STANDARD NUMBER 14

Plastics Piping Components and related materials

NATIONAL SANITATION FOUNDATION
LISTING SERVICES

The mission of the
National Sanitation Foundation
is to develop and administer programs
relating to public health and
environment in areas of service,
research, and education.

National Sanitation Foundation
3475 Plymouth Road, P.O. Box 1468
Ann Arbor, Michigan 48106 USA
Phone: (313) 769-8010 Telex: 753215

NATIONAL SANITATION FOUNDATION
STANDARD 14
FOR
PLASTICS PIPING SYSTEM COMPONENTS AND RELATED MATERIALS

As Prepared by

The NSF Joint Committee

on

Plastics

and

Recommended for Adoption

by

The NSF Council of Public Health Consultants

Adopted

by

The NSF Board of Trustees

October 1965

Revised February 1977

Revised November 1978

Revised December 1980

Revised November 1984

The National Sanitation Foundation
3475 Plymouth Road
P. O. Box 1468
Ann Arbor, Michigan 48106, USA

The following is a list of nationally uniform sanitation standards and criteria established by the National Sanitation Foundation.

1 Soda Fountain and Luncheonette Equipment
2 Food Service Equipment
3 Commercial Spray-Type Dishwashing Machines
4 Commercial Cooking and Hot Food Storage Equipment
5 Commercial Hot Water Generating and Heat Recovery Equipment
6 Dispensing Freezers
7 Food Service Refrigerators and Storage Freezers
8 Commercial Powered Food Preparation Equipment
12 Automatic Ice Making Equipment
13 Refuse Compactors and Compactor Systems
14 Plastics Piping System Components and Related Materials
18 Manual Food and Beverage Dispensing Equipment
20 Commercial Bulk Milk Dispensing Equipment and Appurtenances
21 Thermoplastic Refuse Containers
23 Marine Sanitation Devices
24 Plumbing System Components for Mobile Homes and Recreational Vehicles
25 Vending Machines for Food and Beverages
26 Pot, Pan and Utensil Washers
29 Detergent/Chemical Feeders for Commercial Spray-Type Dishwashing Machines
30 Cabinetry and Laboratory Furniture for Hospitals
31 Polyethylene Refuse Bags
35 Laminated Plastics for Surfacing Food Service Equipment
36 Dinnerware
37 Air Curtains for Entranceways in Food Establishments
40 Individual Aerobic Wastewater Treatment Plants
41 Wastewater Recycle/Reuse and Water Conservation Systems
42 Drinking Water Treatment Units — Aesthetic Effects
43 Chemical Feeding and Processing Equipment Relating to Supplementary Treatment of Potable Water
49 Class II (Laminar Flow) Biohazard Cabinetry
50 Circulation System Components for Swimming Pools, Spas, or Hot Tubs
51 Plastic Materials and Components Used in Food Equipment
52 Supplemental Flooring
53 Drinking Water Treatment Units — Health Effects
54 Flexible Membrane Liners
C-2 Special Equipment and/or Devices
C-8 Pitless Well Adapters
C-9 Evaluation of Special Processes or Devices Used in Treating Wastewater
C-10 Ductless Air Circulating and Treatment Devices

THE NATIONAL SANITATION FOUNDATION

Purpose and Organization

The Foundation, popularly referred to as NSF, is a nonofficial and noncommercial agency. It is incorporated under the laws of Michigan as a not-for-profit organization devoted to research, education and service. It seeks to solve problems involving man and his environment. It wishes to promote man's health and enrich the quality of life through conserving and improving that environment. Its fundamental principle of operation is to serve as a neutral medium in which business and industry, official regulatory agencies and the public come together to deal with problems involving products, equipment, procedures and services related to health and the environment.

NSF is perhaps best known for its role in the developing of standards and criteria for equipment, products and services that bear upon health. The NSF seal is widely recognized as a sign that the article to which it is affixed complies with public health requirements. NSF early in its existence established its own testing laboratory as a subsidiary corporation. This laboratory conducts research; tests and evaluates equipment, products and services for compliance with NSF standards and criteria; and grants and controls the use of the NSF seal.

A brochure is available discussing in some detail the purpose, objectives and philosophy of NSF and its standards and listing programs. It describes the way in which distinguished leaders from business, industry, public health and related professions give generously of their time and talent in helping achieve NSF objectives. The brochure, which is available upon request, is entitled *Facts About Voluntary Standards and Evaluation Services.*

DISCLAIMERS

The National Sanitation Foundation (NSF, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of NSF represent its professional judgement given with due consideration to the necessary limitations of practical operation and state-of-the-art at the time the standard is processed. NSF shall not be responsible to anyone for the use of or reliance upon this standard by anyone. NSF shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this standard.

NSF standards provide basic criteria to insure sanitation and protection of the public health. Provisions for safety have not been included in this standard because governmental agencies or other national standards-setting organizations provide safety requirements.

Participation in NSF standards development activities by regulatory agency representatives (federal, local, state) shall not constitute their agency's endorsement of NSF or any of its standards.

Preference is given to the use of performance criteria measurable by examination or testing in NSF standards development when such performance criteria may reasonably be used in lieu of design, materials, or construction criteria.

The illustrations, if provided, are intended to assist in understanding their adjacent standard requirements. However, the illustrations may not include **all** requirements for a specific product or unit, nor do they show the only method of fabricating such arrangements. Such partial drawings shall not be used to justify improper or incomplete design and construction.

Unless otherwise referenced, the appendices are not considered an integral part of NSF standards. The appendices are provided as general guidelines to the manufacturer, regulatory agency, user, or certifying organization.

CONTENTS

SECTION 9. MARKING

SECTION 10. QUALITY CONTROL

SECTION 11. RECORDS

SECTION 12. PLASTICS INGREDIENTS

NATIONAL SANITATION FOUNDATION POLICIES

APPENDIX A - Review and Evaluation Procedures

APPENDIX B - List of Standards for Plastic Piping System Components Referenced by NSF Standard 14

APPENDIX C - Examples of Marking and Coding of Pipe, Fittings, and Solvent Cement

APPENDIX D - Participating Committees

NSF STANDARD 14
FOR
PLASTICS PIPING SYSTEM COMPONENTS
AND RELATED MATERIALS

SECTION 1. GENERAL

1.0 SCOPE: This standard covers thermoplastic and thermoset plastics piping system components (pipe, fittings, valves, tanks, joining materials, appurtenances, etc.). It also covers materials to fabricate the components and plastic coatings. It provides definitions, material and product requirements, quality control, marking, and record keeping. These are covered in separate sections of this standard. All sections need to be examined to determine the total requirements for a specific product.

1.1 MINIMUM REQUIREMENTS: This standard establishes minimum public health and safety requirements for plastics piping system components and related materials. Variations from these minimum requirements may be permitted when they provide equal or more improved protection of the public's health and safety, make items more resistant to use conditions, and are suitable for the intended end use. Units with components covered under existing NSF standards or criteria shall comply with those applicable requirements.

1.2 STANDARD REVIEW: A complete review of this standard shall be conducted at least every five years to keep requirements consistent with new technology. These reviews shall be conducted by representatives from the industry, public health, and user groups or agencies of the NSF Joint Committee on Plastics.

SECTION 2. DEFINITIONS

2.0 BOND: The union of materials by adhesives.

2.1 BUILDING DRAIN: The lowest part of a draining piping system, receiving discharge from soil, waste, and other drainage pipe inside the building. It conveys these wastes to the building sewer, beginning 3 feet (0.9 m) outside the building wall.

2.2 BUILDING SEWER: The portion of the horizontal piping of a drainage system extending from the end of the building drain, receiving discharge of the building drain. It conveys to discharge or private sewer, individual sewage disposal system, or other point of disposal.

2.3 CALCIUM CARBONATE: A compound obtained by crushing or grinding limestone or precipitating calcium carbonate.

2.4 CALCIUM STEARATE: A compound of calcium with a mixture of solid organic acids obtained from fats and consisting chiefly of variable proportions of calcium stearate and calcium palmitate.

2.5 COMPATIBLE: (1) A condition allowing components of a piping system, or different specific materials to be joined forming satisfactory joints. (2) In elastomeric seal joints, elastomer material does not adversely affect pertinent properties of the plastics pipe or fittings during prolonged intimate contact with the plastics.

2.6 COMPOUND: An intimate admixture of polymers with all materials necessary for the finished product.

2.7 COMPOUNDER: A corporation, company, or individual who blends, mixes, or otherwise modifies listed materials supplied by a raw material manufacturer, for use at another location.

2.7.1 IN-PLANT COMPOUNDER: A finished product manufacturer (pipe, fittings, etc.) who blends, mixes, or modifies materials within the same manufacturing facilities where the final product is extruded, molded, or fabricated.

2.8 CONTAMINATION: Presence of foreign materials, impurities, or diluents affecting one or more physical, chemical, toxicological, or taste and odor properties of the plastics piping system components and related materials.

2.9 CONTINUOUS WASTE: A drain connecting compartments of fixtures to a trap, or other fixtures to a common trap.

2.10 CORROSIVE WASTE: Industrial, chemical, processed liquid, or liquid-borne materials limiting the useful life of the piping system.

2.11 DRAINAGE SYSTEM: Piping within public or private premises conveying sewage, rainwater, or other liquid wastes to a legal point of disposal. It does not include mains of public sewer systems, private or public sewage treatment, or disposal plant.

2.12 ELASTOMER: A macromolecular material that at room temperature returns rapidly to approximately its initial dimensions and shape, after substantial deformation from weak stress and release.

2.13 ELASTOMERIC SEAL: A device, elastomeric in nature, used to produce a tight joint between two or more parts without producing a bond.

2.14 FITTING: Device used to join or terminate sections of pipe.

2.15 GENERICALLY SIMILAR INGREDIENT: An ingredient that is generically similar to an accepted ingredient, but not a new ingredient. It may vary in composition due to manufacturing process, source of materials, potential trace contaminants, etc.

2.16 HEAT JOINING: A joint made by heating the mating surfaces of pipe components and pressing them so they fuse and become essentially one piece.

2.17 HYDROCARBON WAXES: Waxes comprised of the branched or linear hydrocarbons essentially alkane in chemical character.

2.18 HYDROSTATIC DESIGN STRESS: Estimated maximum tensile stress in pipe wall circumference from internal pressure. It can be applied continuously with a high degree of certainty that the pipe will not fail.

2.19 JOINING MATERIAL: Substance used to produce a tight joint (solvent cement, adhesives, elastomeric seals, etc.).

2.20 LUBRICANT: Material used to reduce friction between two mating surfaces being joined by sliding contact action (making a threaded joint, pushing pipe into a gasketed belled end, etc.).

2.21 MANUFACTURER (EXTRUDER, MATERIAL SUPPLIER, OR MOLDER): A corporation, company, or individual who manufacturers plastics piping system components and related materials.

2.22 OXIDIZED POLYETHYLENE WAXES: Waxes composed of oxidized homopolymers of ethylene.

2.23 PIPING PRODUCTS: Includes pipe, fittings, and valves.

2.24 PLASTICS: Materials containing as an essential ingredient one or more organic polymeric substances, solid in a finished state, and then subjected to heat and/or pressure to form a finished article.

2.24.1 THERMOPLASTICS: Plastics that can be repeatedly softened by heating, and hardened by cooling through a temperature range characteristic of the plastics. In the softened state, they can be shaped by flow into articles by molding or extrusion.

2.24.2 THERMOSET PLASTICS: Plastics that when cured by application of heat (radiation, electrical energy, or chemical), changes into a substantially infusible or insoluble product.

2.25 PLASTICS PIPE: A hollow cylinder of plastic compound with wall thickness small in comparison with diameter, and outside and inside walls essentially concentric.

2.26 POTABLE WATER SYSTEMS: Systems to convey drinking water or water for food processing purposes (pipe, fittings, valves, and other accessories normally considered part of a water supply system).

2.27 PVC: Any vinyl chloride based polymer.

2.28 RESIN: A solid or pseudosolid organic material of high molecular weight, exhibiting a tendency to flow when subjected to stress. It usually has a softening or melting range and fractures conchoidally. Thermoset plastic resin is basic thermosetting polymer mixed with other ingredients before manufacture.

2.29 RESIDUAL VINYL CHLORIDE MONOMER (RVCM): Unreacted vinyl chloride remaining in a PVC piping product. The concentration is reported on a weight-to-weight basis as ppm.

2.30 SEALANT: A material used on two mating surfaces to produce a tight joint without producing a bond.

2.31 SOLVENT CEMENT: An adhesive of dissolved plastic resin or compound in a solvent or mixture of solvents. When applied to surfaces of pipe and fittings to be mated, it softens to form a bond.

2.32 SPECIAL ENGINEERED (SE): Specifically designed for a particular end use or application.

2.33 TOXIC: Having an adverse physiological effect on humans.

2.34 TOTAL TRIHALOMETHANES (TTHMs): The sum of four trihalomethanes: chloroform, bromodichloromethane, chlorodibromomethane, and bromoform.

2.35 TRAP: A properly vented fitting or device to provide a liquid seal to prevent back passage of air and will not affect the flow of liquid.

2.36 VALVE: Device used to regulate flow of liquids or gases.

2.37 VENT SYSTEM: Pipe to provide air flow to or from a drainage system, air circulation in the system, and protect trap seals from siphonage and back pressure by limiting air pressure differentials to ± 1 inch (± 25.4 mm) measured in inches of water.

SECTION 3. MATERIALS

3.0 GENERAL: Materials shall meet specific public health, safety, and performance-oriented requirements as established for the intended use. Materials shall be manufactured to prevent possible contamination.

3.1 PHYSICAL/CHEMICAL REQUIREMENTS: Materials produced by a material manufacturer or compounder shall comply with physical, chemical, and performance requirements of applicable standards (American Society for Testing and Materials [ASTM], American National Standards Institute [ANSI], etc.), see Appendix B.

3.2 HYDROSTATIC DESIGN STRESS: Manufacturers of materials for use in plastics pipe for pressure applications shall submit evidence of design stress conformance.

3.2.1 THERMOPLASTIC MATERIALS: Thermoplastic materials shall comply with the *Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials*[1] when tested according to ASTM D2837.

3.2.2 THERMOSET MATERIALS: Thermoset plastic materials shall comply with ASTM D2992 *Standard Method for Obtaining Hydrostatic Design Basis for Reinforcing Thermosetting Resin Pipe and Fittings.* Assignment of design stress shall not constitute acceptance of pipe manufactured by others from the same material.

3.3 POTABLE WATER APPLICATIONS: Plastics materials for pipe, fittings, valves, and joining materials for potable water applications shall comply with the following:

3.3.1 CHEMICAL/TASTE AND ODOR: Chemical/taste and odor evaluations[2] of thermoplastic materials shall be conducted according to procedures in Appendix A. Extractant water shall not exceed maximum levels of US Environmental Protection Agency's *National Interim Primary Drinking Water Regulations* — 1975[3] and NSF limits of acceptance in Table I.

[1]Available from the Plastics Pipe Institute, 355 Lexington Avenue, New York, NY 10017

[2]The procedures in Appendix A and reported in *Study of Plastic Pipe for Potable Water Supplies* are based on long-term evaluation of thermoplastic materials for potable water application for suitability from a public health and use standpoint.

[3]Established in the *National Interim Primary Drinking Water Regulations,* USEPA, 1975 (Published in Federal Register, Vol. 40, No. 248, December 24, 1975).

3.3.2 RESIDUAL VINYL CHLORIDE MONOMER: The maximum limit shall be 10 ppm vinyl chloride monomer. Resin or compound used for conversion into potable water piping products must produce finished products within the 10 ppm RVCM limit. Evaluation of PVC and CPVC piping products shall be conducted according to Appendix A.

3.3.3 TOTAL TRIHALOMETHANES: The maximum permissible level of TTHMs shall not exceed 0.1 ppm (100 ppb) for PVC and CPVC pipe when evaluated according to extraction procedures in Appendix A.[4]

3.4 TRACERS: The addition of innocuous tracers may be required.

3.5 OTHER REQUIREMENTS: Quality control and record keeping shall comply with Sections 10 and 11.

TABLE I

CHEMICAL AND PHYSICAL ANALYSES

Parameter	Max. Per. Level mg/l (ppm)
Antimony	0.05
Arsenic	0.05 [3]
Barium	1.0 [3]
Cadmium	0.01 [3]
Chromium	0.05 [3]
Lead	0.05 [3]
Mercury	0.002[3]
pH	
Phenolic Substances	0.05
RVCM	10. *
Selenium	0.01 [3]
Solids, Total Dissolved	70.
Tin	0.05
TTHM	0.1

Comments: *In the finished product.

TASTE AND ODOR EVALUATIONS

Characteristic	Permissible Level	
Odor	Cold application Hot application	40 60
Taste	Satisfactory	

[4]This requirement shall be reconfirmed by ballot, based on a review of additional data, by January 1985. The MPL of 100 ppb is based on the MCL for TTHMs which was added to the *National Interim Primary Drinking Water Regulations*, USEPA, 1976 (Published in Federal Register Vol. 44, No. 231, November 29, 1979). Preliminary data (NSF Interim Report, *Proposed Organohalide Leachate Testing Protocol for Plastics Piping*, April 1983) indicated that TTHMs are not contributed by listed plastics pipe to drinking water at significant levels.

