ASME A112.19.7-2006

(Revision of ASME A112.19.7M-1995)

Hydromassage Bathtub Appliances

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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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda issued to this edition.

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

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

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FOREWORD

In the late 1970s, the whirlpool bathtub appliance was integrated into modern plumbing systems as a new selection for bather comfort in the bathroom. The popularity of this product increased dramatically, and it is now a common option for the modern bath.

The initial work on a safety standard for whirlpool bathtub appliances was undertaken by a committee of the International Association of Plumbing and Mechanical Officials (IAPMO). The committee's activity resulted in the Product Standard PS 32, Jetted Whirlpool Bathtubs, which was used as a benchmark for the performance of such appliances.

At IAPMO's suggestion, the PS 32 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. The second revision, which was released in 1995, amended the sampling procedures. This current revision contains criteria for the complete testing of suction fittings, which was transferred from the ASME A112.19.8 standard. Criteria for entrapment assessment is addressed with the compliance of the vacuum tests.

The work on this Standard continues and future revisions may include criteria that reflect new technologies and practices.

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.

This revision was approved by the American National Standards Institute on January 23, 2006.

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Standardization of
Plumbing Materials and Equipment

(The following is the roster of the Committee at the time of approval of this Standard.)

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to:

Secretary, A112 Standards Committee
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Three Park Avenue
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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.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

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.

HYDROMASSAGE BATHTUB APPLIANCES

1 GENERAL

1.1 Scope

This Standard establishes performance criteria for whirlpool and air-jetted bathtub appliances and suction fittings used in whirlpool bathtub appliances. It is intended for use by, but not limited to: manufacturers, distributors, retailers, architects, engineers, plumbing contractors, jetters, installers, regulatory agencies, and users. This Standard shall govern the construction, general requirements, test methods, and marking for whirlpool and air-jetted bathtub appliances that incorporate a bathtub, a circulation pump, and a piping system, with or without the introduction of air, either by integral suction or air pump. Optional accessories for such appliances shall be permitted to be provided in the factory or field, provided that such accessories do not negate the performance of whirlpool hydromassage bathtub appliances designed to comply with this Standard. Suction fittings that are used within whirlpool bathtub appliances shall be evaluated to this Standard.

The provisions of this Standard shall enable identification of specific units that are in compliance with this document.

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 intent of this Standard.

1.2 Units of Measurement

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

In this Standard, gallons (U.S. Liquid) per minute is abbreviated gpm and liters (metric liquid) per minute is abbreviated L/min.

1.3 References

The following is a list of publications referenced in this Standard.

IAPMO/ANSI Z124.1.2, Plastic Bathtubs and Shower Units

IAPMO PS 33, Vinyl Reinforced Flexible PVC Hose for Pools, Hot Tubs, Spas and Jetted Bathtubs

Publisher: International Association of Plumbing and Mechanical Officials (IAPMO), 5001 East Philadelphia Street, Ontario, CA 91761

ASME A112.19.1M, Enameled Cast Iron Plumbing Fixtures

ASME A112.19.4M, Porcelain Enameled Formed Steel Plumbing Fixtures

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

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 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

ASTM F 876, Specification for Cross-Linked Polyethylene (PEX) Tubing

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

National Electrical Code

Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471

UL 1795, Hydromassage Bathtubs

Publisher: Underwriters Laboratories Inc. (UL), 333 Pfingsten Road, Northbrook, IL 60062-2096

1.4 Definitions

accessible: having access thereto, but which first may require the removal of an access panel, door, or similar obstruction with the use of tools.

circulation system: the interconnected system traversed by the circulated water from the whirlpool bathtub appliance, which consists of all circulation inlets and outlets, pumps, air induction systems, valves, pipe or tubing, fittings, and other appurtenances, either factory or field assembled.

disintegrate: the loss of any material from the fitting, exclusive of plating or finish.

hydromassage bathtub appliance: a plumbing appliance consisting of a bathtub fixture that is designed to accept and discharge water after each use and employs either a water circulating piping system or an air circulating piping system, or both.

jet: a fitting that creates a high velocity stream of water, with or without the induction of air.

plumbing appurtenance: a manufactured device, a prefabricated assembly, or an on-the-job assembly of component parts that is an adjunct to the basic piping system and plumbing fixtures. An appurtenance demands no additional water supply, nor does it add any discharge load to a fixture or the drainage system.

plumbing fixtures: installed receptors, devices, or appliances that are supplied with water, or receive or discharge liquids or liquid-borne wastes, with or without discharge into the drainage system to which the fixture shall be directly or indirectly connected.

readily accessible: direct access without the necessity of removing or moving any panel, door, or similar obstruction with the use of tools.

2 GENERAL REQUIREMENTS

2.1 Materials

2.1.1 Bathtub Fixtures. Bathtub fixtures shall conform to the applicable product standards based on the material of the bathtub as follows:

(a) Plastic Bathtubs. Plastic bathtubs shall comply with IAPMO/ANSI Z124.1.2.

(b) Cast Iron Bathtubs. Cast iron bathtubs shall comply with ASME A112.19.1M.

(c) Enameled Steel Bathtubs. Enameled steel bathtubs shall comply with ASME A112.19.4M.

2.1.2 Piping

(a) Copper Assemblies. Copper tubing shall be not less than Type M.

(b) Plastic Assemblies

(1) Acrylonitrile Butadiene Styrene (ABS) and Polyvinyl Chloride (PVC) plastic piping and tubing shall be rigid or flexible. Fittings and rigid tubing shall be a minimum of Schedule 40.

(2) Chlorinated Polyvinyl Chloride (CPVC) plastic piping shall be a minimum of SDR-PR.

(3) Cross-linked Polyethylene (PEX) plastic tubing shall conform to the dimensional tolerances of ASTM F 876.

(c) Steel Assemblies. Steel pipe shall be Schedule 40.

(d) Flexible Hose. Flexible hose shall conform to IAPMO PS 33.

2.1.3 Joints

(a) Threaded Joints. Threads on steel pipe shall be standard taper pipe threads in accordance with ASME B1.20.1. Threads on Schedule 40 plastic pipe shall be made with molded threaded adapters. Tubing threads shall conform to fine tubing thread standards. When a pipe joint material is used, it shall be applied only to the male threads and such materials shall be approved types, insoluble in water and nontoxic. Only thread tape or thread lubricant listed specifically for use on plastic threads shall be used. Plugs shall be lubricated with water-soluble, nonhardening material or thread tape.

(b) Couplings and Rubber Hose. Couplings used to join the circulating pump to the circulation system assembly shall consist of an elastomeric sleeve with corrosion-resisting tightening bands or shall be of a rubber hose limited to a maximum length of 8 in. (203 mm). Couplings shall be accessible.

(c) Fasteners. All joints between the blower and the first method of backflow prevention for air-jetted appliances shall be permitted to use mechanical fasteners as a joining method.

