



The information contained in this publication is based on current information and product design at the time of publication and is subject to change without notification. Our ongoing commitment to product improvement may result in some variation. No representations, guarantees or warranties of any kind are made as to its accuracy, suitability for particular applications or results to be obtained therefrom. For verification of technical data or additional information not contained herein, please contact Spears® Technical Services Department [West Coast: (818) 364-1611 - East Coast: (678) 985-1263].

## **PURPOSE OF THIS MANUAL**

This manual is intended as a resource for use by specification engineers, installers, and users in the selection, design and installation of CPVC marine systems installed using Spears® piping systems. All information contained within this manual is considered vital to obtain proper system performance and must be read and fully understood before attempting to install these products. If you have any questions about the safe and proper installation of these products, contact Spears® Manufacturing Company, 15853 Olden Street, Sylmar CA 91342 USA, Telephone (818) 364-1611.

## **Spears® CPVC Material**

### **CPVC**

Chlorinated polyvinyl chloride (CPVC) is created by post chlorination of the PVC polymer. This produces up to a 60°F higher heat handling capability than PVC and greater fire resistance, plus a broad range of chemical resistance. CPVC is excellent for use in marine process piping, hot and cold water service and other elevated temperature applications. CPVC provides relatively low cost compared to alternative materials for similar use.

CPVC pipe is manufactured by extrusion and CPVC fittings are manufactured by injection molding or fabrication. Spears® produces a variety of CPVC pipe, fittings, valves, systems accessories and specialty systems.

Spears® high quality CPVC compounds provide optimum chemical and corrosion resistance with a full range of pressure handling capabilities. Spears® CPVC materials are certified by NSF International to applicable standards including NSF® Standard 61 for use in potable water service, certified lead-free, and to ASTM D1784, Rigid Poly (Vinyl Chloride) (PVC) Compound and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds that specifies Cell Classification for minimum physical property requirements.

### **System Integrity**

Spears® EverTUFF® CPVC marine schedule 40/80 piping systems have been developed and designed to be used as a total marine system consisting of pipe, fittings, accessories, solvent cement and thread sealant. All Spears® EverTUFF® components should be used in order to ensure a sound marine piping system. Substitution of other products for Spears® EverTUFF® CPVC marine pipe, fittings, or solvent cement may be detrimental to system integrity and is not recommended. The Spears® Limited Lifetime Warranty does not cover problems occurring within the marine piping system as the direct result of non-use of Spears® EverTUFF® CPVC marine system products. Spears® EverTUFF® CPVC marine schedule 40/80 piping systems are approved for use in non-essential spaces of a vessel by ABS and U.S. Coast Guard. Consult with Spears® Manufacturing Company for more information or visit [www.spearsmfg.com/marine.htm](http://www.spearsmfg.com/marine.htm).

### **Watertight Deck & Bulkhead Penetrations**

Spears® CPVC marine products can be installed in deck and bulkhead penetrations according to their respective approval requirements. Be sure to check the fire stop system and CPVC material compatibility with the fire stop manufacturer. For more information please contact our Technical Support Department at (818) 364-1611.

Where it is intended to pass plastic pipes through bulkheads or decks, the original integrity of watertight bulkheads and decks is to be maintained at the location. If the bulkhead or deck is also a fire division and destruction by fire of plastic pipes may cause inflow of liquid from a tank, then a metallic shutoff valve operable from above the bulkhead deck is to be fitted at the bulkhead or deck.

Note: Spears® marine approved products have not been tested for "A", "B" or "F" class divisions in accordance with IMO resolution A.754(18), Recommendation on Fire Resistance Tests for "A", "B" and "F" Class Divisions.

### **Penetrating Structural Members**

**Wood Beams**-Spears® EverTUFF® CPVC marine piping can be passed through beams without use of sleeves or insulators. Drill hole 1/4" larger than pipe diameter to allow for expansion and contraction. Floating pipe through beams is advisable.