SECTION 4. REQUIREMENTS FOR PLASTICS PIPING SYSTEM COMPONENTS

4.0 GENERAL: Plastics piping system components shall be produced from only virgin materials complying with this standard. Clean rework material of the same virgin ingredients from the same manufacturer's own production, may be used by the manufacturer if finished products meet the requirements of the intended application.

4.1 CHEMICAL/TASTE AND ODOR AND RVCM REQUIREMENTS: Components for potable water application shall comply with Items 3.3.1 and 3.3.2 for residual vinyl chloride monomer for PVC and CPVC pipe and fittings.

4.2 PHYSICAL, PERFORMANCE-ORIENTED, AND DIMENSION REQUIREMENTS: Plastics piping system components shall comply with physical, performance-oriented, and dimension requirements of the standards in Appendix B. However, there may be noncritical dimension requirements in those standards that do not affect performance or installation of pipe or fittings. Pipe or fittings fully complying with the applicable standard may be accepted. Critical dimensions are identified in Policy D.

4.3 OTHER REQUIREMENTS: Marking, quality control, and record keeping shall comply with Sections 9, 10, and 11.

4.4 SPECIAL ENGINEERED COMPONENTS: Variations in design may be permitted if products conform to applicable sections of this standard and the manufacturer's claims. The variation shall be requested by the manufacturer. The manufacturer shall submit complete design engineering specifications.

4.4.1 SPECIAL TEST REQUIREMENTS: Special tests may be required if necessary to insure adequate protection of the public's health and safety.

4.4.2 FIELD APPLICATION OF COATINGS: Plastic coatings to be applied under field conditions shall meet applicable requirements in this standard under normal conditions.

4.4.3 OTHER REQUIREMENTS: Marking, quality control, and record keeping shall comply with Sections 9, 10, and 11.

SECTION 5. JOINING OR BONDING MATERIALS

5.0 GENERAL: Joining materials shall comply with requirements of Section 3 for the appropriate end use. Joining materials shall also comply with pertinent requirements of the current standards in Appendix B.

5.1 PHYSICAL REQUIREMENTS: Joining or bonding materials shall comply with the applicable standards in Appendix B.

5.2 PERFORMANCE-ORIENTED REQUIREMENTS: Joining or bonding materials shall result in a bond meeting the requirements of the applicable standard in Appendix B.

5.3 POTABLE WATER APPLICATIONS: Joining or bonding materials for potable water applications shall meet the applicable requirements in Section 3.

5.4 OTHER REQUIREMENTS: Marking, quality control, and record keeping shall comply with Sections 9, 10, and 11.

SECTION 6. THREAD COMPOUNDS, SEALANTS, AND LUBRICANTS

6.0 GENERAL: These requirements cover thread compounds, sealants, and lubricants for use in potable water piping systems.

6.1 MATERIALS: Materials shall meet public health, safety, and performance requirements of this standard. They shall not support microbiological growth when evaluated in according to ASTM Recommended Practice G21.[5] Materials shall be manufactured to prevent possible contamination.

6.2 COMPATIBILITY: Thread compounds, sealants, and lubricants shall be compatible with the piping systems recommended for use.

6.3 CHEMICAL/TASTE AND ODOR REQUIREMENTS: Thread compounds, sealants, and lubricants shall contain no ingredients leaching into water in quantities considered toxic. When evaluated chemically and for taste and odor

[5]Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

specified in Appendix A, Part I, [6] they shall conform to minimum public health requirements.

6.4 OTHER REQUIREMENTS: Marking, quality control, and record keeping shall comply with Sections 9, 10, and 11.

SECTION 7. CORROSIVE WASTE SYSTEMS

7.0 GENERAL: Under intended use conditions, corrosive waste system components shall result in a gravity drainage system capable of properly and safely conveying and discharging corrosive wastes. They shall be evaluated against Item 4.4.

7.1 MATERIALS: Corrosive waste system components shall comply with applicable material requirements of Section 3 and Appendix A, Part 3.

7.1.1 VERIFICATION OF CELL CLASSIFICATION: The testing laboratory shall verify the manufacturer's claimed cell classification.

7.1.2 CHEMICAL RESISTANCE: Chemical immersion tests on tensile bars, when tested according to Appendix A, Part 3, shall be:

- CHANGE IN TENSILE STRENGTH: Change shall not exceed ± 15 percent of the unexposed sample.
- CHANGE IN WEIGHT: Change shall not exceed ± 15 percent of the unexposed sample.

7.2 CORROSIVE WASTE SYSTEM COMPONENTS: Corrosive waste system components shall be evaluated against the manufacturer's claims and Appendix A, Part 3.

7.2.1 DIMENSIONS: Pipe and fittings shall meet dimensions and tolerances claimed by the manufacturer.

7.2.2 HYDROSTATIC BURST STRENGTH: Hydrostatic burst tests (using water) shall be conducted against the manufacturer's claims.

7.2.3 RIGIDITY: Data on rigidity shall be supplied by the manufacturer (Appendix A, Part 3). The system shall not be adversely affected when supported as recommended.

7.2.4 RESISTANCE TO EXPOSURE: The manufacturer shall supply data to show the product is not adversely affected by use environment.

7.3 INSTALLATION AND USE: The manufacturer shall provide recommended installation procedures, limitations of use, and a list of corrosive wastes the system is capable of handling.

7.4 OTHER REQUIREMENTS: Marking, quality control, and record keeping shall comply with Sections 9, 10, and 11.

SECTION 8. THERMOSET PLASTIC WATER SOFTENING TANKS

8.0 GENERAL: Where applicable, water softening tanks covered shall comply with requirements of Section 3 and the following:

8.1 PHYSICAL AND PERFORMANCE REQUIREMENTS: Water softening tanks shall comply with the following:

8.1.1 SHORT-TERM RUPTURE: Water softening tanks shall withstand a hydrostatic pressure test of a minimum of 600 psi (4136.4 Pa), applied at a uniform rate so failure occurs in not less than 1 minute. They shall be tested at the manufacturer's recommended maximum temperature.

8.1.2 CYCLIC TESTING: Water softening tanks shall withstand 100,000 cycles of 0 to 150 psi (0 to 1034.1 Pa) for at least 1 second of hydrostatic pressure at the manufacturer's recommended maximum temperature. A short-term rupture of not less than 420 psi (2895.5 Pa) shall be applied at a uniform rate so failure occurs in not less than 1 minute.

8.1.3 QUALIFICATION TEST: For qualification, water softening tanks shall withstand 240 psi (1654.6 Pa) for 15 minutes with no visible leakage.

[6] Procedures in Appendix A, Part I, reported in *A Study of Plastic Pipe for Potable Water Supplies* are based upon long-term evaluation of thermoplastic materials for potable water application for suitability from a public health and use standpoint.

8.1.4 IMPACT RESISTANCE: Water softening tanks shall be resistant to anticipated impact at the use environment (drop impact of 6 feet [1.8 m]).

8.2 OTHER REQUIREMENTS: Marking, quality control, and record keeping shall comply with Sections 9, 10, and 11.

SECTION 9. MARKING

9.0 GENERAL: Marking shall be legible.

9.1 MARKING AND CODING OF PIPE:[7] Manufacturer shall place on plastics pipe the designations and identifications required in the current applicable standards. The pressure rating at a specified temperature should be shown on the pipe, if applicable. Plastics pipe shall also bear an appropriate classification code identifying the day, month, and year of production and the resin used. If pipe is made by multiple head extrusion technique with intermediate storage before marking, the code may indicate the week rather than the day of production. If the manufacturer has more than one plant location or produces for other suppliers/distributors, an identifying symbol shall be used.

9.2 MARKING OF PLASTICS PIPING SYSTEM COMPONENTS: Manufacturer shall place on plastics fittings and appurtenances the designations and identifications required in the current applicable standards in Appendix B. If the manufacturer has more than one plant location or produces for other suppliers/distributors, an identifying symbol shall be used.

9.3 MARKING AND CODING OF THREAD COMPOUNDS, SEALANTS, AND LUBRICANTS; ADHESIVES; AND COATINGS: The manufacturer shall place on the containers the designations and identifications required in the current applicable standards in Appendix B. Container shall bear an appropriate batch number to identify the day, month, and year of manufacture, and resin used. If the manufacturer has more than one plant location or produces for other named suppliers/distributors, an identifying symbol shall be used on the container.

[7]Examples of marking are shown in Appendix C.

9.4 MARKING OF SPECIAL ENGINEERED PRODUCTS: Special engineered products shall be identified by the symbol "SE" immediately following the appropriate product designation.

SECTION 10. QUALITY CONTROL

10.0 GENERAL: Quality control procedures shall be required to assure continued uniform quality and compliance with applicable standards (see Policy D).

10.1 TESTING FACILITIES: The manufacturer shall provide and maintain quality control testing at each production facility (see Policy C).

SECTION 11. RECORDS

11.0 QUALITY CONTROL: The manufacturer shall maintain a record of quality control tests for at least two years.

11.1 PRODUCTION CODE IDENTIFICATION: If code identification of products is required, the manufacturer shall maintain additional records necessary to confirm identification of all products.

SECTION 12. PLASTICS INGREDIENTS

12.0 GENERAL: This section defines requirements that characterize calcium carbonates, calcium stearates, hydrocarbon waxes, and oxidized polyethylene waxes as generically similar ingredients for use in PVC materials and compounds.

12.1 PERFORMANCE: Ingredients shall comply with the latest applicable sections of the PPI Guidelines TR-3, *Policies and Procedures for Design Stresses for Thermoplastic Pipe Materials.*

12.2 POTABLE WATER APPLICATIONS:

12.2.1 CALCIUM CARBONATES: Calcium carbonates shall comply with the requirements of the latest edition of the *Food Chemicals Codex* for toxic substances. An alternate acceptance shall be the water extraction test described in Appendix A, Part 2, Section 7.0. Additionally, calcium stearate or stearic acid may be used to improve dispersion characteristics of ground limestone and precipitated calcium carbonates.

12.2.2 CALCIUM STEARATES: Calcium stearates, when used at twice the recommended use level, shall produce product complying with the specific requirements of Section 3.

12.2.3 HYDROCARBON WAXES: Hydrocarbon waxes shall comply with FDA Regulations, Title 21, CFR-178.3710. When used at twice the recommended use level, they shall produce product complying with the specific requirements of Section 3.

12.2.4 OXIDIZED POLYETHYLENE WAXES: Oxidized polyethylene waxes shall comply with FDA Regulations, Title 21, CFR-177.1620 and 172.260. When used at twice the recommended maximum use level, they shall produce product complying with the specific requirements of Section 3.

12.3 PRODUCT LABELING: The manufacturer shall place on all ingredient containers the manufacturer's name, trade name, product designation, and lot number or production date.

12.4 QUALITY CONTROL: The manufacturer shall perform tests necessary to assure that properties of each lot number or production date of materials complying with the requirements of Item 12.1. Records shall be retained according to Section 11.

NATIONAL SANITATION FOUNDATION POLICIES

Policy A

Policies Relating to the Use of NSF Seals and Logos on Plastic Piping System Components and Related Materials

Policy B

Statement of Policy Relating to Inspection of Facilities, Records, Sampling, Testing and Laboratory Test Reports

Policy C

Quality Control Testing

Policy D

Critical Dimensions

POLICY A
NATIONAL SANITATION FOUNDATION
POLICIES RELATING TO THE USE OF NSF SEALS AND LOGOS
ON
PLASTIC PIPING SYSTEM COMPONENTS AND RELATED MATERIALS

As a public service, the National Sanitation Foundation offers to any reputable manufacturer the use of the NSF seal or logo upon formally listed products subject to the following conditions and stipulations:

General

Who Can Apply

1. Any company, after it has determined that its products are covered by a published NSF standard, may apply for evaluation and listing by National Sanitation Foundation (NSF).

Authorization

2. Evaluation and/or testing of any product which a company desires to have listed shall be made by NSF. Authorization to use the NSF seal or logo upon such products shall not be granted until evidence has been furnished the Executive Vice President of NSF that the product meets the standards.

Contract

3. Each manufacturer who desires the use of the NSF seal or logo must file with NSF a *Contract for Evaluation, Testing and Listing Services Relating to the Use of the NSF Seal or Logo on Listed Plastics Materials or Products.* This contract shall contain an affidavit, signed by the manufacturer, certifying that if said company is authorized the use of the NSF seal or logo, the seal or logo will be placed only on the new products fully complying with the NSF standards; and that said company will abide by the *Policies Relating to the Use of NSF Seals or Logos.*

Responsibility of Manufacturer

4. Evaluation and/or testing by NSF of all items or products produced during any listing period is impractical. It is, therefore, the responsibility of each manufacturer who is granted authorization to use the NSF seal or logo to place the NSF seal or logo only on products fully complying with NSF standards. Further, it is understood that only products bearing the seal or logo shall be considered as listed.

Compliance

5. The manufacturer shall comply with the requirements of NSF Standard No. 14 for Plastic Piping System Components and Related Materials covered under this standard and the policies included therein, the purposes of which are to aid in the preservation and protection of the public health and safety.

Observance of Requirements

6. The observance of the requirements of standards by a manufacturer is one of the conditions of the continued listing of the manufacturer's product. NSF, however, assumes no responsibility for the effect of such observance or nonobservance by the manufacturer upon the relations between the manufacturer and any other party or parties arising out of the sale or use of the product otherwise.

Reviews and Revisions

7. A complete review of this standard shall be conducted at intervals of not more than five years to determine what changes, deletions or additions, if any, are necessary to maintain current and effective requirements consistent with new technology and progress. These reviews shall be conducted by appropriate representatives from the industry, public health and user groups. Final adoption of revisions shall be in accordance with the procedures established by the NSF Joint Committee on Plastics.

NSF's Opinion

8. Manufacturer acknowledges that NSF's opinion is given to manufacturer solely as an opinion, reached in good faith on the basis of the facts known to NSF at the time, and NSF in no way shall be liable or responsible to manufacturer in the event its opinion is erroneous.

Advertising

Misuse

1. The manufacturer shall not directly or indirectly in any way represent that any of its products, which are not listed (whether this is due to rejection by NSF, lack of test completion, failure to submit for testing or otherwise), are listed by NSF unless listing of such product is in effect.

Misuse

2. The manufacturer shall not directly or indirectly advertise or in any way represent that any of its unlisted products are comparable, in quality or otherwise, or usable as a substitute for listed products; whether such listed product be of its own manufacturer or otherwise.

Misuse

3. The manufacturer shall not directly represent, advertise or claim that any listed product is suitable for an end use in an application for which NSF has not listed same.

Manufacturer's Claims

4. The manufacturer shall not claim or represent that any unproven test procedure is a satisfactory quality control method or indicator, nor equal to an established test procedure.

Literature

5. The manufacturer shall properly identify, showing date of release, all sales literature, technical data publications and promotion material relating to plastic pipe, fittings and/or appurtenances.

Misuse

6. The manufacturer shall not make reference to the NSF listing or to an NSF listed product in its advertising of unlisted products and thus create the false impression that the unlisted produts may be listed, are made from listed materials, or otherwise may be equally as safe as the NSF listed products.

Special Engineered

Departing from Existing Standards

1. When a departure in dimension and tolerance is requested in a product manufactured from a material covered by an existing ASTM, ANSI, AWWA specification or product standard, NSF may extend approval upon:

   1.1 Receipt of satisfactory evidence from an appropriate standard organization that a change is under development.

   1.2 Satisfactory completion of testing of the product against the most applicable requirement. However, the manufacturer may, if refused consideration within a reasonable time by the appropriate standards organization for the requested change, appeal to the NSF Joint Committee on Plastics.

Departure from Existing Standards

2. When a change in pressure rating or temperature rating of a pipe manufactured from a material covered by an existing ASTM, ANSI or AWWA specification is requested, the laboratory may accept same; provided a hydrostatic design stress has been properly assigned for said temperature and the product has satisfactorily completed testing against the appropriate requirements of the applicable standards.

Departure from Existing Standards

3. Items of a material, resin type, schedule or series, pressure rating and dimension not covered by a standard deemed applicable by the NSF Joint Committee on Plastics, shall have such standard under development as evidenced in a manner satisfactory to NSF. However, NSF may waive said provisions when the production and use of the item in question is so limited as to make such action impractical. Then the item shall meet, on an interim basis, the performance requirements of the most applicable standard as determined by NSF.