2.1.4 Pumps. Unless part of a listed complete whirlpool or air-jetted bathtub appliance, all air and water pumps shall be in compliance with UL 1795.

2.1.5 Suction Fittings. Suction fittings shall comply with the requirements of paras. 3.2 and 3.3.

2.2 Circulation Piping and Air Line Installation

(a) All piping or tubing, whether rigid or flexible, shall be installed to provide for drainage of the water from the circulation system in accordance with para. 3.1.

NOTE: Flexible tubing shall be provided with additional support per the tubing manufacturer's instructions to eliminate sagging.

(b) Water and air pumps shall be connected to the circulation system by use of fittings, couplings, or other means to provide for removal, repair, or replacement.

(c) A minimum of $\frac{1}{4}$ in. (6.4 mm) I.D. drain tubing (or other method) shall be provided to drain the pump volute where a self-draining volute is not provided. The volute drain opening in a self-draining pump shall be not less than $\frac{3}{16}$ in. (4.8 mm) I.D.

(d) The separation between multiple suction fittings, whether in the same or different design plane, shall be 12 in. (305 mm) minimum.

(e) The circulation system shall be watertight. Any leakage of the system during testing shall be cause for rejection.

2.3 Installation Instructions

Installation instructions shall be provided with each whirlpool or air-jetted bathtub appliance and shall provide the information cited in paras. 2.3.1 through 2.3.4.

2.3.1 Roughing-In Reference. Where applicable, product rough-in dimensions for water supply, drains, and overall dimensions of the whirlpool or air-jetted bathtub appliance shall be provided.

2.3.2 Service Access. Service access shall be provided for pump/motor removal. Recommended minimum dimensions for access shall be provided.

2.3.3 Electrical. Information shall be provided pertaining to the safe installation of either electrical components or lighting, or both, conforming with Section 680 of the National Electrical Code. The instructions shall

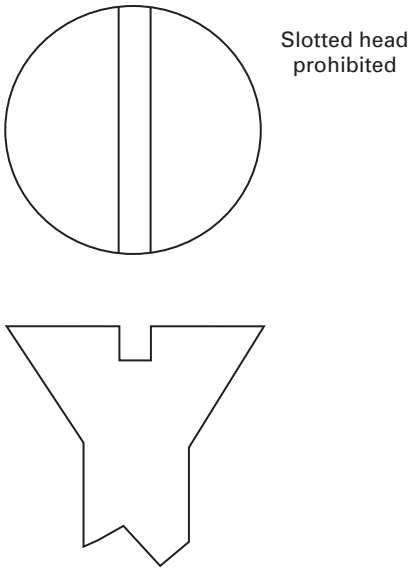


Fig. 1 Prohibited Screw Head

include a warning relative to the installation of the ground fault circuit interrupter (GFCI) protection in accordance with the local codes.

2.3.4 Installation Precautions. Precautions shall be provided that will warn of potential danger or damage to the whirlpool bathtub appliance unit during installation.

2.4 Operation, Use, and Care Instructions

2.4.1 Operating and Use Instructions. Instructions and precautionary warnings shall be provided on the general operation and use of the whirlpool bathtub appliance by the consumer.

2.4.2 Flushing Instructions. The operating use and care instructions shall contain a notice to flush the whirlpool or air-jetted bathtub appliance plumbing system periodically (not to exceed 90 days).

2.5 Field-Assembled or Retrofitted Units

Field-assembled or retrofitted bathtubs shall comply with the requirements of this Standard.

2.6 Backflow Protection

For systems with a submerged inlet or which are equipped with a potable water flush system, backflow protection shall be provided as required by the plumbing code.

2.7 Suction Fitting Assembly Requirements (Whirlpool Appliances Only)

Fittings shall be designed so that tools are required for disassembly. Standard slotted screws shall not be permitted for affixing grates and covers to the suction fitting body. See Fig. 1 for a depiction of a prohibited screw.

2.8 Suction Fitting Design

Apertures in suction fitting covers shall not allow the passage of a 0.31 in. (7.87 mm) circular rod with an applied force no greater then 5 lbf (22 N).

3 TESTING

3.1 Water Retention Within Whirlpool or Air-Jetted Bathtub Appliances

Hydromassage bathtub appliances shall be of such design as to prevent retention of water in excess of 1.5 fl oz (44 mL) for each jet and suction fitting. Maximum water retention for air-jetted hydromassage appliances shall not exceed 13.5 fl oz (400 mL). Tests shall be conducted in accordance with this paragraph and the sampling method cited in para. 3.4.

NOTE: For example, a whirlpool bathtub appliance with four jets and one suction fitting satisfies this requirement if the residual water is equal to or less than 7.5 fl oz (220 mL). An air-jetted hydromassage appliance shall not have residual water in excess of 13.5 fl oz (400 mL) regardless of the number of air jets. For combination whirlpool and air-jetted appliances, these amounts are cumulative. For example, the maximum residual water allowed in a combination four-jet one-suction fitting whirlpool and air-jetted appliance is 21 fl oz (620 mL).

3.1.1 Preconditioning (Flexible Circulation Piping Only). Where flexible piping is used, water at 135°F ± 5°F (57°C ± 3°C) shall be placed in the unit at a height required to properly operate the appliance. The water shall be circulated for 2 hr ± 10 min. The water temperature shall be maintained by covering or other means so that the water temperature, after the 2 hr test, shall not be less than 130°F (54°C). After the 2 hr test period, the fixture shall be drained and allowed to cool to ambient temperature.

NOTE: This preconditioning test shall not apply where flexible circulation piping is supported at maximum intervals of 12 in. (304 mm) in length, or where less than a total of 12 in. (304 mm) of flexible circulation piping is used in a section immediately adjacent to the pump motor.

3.1.2 Procedure. The following test procedure shall be conducted within a 1 hr ± 5 min time interval.

NOTE: Water retention shall be evaluated using a chlorine test. Good laboratory technique is critical to prevent inadvertent contamination of samples.

(a) The whirlpool or air-jetted bathtub appliance shall be positioned in a level and connected position as it would be installed in the field. Directional jets which are not self-adjusting shall be positioned horizontally.

(b) The appliance shall be filled with water 75°F ± 5°F (24°C ± 3°C) until jets are completely covered. The chlorine level of the test water shall be recorded.

(c) The pump shall be operated from 2 min to 3 min.

(d) The appliance shall be allowed to drain completely.