**Steel Beams**-When EverTUFF® CPVC marine piping passes through steel beams, use compatible plastic insulators, rubber grommets, pipe insulation or similar devices to prevent abrasion and noise. Floating pipe through beams is advisable.

**Important:** Do not penetrate beams, columns or structural members before consulting design engineer.

"Lead Free" low lead certification - unless otherwise specified, all Spears® Plastic Piping specified here-in are certified by NSF International to ANSI/NSF® Standard 61, Annex G and is in compliance with California's Health & Safety Code Section 116825 (commonly known as AB 1953) and Vermont Act 193. Weighted average lead content <=0.25%.



# CPVC Performance Engineered and Tested



**SPEARS® EverTUFF® CPVC Marine pipe and fitting designs combine years of proven experience with computer generated stress analysis to yield the optimum physical structure and performance for each fitting. Material is uniformly placed in areas of high stress concentration for substantially improved pressure handling capability. Resulting products are subjected to numerous verification tests to assure the very best CPVC marine piping products available.**

## **1/2" Through 12" Availability**

Spears® comprehensive line of CPVC marine fittings and pipe offers a variety of configurations in Schedule 80 sizes 1/2" through 12".

## **Exceptional Chemical & Corrosion Resistance**

Unlike metal, CPVC fittings never rust, scale or pit, and will provide many years of maintenance-free service and extended system life.

## **Higher Temperature Ratings**

High Temperature CPVC thermoplastics can handle fluids at service temperatures up to 200°F, allowing a wide range of process applications.

## **Higher Flow Capacity**

Smooth interior walls result in lower pressure loss and higher volume than conventional metal fittings.

## **Lower Installation Costs**

Substantially lower material costs than copper or steel combined with lighter weight and ease of installation, can reduce installation costs by as much as 60% over conventional metal systems.

## **1/2" Through 12" CPVC Marine Pipe Availability**

Spears® premium quality CPVC Schedule 80 is offered in sizes 1/2" through 12". Schedule 40 CPVC marine pipe is also available.

## **United States Coast Guard Approval**

Spears® EverTUFF® Marine Schedule 40 and Schedule 80 CPVC pipe and Schedule 80 fittings are USCG Approved for use in non-essential marine and offshore applications in nominal pipe sizes 1/2" through 12". Spears® USCG approval details and restrictions are available on the USCG equipment search website at [www.cgmix@uscg.mil](http://www.cgmix@uscg.mil).

## **American Bureau of Shipping (ABS) Type Approval**

Spears® EverTUFF® Marine Schedule 40 and Schedule 80 CPVC pipe and Schedule 80 fittings are ABS Type Approved for use in non-essential marine and offshore applications in nominal pipe sizes 1/2" through 12". Type Approval details and restrictions are available on the ABS website at [www.eagle.org](http://www.eagle.org).



## General Information

### Recommendations for Installers and Users

Plastic piping systems should be **ENGINEERED, INSTALLED** and **OPERATED** in accordance with **ESTABLISHED DESIGN AND ENGINEERING STANDARDS AND PROCEDURES** for plastic piping systems. Suitability for the intended service application should be determined by the installer and/or user prior to installation of a plastic piping system. **PRIOR TO ASSEMBLY, all piping system components should be inspected for damage or irregularities. Mating components should be checked to assure that tolerances and engagements are compatible. Do not use any components that appear irregular or do not fit properly. Contact the appropriate manufacturer of the component product in question to determine usability. Consult all applicable codes and regulations for compliance prior to installation.**

**Solvent Weld Connections** - Use Marine-24 solvent cement and primers formulated for the intended service application, pipe size and type of joint. While the pipe and fitting materials may be compatible with the intended medium, the solvent cement may not be. Consult the manufacturers for suitability of use. Read and follow the cement and primer manufacturers' applications and cure time instructions thoroughly. Be sure to use the correct size applicator.