Charges

General Charges

1. Minimum charges will be made for services. These service charges cover cost of standards development, inspection at the company's facilities, printing and distribution of listing and administrative processing. Service charges will start at the date of execution of contract for evaluation and listing service by the company. Services of NSF will be available to the company; it will be the company's responsibility to avail itself of these services within the period specified in the application. In the case of a company who does not avail itself of services, the monies paid upon the application will be considered expended during the period specified in the contract. Additional service charges may be rendered for special field evaluations and investigations of listed products found not to be in compliance with the applicable NSF standards. Any deletion in evauation/listing services or testing must be communicated to NSF within 30 days of the date of the annual invoice or the charges shall be due and payable as stated. Further, all costs incurred by NSF in collection thereof shall be charged to and paid by the firm invoiced.

Special Testing Charges

2. The cost of evaluation and testing of products sent to NSF as well as any required special testing at the plant shall be subject to charges to be agreed upon between the applicant and NSF.

Listing

Authorization

1. By authority of the Board of Directors of the National Sanitation Foundation, the Executive Vice President may, based upon compliance with the required NSF examinations of materials and inspections, authorize listing of plastics materials or plastics items as eligible for the seal or logo. Manufacturers of such materials and plastics items will be advised of such listing in writing and the listing will be sent to health and other government authorities and otherwise publicized.

Notification

2. When NSF determines, after testing, that a plastics item is in compliance with applicable requirements of the standard, it will thereupon list said item in its public listing of such product. In the event that removal from listing is necessary, NSF may not publish, without the express consent of the manufacturer, any information concerning the listed item other than such things as general composition, type and trade name or symbol, and the fact that, upon testing, the item has been found unsatisfactory for use or that the item does not conform to the requirements of the standard.

Additions

3. NSF agrees to list without chemical evaluation and without extra charge any one of the general classifications of materials (such as polyethylene, PVC or ABS) which is the same as that of a plastics items already listed and paid for, unless testing of such products has already been completed for the year; in which case charges will be made for testing of new products offered for listing.

Use of NSF Seal or Logo

Use

1. The manufacturer shall place the NSF seal or logo in accordance with NSF policy at the time of manufacture on all listed items together with some identifying trade name or symbol registered with NSF. The manufacturer shall place on all listed items at the time of manufacture the applicable standard designation and the type and schedule or series thereof. The NSF seal, logo and all other required markings shall be applied in a manner which, in the opinion of NSF, is legible and permanent.

Use

2. The manufacturer shall use NSF's seal or logo in accordance with established NSF policies governing its use and agrees not to use the NSF seal or logo on products for which listing has not been authorized, nor on price lists or advertisements where the presence of such seal or logo tends to mislead buyers, nor permit the distribution of the NSF seal or logo to any unauthorized person.

Use

3. The NSF seal or logo may be applied to cartons or containers for listed materials in the form, size and color prescribed by NSF. On listed plastic pipe, the NSF seal or logo shall be applied to every piece of pipe at the intervals and of the type prescribed by NSF. The letters NSF shall be in upper case and shall not be less than ⅛ inch (3.18 mm) in height. Each listed item, other than pipe, shall bear the NSF seal or logo of the type prescribed by NSF. Piping system components not bearing the NSF seal will be considered unauthorized for listing.

Misuse

4. NSF will use every legal means available to prevent the unauthorized use of its seal or logo on unlisted items.

Withdrawal of Listing

Withdrawal of Listing

1. By authority of the Board of Directors, the Executive Vice President of NSF reserves the right to withdraw the listing of any item at any time for failure to comply with the standard and attendant policies. Upon notice of the removal of a product from NSF listing, the manufacturer shall immediately stop applying the NSF seal or logo to such products.

Withdrawal

2. By authority of the Board of Directors of the National Sanitation Foundation, the Executive Vice President may withdraw the listing of any item at any time for failure to comply with the standard and attendant policies. Upon notice of the removal of an item of equipment or product from the NSF listing, the manufacturer shall immediately stop applying the NSF seal or logo to such unlisted product. The manufacturer shall, within 20 days of notification that a product(s) is no longer listed, remove the NSF logo from all such product(s) in his possession or under his control and so notify his distributors and outlets to this effect.

Withdrawal of Seal or Logo

3. When after receipt of satisfactory evidence of correction of reported violations, subsequent evaluations of the products (future production or the specific product in question) indicate that the corrective measures have not been, or are not being effected, the authorization to use the NSF seal or logo shall be withdrawn. When authorization to use the NSF seal or logo has been withdrawn from a manufacturer under the above provisions, NSF may advise such health agencies, manufacturers and other interested parties as deemed appropriate.

Reinstatement

4. Reinstatement following withdrawal of listing and authorization to use the NSF seal or logo by the manufacturer, shall be effected only after reevaluation of the product in question by NSF. The cost of reevaluation shall be subject to such charges as are established by NSF.

POLICY B
NATIONAL SANITATION FOUNDATION
STATEMENT OF POLICY RELATING TO
INSPECTION OF FACILITIES, RECORDS, SAMPLING, TESTING AND LABORATORY TEST REPORTS

Inspection

General

1. Actual physical inspection is required of each plant manufacturing plastic piping system components and related materials covered by this standard prior to the granting of the right to use the NSF seal or logo.

Entry

2. NSF reserves the right to make an inspection of a plant manufacturing materials in connection with any investigations that may be necessary relating to such materials. It is also understood that representatives may be sent to such manufacturers' warehouses to collect samples of materials bearing the NSF seal or logo.

Frequency

3. A minimum of one inspection is required each year of quality control procedures at the plant of each listed manufacturer. Such additional inspections are to be made as deemed necessary by NSF.

Entry

4. NSF may make reasonable inspection, with or without notice, of the place or places at which listed or unlisted items are made by manufacturer and of such places under the control of the manufacturer, including all facilities for storing, mixing, grinding, making pellets, extruding, molding and shipping; except where manufacturer is precluded from doing so by agreement with third parties or by government regulations and NSF has been satisfied as to the validity of these restrictions.

Violations-Compliance

5. Violations of this standard noted during NSF's plant inspections shall be corrected within 30 days or as mutually agreed upon by the manufacturer and NSF.

Examination

6. NSF shall be permitted reasonable interrogation during the inspections of persons engaged in the handling, manufacture or procurement of a listed item. This shall include the examination of the listed items manufactured by others that may be in storage for resale. Access for inspections by authorized representatives of NSF shall be granted by manufacturer during production hours without undue delay. Nothing herein contained shall be construed as obligating the manufacturer to disclose to NSF or its representatives any confidential or proprietary information with respect to the manufacturer's process or *know-how*. In the event such confidential or proprietary information is disclosed to NSF, it is understood that there will be no publication or disclosure of such information without the consent of the manufacturer.

Records

Formulation Information

1. The manufacturer shall submit at the time of requesting evaluation and qualification of a thermoplastic material, thread compound, sealant, lubricant and joining material, complete formulation information for such material. When any change is made in the formula or in the source of supply of ingredients therein, such additional information shall also be submitted. Said information shall be retained on a confidential basis.

Sales

2. The manufacturer of plastic piping system components and related materials authorizes NSF to request any and all manufacturers of NSF listed plastic piping system components and related materials covered by this standard to reveal to NSF its records of sales of plastic materials to the manufacturer of such products.

Inventory

3. The manufacturer of products agrees to keep up-to-date records of receipts, sales and stock on hand of listed items; and upon demand by NSF, agrees to furnish such records to NSF within five days after such demand, or at the option of NSF agrees to permit prompt and full access to such records by NSF at any time. NSF agrees that information obtained shall be treated as confidential.

Materials

4. The manufacturer of materials will submit to NSF promptly on demand an accurate and complete record of the number of pounds of listed materials sold to any manufacturer having items listed with NSF during any prescribed period of time covered by the listing. Authorization for said manufacturer to reveal this information to NSF is a requirement between NSF and manufacturer of listed products. Such information received from manufacturer of materials shall be held in confidence by NSF except that reports of sales to a particular manufacturer of products may be revealed to that manufacturer, and when relevant, in any court action in which manufacturer and NSF are adverse parties.

Ingredients

5. It is also understood that material manufacturers authorized to use the NSF seal or logo on certain listed materials will furnish NSF, upon request, with information relative to quantities, dates of delivery and like information on listed raw materials purchased by any manufacturer producing listed items.

Sampling

Sampling

1. The manufacturer shall furnish, without charge to NSF, samples of each type of product for which listing is desired, manufacturer of listed resins, or compounds, and notify NSF of any changes in materials used.

Sampling

2. Manufacturer will permit NSF's authorized agent to take, without cost or expense to NSF, such samples of "the plastic" as NSF may reasonably need for the purpose of testing and retesting. All such samples shall be forwarded *immediately* to NSF prepaid by manufacturer. Laboratory may test and retest such samples, and those which NSF obtains from other sources, in the best interests of the public. For samples which have been selected and identified for shipment to NSF and are not promply shipped, it will be necessary for NSF to send a representative to the plant at manufacturer's expense to recollect samples for testing. The manufacturer recognizes that the inspection and sampling of products by personnel of NSF is on behalf of said manufacturer as well as in the public interest; and that while engaged in such inspection and sampling procedcures, NSF personnel are to be given the assistance necessary to perform their duties and shall not be required to sign documents indicating their waiver of rights in the event of an accident resulting from negligence on the part of the manufacturer.

General

3. A sample of each listed material for making plastic pipe, fittings, valves, traps and appurtenances or other products covered by this standard will be tested at least once a year and, in addition, as frequently as may be deemed necessary by NSF. Such testing shall be at a uniform charge per sample to such material manufacturer or compounder. A sample of each type of listed plastic item or joining material from each plant location will be tested each year at the expense of said manufacturer. Samples of listed materials and listed items may be obtained by NSF from any source deemed advisable. Required samples are to be supplied by the manufacturers of listed materials and products without charge to NSF. NSF may test and retest such samples, and those which NSF obtains from time to time from other sources, in the best interests of the public. For RVCM analysis, a single sample shall be collected of both pipe and fittings, as applicable, at the time of routine inspections of the production facility.

Materials

4. For each listed item requiring performance testing, one sample shall be required per year for each resin type and of each hydrostatic design stress of a given material. Blends of two or more compounds in the manufacture of a product shall be considered a new compound. The sample shall be selected and prepared in accordance with the requirements of NSF.

Who & Where

5. Chemical/taste and odor evaluation and performance test samples shall be collected at random by authorized representatives of NSF from current production.

I.D. Stamp

6. Samples shall be properly identified by an identifying stamp at the time of collection for forwarding "prepaid" by the manufacturer to NSF.

Tracers

Tracers

1. Compounders of polyolefins for potable water applications shall use polyolefin resins which contain the material manufacturer's innocuous trace element or compounders may add their own tracer.

Resin Manufacturer

2. When the tracer is included in the resin, the tracer determination will be completed twice annually for both the natural (resin) and the blended compound.

Compounder

3. Compounders shall be permitted to add their own tracer, provided that: (a) the innocuous tracer and amount thereof, has been accepted by NSF; and (b) the tracer chemical description and amount is included in the *NSF Confidential Report on Plastics Formulation for Materials* together with the resin and other qualified ingredients.

Compounder

4. When tracer is added by the in-plant compounder, tracer determination will be conducted twice annually in the compound.

Testing

General

1. Actual NSF examination of specimens of materials offered for use in the manufacture of piping products, appurtenances, joining materials or other products covered by this standard is required and actual NSF examination of specimens of piping products, apputenances, joining materials or other products covered by this standard also is required before the right to use the NSF seal or logo on such materials is initially granted and at least once a year thereafter.

General

2. NSF will make with reasonable promptness the performance tests to determine the physical characteristics of the piping products, appurtenances or other products covered under this standard as required in the latest applicable standard as determined by the NSF Joint Committee on Plastics.

Reporting of Laboratory Test Results, Retesting and Listing Withdrawal

Test Results

1. Immediately upon completion of RVCM, physical, performance oriented or chemical/taste and odor testing, the laboratory shall report to the manufacturer whether the results thereof are "satisfactory" or "unsatisfactory." If the results are "unsatisfactory," the laboratory shall advise the manufacturer of the details of the adverse results and all particulars thereto that are known to the laboratory.

Retesting

2. When the RVCM, physical, performance oriented or chemical/taste and odor test is deemed "unsatisfactory" and subsequently reported to the manufacturer thereof, said manufacturer shall take immediate steps to determine the cause of said unsatisfactory results. The findings of the manufacturer shall be reported to the laboratory together with the evidence of corrective action taken within a period of not more than 30 days.

Listing Withdrawal

3. Retest samples may be required by the laboratory when the results of the initial sample are deemed "unsatisfactory." When the retest results of RVCM, physical, performance oriented or chemical/taste and odor samples are "unsatisfactory," the laboratory shall remove from its listing the item(s) in question and said manufacturer shall cease to use the NSF seal or logo thereon. The item(s) may be reinstated in the listing upon resubmission of samples as required by the laboratory, and "satisfactory" results are obtained upon completion of RVCM, physical, performance oriented or chemical/taste and odor testing thereof.

Reports

Confidential Disclosure

1. The material supplier and the compounder shall submit to NSF a true and complete list of ingredients and sources of ingredients of "the compound" which NSF will hold in confidence, and also agree to notify NSF when any change is made in the formula or source of supply of the ingredients therein of a listed compound. NSF shall make with reasonable promptness such tests as, in its expert opinion, are deemed necessary or desirable to determine that "the compound" is suitable for the intended use.

Confidential Disclosure

2. Compounder may be required to submit to NSF, accurate reports covering the number of pounds of NSF listed materials for each listed designation purchased, sold and in stock as new material or finished products. Manufacturer further agrees to submit to NSF, accurate reports covering the number of pounds of materials compounded by manufacturer as NSF listed, in accordance with this policy, purchased, sold and in stock as "compound" or finished product. Compounder further agrees (a) to keep up-to-date records of receipts, sales and stock on hand; (b) to submit to NSF, promptly and on demand, a special report covering a designated period of time; and (c) to permit an authorized NSF representative to examine the records as may be required.

Information on Shipments

3. It is also understood that material manufacturers authorized to use the NSF seal or logo on certain listed materials will furnish NSF, upon request, with information relative to quantities, dates of delivery and like information on listed raw materials purchased by any manufacturer producing listed items.

POLICY C

NATIONAL SANITATION FOUNDATION

QUALITY CONTROL TESTING

Equipment to perform the following in-plant tests shall be in evidence and the following indicated quality control tests are required at the indicated frequency on all listed plastic piping system components and related materials. Refer to the applicable standard for specific test procedures.

POTABLE WATER PIPE

Test	ABS	PE	PB	PVC	CPVC	Thermoset	Thermoset Mortar Pipe
Dimensions[1]	x	x	x	x	x	x	x
Short Term Rupture[4]	x	x	x	x		x	
Sustained Pressure[7]	x	x	x	x			
Pipe and Fitting Assemblies[7]					x		
Acetone[3]				x			
Flattening Resistance[4]	x			x			
Hydrostatic Proof Test[16]				x			
Stiffness[2]						x	
Hoop Tensile[18]							x
Stiffness[18]							x
Impact[4] at 73°F (22.8°C)				x			

POTABLE WATER FITTINGS

Test	ABS	PVC	CPVC	Insert Fittings
Dimensions				
ID of Socket Entrance[5]	x	x	x	
ID of Socket Bottom[5]	x	x	x	
Socket Length[13]	x	x	x	
Wall Thickness[4]	x	x	x	
Length of Thread[13]	x	x	x	
Length of Barb (minimum)[13]				x
OD Diameter of Barbs[5]				x
Wall Thickness at Root Depth (minimum)[5]				x
Short Term Rupture[4]	x	x		
Sustained Pressure[6 7 10]			x	

DWV PIPE AND FITTINGS

Test	ABS	PVC
Dimensions — Pipe[1]	x	x
Dimensions — Fittings		
ID of Socket Entrance[5]	x	x
ID of Socket Bottom[5]	x	x
Socket Length[13]	x	x
Wall Thickness[4]	x	x
Length of Thread[13]	x	x
Impact[12 4] at 73° F (22.8° C)	x	x
Impact[13 4] at -40° F (-40° C)	x	
or 32° F (0° C)		x
Short Term Rupture — Pipe[3 10]		x
Short Term Rupture — Fittings[3 10]		x
Deflection Load and Crush Resistance[7]	x	x

CONTINUOUS WASTE TUBING AND FITTINGS

Test	ABS	PVC	PP
Dimensions — Pipe[1]	x	x	x
Dimensions — Fittings			
ID of Socket Entrance[5]	x	x	x
ID of Socket Bottom[5]	x	x	x
Socket Length[13]	x	x	x
Wall Thickness[4]	x	x	x

SOLVENT CEMENTS

Test	ABS	PVC	CPVC	ABS-PVC Transition
Thermocycling				
Transition Fittings and Adhesives[9 6 10]			x	
Viscosity[8]	x	x	x	x
Sustained Pressure Strength[3 10]			x	
Shelf Stability[9]			x	

SEWER PIPE AND FITTINGS
(against requirements ASTM D3033, 3034 and 2751)

Test	ABS	PVC
Dimensions[1] — Pipe	x	x
Dimensions — Fittings		
ID of Socket Entrance[5]	x	x
ID of Socket Bottom[5]	x	x
Socket Length[13]	x	x
Wall Thickness[4]	x	x
Length of Thread[13]	x	x
Impact[4] at 73° F (22.8° C)	x	x
Flattening[4] — Pipe	x	x
Stiffness[4] — Pipe	x	x

CORRUGATED DRAIN TUBING
(against requirements ASTM F405)

Test	PE
Dimensions — inside diameter of tubing [11]	x
Material distribution and/or wall thickness[1]	x
Gram weight[1]	x
Perforations (hold diameter)[2]	x
Stiffness[3] — Pipe	x
Elongation[10 15]	x
Environmental stress cracking[10 15]	x

WELL CASING

Test	ABS	PVC
Dimensions — Pipe[1]	x	x
Dimensions — Couplings or Bell Socket		
ID of Socket Entrance[5]	x	x
ID of Socket Bottom[5]	x	x
Socket Length[13]	x	x
Wall Thickness[4]	x	x
Length of Thread[13]	x	x
Impact[12] at 73° F (22.8° C)	x	x
Impact[4] at 32° F (0° C) per established impact class	x	x
Short Term Rupture — Pipe[3] [10]	x	x
Tup Puncture for Point Load[12] [14]	x	x
Deflection Load & Crush Resistance[7]	x	x
Socket Concentricity or Alignment[13]	x	x

THERMOSET PLASTIC WATER SOFTENING TANKS

Short Term Rupture Test

Short term rupture testing shall be carried out on tanks of each diameter produced in a run[17] in accordance with the following frequencies (at 120° F [48.9° C]):

0 — 2000	0.2 percent
2000 — 3000	0.2 percent
3000 — 4000	0.1 percent
over 4000	0.1 percent

Cyclic Test

Cyclic testing shall be carried out on tanks of each diameter in a run[17] at the following freqencies (at ambient):

0 — 2000	0.05 percent
2000 — 3000	0.04 percent
3000 — 4000	0.03 percent
over 4000	0.02 percent
Hydraulic	1.5 x Rated Working Pressure
Pneumatic	1.25 x Rated Working Pressure

MATERIALS PRODUCED BY MANUFACTURERS (MATERIAL SUPPLIERS) AND SPECIAL COMPOUNDERS

(This does not include in-plant compounders, see Item 2.6.1)

General Certification of Cell Classification

On a semi-annual basis the compounder shall check his current production for all of the parameters in the cell classification. This information should be recorded in the permanent files at the compounder.