Table 1 Chlorine Concentration for Test Determination

Amount of Water, L (gal)	Dilution ppm	Amount of Chlorine Solution, g [Note (1)]		
		100%	55%	62%
18.9 (5)	100	1.9	3.4	3.0
37.9 (10)	200	7.6	13.8	12.2
56.8 (15)	300	17.0	31.0	27.5
75.7 (20)	400	30.3	55.1	48.9
94.6 (25)	500	47.3	86.0	76.3
113.6 (30)	600	68.1	123.8	109.9
132.5 (35)	700	92.7	168.6	149.6
151.4 (40)	800	121.1	220.2	195.3
170.3 (45)	900	153.3	278.7	247.2
189.3 (50)	1,000	189.3	344.1	305.2
208.2 (55)	1,100	229.0	416.4	369.0
227.1 (60)	1,200	272.5	495.5	439.6
246.0 (65)	1,300	319.8	581.5	515.8
265.0 (70)	1,400	370.9	674.4	598.3
284.0 (75)	1,500	425.8	774.2	686.8
303.0 (80)	1,600	484.5	880.9	781.4
322.0 (85)	1,700	546.9	994.9	882.1
341.0 (90)	1,800	613.2	1,114.9	989.0
360.0 (95)	1,900	683.2	1,242.2	1,102.0
379.0 (100)	2,000	757.0	1,376.4	1,221.0

NOTE:

(1) Chlorine solutions are usually available in one of three powder concentrations (55%, 62%, and 100%). The following formula shall be used to determine chlorine concentration as measured in grams. Time-release formulas shall not be used. Chlorine with active ingredient Sodium Dichloro-S-Triazinctrione has been shown to dissolve quickly and work well for this procedure.

$$\text{Powder (g)} = \frac{0.003785 \times \text{Capacity (gal)} \times \text{Dilution (ppm)}}{\text{Powder Concentration}}$$

EXAMPLE: Determine the amount of chlorine solution in grams required for a bathtub that has a capacity of 45 gal when using chlorine at a 55% solution.

$$\text{Example} = \frac{0.003785 \times 45 \times 900}{0.55} = 278.7 \text{ g}$$

(e) Using a graduated container, the tub shall be refilled with enough water to cover the jets, measuring the water in quantities as given below.

(f) The quantity of water added to the nearest ½ gal (1.9 L) shall be recorded and 1 gal per 50 gal (3.8 L per 189.3 L) quantity and 2 gal per 100 gal (7.6 L per 379 L) quantity shall be removed to dissolve the chlorine in accordance with Table 1. The appropriate column in Table 1 shall be selected based upon the chlorine concentration to determine the amount of chlorine solution to be added.

(g) The measured quantity of chlorine solution shall be dissolved in the removed sample and this solution shall be poured into the appliance.

(h) The appliance pump shall be run for 2 min. The pump shall be shut off and the appliance shall be allowed to drain totally. For air-jetted tubs only, the water shall be allowed to sit in the tub for 10 min to allow back drainage of the water into the air channels prior to draining. Five minutes after draining, excess water shall be wiped from the appliance's surface.

(i) The appliance shall be refilled with the same volume of water as noted in para. 3.1.2(f). The pump shall be operated for 2 min.

(j) A sample of the water from the bathtub shall be placed into the colorimeter[1] and the instrument shall be adjusted according to the instructions.

(k) The free chlorine solution or tablet provided with the colorimeter sample shall be added and this chlorine reading shall be compared with the values stated in Table 2. Not more than 1 min shall be allowed to elapse before taking a reading.

3.1.3 Performance Requirement. For whirlpool appliances, the cumulative residual water shall not exceed

[1] Examples of colorimeters that shall be permitted for this test are as follows: DR 100 Colorimeter (Catalog 411-02), available from Hach Chemical, P.O. Box 389 Loveland, CO 80539 [(800)525-5940], or LaMotte Colorimeter, available from LaMotte Chemical Products, P.O. Box 329, Chestertown, MD 21620 [(410)778-3100].

Table 2 Residual Water Comparison Table

Chlorine Reading ppm	Residual Water, L (fl oz)
3.0	0.568 (19.20)
2.9	0.549 (18.56)
2.8	0.530 (17.92)
2.7	0.511 (17.28)
2.6	0.492 (16.64)
2.5	0.473 (16.00)
2.4	0.454 (15.36)
2.3	0.435 (14.72)
2.2	0.416 (14.08)
2.1	0.397 (13.44)
2.0	0.379 (12.80)
1.9	0.360 (12.16)
1.8	0.341 (11.52)
1.7	0.322 (10.88
1.6	0.303 (10.24)
1.5	0.284 (9.60)
1.4	0.265 (8.96)
1.3	0.246 (8.32)
1.2	0.227 (7.68)
1.1	0.208 (7.04)
1.0	0.189 (6.40)
0.9	0.170 (5.76)
0.8	0.151 (5.12)
0.7	0.132 (4.48)
0.6	0.114 (3.84)
0.5	0.095 (3.20)
0.4	0.076 (2.56)
0.3	0.057 (1.92)
0.2	0.038 (1.28)
0.1	0.019 (0.64)

GENERAL NOTE: Where chlorinated tap water is used, the chlorination reading of the water shall be factored out of the test reading.

1½ fl oz (44 mL) for each jet and suction fitting. For air-jetted appliances, the total water retention for the test unit shall not exceed 13.5 fl oz (400 mL).

3.2 Physical Testing of Suction Fittings (Whirlpool Appliances Only)

This test shall be conducted to establish structure performance for each model suction fitting supplied as original equipment on whirlpool bathtub appliances. It shall not be necessary to conduct this testing on previously rated suction fittings.

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

3.2.1.1 General. A minimum of six fittings shall be tested in each test condition unless otherwise stated. If one fitting fails the test, the test shall be repeated with six new fittings. No failures shall occur in the second six new fittings. No more than one unit in the total of twelve units shall fail. Testing shall be performed immediately after conditioning, as described in para. 3.2.1.3.

3.2.1.2 Crack Detection. After each physical test, the unit shall be washed with a standard liquid detergent solution, rinsed with clear water and dried prior to application of ink as specified in para. 3.2.1.2(b). After inking, the unit shall be visually inspected in accordance with para. 3.2.1.2(a) for compliance with para. 3.2.1.2(b)(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):

Monsanto TKPP	8.0%
Sterox NJ	7.0%
Stepan SXS	8.0%
Butyl Celloslove	1.5%
Water	75.5%

(a) 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) after being inked in accordance with the ink test in para. 3.2.1.2(b).

(b) Inking Procedure

(1) Test Method. After the unit has been washed and dried as described in para. 3.2.1.2, 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. The ink shall be rinsed from the surface and then dried before inspection.

(2) Performance Requirement. The fitting shall be free from cracks. The presence of seams, flow lines, and knit lines within fittings shall be permitted and shall not be considered as cracks.

3.2.1.3 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.