**Threaded Connections** - Use a quality grade thread sealant. **WARNING: SOME PIPE JOINT COMPOUNDS OR PTFE PASTES MAY CONTAIN SUBSTANCES THAT COULD CAUSE STRESS CRACKING TO PLASTIC.** Spears® Manufacturing company recommends the use of Spears® **BLUE 75™** Thread Sealant which has been tested for compatibility with Spears® products. Please follow the sealant manufacturers' application/installation instructions. Choice of an appropriate thread sealant other than those listed above is at the discretion of the installer. 1 to 2 turns beyond **FINGER TIGHT** is generally all that is required to make a sound plastic threaded connection. Unnecessary **OVERTIGHTENING** will cause **DAMAGE TO BOTH PIPE AND FITTING.**

### EverTUFF® Marine Schedule 40/80 Pipe & Fittings Sample Engineering Specification

Spears® EverTUFF® Marine Schedule 40 and Schedule 80 pipe and Schedule 80 fittings shall be manufactured by Spears® Manufacturing Company from a Type IV, Grade I Chlorinated Polyvinyl Chloride (CPVC) compound with a Cell Classification of 23447 per ASTM D1784. The pipe and fittings shall be manufactured in strict compliance to ASTM F441 and ASTM F439 respectively consistently meeting the quality assurance test requirements of these standards. All Spears® EverTUFF® marine pipe and fittings shall be manufactured in the U.S.A. The pipe shall be provided with plain end in 20 foot or 10 foot cut lengths as specified and wrapped for protection. All Spears® EverTUFF® marine CPVC pipe and fittings shall be certified by NSF International for potable water applications and marked accordingly and available in sizes 1/2" through 12". All Spears® EverTUFF® marine CPVC schedule 40 and schedule 80 pipe shall be approved by the United States Coast Guard, meet the low flame spread requirements and smoke and toxicity requirements of the 2010 FTP Code Annex 1, Parts 2 and 5, and may be installed in accommodation, service and control spaces without meeting the additional requirements of 46 CFR 56.60-25(a)(2) as manufactured by Spears® Manufacturing Company.

All EverTUFF® Marine CPVC Schedule 40 and Schedule 80 pipe and Schedule 80 fittings shall be approved by the American Bureau of Shipping (ABS) and meet IMO FTP Code Annex 1, Part 5 for Surface Flammability and Part 2 for smoke and toxicity with a Limited Lifetime Warranty as manufactured by Spears® Manufacturing Company. Offshore applications for non-essential systems including fresh water, potable water and brine in services requiring no fire endurance testing or electrical conductivity testing. Piping to be used in non-hazardous areas only.

"Lead Free" low lead certification - unless otherwise specified, all Spears® Schedule 80 fittings specified here-in are certified by NSF International to ANSI/NSF® Standard 61, Annex G and is in compliance with California's Health & Safety Code Section 116825 (commonly known as AB1953) and Vermont Act 193. Weighted average lead content <=0.25%.