Lot-by-Lot Quality Control

The following tests shall be performed on a lot-by-lot basis and the results placed on file at the compounder.

RVCM (PVC/CPVC)
Resin Molecular Weight (PVC/CPVC) or Density (PE)
Specific Gravity (PVC)
Izod Impact (PVC/CPVC/ABS)
Acrylonitrile Content (ABS)
Carbon Black (PE)

FREQUENCY OF TESTING FOOTNOTES FOR POLICY C

[1]At start up of a given size or material and once per two hours thereafter for each extruder. However, when pipe is made by multiple head extrusion method with intermediate storage, the dimensions shall be made on each intermediate coil.

[2]At start up of a given size or material and once per shift thereafter for each extrusion outlet.

[3]At start up of a new material and once per year thereafter. NSF Testing Laboratory will conduct the annual test.

[4]At start up of a given size, machine or material and once per 24 hours thereafter for each material in a plant. Where one material is continuously used in several machines, or sizes, sample selection shall be from a different extruder each day and sampling rotated in sequence between all sizes or machines.

[5]At start up of a given size, style or material and once per shift thereafter.

[6]Tested under ASTM D2846 or F493 as a system.

[7]At start up with a new material and once per year thereafter. NSF Testing Laboratory annual testing may be considered as fulfilling this requirement.

[8]Once per batch.

[9]At start up of a new solvent cement and once per year thereafter.

[10]A company laboratory or an independent laboratory may be used.

[11]At start up of a given size or material and once per year thereafter.

[12]For fittings: at start up of a given size, pattern or material and once per shift thereafter for each size (not each configuration).

[13]For fittings: at start up of a new material or new pattern and twice per year thereafter for each size (not each configuration).

[14]For pipe: at start up of a given size or material and once per shift thereafter per plant.

[15]At start up of a given size, pattern or material and twice per year thereafter for each size.

[16]Each length of pipe meeting American Water Works Association Standard C-900 only.

[17]Tanks produced of a given diameter and design pressure in any 6 month period.

[18]Tested under D3517, one test per 100 lengths produced. For pipe sizes 16 inches and smaller, the manufacturer shall perform stiffness tests (hoop tensile tests) on pipe at a frequency of one test from a sample taken at random on a weekly basis or each manufacturing run, whichever is the most frequent, of the same type and size.

POLICY D
NATIONAL SANITATION FOUNDATION
CRITICAL DIMENSIONS

The following indicates the dimensions deemed critical for the various types, sizes, schedules and Standard Dimension Ratios (SDR) of pipe and fittings for potable water and drain, waste and vent applications. Refer to the applicable standard for requirements and to ASTM D2122 for methods of determining dimensions. The following dimensions are deemed to be more critical than others for making sound joints.

PIPE

Outside Diameter Dimensioned Pipe

Outside Diameter
Minimum Wall Thickness
Out of Roundness for Schedule 40 and 80 and SDR 21 and 26 pipe
4 inches (101.6 mm) and larger

Applicable Standards:

ABS	PE	PVC	Other
ASTM D1527	ASTM D2447	ASTM D1785	PB—ASTM D2666
ASTM D2282	ASTM D2737	ASTM D2241	CPVC—ASTM D2846
ASTM D2661	ASTM D3287	ASTM D2665	CPVC—ASTM D2241
ASTM D2751	ASTM D3035	ASTM D2740	CPVC—ASTM D1785
ASTM F409	AWWA C901	ASTM D2672	CPVC—ASTM F441
ASTM F480		ASTM D2729	PB—ASTM D3000
		ASTM D2949	PB—ASTM D3309
		ASTM D3033	SR—ASTM F480
		ASTM D3034	
		ASTM F409	
		ASTM F480	
		AWWA C900	

Inside Diameter Dimensioned Pipe

Inside Diameter
Minimum Wall Thickness

Applicable Standards:

PE	PB
ASTM D2104	ASTM D2662
ASTM D2239	
ASTM D2477	
ASTM F405	
AWWA C901	

FITTINGS

Socket Type Fittings

Inside Diameter of Socket Entrance
Inside Diameter of Socket Bottom
Socket Length (minimum)
Wall Thickness (minimum)

Applicable Standards:

ABS	PVC	Other
ASTM D2469	ASTM D2466	CPVC—ASTM D2846
ASTM D2468	ASTM D2467	PE—ASTM D2683
ASTM D2661	ASTM D2665	PE—AWWA C901
ASTM F409	ASTM D3036	
	ASTM D2672	
	ASTM D2729	
	ASTM D2949	
	ASTM D3033	
	ASTM D3034	
	ASTM F409	
	AWWA C900	

Insert Type Fittings

Outside Diameter of Barbs
Wall Thickness at Root Depth (minimum)
Length of Barbs (minimum)

Applicable Standards:

ASTM D2609

Threaded Type Fittings

Threads Conform to ANSI Standard Pipe Threads ANSI B2.1
Wall Thickness (minimum)
Length of Thread (minimum)

Applicable Standards:

ABS	PVC	Other
ASTM D2465	ASTM D2464	CPVC—ASTM D2846

APPENDIX A
REVIEW AND EVALUATION
PROCEDURES

Part 1

Review Procedure for Ingredients Intended for Use in NSF Listed Potable Water Formulations

Part 2

Chemical and Taste and Odor Evaluations of Plastics

Part 3

Evaluation Procedures for Materials and Plastic Piping System Components for Corrosive Water Systems

National Sanitation Foundation
3475 Plymouth Road
P. O. Box 1468
Ann Arbor, Michigan 48106 U.S.A.

PART 1
REVIEW PROCEDURES
FOR
INGREDIENTS INTENDED FOR NSF LISTED
POTABLE WATER FORMULATIONS

SECTION 1. INGREDIENTS

1.0 GENERAL: The ingredient review procedures detailed below include those for:

1.0.1 ACCEPTANCE of a new ingredient[1] and a generically similar ingredient[2]

1.0.2 QUALIFICATION of a new compound or material or change in formulation

1.0.3 MONITORING of a listed product

1.1 ACCEPTANCE STAGE - NEW INGREDIENTS: Ingredient producer shall submit pipe and compound formulated to contain the ingredient of interest at twice the proposed recommended maximum use level.

1.1.1 Samples shall be exposed by NSF using the standard (multiple) exposure procedure.

1.1.2 No level of a constituent of interest greater than 10 times the MCL expressed in Standard No. 14, Table I, shall be measurable in water from the first exposure; and no level greater than the MCL (Standard No. 14, Table I) shall be measurable in water from the third exposure.

1.1.3 If the basic constituent of the ingredient; e.g., antimony; is not on FDA list of sanctioned materials, 90-day animal feeding study[3] and Ames test data shall be conducted and the data submitted to NSF. The protocol for the 90-day animal feeding study shall include feeding levels at effect, no known effect and an intermediate level.

1.1.4 If the ingredient is accepted in the U.S. Federal Code of Federal Regulations (CFR), Title 21 (Food and Drugs Regulations), the applicable section shall be referenced.

1.1.5 The ingredient suppier shall provide the chemical abstracts registry number.

1.1.6 The ingredient supplier shall submit the chemical description of the ingredient including molecular structure, and percent of components. A list of known contaminants shall be provided and the amounts noted in ppb. NSF shall be notified of ingredient(s) containing known carcinogens with appropriate references cited.

1.1.7 A complete literature review may be required to support application for acceptance.

1.1.8 The ingredient manufacturer shall certify that the ingredient is suitable for use in a potable water product.

1.1.9 If the extraction test and 90-day feeding study as well as the other information submitted by the ingredient manufacturer are acceptable, the ingredient may be accepted for use in products listed under NSF Standard No. 14 for potable water applications.

1.1.10 Acceptance of a proposed "new ingredient" shall be at the sole discretion of NSF, based on the requirements specified above as well as, but not limited to, the following considerations:

- available scientific information and data (published and unpublished)
- risk benefit assessment
- toxicological significance
- health effects

1.2 ACCEPTANCE STAGE — GENERICALLY SIMILAR INGREDIENT: Ingredient

[1]New Ingredient - any chemical or substance not previously accepted for use in products intended for application in potable water systems.

[2]Generically Similar Ingredient - an ingredient that is not considered a "new ingredient" and while generically similar to an accepted ingredient, may vary in composition due to manufacturing process. source of materials, potential trace contaminants, etc.

[3]It is suggested that the protocol for the feeding study be reviewed by NSF toxicologists for their suggestions prior to the beginning of any actual animal feeding studies.

supplier shall submit pipe and compound formulated to contain the ingredient of interest at twice the proposed recommended maximum use level.

1.2.1 Samples shall be exposed by NSF using the standard (multiple) exposure procedure.

1.2.2 No level of a constituent of interest greater than 10 times the MCL expressed in NSF Standard No. 14, Table I, shall be measurable in water from the first exposure; and no level greater than the MCL (NSF Standard No. 14, Table I) shall be measurable in water from the third exposure.

1.2.3 If the ingredient is accepted in the U.S. Code of Federal Regulation, Title 21 - (Food and Drug Regulations), the applicable section shall be referenced.

1.2.4 The ingredient supplier shall provide the chemical abstracts registry number.

1.2.5 The ingredient supplier shall submit the chemical description of the ingredient including molecular structure and percent of components. A list of known contaminants shall be provided and the amounts in ppb. NSF shall be notified of ingredient(s) containing known carcinogens with appropriate references cited.

1.2.6 A complete literature review may be required to support application for acceptance.

1.2.7 The ingredient manufacturer shall certify that the ingredient is suitable for use in a potable water product.

1.2.8 If the extraction test as well as the other information submitted by the ingredient supplier is acceptable, the ingredient may be accepted for use in products listed under NSF Standard No. 14 for potable water applications.

1.2.9 Acceptance of a proposed "generically similar ingredient" shall be at the sole discretion of NSF, based on the requirements specified above as well as, but not limited to, the following considerations:

- available scientific information and data (published and unpublished)
- risk benefit assessment
- toxicological significance
- health effects

1.3 QUALIFICATION STAGE: New product or change in formulation: A producer desiring to qualify a new material, compound or product, or to change an ingredient in an accepted formula shall submit the formulation on a form provided by NSF and a sample of the product and material or compound from which it is formulated. No level of a constituent of interest greater than 10 times the MCL expressed in NSF Standard No. 14, Table I, shall be measurable in water from the first exposure; and no level greater than the MCL (NSF Standard No. 14, Table I) shall be measurable in water from the third exposure.

1.4 MONITORING STAGE (LISTED-QUALIFIED PRODUCTS): Sample of product and/or compound or material used in products shall be selected randomly by NSF personnel during unannounced visits to production facilities. Samples may be taken during production or from inventory.

1.4.1 Sample shall be extracted by NSF under standard (multiple) exposure procedures.

1.4.2 Levels measured shall not be greater than the established MCL specified for "monitoring."

TABLE A-I

SUMMARY OF REVIEW PROCEDURES FOR ACCEPTANCE, QUALIFICATION AND MONITORING STAGES

ACCEPTANCE	QUALIFICATION	MONITORING
(New or Generically Similar Ingredient)	*(New Product or Change in Formulation)*	
2 X Recommended Maximum Use Level	Recommended Maximum Use Level	Use Level
(Pipe and Compound)	*(Pipe and/or Compound)*	*(Pipe and/or Compound)*
Multiple Exposure	Multiple Exposure	Multiple Exposure
pH 5.0	pH 5.0	pH 5.0
MCL[4]: 1st extraction ≤10 X MCL[4] 3rd extraction ≤ MCL[4]	MCL[4]: 1st extraction ≤10 X MCL[4] 3rd extraction ≤ MCL[4]	3rd extraction MCL[4]

[4]Maximum Contaminant Level, U. S. Environmental Protection Agency, National Interim Primary Drinking Water Regulations, 1975, and NSF limits of acceptance as shown in NSF Standard 14, Table I.

PART 2

LABORATORY PROCEDURES FOR SAMPLE PREPARATION EXTRACTANT WATER EXPOSURE TASTE AND ODOR

SECTION 1. SAMPLES

1.0 REQUIREMENTS: Use a "standard" ratio equivalent to 1 square inch (6.5 cm^2) surface area of plastic sample to 4 ml of extractant water for all exposures.

Table A-II
Standard ratio, sample: extractant water

Plastics Sample Surface Area (Sq. In.)	(cm^2)	Extractant Water Volume (liters)
250	1612.9	1.0
500	3225.8	2.0
1000	6451.6	4.0
100*	645.2	4.0

*nylon only

1.1 PREPARATION: Prepare sample so that entire surface area to be exposed is covered by extractant water. To minimize exposure of cut edges, limit sawing of samples to that which is needed to satisfy this condition. Remove burrs from sawing prior to sample exposure.

Pipes: Cut samples into 5 inch (127.0 mm) sections. If pipe diameter is too large for extraction vessel, split sections lengthwise.

Compounds and Materials: Injection mold, compression mold, or mill and compression mold compounds and materials into flat sheets; cut to provide the required surface area for exposure.

Fittings, Tanks and Special Samples: If size permits, expose samples as received.

Solvent Cements: Spread samples over 10 square inches (64.5 cm^2) of surface on a plastic pipe for at least 72 hours curing time prior to exposure.

1.2 WASHING: Place prepared samples in coated stainless steel baskets for washing. Wash all pipe, plaques and fittings samples in automatic glassware washer using a cold wash cycle. Run washer through cycle with no plastics samples to insure that holding tank contains cold water only. Place baskets with samples in washer, set washer for "detergent wash" and "distilled water final rinse" and run. (EL Detergent 101 and EL Detergent Additive 601 are used for washing; Economics Laboratories, Inc., St. Paul, MN 55102)

1.3 DRYING AND STORAGE: Place baskets with samples in laminar flow hood until they are completely dry.

Remove dried samples from baskets and store in paper bags properly labelled with sample identification number. Fold down tops of bags to prevent dust accumulation.

SECTION 2. EXTRACTANT WATER

2.0 CHEMICAL CHARACTERISTICS: Prepare "standard" extractant water to contain 100 mg/l hardness (as $CaCO_3$) and 0.5 mg/l chlorine in distilled water. Adjust pH to 5.0 ± 0.2 with CO_2.

2.1 REAGENTS: Buffer Stock Solution: Dissolve 3.36 g sodium bicarbonate ($NaHCO_3$) in distilled water. Make up to one liter. Make fresh daily.

Hardness Stock Solution: Dissolve 4.44 g chloride (anhydrous $CaCl_2$) in distilled water. Make up to one liter. Make fresh daily.