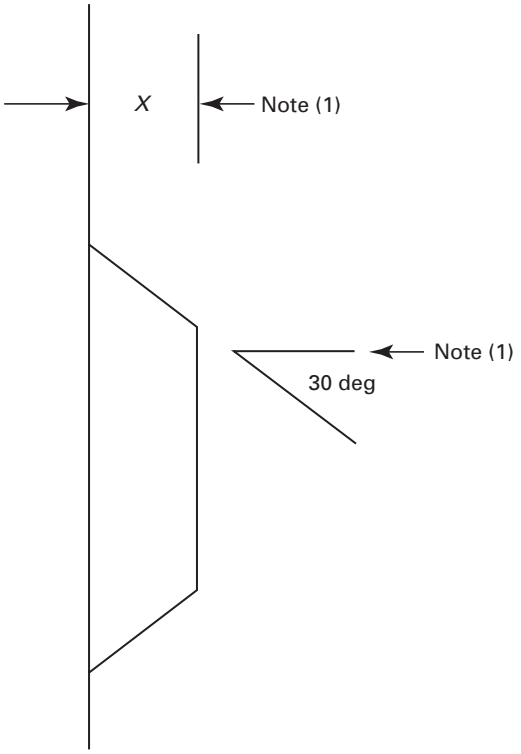
3.2.1.4 Test Fixture. The fitting(s) shall be installed in a rigid fixture which is capable of supporting the fitting(s) in a manner similar to the actual installation.

3.2.1.4.1 Test Equipment for Load and Deflection Tests. A point load machine calibrated in 5 lb (2.3 kg) increments and which is equipped with a 2 in. ± 1/32 in. (51 mm ± 0.8 mm) diameter steel tup with a 2 in. ± ½ in. (51 mm ± 13 mm) radius nose shall be used. Load speed shall be 0.20 in./min to 0.25 in./min (5.1 mm/min to 6.4 mm/min).

3.2.2 Structural Integrity Tests

3.2.2.1 Deflection Testing of a Fitting Intended for Installation in a Horizontal Plane

3.2.2.1.1 Test Method. The center of the fitting face shall be subjected to a point load of 300 lb ± 10 lb (136 kg ± 4.5 kg) using the tup and tup speed described in para. 3.2.1.4.1. Six units shall be tested.



NOTE:
(1) Testing required if distance, *X*, exceeds ½ in. (13 mm), or if angle of fitting top is 30 deg or less.

Fig. 2 Shear Test

3.2.2.1.2 Performance Requirement. Deflection in excess of 0.350 in. (8 mm) at the 300 lb (136 kg) load shall be deemed a failure. The fittings shall not disintegrate or crack.

3.2.2.2 Deflection Testing of a Fitting Intended for Installation in a Vertical Plane

3.2.2.2.1 Test Method. The center of the fitting face shall be subjected to a point load of 150 lb ± 5 lb (68 kg ± 2.3 kg) using the tup and tup speed described in para. 3.2.1.4.1. All six new units shall be tested.

3.2.2.2.2 Performance Requirement. Deflection in excess of 0.350 in. (8 mm) at the 150 lb ± 5 lb (68 kg ± 2.3 kg) load shall be deemed a failure. Fittings shall not disintegrate or crack.

3.2.2.3 Point Load to Protrusion Test

3.2.2.3.1 Test Method. Using the test equipment described in para. 3.2.1.4.1, the same six units in paras. 3.2.2.1 and 3.2.2.2 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 grate or until a value of 600 lb ± 10 lb (272 kg ± 4.5 kg) is reached.

3.2.2.3.2 Performance Requirement. Fittings shall not disintegrate when a value of 600 lb ± 10 lb (272 kg ± 4.5 kg) is reached.

3.2.2.4 Shear Load Test. This test shall be applied to any vertically mountable fitting whose horizontal edge extends perpendicularly ½ in. (13 mm) or more from the vertical mounting plane. If the fitting has a rounded or tapered surface as shown in Fig. 2, the fitting shall be tested if the angle of taper is 30 deg or less to the vertical surface, regardless of the installation orientation.

3.2.2.4.1 Test Method. The fitting shall be tested by the application of a 150 lb ± 5 lb (46 kg ± 1.5 kg) test load applied parallel to the mounting plane. The six new units shall be tested using the equipment described in para. 3.2.1.4.1.

3.2.2.4.2 Performance Requirement. The grating or cover shall remain in place. The fitting shall not disintegrate.

3.2.3 Vacuum and Point Impact Test. A 5 lb (2 270 g) steel tup, 2 in. (51 mm) minimum diameter with a 2 in. ± ½ in. (51 mm ± 13 mm) radius nose shall be used.

3.2.3.1 Test Method. Each of six new fittings shall be subjected to the following testing sequence:

(a) The fitting to be tested shall be covered with a 20 mil (0.51 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 300 sec ± 10 sec.

(b) The vacuum shall be removed. The plastic film shall be removed. The center of the fitting shall be impacted at 15 ft-lbf (20 J) using the test method in ASTM D 2444, with a 5 lb (2.3 kg) steel tup with dimensions as described in para. 3.2.1.4.1. The 5 lb (2.3 kg) tup shall be dropped from a distance of 3 ft (9 m).

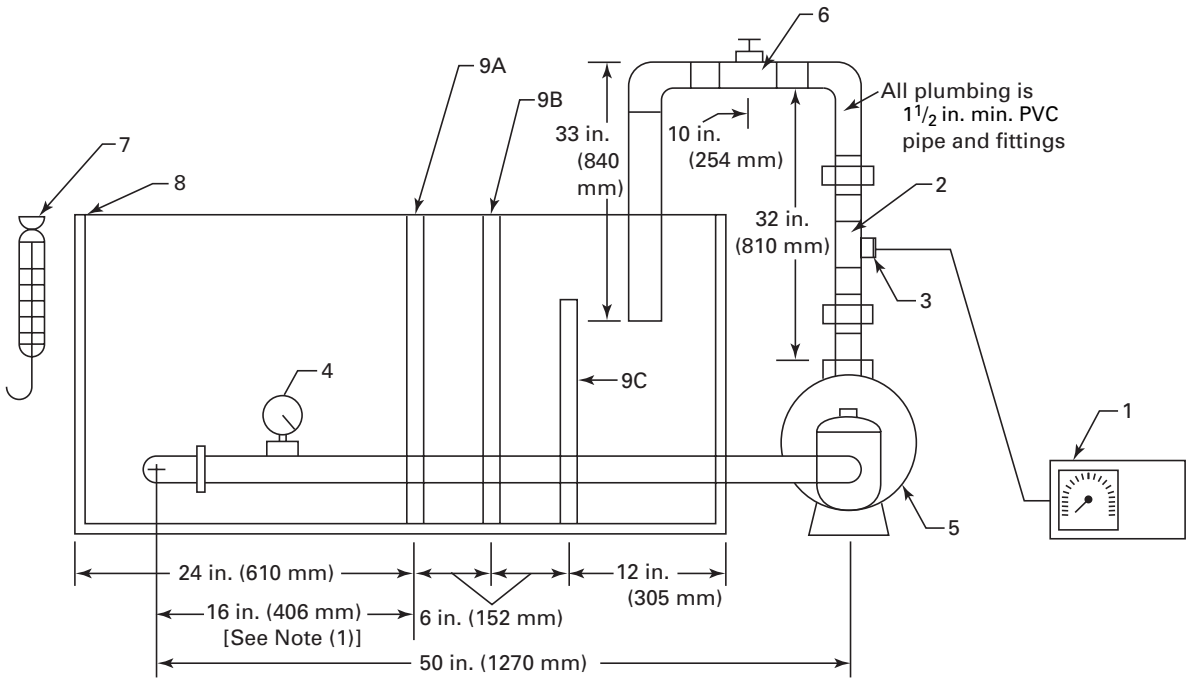
(c) Again the fitting shall be covered with the plastic film and again the 28.5 in. Hg (724 mm Hg) vacuum shall be applied within 60 sec ± 5 sec. The vacuum shall be sustained for an additional 300 sec ± 10 sec.

