on two separate vertical walls)

(4) instructions stating that in the event of one suction outlet being completely blocked, the remaining suction outlets serving that system shall have a flow rating capable of the full flow of the pump(s) for the specific suction system

(5) maximum flow rating with head loss curve

(6) acceptable connecting pipe size(s)

(7) mounting position(s)

(8) suction outlet part number(s), and/or model number(s), and detailed field build sump design specifications, when applicable

(9) part number/description list, and "Replace within 'YY' installed years" for all parts

(10) tools required

(11) service and winterizing instructions

(b) a cautionary note not to exceed the maximum allowable flow rate stated on the suction fitting

(c) a note that the suction fitting including fasteners should be observed for damage or tampering before each use of this facility

(d) a statement that missing, broken, or cracked suction fittings shall be replaced before using this facility

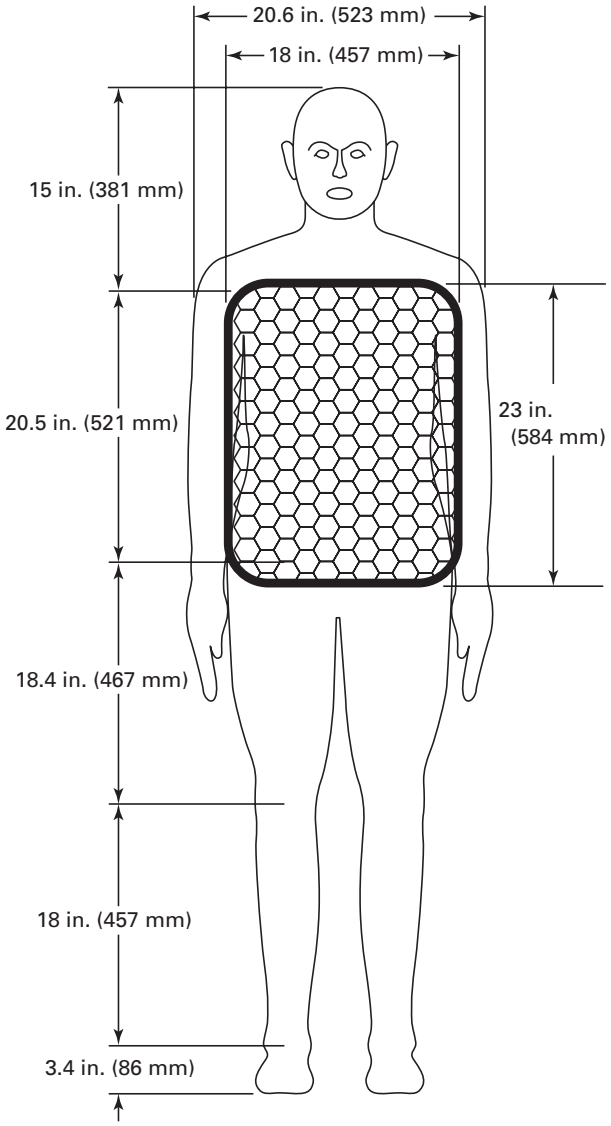
(e) a statement that loose suction fittings shall be reattached or replaced before using this facility

(f) a statement "Read, then keep these instructions for future reference"

(g) a cautionary note about increasing flow by increasing pump size

MANDATORY APPENDIX I
TORSO SPECIMEN WITH RECTANGLE SUPERPOSED

Fig. I-1 99th Percentile Man



MANDATORY APPENDIX II
FITTING TYPE REQUIREMENTS

Table II-1 Fitting Type Requirements

Type	Field Fabricated Outlets	Venturi Outlets	Swim Jet Combination Fittings	Submerged Suction Outlets
Single or dual	Per manufacturer	Per manufacturer	Per manufacturer	Per manufacturer
Require tools to open	Yes	Yes	Yes	Yes
UV test and usable lifetime labeling	Yes	Yes	Yes	Yes
Sump required	Yes	Yes	No	Yes
Body entrapment test	Yes	Yes	Yes	Yes
Vertical load	Note (1)	Yes	Yes	Yes
Horizontal load	Note (1)	Yes	Yes	Yes
Excess load	Note (1)	Yes	Yes	Yes
Shear test	Note (1)	Yes	Yes	Yes
Vacuum test	Note (1)	Yes	Yes	Yes
Pull test	Note (1)	Yes	Yes	Yes
Hair test	No	Yes	Yes	Yes
Finger test	Note (1)	Yes	Yes	Yes

NOTE:
(1) Design must be per Registered Design Professional.

NONMANDATORY APPENDIX A
SUCTION FITTING TEST FORM — HAIR ENTRAPMENT

SUCTION FITTING TEST FORM

Date: _____ Pump Type: _____ Water Temp: _____

Operator: _____ Hair Type: _____ Maximum Flow (gpm) [Note (1)] _____

Protocol: _____ Fitting Description: _____ Maximum Vacuum (in Hg) [Note (2)] _____

Manufacturer Rating (if known):

F_i (gpm) [Note (3)]	V_i (in Hg) [Note (4)]		1 2 3 4 5 6 7 8 9 10	Comments [Note (7)]
		F_f (gpm) V_f (in Hg) Pull (lbf) [Notes (5),(6)]		
		F_f V_f Pull		
		F_f V_f Pull		
		F_f V_f Pull		
		F_f V_f Pull		
		F_f V_f Pull		

NOTES:

(1) Maximum Flow (gpm) shall be the flow rate measurement in gallons per minute with the fitting in place with all valves fully open.
(2) Maximum Vacuum (in Hg) shall be the vacuum recorded in inches of mercury as measured at maximum flow.
(3) F_i shall mean the initial flow rate in gallons per minute which is measured before the entanglement effort is started.
(4) V_i shall mean the initial vacuum as measured in inches of mercury before the entanglement effort is started.
(5) F_f shall mean the final flow rate measured prior to removal of the hair.
(6) V_f shall mean the final vacuum measured prior to removal of the hair.
(7) Report any significant changes here.

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