Chlorine Stock Solution: Add 7.3 ml sodium hypochlorite (5 percent NaOCl) to 200 ml distilled water. Make fresh weekly. Keep in tightly stoppered bottle. Determine the strength of the chlorine stock solution by diluting 1 ml to 1 liter with standard extractant water, and immediately analyze for total available residual chlorine. Reference this determination as "A." To determine the volume of $C1_2$ stock solution necessary to pipet into the exposure water to achieve a 0.5 mg/l $c1_2$ residual, use the following formula:

$$C1_2 \text{ stock soln. (mls)} = \frac{0.5B}{A}$$

WHERE:

A = Cl_2 equivalent per ml of Cl_2 stock soln.

B = liters of standard extract water.

2.2 WATER: Prepare "standard" extractant water by adding stock reagent solutions to distilled water, as shown in Table A-III.

Table A-III

"Standard" Extractant Water

Distilled Water (liters)	Buffer Stock Solution (ml)	Hardness Stock Solution (ml)	Chlorine Stock Solution (ml)
1	25	25	*
6	150	150	*
12	300	300	*
15	375	375	*

Bubble with CO_2 until pH 5.0 ± 0.2 is attained.
*Note: Reference 2.1 Chlorine Stock Solution.

SECTION 3. EXPOSURE

3.0 VESSELS ONE-LITER EXPOSURES: Use 2-liter beakers to exposure 250 square inches (1612.9 cm^2) of plastics sample in 1 liter of "standard" water. Cover beakers with glass plate or with plastic wrap which has been shown not to contribute detectable levels of parameters measured for conformance with NSF Standard 14, Table I.

EXPOSURES GREATER THAN ONE LITER: Use 9-liter glass stoppered serum bottles for exposure to volumes greater than 1 liter, and battery jars with plate glass covers for samples which are too large to be exposed in 9-liter serum bottles.

3.1 EXPOSURE CONDITIONS: All tests for acceptance, qualification and routine monitoring shall be conducted with the multiple exposure procedure except dip tubes, which shall be tested with single exposure.

Single Exposures: *(Dip Tubes only) Expose for 72* ±4 hours at 99±0.5°C.

Multiple Exposures:

Cold Applications Samples:
1. 24±1 hour at 37±0.5°C
2. 24±1 hour at 37±0.5°C
3. 72±4 hours at 37±0.5°C

Hot Applications Samples:
1. 1 hour at 82±0.5°C
2. 1 hour at 82±0.5°C
3. 0.5 hour at 82±0.5°C + 72±4 hours at 37±0.5°C

Analyses are performed on final extractant water only. Water from first and second exposures is discarded. There is no time interval between exposures.

Pans: Cover 1,000 square inches (6451.6 cm^2) of surface area of samples received as shallow pans with 4 liters of "standard" water by pouring directly into the pan. Cover pan with sheet of glass *during exposure.*

Tanks: Tanks, including water softener and underground storage tanks shall be exposed as follows:

Calculate inside surface area of tank. Add sufficient volume of "standard" water to provide for exposure of entire tank inner surface at the ratio of 1 square inch (6.5 cm^2) to 4 ml water.

Place tank on its side for 72±4 hours at 37±0.5°C. Rotate tank one time each 24 hours to provide contact between water and entire surface area of tank to be exposed.

Discard water from first 72 hour exposure, refill with an equivalent volume of water and repeat entire exposure procedure.

Controls: Place equivalent volume of formulated water in extraction vessel and expose as a control. Include one control for each combination of extraction vessel and/or exposure condition in the daily sample run.

SECTION 4. RECOVERY OF WATER FOLLOWING EXPOSURE

4.0 SEPARATION: Separate water from exposed samples of plastics *immediately after exposure vessels are removed from*

elevated temperature environments by pouring through filter paper (white, crepe, VWR Grade 6.5) into ground glass stoppered bottles.

4.1 SAMPLE STORAGE:Remove plastics samples from exposure vessels, dry, return to properly marked storage bags and seal.

SECTION 5. TASTE AND ODOR EVALUATION

5.0 GENERAL REQUIREMENTS: Final extractant water exposed to plastics shall have a threshold odor number less than 40 for cold applications, and less than 60 for hot applications. A paired sample technique in which the stronger odor in each pair is identified shall be used in determining threshold odor levels.

5.1 PREPARATION: Odor-Free Water: Prepare odor-free water by passing distilled water through activated charcoal column.

Taste Test

Place 200 ml final extractant water (i.e., water from final exposure period) for each sample in separate BOD bottles. Place 200 ml control water in BOD bottle.

Odor Test

Cold Applications Samples:

Place 5 ml final extractant water in each of two BOD bottles and dilute to 200 ml with odor-free water.

Place 5 ml control water in each of two BOD bottles and dilute to 200 ml with odor-free water. (NOTE: Always prepare one bottle control water for each sample bottle. Odor is determined from duplicate sets of paired sample/control bottles prepared for each sample tested, as diagrammed in Figure A1.)

Retest all samples with threshold odor level of 40 or greater at 1:40 dilutions.

Hot Applications Samples:

Place 3 ml final extractant water in each of two BOD bottles and dilute to 200 ml with odor-free water.

Place 3 ml control water in each of two BOD bottles and dilute to 200 ml with odor-free water.

Retest all samples with threshold odor level of 60 or greater at 1:60 dilution.

Labelling: Label all bottles with three digit numbers selected from a table of random numbers. (NOTE: Odor evaluations can be performed at any threshold odor level of interest by diluting sample and control apropriately.)

5.2 TEST PROCEDURES: The NSF odor procedure is a modification of the paired sample technique described in American Society for Testing and Materials (ASTM) Special Technical Publiation 434: *Manual on Sensory Testing Methods,* prepared by ASTM Committee E-18. The modified procedure permits the panel member to identify the member of the sample/control pair containing the strongest odor versus identification of the control bottle in the pair. Statistical basis for the paired sample technique is appended.

Panel: Use panel of at least 10 members prescreened to eliminate persons who are unusually sensitive or insensitive to taste and odors.

Numbers of Samples: No less than two and no more than seven samples shall be evaluated at any time.

Taste Test:

Maintain all bottles - extractant water and control - at room temperature.

Arrange samples and control in random order for evaluation by panel.

Do not indicate to the panel which bottle contains control water.

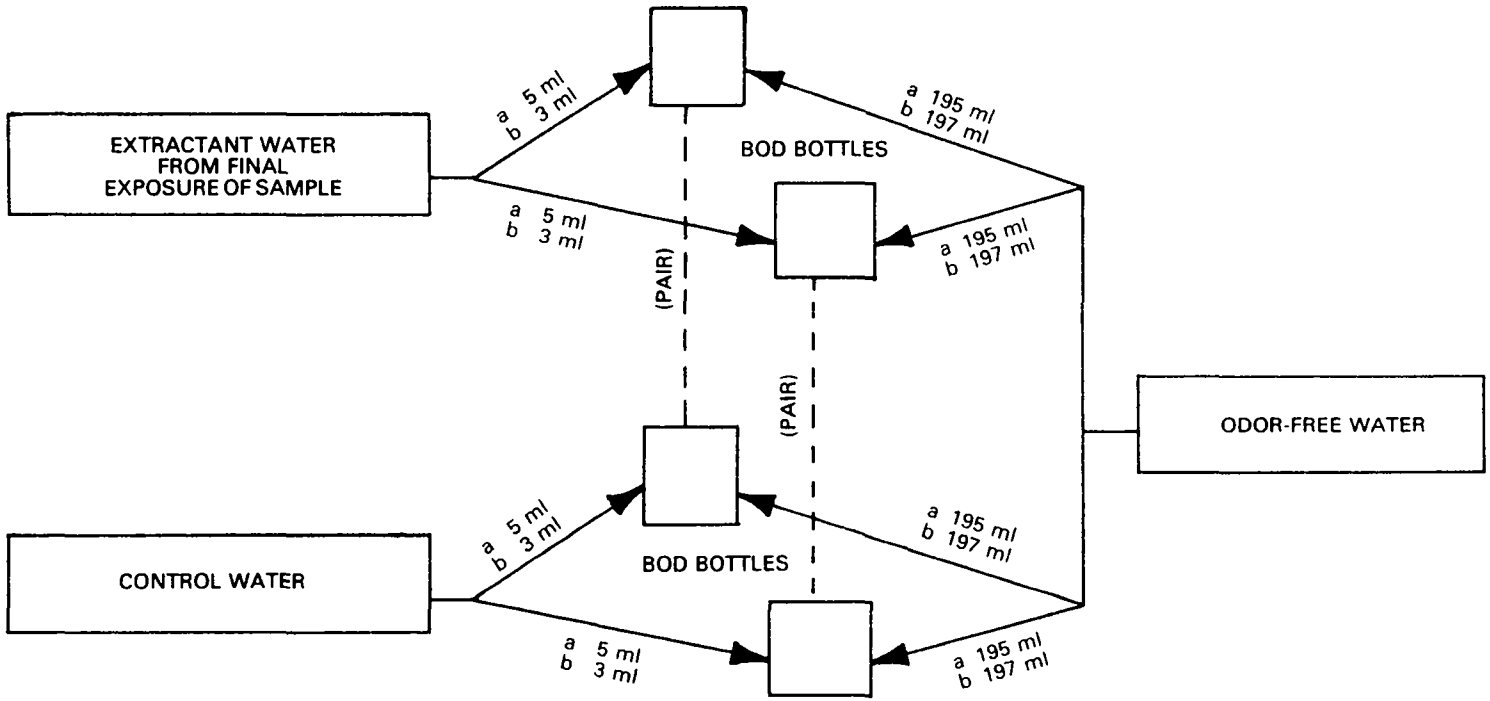
A panel member shall pour taste samples into 25 ml beaker and record taste as "sweet," "sour," "bittler" or "salty."

Panel member shall rinse mouth with odor-free water before proceeding to the next taste sample.

If panel consistently reports the taste of a particular sample to be more disagreeable than taste of the control, sample fails the taste test.

Odor Test:

Hold BOD bottles containing cold application samples and paired controls in water bath at 22°C. Hold hot application samples and paired controls in water bath at 60°C.



a = Threshold odor < 40 (1:40 dilution). All cold water applications samples.

b = Threshold odor < 60 (1:60 dilution). All hot water applications samples and retest of cold samples which fail 1:20 dilution; i.e., threshold odor ≥ 20.

Figure A1. Schematic Illustration of Preparation for Taste and Odor Evaluations

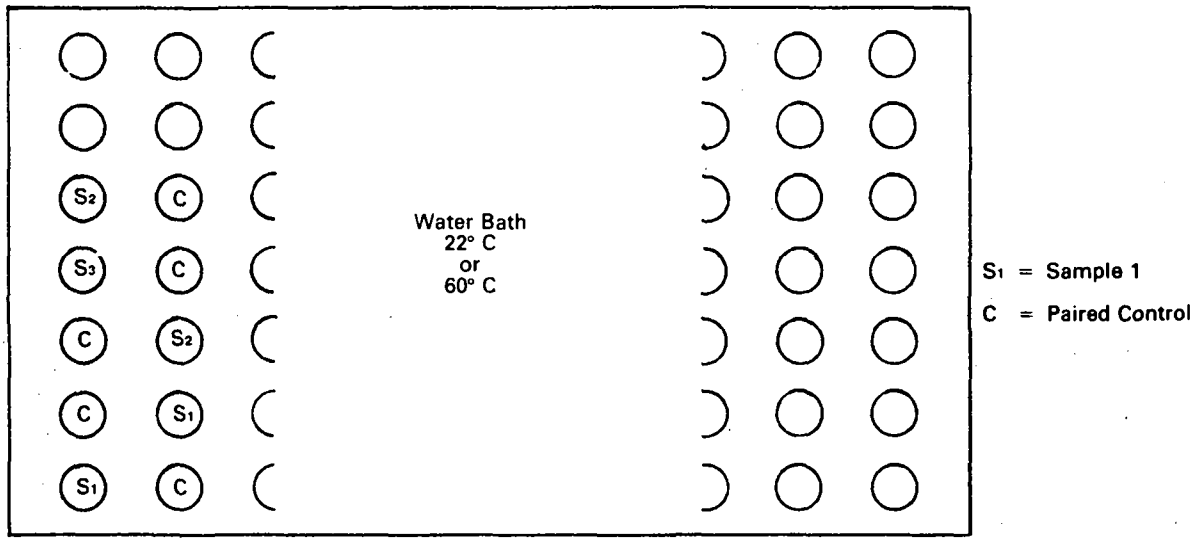


Figure A2. Water Bath Set-Up for Odor Test on Seven Samples

Arrange BOD bottles in water bath as shown in Figure A2. Include one bottle containing diluted extractant and one bottle with diluted paired control in each pair of bottles. Note that one S_1 bottle is placed left of C, the second S_1 bottle is right of C, but order of paired bottles is random.

A panel member shall examine each pair in turn and determine which member of the pair has the strongest odor.

Data from all panel members are summed and reported as the number of times sample was selected as the member of the pair which contained the strongest odor. Table A-III is used to determine whether sample passes or fails, based on the number of times sample was presented for analysis; e.g., 2n, where n = number of panel members.

5.3 GENERAL DISCUSSION OF ODOR TEST PROCEDURES: References are to ASTM Special Technical Publication 434: *Manual on Sensory Testing Methods,* sponsored by ASTM Committee E-18 on Sensory Evaluation of Materials and Products.

5.3.1 It is impossible to achieve statistically significant results with fewer than three panel members under test conditions specified. With five panel members, more than one error would make the result insignificant at the 95 percent confidence level. With 10 panel members, a 15 percent error rate will still allow results significant at the 99 percent confidence level. If it is necessary to use a different number of panel members, the criterion for failing must be appropriately adjusted (see IV.E.4.d.[1] and NSF Standard 14, Table I).

Panel members should have the test procedures carefully explaind to them. Specifically, they should understand that they must choose which bottle in a pair has the strongest odor regardless of how confident they are in their selection. Clearly, if the difference between the control and the sample is quite noticeable, nobody should make any errors. If the difference is unnoticeable, then overall there is a 50-50 chance of making an error. The significance of the test occurs when the panel as a whole is closer to 100 percent right than 50 percent right, and this depends on each panel member making his/her best judgement on each pair. The panel members should be reminded that the order of samples in the test is completely

[1]Reference ASTM Special Technical Publication 434: *Manual on Sensory Testing Methods,* sponsored by ASTM Committee E-18 on Sensory Evaluation of Materials and Products.

random and that in every pair, one bottle is identical to the control bottle and the other bottle contains sample extractant (see I.B.3.A.[1][1]).

5.3.2 Two sample bottles are prepared for each sample to control for "position error" (see Item 5.3.6), and to have 20 rather than 10 evaluations for each sample, increasing the likelihood for statistically significant results when there is a real difference in odor. This requires 10 ml of the sample extractant and 390 ml of odor-free water for each sample.

5.3.3 If n is the number of samples to be run (not more than seven), the 2n control bottles must be prepared. Maximum total requirement is 270 ml of control water. Maximum total requirement of odor-free water is 6.0 liters (including odor-free water used in sample bottles).

5.3.4 Reference I.B.6.e.[1]

5.3.5 The key sheet is clearly needed for control and records. The key sheet should include date and time of testing and adequate information to identify later the samples being tested.

5.3.6 Each sample must occur once on the left in a pair and once on the right in a pair to control for position error (reference I.C.3.e.[3])[1]. The sequence in which the pairs are placed must be random to reduce the likelihood of error based on order of presentation. The panel members must be informed that the sequence, in fact, is random.

5.3.7 The panel member's response sheet should include identification of the panel member, and the date and time of testing. Spaces should be provided to record either "left" or "right" for each pair in the test and the pair number.

5.3.8 Reference I.C.3.f.(4)(d)[1]

5.3.9 The confidence levels given in Table A-IV are described as 1-p, where p is the probability of getting at least the specified number of correct identifications of the control, given that the control is identical to the sample (e.g., 99 percent confidence level means that 1 percent of the time, at least the specified number is expected when there is no difference in the odor of the sample and control).

Confidence levels in Table A-IV are obtained from the percentiles of the "t" distribution. This distribution is parameterized by the sampling degrees of freedom. The degree of freedom is 19 for the test procedure using ten panel members and two pairs containing the sample and control.

The t-value is computed by the formula:

$$t = \frac{F - 0.5}{\sqrt{\frac{.5 \times .5}{19}}} = \sqrt{19}\ (2F - 1)$$

where F = the fraction of correct choices, t can be evaluated for different numbers of correct identifications of the control:

Number Correct	t-value	Confidence Level (%)[1]
14	1.74	90.0
15	2.18	97.5
16	2.62	98.0
17	3.05	99.50
18	3.49	99.50
19	3.92	99.95

[1]These are the entries for No. responses equal to 20 in Table A-IV; the other entries in Table A-IV were obtained in a like manner.