(d) After removal from the test fixture, water-soluble contrasting ink shall be applied in accordance with para. 3.2.1.2 and the fitting shall be inspected for cracks, breaks, or fractures.

3.2.3.2 Performance Requirement. The grating or cover shall remain in place. The fitting shall not crack or disintegrate. Disintegrate shall mean the loss of any material from the fitting, exclusive of the plating or finish.

3.3 Hair Entanglement Test (Whirlpool Appliances Only)

3.3.1 Hair Entanglement Test for Suction Fittings. The suction fitting in the whirlpool bathtub appliance shall



Legend

Item No.	Description
1	Flow meter
2	Return feed line (positive pressure)
3	Tapped tee for flow meter connection
4	Pressure gauge
5	Pump
6	Control valve
7	Force meter scale
8	Test tank
9	Baffles (see Figs. 4A, 4B, and 4C)

NOTE:
(1) A minimum of 16 in. (406 mm) of straight Schedule 40 plastic pipe, the same size as the suction fitting socket, shall be required.

Fig. 3 Test Tank for Suction Fitting Analysis

be tested for hair entanglement as defined in paras. 3.3.1.1 through 3.3.1.3. The test shall be performed both to establish a flow rating for the fitting (para. 3.3.1.1) and to determine compliance with the performance requirements (para. 3.3.1.2) when installed in the fixture. The tests in para. 3.3.1.2 shall be conducted in accordance with the sampling method cited in para. 3.4. One fitting within the unit shall be selected at random and the hair entanglement procedure shall be conducted with the pump operating at its highest speed. The pulling force to remove the dowel test assembly shall be less than 5 lbf (22 N) when tested ten successive times.

3.3.1.1 Testing of the Fitting in Test Fixture. This test shall be conducted to establish a flow rating for each model suction fitting supplied as original equipment on whirlpool bathtub appliances where this testing has not been previously conducted. It shall not be necessary to conduct this testing on suction fittings installed in whirlpool appliances that have been previously tested and rated.

(a) Test Fixture. The hair entanglement test fixture shall be: comprised of the test tank (Fig. 3), equipped with baffles (Fig. 4), the support for the pull structure (Fig. 5) and the pull cylinder mechanism (Fig. 6 and related notes). The test cylinder shall be affixed to the test fixture as shown in Fig. 7. The support structure (Fig. 5) shall be fabricated of wood or other structural materials to provide a rigid test apparatus. A properly grounded pump capable of producing a flow rate of at