SECTION 6. CHEMICAL METHODS

6.0 HEAVY METALS

6.0.1 GENERAL: The determination of heavy metals in extractant water is accomplished, with the exception of chromium, using atomic absorption analysis. This technique is based on the quantum mechanical principle that atoms absorb light at energy levels corresponding to characteristic orbital energies of the atom. By measuring the attenuation of a monochromatic

TABLE A-IV

CONFIDENCE LEVELS[1]

No.[2]	No. of responses: 20	22	24	26	28	30	32	34	36	38	40	42	44	46	48
10	N.S.[3]														
11	N.S.	N.S.													
12	75.00	60.00	N.S.												
13	90.00	75.00	60.00	N.S.											
14	95.00	75.00	75.00	60.00	N.S.										
15	97.50	90.00	75.00	75.00	60.00	N.S.									
16	98.00	97.50	90.00	75.00	75.00	60.0	N.S.								
17	99.50	98.00	95.00	90.00	75.00	75.00	60.00	N.S.							
18	99.50	99.50	97.50	95.00	90.00	75.00	75.00	N.S.	N.S.						
19	99.95	99.50	99.50	97.50	95.00	90.00	75.00	75.00	60.00	N.S.					
20	99.95	99.95	99.50	99.00	99.00	95.00	90.00	75.00	60.00	60.00	N.S.				
21		99.95	99.50	99.50	99.00	97.50	95.00	90.00	75.00	60.00	60.00	N.S.			
22		99.95	99.95	99.50	99.50	99.00	97.50	95.00	90.00	75.00	60.00	60.00	N.S.		
23			99.95	99.95	99.50	99.50	97.50	97.50	95.00	75.00	75.00	60.00	60.00	N.S.	
24			99.95	99.95	99.95	99.50	99.00	97.50	97.50	90.00	75.00	75.00	60.00	60.00	N.S.
25				99.95	99.95	99.95	99.95	99.00	97.50	95.00	90.00	90.00	75.00	60.00	60.00
26				99.95	99.95	99.95	99.95	99.50	99.00	97.50	95.00	90.00	75.00	75.00	60.00
27					99.95	99.95	99.95	99.50	99.50	99.00	97.50	95.00	90.00	75.00	75.00
28					99.95	99.95	99.95	99.95	99.95	99.50	99.00	97.50	95.00	90.00	75.00
29						99.95	99.95	99.95	99.95	99.50	99.50	99.00	97.50	95.00	90.00
30						99.95	99.95	99.95	99.95	99.50	99.50	99.50	97.50	97.50	95.00
31							99.95	99.95	99.95	99.95	99.50	99.50	99.50	97.50	97.50
32							99.95	99.95	99.95	99.95	99.95	99.50	99.50	99.00	97.50
33								99.95	99.95	99.95	99.95	99.95	99.50	99.50	99.00
34								99.95	99.95	99.95	99.95	99.95	99.95	99.50	99.50
35									99.95	99.95	99.95	99.95	99.95	99.50	99.50
36									99.95	99.95	99.95	99.95	99.95	99.95	99.50

[1]Sample fails when confidence level reaches 99% or greater

[2]Number of times sample identified as strongest odor in sample/control pair.

[3]N.S. = No significant difference.

light beam passing through the sample atoms, the concentration of metal in the sample can be determined using Beer's Law.

NSF employs an external standard technique for calibration and sample determination. Three standard solutions are made in concentrations corresponding to the region in which the samples are expected to lie. Standards are run concurrently with samples to insure quality control and to indicate any significant deviations in instrumental response. The concentrations of the samples are then obtained from graphs of absorbance versus concentration for the standards.

A study of testing results for several routine analyses was made to determine reproducibility and levels of detection obtained on average working days in the NSF laboratories. This study was done without the prior knowledge of laboratory personnel.

Detection limits were determined as twice the noise level of the recorder output for an analysis. Reproducibility was detemined to be the standard deviation of the absorbance values obtained for a specific concentration of a standard. Arithmetic mean values of the standard were then plotted against concentration, and a least squares line drawn. Detection limits and reproducibility values were then determined from this graph. This procedure was followed for each metal. The results are shown in Table A-V.

Updating analytical procedures is a continuous process at NSF.

All standards and samples are made in the matrix of NSF formulated extractant water[2].

6.0.2 EQUIPMENT:

Perkin-Elmer Model No. 560 atomic absorption spectrophotometer

TABLE A-V

DETECTION LIMITS AND REPRODUCIBILITY OF METALS ANALYSES

Metal	MCL[1] (mg/l)	Reproducibility at MCL (mg/l)	DL[2] (mg/l)	Reproducibility at lowest standard (mg/l)
Antimony	0.05	±0.0007	0.007	±0.0005
Arsenic	0.05	±0.0007	0.004	±0.0008
Barium	1.0	±0.05	0.008	±0.004
Cadmium	0.01	±0.0002	0.0005	±0.0001
Chromium	0.05	±0.002	0.005	±0.002
Lead	0.05	±0.0009	0.002	±0.0007
Mercury	0.002	±0.0004	0.0003	±0.0004
Selenium	0.01	±0.001	0.003	±0.0005
Tin	0.05	±0.002	0.005	±0.0009

[1]maximum contaminant limit (MCL)

[2]detection limit (DL)

[2]NSF Standard No. 14, Appendix A, Section 2.

E.D.L. Power Supply, P.E. No. 040-0354

Perkin-Elmer Graphite Furnace, H.G.A. 2200

Perkin-Elmer PRS-10 Printer Sequencer

Perkin-Elmer AS-1 Auto Sampling System

Burner Control Box, P.E. No. 057-0262

Perkin-Elmer Hitachi 200 Recorder

Acetylene Gas Tank and Regulator

Argon Gas Tank and Regulator

Nitrous Oxide Gas Tank and Regulator

Inorganic 1000 ppm metal standards in matrix of dilute hydrochloric acid

Eppendorf micro-pipets

6.0.3 PROCEDURE, (Atomic Absorption Spectrophotometer) AAS:

Atomization Method - graphite furnace (except mercury)

Sample Matrix - 0.1 ml of Suprapur® HNO_3 in 50 ml of extractant water

Slit - Alternate

Gain — Set between 35 - 40 units

Source — Set to specifications of lamp being used

Signal — Absorbance

Mode — Continuous

Recorder - Absorbance

Background Corrector - AA (Background correction not used routinely)

Recorder Chart Expansion - Set as desired

The lamp is allowed its specified warm up time

Standards are made by adding appropriate aliquots of 1000 ppm standards to the correct matrix. Controls are made with the same matrix but with no exposure to plastics and no addition of the standard.

After proper alignment, each standard is analyzed at least two times. Following this, controls and samples are analyzed two times. Standards are interspersed in the analysis with a total standard frequency of no less than 5 percent of analysis time. Following the completion of the sample run, each standard is rerun. If the instrument response has changed, all questionable samples are rerun immediately followed by a series of standards.

6.0.4 METHODS:

Antimony (Sb):

Standards — 0.1, 0.05, 0.02 mg/l

Graphite Furnace Settings

	Temperature °C	*Time,* Sec.
Dry	110	20
Char	825	22
Atomization	2700	6

Purge gas - Argon
Purge gas flow rate - 300 cc/min
Purge gas interrupt — 3 sec.
Sample volume 20 2μl

Instrumental Parameters

- Slit — 0.2 mm
- Source — HCL, P.E. No. 303-6010
- Wave length — 217.6 nm

Photometric Range - 0.5

Arsenic (As):

Standards — 0.100, 0.050, 0.020 mg/l

Graphite Furnace Settings

	Temperature °C	*Time,* Sec.
Dry	110	20
Char	250	20
Atomization	2700	6

Purge gas - Argon
Purge gas flow rate - 300 cc/min
Purge gas interrupt — 3 sec.
Sample volume 20 μl

Instrumental Parameters

- Slit — 0.7
- Source — EDL, P.E. No. 303-6211
- Wave length — 193.7 nm

Photometric Range - 0.5

Barium (Ba):

Standards — 0.100, 0.050, 0.020 mg/l

Graphite Furnace Settings

	Temperature °C	*Time,* Sec.
Dry	110	23
Char	1100	36
Atomization	2700	5

Purge gas - Argon
Purge gas flow rate - 300 cc/min
Purge gas flow reduction rate - 110 cc/min for 3 sec.
Sample volume — 20 μl

Instrumental Parameters

- Slit — 0.2
- Source — HCL, P.E. No. 303-6012
- Wave length — 553.6 nm

Photometric Range - 0.5

Cadmium (Cd):

Standards - 0.0100, 0.0050 0.0020 mg/l

Graphite Furnace Settings

	Temperature °C	Time, Sec.
Dry	110	20
Char	280	32
Atomization	2100	6

Purge gas - Argon
Purge gas flow rate - 300 cc/min
Purge gas interrupt - 3 sec.
Sample volume - 20 μl

Instrumental Parameters

- Slit - 0.2
- Source - HCL, P.E. 303-601b
- Wave length - 228.8 nm

Photometric Range - 1.0

Chromium (Cr):

Standards - 0.100, 0.050 0.020 mg/l

Graphite Furnace Settings

	Temperature °C	Time, Sec.
Dry	110	20
Char	1100	32
Atomization	2700	6

Purge gas - Argon
Purge gas flow rate - 300 cc/min
Purge gas interrupt - 3 sec.
Sample volume - 20 μl

Instrumental Parameters

- Slit - 0.7
- Source - HCL, P.E. 303-6021
- Wave length - 357.9 nm

Photometric Range - 1.0

Lead (Pb):

Standards - 0.050, 0.030, 0.010 mg/l

Graphite Furnace Settings

	Temperature °C	*Time,* Sec.
Dry	110	20
Char	700	20
Atomization	2300	6

Purge gas - Argon
Purge gas flow rate - 300 cc/min
Purge gas interrupt - 3 sec.
Sample volume - 20 μl

Instrumental Parameters

•Slit - 0.7
•Souce - HCL, P.E. 303-6111
•Wave length - 217.0 nm

Photometric Range - 0.2

Mercury (Hg):

Sample Matrix - sample water treated in accordance with Perkin-Elmer instructions for Mercury Analysis System No. 303-0830

Standards - 0.010, 0.0050, 0.0020 mg/l

Atomization Method - Perkin-Elmer Flameless Mercury Analysis System 303-0830

Instrumental Parameters

•Slit - 0.7
•Souce - HCL, P.E. 303-6044
•Wave length - 253.7 nm

Photometric Range - 0.5

Selenium (Se):

Standards - 0.050, 0.020, 0.0050 mg/l

Graphite Furnace Settings

	Temperature, °C	*Time,* Sec.
Dry	110	20
Char	370	36
Atomization	2700	5

Purge gas - Argon
Purge gas flow rate - 300 cc/min
Purge gas interrupt - 3 sec.
Sample volume - 20 μl

Instrumental Parameters

•Slit - 0.7
•Source - EDL, P.E. 303-6262
•Wave length - 196.0 nm

Photometric Range - 0.2

Tin (Sn):

Standards - 0.100, 0.050, 0.020 mg/l

Graphite Furnace Settings

	Temperature °C	*Time* Sec.
Dry	110	30
Char	700	32
Atomization	2700	5

Purge gas - Argon
Purge gas flow rate - 300 cc/min
Purge gas interrupt - 3 sec
Sample volume - 20 μl

Instrumental Paameters

•Slit - 0.7
•Source - EDL, P.E. 303-6274
•Wave length - 224.6 nm

Photometric Range - 0.5

6.0.5 QUALITY CONTROL: Any plastics sample which fails any chemical parameter is retested to assure that the problem is associated with the sample versus the analysis or analytical technique.

In accordance with the 14th Edition of *Standard Methods for the Examination of Water and Wastewater,* the NSF laboratory utilizes two methods of quality control, internal and external. The internal method includes standard solutions and controls which correct for chemical interference in the extractant water. Standards and controls comprise 15% of the analytical time for heavy metals determinations; i.e., one in six randomly spaced controls.

External quality control samples are analyzed on an average of once every three months, either as EPA reference standards or solutions of NSF extractant water spiked with metals at concentrations which approximate a "typical" plastics sample. The quality control samples are prepared by personnel

other than those involved in the analysis and are coded in a manner which simulates actual plastics samples. The analyst receives the quality control sample, along with actual plastics samples, with no knowledge of its status as a quality control sample.

6.1 RESIDUAL VINYL CHLORIDE MONOMER (RVCM)

6.1.1 GENERAL: It has been demonstrated that a level of 10 ppm RVCM in PVC and CPVC piping system components will result in undetectable (where detection is 50 ppb) levels of RVCM leaching into water passing through the system. Accurate determination of these low levels of RVCM is made using gas chromatographic (GC) separation and flame ionization detection.

A small amount of plastic is dissolved in a sealed tube half filled with an appropriate solvent. The tubes are then heated so that essentially all the vinyl chloride monomer (VCM) goes into the vapor phase (head space). An aliquot of head space is then injected into the GC system and analyzed for VCM content.

For the first six months that NSF tested for RVCM content in accordance with Standard No. 14 using this procedure, two independent laboratories participated with NSF in round-robin testing. In the 0 to 20 ppm range, the average variation about mean values of duplicate samples was less than 1 ppm. For samples exchanged which were found to have greater than 20 ppm RVCM, the average deviation was ± 4.1 percent. To date, the average deviations (reproducibilities) of standard solutions used by NSF have been less than 0.2 ppm. These standards contained 10-20 ppm of VCM.

6.1.2 EQUIPMENT: (All equipment and parts numbers through the Septa-Sandwich Type refer to Perkin-Elmer designations)

Gas Chromatograph, Perkin-Elmer Model F-42 Head Space Analyzer, No. 105003

Flame Ionization Detector (F.I.D.) No. 1050201 (sensitivity .015 coul/gC)

Model I Computing Integrator, No. 023-1001

Columns — ⅛" x 3' and ⅛" x 6' Carbowax 1500, No. 1050254

Back Flush Unit, No. 1050224

Thermometer 0°-100°C, No. 105-0109

Sample Tray Thermostat System (Haake), No. 1050124

Sample Bottles, No. 1050118

Septa-Sandwich Type, for Automatic Dosing, No. 105-1008

Hydrogen Cylinder with Regulator and Filter Drier

Air Cylinder with Regulator and Filter Drier

Nitrogen Cylinder with Regulator and Filter Drier

Analytical Balance, capable of weighing ± .0001 g

Soap Film Flow Meter, Hewlett Packard, No. 0101-113

Pressure-Lok Series A-2 Syringe, 0-100 microliter

10 Microliter Liquid Syringe

Repipet, with 1000 ml square amber bottle and 20 ml pipet, Fisher No. 13-687-36

Thomas-Atlab Reciprocating Shaker, No. 8289-B10

6.1.3 REAGENTS:

Vinyl Chloride (VC) — 99.9 percent (if available)

N,N-Dimethylacetamide (DMAC), redistilled in glass

6.1.4 INSTRUMENT PREPARATION:

Install three foot (0.9 m) column between the injector and the backflush tee; connect six foot (1.8 m) column to the backflush tee. Do not connect the six foot (1.8 m) column to the detector until the column has been conditioned.

Neumatic Settings:

- Nitrogen
- Tank regulator, 40 psi (275.8 kPa)
- Chromatograph regulator at 1.0 Bar

These settings yield a resultant flow of 240 ml/min with the columns used and optimize interference separation and analytical speed. The retention time is 70 seconds.

Hydrogen

- Tank regulator, 42 psi (289.5 kPa)
- Chromatograph regulator, 2.1 Bar

Air

- Tank regulator, 40 psi (275.8 kPa)
- Chromatograph regulator, 2.5 Bar

F.I.D.

- Air and Hydrogen, 2.5 Bar

NOTE: The air-hydrogen mixture is adjusted to maximize detector response.

Backflush

- Backflush regulator, 1 Bar

Temperature settings

- Oven — 80° C
- Needle — 150° C
- Injector and detector — 150° C
- Water bath — 90° C

Program Settings

- Injection time — 4 sec.
- Analysis time — 1 min.
- Backflush time — 3 min.
- Waiting time — 0.3 min.

NOTE: The program settings are functions of column characteristics (i.e., length, packing, retention, etc.) and may need to be changed when columns are changed or reconditioned.

6.1.5 ANALYTICAL PROCEDURE:

Prior to sample analysis, prepare standards containing 300 to 700 ppm of VCM, to be used for column conditioning.

Standard Stock Preparation

- Standard stock solutions are prepared monthly. A small portion of liquid VCM (approximately 30 μl) is injected into a sealed sample bottle filled with DMAC. The sample bottle and DMAC are preweighed so that the weight of DMAC is known. The difference between the final weight and the weight of the bottle and DMAC is the weight of VCM added. This weight can be used to determine the concentration of VCM in the DMAC. These stock standards can be refrigerated and stored for more than six months.