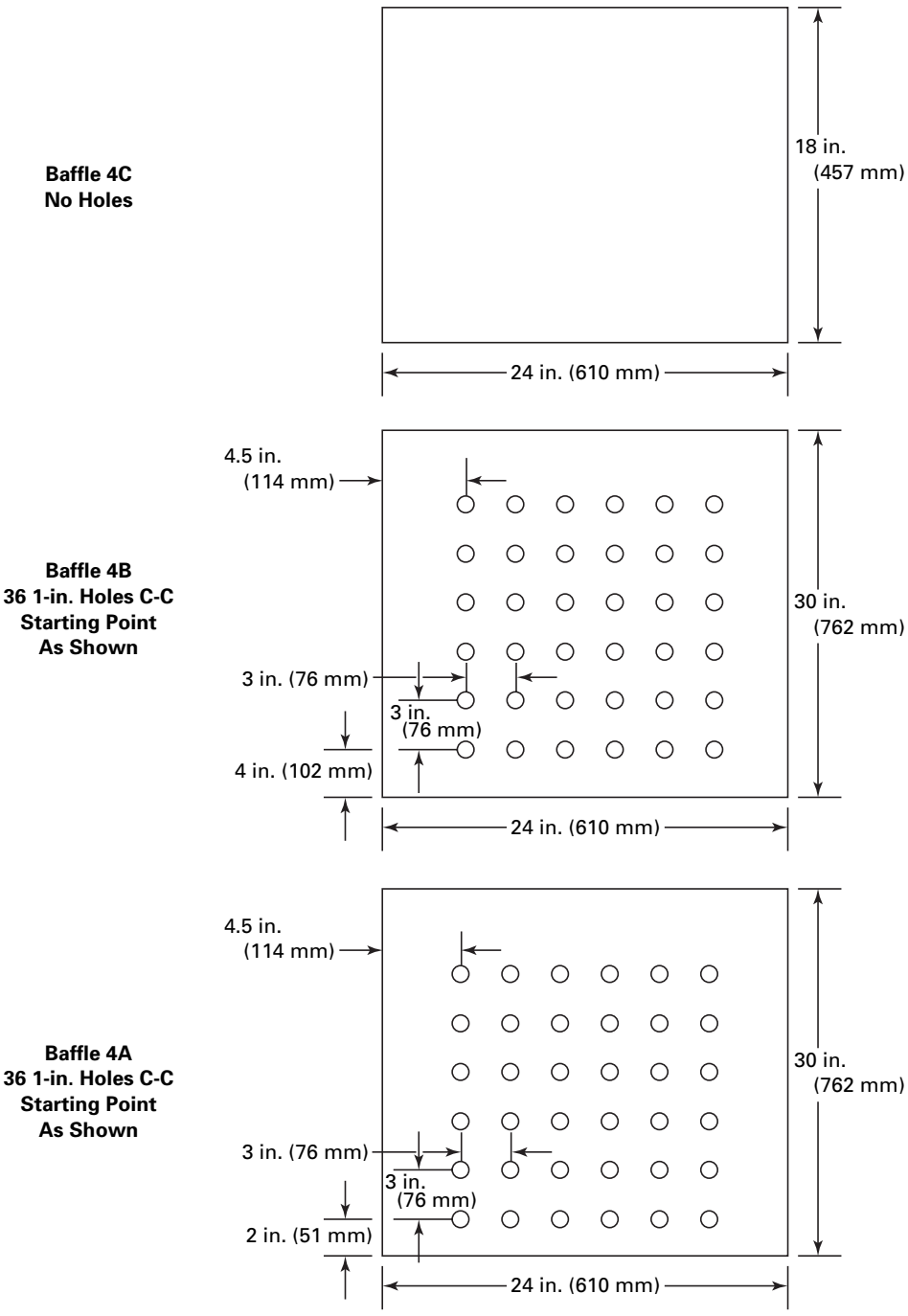


Fig. 4 Baffle Design

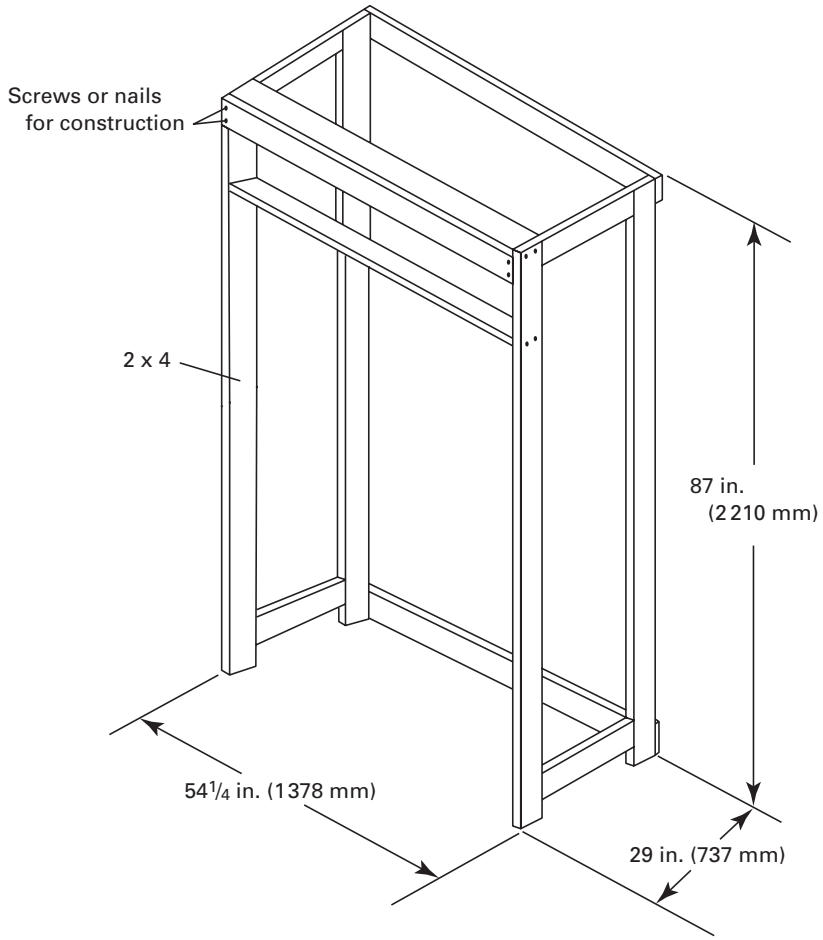


Fig. 5 Support Fixture for Pull Test (Wood Support Structure Shown)

least 25% greater than the fitting manufacturer's recommended rating of the fitting shall be used.

NOTE: A 2 hp pump has been found to be suitable for fittings up to 2 in. pipe diameter. For evaluation of fittings greater than 2 in. in pipe diameter, the manufacturer's recommended pump shall be used for testing to achieve the required flow.

3.3.1.2 Test Method

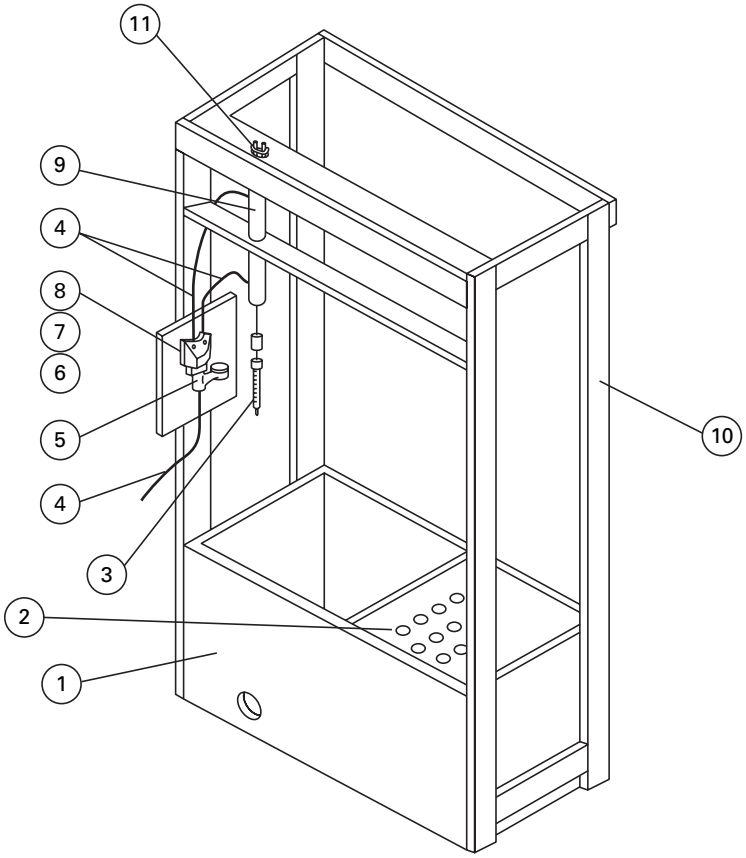
(a) The suction fitting to be tested shall be installed in accordance with manufacturer's installation instructions, through the side wall of the test tank for vertical fittings or through the floor of the container for horizontal fittings. Fittings intended for installation in the vertical or horizontal position shall be tested in the vertical position. The fitting shall be connected to a 90 deg elbow the same size of the fitting outlet located on the outside and as close to the suction fitting as possible. A minimum of 16 in. (406 mm) of straight Schedule 40 plastic pipe the same size as the suction fitting socket shall be attached to the connection as shown in Fig. 3.

(b) The pump inlet shall be connected to Schedule 40 plastic pipe using adapters as necessary.

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

(d) Natural, medium to fine, straight, light-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. When tangles in the wig cannot be removed, a fresh sample of hair shall be used for each appliance tested. Hair shall be trimmed evenly.

(e) A scale accurate to within 0.25 lb at a reading of 5 lb shall be used to determine pounds of pull against the entanglement.



Item #	Description	Part #
1.	Test tank: acrylic (1/2 in.) Outside dimensions 48 in. L x 24 in. W X 30 in. D	
2.	Baffle (to fit tank) (see Fig. 4)	
3.	Scale (for measuring pull force) 0 lb to 12 lb	#791-10 (Chatillon)
4.	Air hose 1/4 in. I.D. x 1/2 in. O.D.	
5.	Parker filter regulator	04E01BI3F
6.	Parker exhaust muffler	EM37
7.	Parker flow control valve	SP37
8.	Parker manual control valve	422CR021W
9.	Parker cylinder, 1 1/8 in. bore x 20 in. stroke	PV 16 x 20
10.	Cylinder/equipment structure (See Fig. 5)	
11.	Cylinder connection 1/4 in. x 2 in. x 3 1/2 in. U-Bolt with nuts (See Fig. 7)	

Fig. 6 Test Equipment With Puller Assembly

(f) The 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).

(g) Prior to use, the hair shall be cleaned in a 10% solution by volume of Alpha Olefin Sulfonate (AOS) and water. After cleaning thoroughly, rinse in clear water. Hair samples shall be cleaned after every ten pulls. The hair shall be saturated for a minimum of 2 min in the test tank. When saturated, the free end of the hair shall be placed approximately 12 in. (305 mm) in front of the suction fitting, and 2 in. (51 mm) above of the face of the fitting, as illustrated in Step A of Fig. 8.

NOTE: Samples of AOS are available from IAPMO, 5001 Philadelphia St. Ontario, CA 91761.

(h) The hair shall be slowly lowered closer to the fitting and the ends of the hair shall be fed into the fitting in the direction of the intake flow as illustrated in Step B of Fig. 8. The hair shall be continually fed into the fitting while moving the dowel from side-to-side in a sweeping motion as illustrated in Step C of Fig. 8. The magnitude of the sweeping motion shall be reduced with each pass of the dowel. The hair shall be fed into the fitting over a minimum of 15 sec ± 5 sec and a

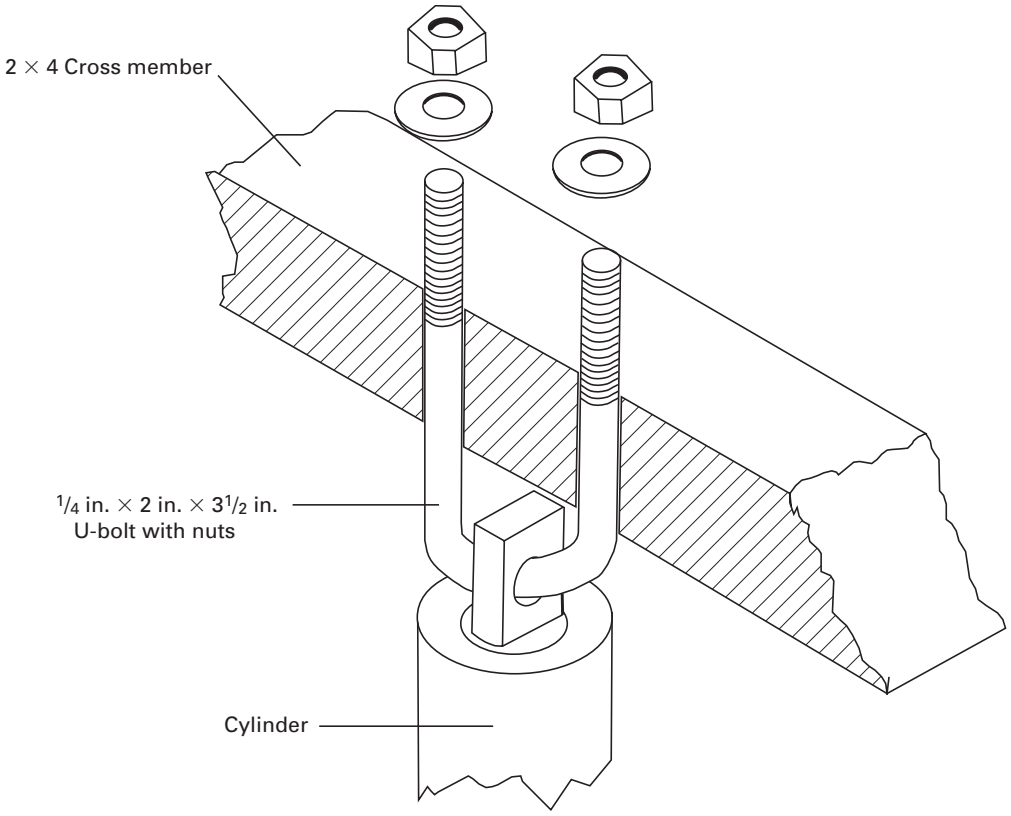


Fig. 7 Assembly of Cylinder to Support Member

maximum of 60 sec. Then the dowel end shall be held against the fitting for 30 sec ± 5 sec as illustrated in Step D of Fig. 8. The dowel shall then be released and allowed to free float for 30 sec ± 5 sec.

(i) If testing a horizontal fitting, testing shall start with the end of the hair 1 in. (25 mm) above the fitting in a similar sweeping motion.

(j) With the pump still operating, the amount of force necessary to free the hair from the fitting shall be measured. The dowel shall be attached to the scale and the scale and dowel shall be pulled in a vertical orientation by activating the pneumatic hair removal mechanism as illustrated in Step E of Fig. 8. The force of the entanglement shall be measured and recorded. Repeat the test ten times.

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

(l) If 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 its best performance value.

3.3.1.3 Performance Requirement. A pull of 5 lbf (22 N) or greater on any one of the ten tests, including the 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 fittings.

3.3.2 Testing Within the Appliance

3.3.2.1 Test Method. The whirlpool bathtub appliance shall be tested for hair entanglement in accordance with the procedures listed below using the sampling method as defined in para. 3.4.

(a) The suction fitting to be tested shall be installed in the whirlpool bathtub appliance in accordance with the manufacturer's instructions.

(b) The whirlpool bathtub appliance shall be filled to 1 in. (25 mm) below the drain overflow with 90°F ± 5°F (32°C ± 3°C) water.

(c) Natural, medium to fine, straight, light-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. When tangles in the wig cannot be removed, a fresh sample of hair shall be