- Example

$D \frac{25}{4}$ DMAC = 0.9366 g/ml

$D \frac{25}{4}$ VCM = 0.9080 g/ml

(0.0272 g VCM) / (0.9080 g/ml VCM) = 0.03 ml VCM

(22.4782 g DMAC) / (0.9366 g/ml DMAC) = 23.9998 ml DMAC

Standard Stock = (0.0272 g VCM) / (23.9998 ml DMAC + 0.03 ml VCM) = 0.0011 g/ml VCM

Calibration Standard Preparation

- Add 10 ml of DMAC to a sample vial and seal

- Inject an appropriate amount (10 μl) of stock solution under the surface of the DMAC

- Calculate the weight of VCM in

the sample bottle as follows: (0.0011 g/ml) (0.010 ml) = 0.000011 g VCM

•Convert to ppm with respect to a 0.5000 g sample as follows:

$$\frac{(1.1 \times 10^{-5}\ g)\ (1 \times 10^{6})}{0.5000\ g} = 22\ ppm$$

NSF standards are normally in the 10 to 30 ppm range.

Sample Preparation

•Take sample shavings from various locations around the perimeter of the sample to be tested. This minimizes the heat generated by taking shavings and gives a representative cross-section of the pipe or fitting.

•Add 0.5 g (to the nearest 0.1 mg) of sample to a sample bottle.

•Add 10 ml of DMAC to sample vial and seal vial.

•Shake sample vials until plastic is completely dissolved.

(NOTE: Small particles, additives, are sometimes observed; these will not affect the analysis.)

•Load the carousel with three "wake-up" bottles (if this is the first run of the day), three standards for calibration, and the samples interspersed with an occasional standard (15 percent of analyses are standards and/or blanks).

6.1.6 QUALITY CONTROL: Analyze all samples in duplicate. If the mean result of the duplicate is greater than the maximum permissible limit, analyze a new sample in duplicate. If it should fail this second test, the manufacturer is requested to submit additional pipe and the same sequence is repeated. Consequently, a sample is reported as failing only after four duplicate analyses.

In addition to the daily standard solutions which are interspersed with the samples, standard stock solutions from previous days are included routinely.

6.2 OTHER CHEMICAL PARAMETERS

6.2.1 PHENOLS: Phenols are measured in accordance with *Standard Methods for the Examination of Water and Wastewater*, 14th Edition, page 577 (4-aminoantipyrine method with preliminary distillation step).

6.2.2 ACRYLONITRILE: Acrylonitrile is measured in accordance with ASTM D1013.

6.2.3 SOLIDS, TOTAL (DISSOLVED): Total dissolved solids are measured in accordance with *Standard Methods for the Examination of Water and Wastewater,* 14th Edition, page 91.

6.3 TOTAL TRIHALOMETHANE (TTHM) ANALYSIS — IN-THE-PIPE EXPOSURE:

6.3.1 GENERAL: EPA has set the maximum total trihalomethane (TTHM) level in drinking water at 100 ppb (μg/l).[3] Levels of individual trihalomethanes, (THMs) leached from CPVC and PVC pipe into water are determined by gas chromatography (GC) after exposing the pipe to a standard extractant water. Five other organohalides (1,2-Dichloroethane, 1,1,1-Trichloroethane, Carbon Tetrachloride, Trichloroethylene, and Tetrachloroethylene) are monitored along with the THMs. If a sample chromatogram shows a peak at a retention time not corresponding to one of the nine compounds to be specifically analyzed, that peak is identified by gas chromatography/mass spectrometry (GC/MS), quantitated, and reported.

[3]Federal Register, Vol. 44, No. 231, November 29, 1979, including Part III, Appendix C.

A pipe is filled with extractant water, stoppered, and exposed according to NSF's standard (multiple) cold exposure procedure. The pipe surface area to water volume ratio is calculated according to the inside diameter (ID) of the exposed pipe. The exposure water is then injected into a purge and trap liquid concentrator linked to a GC system, for TTHM analysis.

6.3.2 EQUIPMENT:

Gas Chromatograph, Tracor 565

Computing Integrator, Spectra Physics SP4100

Purge and trap liquid concentrator, Tekmar LSC-2 with autosampler, Tekmar Model ALS Automatic Laboratory Sampler

Columns
- GC - 2 mm ID x 2 m glass column packed with 1 percent SP-1000 on 60/80 mesh Carbopack B
- Purge and Trap - Tenax/Silica Gel Trap

Detector - Hall Electrolytic Conductivity Detector, Tracor 700A

Helium cylinder (Grade 5) with 2-stage regulator and oxygen trap

Hydrogen cylinder (Grade 5) with 2-stage regulator and activated carbon filter

Analytical balance, capable of weighing ±0.0001 g

Soap film flow meter, Hewlett Packard No. 0101-113

25 ml volumetric flask, screw cap with Teflon®-faced silicone septum

100 ml volumetric flask, screw cap with Teflon®-faced silicone septum

Syringes
- 5 ml glass with luer lock tip
- 25μl Hamilton micro syringe 702N; Syringe valve

Sampling vials, Pierce 13075 40 ml screw cap vials with Pierce 12722 Teflon®/Silicone Closures

Teflon® or ground glass tapered closures to fit a variety of pipe diameters

6.3.3 REAGENTS:

Organic-free water, Millipore Milli-Q® water system with Organex-Q® cartridge

n-Propanol

Methanol

Reference Material[4]
- Bromoform 97 percent
- Bromodichloromethane 98 percent
- Carbon Tetrachloride 98 percent
- Chlorodibromomethane 98 percent
- Chloroform 99 percent
- 1,2-Dichloroethane 97 percent
- Tetrachloroethylene 98 percent
- 1,1,1-Trichloroethane 98 percent
- Trichloroethylene 98 percent

6.3.4 INSTRUMENT SETTINGS: Install the prepared and conditioned (at 220°C overnight with a carrier gas flow of 40 ml/min.) GC column listed above according to manufacturer's instructions. Optimize reactor temperature of Hall detector according to manufacturer's instructions. Set output level to 1000 to accommodate negative peaks, SP4100 as needed.

Pneumatic Settings:
- Helium: 25 ml/min.
- Hydrogen: 50 ml/min.

Program Settings:
- GC Oven
  Initial temperature - 25°C
  Initial hold time - 1 min.
  Ramp rate - 8°/min
  Final temperature - 215°C
  Final hold time - 10 min.

[4]All reference material may be obtained from Aldrich Chemical Co.

•Purge and Trap
Purge gas - Helium
Purge flow - 40 cc/min.
Purge time - 12.0 min.
Purge temperature <30°C
Desorb time - 4.0 min.
Desorb temperature - 180°C
Bake time - 8.0 min.
Bake temperature - 180°C

6.3.5 PROCEDURES FOR SAMPLE PREPARATION AND EXTRACTANT WATER EXPOSURE:

Samples

Requirements: Pipe ID must be 2 inches (50.8 mm) or less; this procedure is not intended for pipes larger than 2 inches (50.8 mm) ID. The surface area to water volume ratio of the exposure may be calculated using the following formula:

$$\frac{\text{ID of pipe sample (in.)} \times 9.766}{\text{Surface area/Vol. ratio (in.}^2\text{/ml)}} =$$

Preparation: Cut pipes to a length that will hold a minimum of 50 ml of exposure water. Cut ends flush, deburr,and trim to accommodate closures.

Washing: Hand wash prepared samples with detergent, brushing the inside of the pipe lightly. Rinse with tap water, rinse with organic-free water, and allow to air dry in an uncontaminated atmosphere.

Extractant Water

Chemical Characteristics: Prepare "standard" extractant water to contain 100 mg/l hardness (as $CaCO_3$) in organic-free water.

Reagents: Buffer Stock Solution: Dissolve 3.36 g Sodium Bicarbonate ($NaHCO_3$) in organic-free water. Make up to one liter.

Hardness Stock Solution: Dissolve 4.44 g anhydrous Calcium Chloride ($CaCl_2$) in organic-free water. Make up to one liter.

Water: Prepare extractant water by adding stock reagent solutions to organic-free water, as shown in Table A-VI.

TABLE A-VI
EXTRACTANT WATER

Organic-Free Water (Liters)	Buffer Stock Solution (ml)	Hardness Stock Solution (ml)
1	25	25
6	150	150
12	300	300
15	375	375

Exposure

Pipe Closures: Stopper one end of pipe sample using standard taper ground glass stoppers or tapered Teflon® plugs (whichever is available to accommodate ID of pipe sample). Fill pipe to overflowing with extractant water. Tap sides of the pipe to release any air bubbles and insert a stopper in the other end of the pipe, being careful to avoid the formation of headspace. Check ends for leaks.

Exposure Conditions: All tests for acceptance, qualification, and routine monitoring are conducted with a multiple exposure procedure. Analysis is performed on the final extractant water only.

Multiple Exposures:
1. 24± 1 hour at 37±0.5°C
2. 24± 1 hour at 37±0.5°C
3. 72± 4 hours at 37±0.5°C

Controls: Fill a 40 ml glass vial, having a screw cap and Teflon®-lined silicone septum, with extractant water. Expose along with pipe samples during the final exposure (72±4 hours at 37±0.5°C). Include at least one control for every 10 pipe samples in the daily run.

Recovery of Water Following Exposure

Pouring: Observe the pipe, check for and note any signs of leaks or headspace. Remove the stopper from one end of the pipe sample and pour the water into a clean 40 ml screw cap vial (washed in dishwasher, rinsed in Milli-Q,® baked at 105°C for 1 hour, and allowed to cool to room temperature in an uncontaminated atmosphere) to overflowing. Seal the vial without headspace using a Teflon®-lined silicone septum.

Sample Water Storage: Store the sealed sample vials at 4±0.5°C until time of analysis. The storage time may not exceed 14 days. Samples must be brought to room temperature before analysis.

6.3.6 ANALYTICAL PROCEDURE:[3] Prior to analysis, GC conditions and requirements must be met before analysis may continue.

Standardization and Calibration

Standard Stock Preparation: Prepare standard stock solutions monthly. Place about 24 ml of methanol in a 25 ml volumetric flask. Weigh the flask to the nearest 0.1 mg. Drop 2 to 3 drops of reference standard directly into the methanol. Reweigh the flask to determine amount of reference standard added. Dilute to volume and mix by inverting several times. Transfer the standard stock solution into a 15 ml screw cap bottle with a Teflon® liner. Store at 4°C. Standard may be used for up to 4 weeks of daily check standards if documentation shows no significant changes in peak areas.

Aqueous Calibration Standard: Rapidly inject a measured amount of the stock solution, using a 25μl Hamilton 702N microsyringe, into the expanded area of a volumetric flask (no more than 20μl into 100 ml of organic-free water) filled with organic-free water. Mix by inverting the flask three times. Discard aqueous standards after one hour unless stored as described in Section 6.3.5, Recovery of Water Following Exposure, in this procedure.

Quality Check Standard: Before sample analysis, run a 2 mg/l quality check standard. Analysis of this standard must result in concentrations within 20 percent of the true values.

Analytical Quality Control

Instrument Status and Lower Limit of Detection (LOD): Determine daily the LOD of each compound based on the Quality Check Standard and the noise level of the base line, as follows:.

$$\text{LOD } (\mu g/l) = \left(\frac{A \times ATT}{B \times ATT}\right) C$$

A = 5 times noise level (mm) at exact retention time of the THM

B = Peak height (mm) of Quality Check Standard

C = Concentration (mg/l) of Quality Check Standard

ATT = Attenuation factor

Sample Blank: Analyze daily organic-free water for potential interferences.

Generated Spike: Every tenth sample, analyze a laboratory-generated spike of organic-free water made at the time of analysis.

Duplicate Analysis: Analyze 10 percent of all pipe samples in duplicate.

Exposure Spike: Expose duplicate lengths of 10 percent of all samples as in Section 6.3.5 using exposure water spiked with each of the nine organic compounds to a concentration of 5 - 10 μg/l, as opposed to organic-free water.

Precision and Accuracy: Maintain records of precision and accuracy data collected from Quality Check Standards, duplicate analyses, generated spikes, and exposure spikes.

Retention Times: Maintain a record of retention time for each reference standard. Retention times may not vary by more than 10 percent of the established norm.

Analysis

Sampling: Pour sample to be analyzed into a clean 5 ml syringe with a luer lock tip and 2-way valve. Load 5 ml of sample into purge and trap device.

Parameters: Set Purge and Trap and GC conditions as stated in Section 6.3.4 and start analysis.

Calculations: Identify each compound in the resulting chromatogram by comparing retention times of sample peaks to retention times of reference peaks from Quality Check Standard.

Calculate the concentration of sample peak by comparing peak area of sample to the peak area and concentration of the reference standard peak. Report results to two significant figures.

6.3.7 ALTERNATE METHOD OF ANALYSIS: When the Purge and Trap method of sample extraction cannot be employed, an alternative method is available. The alternative method involves a liquid/liquid sample extraction.[3] Major drawbacks to the method are that 1,2-dichloroethane cannot be detected, and the maximum detectable amount of carbon tetrachloride is about 15 μg/l due to detector saturation.

SECTION 7. ALTERNATE METHOD OF CALCIUM CARBONATE ANALYSIS

7.0 SAMPLE PREPARATION: Prepare 1 liter of "standard" extractant water as specified in Appendix A, Part 2, Section 2.

7.1 TEST PROCEDURES: Stir in 1 gram of calcium carbonate into 1 liter of cold "standard" extractant water. Prepare in duplicate. Also prepare a blank. Expose according to Appendix A, Part 2, Section 3. At the end of each exposure period, siphon off the extractant water and re-expose the calcium carbonate. Analyze the first and third extractions for heavy metals as required in Section 3, Table 1, using the procedures specified in Appendix A, Part 2, Section 6.

7.2 RESULTS: Compare the heavy metals present in the first and third extractions.

PART 3

EVALUATION PROCEDURES FOR MATERIALS AND PLASTIC PIPING SYSTEM COMPONENTS FOR CORROSIVE WASTE SYSTEMS

SECTION 1: POLYETHYLENE AND POLYPROPYLENE MATERIALS FOR PLASTIC PIPING SYSTEM COMPONENTS

1.0 PHYSICAL AND CHEMICAL RESISTANCE PROPERTIES

1.1 VERIFICATION OF CELL CLASSIFICATION: Verification of cell classification as described in ASTM D1248 for polyethylene or ASTM D2146 for polypropylene.

1.1.1 ASTM D1248 for polyethylene a Type, Class, Category, Grade

1.1.2 ASTM D2146 for polypropylene a Type, Class, Grade.

1.2 CHEMICAL RESISTANCE

1.2.1 Chemical resistance tests shall be performed in accordance with ASTM D543 on reagents listed below:

- 50 percent acetic acid
- 25 percent sodium hydroxide
- 100 percent acetone
- 100 percent methanol
- 25 percent nitric acid

1.2.2 Special chemical exposure resistance claimed by the manufacturer may require additional testing.

1.2.3 Immersion tests shall be run on tensile bars molded from corrosive waste materials.

1.2.4 Run tensile tests on exposed tensile bars according to ASTM D638.

1.2.5 Test procedure for chemical immersion tests on tensile bar specimen as outlined below:

1.2.5.1 Tensile bars shall be totally immersed in reagents (see Item 1.2.1, Chemical Resistance).

1.2.5.2 Exposure is for 28 days

1.2.6 Pass/fail criteria on exposed tensile bars

1.2.6.1 Change in tensile strength shall not be more than ± 15 percent of the unexposed sample.

1.2.6.2 Change in weight shall not be more than ± 15 percent of the unexposed sample.

2.0 PHYSICAL TESTING OF CORROSIVE WASTE SYSTEM COMPONENTS

2.1 DIMENSIONS AND TOLERANCES: Dimensions and tolerances for polyethylene and polypropylene pipe shall be as outlined in ASTM D2447. Fittings shall be checked against ASTM D2665 for wall thickness and the manufacturer's claims for dimensions and tolerances.

2.2 HYDROSTATIC BURST TESTS: Hydrostatic burst tests (using water) shall be conducted on pipe and fittings assemblies as outlined in ASTM D1599 test method. Bursts shall be conducted against manufacturer's claimed minimum burst strength.

2.3 RIGIDITY AND SUPPORT SPACING: (Data to be supplied by the manufacturer.)

2.3.1 Clean span of pipe under test shall be at least equal to the distance between supports as recommended by the manufacturer.

2.3.2 Bearing edges shall be at right angles to clear span under test.

2.3.3 Test specimen shall be filled with water at 180° F and held full while allowing the pipe to return to ambient (73.4° F) temperature over a 24-hour period.

2.3.4 Maximum allowable deflection shall not be more than 0.25 inch per running foot (6.4 mm per 0.3 m), measured at the lowest point after the 24-hour exposure, while water is still in the pipe.

2.3.5 Data on observations of field installations shall be provided to demonstrate that maximum permissible deflection shall be such that recommended fittings and joinings shall not show signs of splitting, cracking or separating when supported as recommended.

2.4 RESISTANCE TO EXPOSURE IN NORMAL ENVIRONMENT (data to be supplied by manufacturer): Data on observation of available installations shall be provided to demonstrate no adverse effect from exposure to normal environment, or data may be supplied to show conformance with ASTM D756 relative to cracking, checking and weathering.