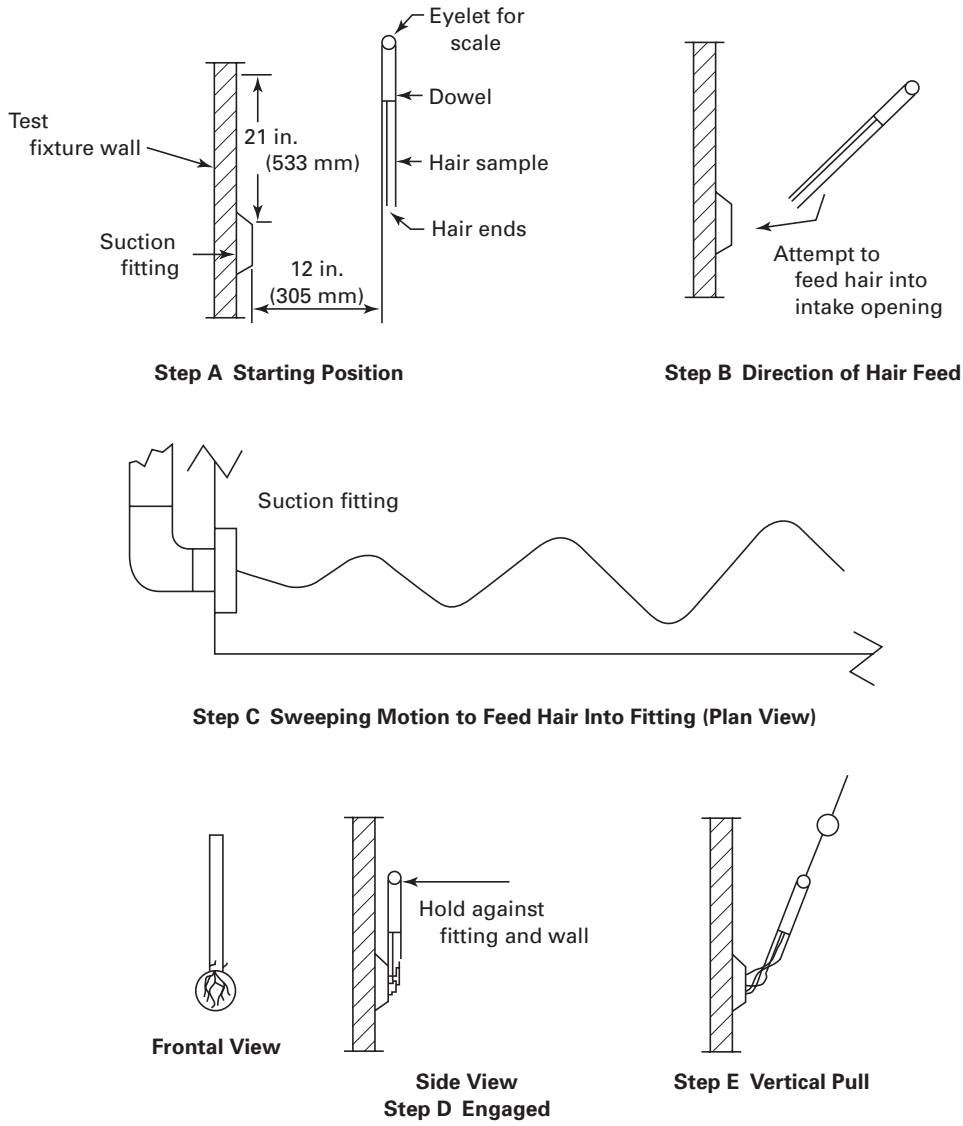


Fig. 8 Suction Fittings Testing Protocol

used for each appliance tested. Hair shall be trimmed evenly.

(d) A scale which is accurate to within 0.25 lb at a reading of 5 lb of the full scale shall be used to determine pounds of pull against the entanglement.

NOTE: A Chatillon model number 791-10, or equivalent, shall be used.

(e) Prior to use, the hair shall be cleaned in a 10% solution by volume of Alpha Olefin Sulfonate (AOS) and water. After cleaning, the hair sample shall be thoroughly rinsed in clear water. This cleaning shall be repeated only if the hair appears dirty or tangled between successive groups of passes.

NOTE: Samples of AOS are available from IAPMO, 5001 Philadelphia St. Ontario, CA 91761.

(f) The pump shall be activated and the flow of the jets shall be directed away from the suction fitting.

(g) The hair shall be saturated for a minimum of 2 min in testing water. After being saturated, the free end of the hair shall be placed approximately 12 in. (305 mm) in front of the suction fitting, and 2 in. (51 mm) above the face of the fitting.

(h) The hair shall be slowly lowered closer to the fitting and the ends of the hair shall be fed into the fitting in the direction of the intake flow. Continue to slowly feed the hair by moving the dowel from side to side in a sweeping motion, while shortening each pass of the dowel for a minimum of 15 sec and a maximum of 60 sec. Then, lay the dowel end against the fitting for a minimum of 30 sec ± 5 sec.

Table 3 Parameters for Random Sampling

Sample Number	Tub Volume [Note (1)]	Number of Jets	Pump Size [Note (2)]
1	Largest	Greatest	Largest
2	Largest	Least	Smallest
3	Smallest	Greatest	Largest
4	Smallest	Least	Smallest

GENERAL NOTE: This section does not require that a minimum number of models be tested and shall not apply where a manufacturer submits four or fewer models for testing.

NOTES:

(1) As measured in gallons (liters) to the overflow.

(2) As rated in gallons per minute (gpm) [liters per minute (L/min)].

(i) If testing a horizontal fitting, start 2 in. (51 mm) above the fitting in a similar sweeping motion.

(j) With the pump still operating, test for the amount of pull necessary to free the hair from the fitting. The force of the entanglement shall be measured and recorded by pulling the scale and dowel vertically.

(k) Paragraphs (h) through (j) shall be repeated 10 times.

3.3.2.2 Performance Requirement. A pull of 5 lbf (22 N) or greater on any one of the ten tests, including the weight of the saturated test apparatus, shall be deemed a failure.

3.4 Random Sampling Method

Representative samples of hydromassage bathtub appliances shall be tested in accordance with the parameters shown in Table 3, in order to verify system compliance with the performance requirements for the test method as defined in paras. 3.1 and 3.3. The random sampling shall represent the parameters in Table 3.

4 MARKING AND LABELING

4.1 Factory-Assembled Whirlpool or Air-Jetted Bathtub Units

4.1.1 Labeling. The manufacturer's name or trademark shall be permanently and legibly marked on the bathtub.

4.1.2 All Units. For all units, an adequately sized label shall be affixed to the exposed surface and adjacent to the waste and overflow. It shall be printed in $^{3}/_{16}$ in. (4.8 mm) high letters, in a contrasting color, and shall read as follows: "TUB SHALL BE TESTED. FILL THE TUB WITH WATER TO OVERFLOW DURING ROUGH INSPECTION AND INSPECT FOR LEAKS."

4.2 Field Assemblies and Retrofitted Units (Whirlpool Appliances Only)

Piping systems that are field assembled or retrofitted shall be identified with an adequately sized label containing

(a) the circulation system manufacturer's name, address, and telephone number

(b) the installer's name, address, and telephone number

(c) the date of installation

The label shall be affixed in a location visible after installation.

For all assembled units, an adequately sized label shall be affixed to the exterior and adjacent to the waste and overflow. It shall be printed in $^{3}/_{16}$ in. (4.8 mm) high letters, in a contrasting color, and shall read as follows: "TUB SHALL BE TESTED. FILL THE TUB WITH WATER TO OVERFLOW DURING ROUGH INSPECTION AND INSPECT FOR LEAKS."

4.3 Permanent Marking of Suction Fittings (Whirlpool Appliances Only)

The fitting shall have markings as follows:

(a) manufacturer's name or registered trademark

(b) model number

(c) maximum flow rate in gpm

NONMANDATORY APPENDIX A
SUCTION FITTING TEST FORM

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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