APPENDIX B

List of Standards
for
Plastic Piping System Components
Referenced by NSF Standard No. 14

APPENDIX B

LIST OF STANDARDS FOR PLASTIC PIPING SYSTEM COMPONENTS REFERENCED BY NSF STANDARD NO. 14

Description	ANSI	ASTM	FS	Other
Potable Water Pipe — PVC				
Rigid Unplasticized Polyvinyl Chloride Pipe		D1785		
Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR and Class T)	B72.2-67	D2241		AWWA C900
Specification for Polyvinyl Chloride (PVC) Plastic Tubing		D2740		
Bell End PVC Plastic Pipe		D2672		
Potable Water Pipe — ABS				
ABS Plastic Pipe (IPS Dimensions)	B72.1-67	D1527 D2282		
Threaded Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Sch. 80		D2465		
Potable Water Pipe — PE				
Polyethylene (PE) Plastic Pipe, Schedules 40 and 80 Based on Outside Diameter	B72.1-67	D2447	L-P-315a	
Polyethylene (PE) Plastic Pipe, Schedule 40		D2104		
Polyethylene (PE) Plastic Pipe (SDR-PR)		D2239		
Polyethylene (PE) Plastics Pipe (SDR-PR) Based on Controlled Outside Diameter		D3035		
Polyethylene (PE) Plastic Tubing		D2737		
AWWA Standard for Polyethylene (PE) Pressure Pipe, Tubing and Fittings				AWWA C901
Potable Water Pipe — CPVC				
Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable *Hot* Water Systems		D2846		
Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Schedules 40 & 80		F441		
Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)		F442		
Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fitting, Sch. 40		F438		
Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Sch. 80		F439		
Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fitting, Sch. 80		F437		
Bell End Chlorinated Poly(Vinyl Chloride) (CPVC) Pipe, Sch. 40		F443		

Potable Water Pipe — PB			
Specification for Polyethylene (PE) Plastic Tubing		D2737	
Polybutylene (PB) Plastic Pipe (SDR-PR)		D2662	
Polybutylene (PB) Plastic Tubing		D2666	
Polybutylene (PB) Plastic Pipe (SDR-PR) Based on O.D.		D3000	
Polybutylene (PB) Plastic Hot-Water Distribution System		D3309	
Potable Water — Well Casing			
Thermoplastic Water Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR)		F480	
Potable Water Fittings — PVC			
Threaded Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Sch. 80		D2464	
Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Sch. 40		D2466	
Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Sch. 80		D2467	
Potable Water Fittings — ABS			
Socket-Type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Sch. 40		D2468	
Socket-Type Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fitting, Sch. 80		D2469	
Potable Water Fittings — PE			
Standard Specification for Plastic Insert Fittings for Polyethylene (PE, PP, NP & PA) Plastic Pipe	B16.27-62	D2609	
Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing		D3261	
DWV Pipe and Fittings — PVC			
Polyvinyl Chloride (PVC) Plastic Drain, Waste & Vent Pipe and Fittings		D2665	L-P-320a
Polyvinyl Chloride (PVC) for 3" Thinwall		D2949	
DWV Pipe and Fittings — ABS			
Acrylonitrile-Butadiene-Styrene (ABS) Plastic Drain, Waste & Vent Pipe and Fittings		D2661	L-P-322a
Acrynitrile-Butadiene-Styrene (ABS) Plastic Drain, Waste & Vent Piping Having a Foam Core		F628	
DWV Pipe and Fittings — ABS—PVC			
Drain, Waste & Vent (DWV) Plastic Fittings Patterns		D3311	
Tubular Pipe and Fittings (PVC, ABS, PP)			
Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings		F409	
Sewer and Drain Pipe			
Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings		D2751	

Polyvinyl Chloride (PVC) Sewer Pipe and Fittings	D3033 D3034
Corrugated Polyethylene Tubing and Fittings	F405
Solvent Cements	
Solvent Cements for ABS Plastic Pipe and Fittings	D2235
Solvent Cements for PVC Plastic Pipe and Fittings	D2564
Solvent Cements for Joining ABS Pipe and Fittings to PVC Pipe and Fittings for Non-Pressure Applications	D3138
Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings	F493
Thermoset Plastic Piping System Components	
Filament-Wound Reinforced Thermosetting Resin Pipe	D2996
Centrifugally Cast Reinforced Thermosetting Resin Pipe	D2997
Reinforced Platic Mortar Pressure Pipe	D3517

LIST OF STANDARDS
FOR
THERMOPLASTIC MATERIALS FOR PLASTIC PIPING SYSTEM COMPONENTS

Description	ANSI	ASTM	FS	Other
PVC				
Rigid Poly(Vinyl Chloride) Compounds and Chlorinated Poly(Vinyl Chloride) Compounds		D1784		
ABS				
Rigid Acrylonitrile-Butadiene-Styrene (ABS) Plastics		D1788		
PE				
Polyethylene Platics Molding and Extrusion Materials		D1248		
Polyethylene Plastics Pipe and Fitting Materials		D3350		
PP				
Propylene Plastic Molding and Extrusion Materials		D2146		
PB				
Polybutylene Plastics		D2581		
PS				
Styrene-Butadiene Molding and Extrusion Materials		D1892		

NOTE: Copies of the ASTM Standards may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylania 19103

APPENDIX C

Examples of Marking and Coding of Pipe, Fittings and Solvent Cement

EXAMPLES OF MARKING AND CODING OF PIPE, FITTINGS AND SOLVENT CEMENT

The marking and coding generally following marking requirements in applicable standards such as ASTM, AWWA, etc. The following illustrates the required markings and code information:

Size	Material	Pressure	Std. No.	Trade Name	Code/ Lot	NSF Logo
Potable Water Pipe:						
2"(50.8 mm) SDR 26	PVC 1120	160 psi @73°F (1103 Pa @22.8°C)	ASTM D2241	Vega	1510A	NSF-pw
DWV Pipe:[1]						
2"(50.8 mm)	ABS IG2	--	ASTM D2661	Dodge	312B	NSF-dwv
Dual Markings (PW & DWV):[2]						
2"(50.8 mm)	PVC	--	ASTM D2665	Colt	712A	NSF-dwv [2]
followed in line with:	PVC 1120	280 psi @73°F (1930.3 Pa @22.8°C)	ASTM D1785	Bradford		NSF-pw [2]
Potable Water Fittings:						
3"(76.2 mm)	PVC 1		ASTM D3036	Chevy		NSF-pw
Continuous Waste Fittings[4]						
1½ x 1½" (38.1 x 38.1 mm)	ABS		ASTM F409	Mercury		NSF-tubular
Solvent Cement[3]	PVC Solvent		ASTM D2564	Volare	12H	NSF-pw
Thermoset Pipe						
12"(304.8 mm)	RTRP-IIAD	280 psi @___°F (1930.3 Pa @_____°)	ASTM D2996	XYZ	177	NSF-pw
Thermoset Fittings/Tanks						
6 x 6 x 36" (152.4 x 152.4 x 914.4 mm)	RTRP	200 psi @ 73° F (1378.8 Pa @22.8°C)	ASTM D2996	XYZ	177	NSF-pw

[1]DWV imprint on both sides of pipe.

[2]DWV imprint on both sides (180°) of pipe with an alternating imprint for potable water markings on one side of pipe.

[3]In addition to the items above, the solvent cement label shall:
1. Use application for cement, potable water, DWV, sewer or both.
2. Procedures for use and any safety precautions needed.

[4]Tubular fittings shall be marked on both sides; tubing on one side.

APPENDIX D

Participating Committees

NSF JOINT COMMITTEE ON PLASTICS (1984)

Chairman, Foster, Charles K., PE, Chief, Bureau of Environmental Health, Texas Department of Health, 1100 West 49th Street, Austin, TX 78756

Bell, Frank, Senior Environmental Engineer, Office of Drinking Water, WH 550, USEPA, Washington, DC 20460

Choquette, Kenneth, Director, Health Engineering, Department of Health, Lucas State Office Building, Des Moines, IA 53019 (Conference of State Sanitary Engineers)

Cummings, James, Chief, Plumbing Division, Michigan Department of Labor, Bureau of Construction Codes, State Secondary Complex, 7150 Harris Drive, P.O. Box 30015, Lansing, MI 48909

Gass, Tyler, Bennett & Gass Inc., P.O. Box 51, Westerville, OH 43081 (National Water Well Association)

Gensler, Lt. Cmdr. Jay D., USAMBRDL, Fort Detrick, Frederick, MD 21701

Higham, Tom, IAPMO, 5032 Alhambra Avenue, Los Angeles, CA 90032 (International Association of Plumbing and Mechanical Officials)

Hilbert, Morton S., Department of Environmental and Industrial Health, School of Public Health, University of Michigan, Ann Arbor, MI 48109

Klimboff, Morris, Vice President, Research and Development, Fiat Products, Inc., 300 Lawton Avenue, Monroe, OH 45050 (American Society for Sanitary Engineering)

Richard, Joe G., Jr., Owen and White Inc., P.O. Box 66396, Baton Rouge, LA 70896 (American Water Works Association)

Industry

Alexander, Lloyd R., Phillips Chemical Company, 12 D1 Phillips Building, Bartlesville, OK 74004

Coe, Donald E., Borg-Warner Chemicals, Borg-Warner Corporation, P.O. Box 68, Washington, WV 26181

Dicks, Manfred, American Hoechst Corporation, Plastics Division, 289 North Main Street, Leominster, MA 01453

Duecker, Thomas, J-M Manufacturing Company, Inc., 1051 Sperry Road, Stockton, CA 95206

Fidler, J. W., Hercules Chemical Company, Inc., 29 West 38th Street, New York, NY 10018

Finn, Paul F., President, Finn Industries, 2547 West Jackson Street, Phoenix, AZ 85009

German, Rex, Nebraska Plastics, Inc., P.O. Box 45, Cozad, NE 69130

Hodges, B. W., Charlotte Pipe and Foundry Company, Plastics Division, P.O. Box 1220, Monroe, NC 28110

LaBranche, Harvey, Western Plastics Corporation, 2330 Port of Tacoma Road, Tacoma, WA 98421

Lindegren, C. R., Shell Chemical Company, P.O. Box 399, Riverside, CT 06878

McGregor, Jim, Can-Tex Industries, Plastic Pipe Division, P.O. Box 340, Mineral Wells, TX 76067

Morin, Robert G., Monsanto Polymer Products Company, 645 Shawnigan Drive, Chicopee, MA 01020

Petro, Paul, Plexco, Division of Amstead Industries, 3240 North Mannheim Road, Franklin Park, IL 60131

Richmond, Gary, Crestline Plastic Pipe Company, P.O. Box 41, Henderson, KY 42420

Sankey, John, Hancor, Inc., 401 Olive Street, Findlay, OH 45840

Silver, Jack, Industrial Polychemical Services, P.O. Box 471, Gardena, CA 90247

Steinbruck, Keith H., Simpson Extruded Plastics Company, 2220 Nugget Way, P.O. Box 10049, Eugene, OR 97440

Stiskin, Hal, R & G Sloane Manufacturing Division, The Susquehanna Corporation, 7660 North Clybourn Avenue, Sun Valley, CA 91352

Struber, Vic, Argus Chemical Division, Witco Chemical Corporation, 633 Court Street, Brooklyn, NY 11231

Sturn, Norm, Diamond Plastics Corporation, 2323 Marshall Street, P.O. Box 2748, Lubbock, TX 79408

Switalski, Thomas A., Certain-Teed Corporation, Pipe and Plastics Group, P.O. Box 860, Valley Forge, PA 19482

Wilging, Robert C., B. F. Goodrich Chemical Company, 6100 Oak Tree Boulevard, Cleveland, OH 44131

Williams, R. M., Genova Inc., 7034 East Court Street, Davison, MI 48423

Williams, Anthony L., M&T Chemicals, One Woodbridge Center, Woodbridge, NJ 07095

Witman, Robert, Carstab Corporation, West Street, Reading, OH 45215

NATIONAL SANITATION FOUNDATION
COUNCIL OF PUBLIC HEALTH CONSULTANTS
(1984)

Chairman, Middendorf, William B., Special Project Manager, Susquehanna River Basin Commission, 1721 North Front Street, Harrisburg, PA 17102

Vice Chairman, Wellings, Flora Mae, ScD, Director of Epidemiology Research Center, Department of Health and Rehabilitative Services, 4000 West Buffalo Avenue, Tampa, FL 33614

Secretary, Sherlaw, Gary W., National Sanitation Foundation, 3475 Plymouth Road, P.O. Box 1468, Ann Arbor, MI 48106

Baker, Ned E., AHEC Program Director, Medical College of Ohio, CS No. 10008, Toledo, OH 43699

Banks, Arthur L., Director, Retail Food Protection Branch, HFF-342, Food and Drug Administration, USPHS, 200 C Street SW, Washington, DC 20204

Broadway, William A., Jr., Regional Sanitarian, 22 Asbury Road, Asheville, NC 28804

Cotruvo, Joseph, PhD, Director, Criteria and Standards Division, Office of Drinking Water (WH-550), USEPA, Washington, DC 20460

DeRoos, Roger L., PhD, Director, Environmental Health and Safety GS-05, University of Washington, Seattle, WA 98195

Doull, John, MD, PhD, Department of Pharmacology, University of Kansas Medical Center, Kansas City, KS 66103

Eich, Henry F., 2615 Lincoln Avenue, Belmont, CA 94002

Foster, Charles K., PE, Chief, Bureau of Environmental Health, Texas Department of Health, 1100 West 49th Street, Austin, TX 78756

Gordon, Larry J., Director, Environmental Health Department, PO Box 1293, Albuquerque, NM 87103

Gray, Melville W., Deputy Director of Environment, Department of Health and Environment, Forbes Field/Building 470, Topeka, KS 66620

Herndon, Col. J. Earl, Jr., Chief Sanitary Engineer, Medical Services Corps, Office of the Surgeon General, Headquarters, Department of the Army, Washington, DC 20310

Hickman, J. Roy, Director, Bureau of Chemical Hazards, Health and Welfare Canada, Tunney's Pasture, Ottawa, Ontario, Canada K1A 0L2

Hilbert, Morton S., Department of Environmental and Industrial Health, School of Public Health, University of Michigan, Ann Arbor, MI 48109

Jackson, Robert S.,MD, Health Commissioner, South Carolina Department of Health and Environmental Control, 2600 Bull Street, Columbia, SC 29205

Kelley, William, Chief, Division of Water Supply, Bureau of Environmental and Occupational Health, Michigan Department of Public Health, 3500 North Logan, Box 30035, Lansing, MI 48909

Kupfer, George A., Director, Bureau of Consumer Protection and Environmental Health, 841 North Broadway - Room 105, Milwaukee, WI 53202

Lindsey, Alfred W., Deputy Director, Hazardous and Industrial Waste Division, Office of Solid Wastes (WH-565), US Environmental Protection Agency, Washington, DC 20460

Marsh, Boyd T., Director, Environmental Health Division, Summit County General Health District, 1100 Graham Circle, Cuyahoga Falls, OH 44224

McIntire, Matilda S., MD, Creighton School of Medicine, Pediatrics Department, 601 North 30th Street - Suite 6820, Omaha, NE 68131

Menzel, Daniel B., PhD, Professor of Pharmacology and Medicine, Duke University Medical Center, Box 3813, Durham, NC 27710

Mitchell, H. Clifford, 104 Magnolia Court, Pine Knoll Shores, Route 3, Morehead City, NC 28557

Mood, Eric W., Associate Clinical Professor, Yale University School of Medicine, Department of Laboratory Epidemiology and Public Health, 60 College Street, New Haven, CT 06510

Morgan, Monroe T., DrPH, Professor and Chairman, Department of Environmental Health, East Tennessee State University, PO Box 22960A, Johnson City, TN 37614

Olson, Donald E., Chief, Division of Environmental Health, Omaha-Douglas County Health Department, 1819 Farnam Street - Room 1113, Omaha, NE 68183

Peabody, Frank R., PhD, Professor and Associate Chairman, Department of Microbiology and Public Health, Michigan State University, East Lansing, MI 48824

Pickard, Ralph C., Assistant Commissioner for Environmental Health, Indiana State Board of Health, 1330 West Michigan Street, P.O. Box 1964, Indianapolis, IN 46206

Pitts, Travis, Assistant Chief, Department of Housing and Community Development, 6007 Folsom Boulevard, P.O. Box 1407, Sacramento, CA 95807

Preston, David, Executive Director, American Water Works Association, 6666 West Quincy, Denver, CO 80235

Rhodes, Martha E., PhD, Assistant Commissioner, Florida Department of Agriculture and Consumer Services, Capitol, Tallahassee, FL 32301

Sorg, Thomas J., Environmental Protection Agency, Office of Research and Development, 26 West St. Clair, Cincinnati, OH 45268

Young-Horvath, Viola Mae, PhD, 5203 Bangor Drive, Kensington, MD 20795

***THE HOPE OF MANKIND** rests in the ability of man to define and seek out the environment which will permit him to live with fellow creatures of the earth, in health, in peace, and in mutual respect.*

852401