**Marine & Offshore Technical**  
**EverTUFF® CPVC Marine System Design & Installation Guide**

**Typical Physical Properties of Spears® EverTUFF® CPVC Material**

| <b>GENERAL</b>                              | <b>CPVC Value</b>        | <b>Test Method</b> |
|---|--------------------------|--------------------|
| Cell Classification                         | 23447                    | ASTM D 1784        |
| Maximum Service Temperature                 | 200°F                    |                    |
| Color                                       | Medium Gray              |                    |
| Specific Gravity, (g/cu.cm @ 73°F)          | 1.51                     | ASTM D 792         |
| Water Absorption % increase 24 hrs @ 25°C   | 0.03                     | ASTM D 570         |
| Hardness, Rockwell                          | 117 - 119                | ASTM D 785         |
| Poisson's Ratio @ 73°F                      | 0.370                    |                    |
| <b>MECHANICAL</b>                           |                          |                    |
| Tensile Strength, psi @ 73°F                | 7,900                    | ASTM D 638         |
| Tensile Modulus of Elasticity, psi @ 73°F   | 426,000                  | ASTM D 638         |
| Flexural Strength, psi @ 73°F               | 15,000                   | ASTM D 790         |
| Flexural Modulus, psi @ 73°F                | 360,000                  | ASTM D 790         |
| Compressive Strength, psi @ 73°F            | 10,000                   | ASTM D 695         |
| Izod Impact, notched, ft-lb/in @ 73°F       | 2.9                      | ASTM D 256         |
| <b>THERMAL</b>                              |                          |                    |
| Coefficient of Linear Expansion (in/in/°F)  | $3.2 \times 10^{-5}$     | ASTM D 696         |
| Coefficient of Thermal Conductivity         |                          | ASTM C 177         |
| Calories • cm/second • cm <sup>2</sup> • °C | $3.27 \times 10^{-4}$    |                    |
| BTU • inches/hour • Ft <sup>2</sup> • °F    | 0.95                     |                    |
| Watt/m/K                                    | 0.137                    |                    |
| Heat Deflection Temperature                 |                          |                    |
| Under Load (264 psi, annealed)              | 235                      | ASTM D 648         |
| <b>ELECTRICAL</b>                           |                          |                    |
| Dielectric Strength, volts/mil              | 1,250                    | ASTM D 149         |
| Dielectric Constant, 60Hz, 30°F             | 3.70                     | ASTM D 150         |
| Volume Resistivity, ohm/cm @ 95°C           | $3.4 \times 10^{12}$     | ASTM D 150         |
| Spears® CPVC Pipe is non-electrolytic       |                          |                    |
| <b>FIRE PERFORMANCE</b>                     |                          |                    |
| Flammability Rating                         | V-0, 5VB, 5VA            | UL-94              |
| Flame Spread-Smoke Development-Toxicity     | Annex 1, Part 5 & Part 2 | 2010 FTP Code      |
| Flash Ignition Temp.                        | 900°F                    |                    |
| Average Time of Burning (sec.)              | <5                       | ASTM D 635         |
| Average Extent of Burning (mm)              | <10                      |                    |
| Burning Rate (in/min)                       | Self Extinguishing       |                    |
| Limiting Oxygen Index (LOI)                 | 60                       | ASTM D 2863        |

**Note:** The physical properties shown above are considered general for CPVC. Contact Spears® Technical Services for additional information if necessary.



## FLOW VELOCITY & FRICTION LOSS

### Friction Loss Through Pipe

The Hazen-Williams equation below is widely used to calculate friction loss for water through CPVC pipe

$$f = .2083 \times (100/C)^{1.852} \times \frac{G^{1.852}}{d_i^{4.8655}}$$

Where:

f = Friction head of feet of water per 100' for the specific pipe size and I.D.

C = A constant for internal pipe roughness (=150 for thermoplastic pipe)

G = Flow rate of U.S. gallons per minute

d<sub>i</sub> = Inside diameter of pipe in inches

### Friction Loss Through Fittings

Friction loss through fittings is expressed in equivalent feet of the same pipe size and schedule for the system flow rate.

#### Average Friction Loss for CPVC Fittings in Equivalent Feet of Straight Run Pipe

| Item       | 1/2 | 3/4 | 1   | 1-1/4 | 1-1/2 | 2    | 2-1/2 | 3    | 4    | 6    | 8    | 10   | 12   |
|------------|-----|-----|-----|-------|-------|------|-------|------|------|------|------|------|------|
| Tee Run    | 1.0 | 1.4 | 1.7 | 2.3   | 2.7   | 4.0  | 4.9   | 6.1  | 7.9  | 12.3 | 14.0 | 17.5 | 20.0 |
| Tee Branch | 3.8 | 4.9 | 6.0 | 7.3   | 8.4   | 12.0 | 14.7  | 16.4 | 22.0 | 32.7 | 49.0 | 57.0 | 67.0 |
| 90° Ell    | 1.5 | 2.0 | 2.5 | 3.8   | 4.0   | 5.7  | 6.9   | 7.9  | 11.4 | 16.7 | 21.0 | 26.0 | 32.0 |
| 45° Ell    | .8  | 1.1 | 1.4 | 1.8   | 2.1   | 2.6  | 3.1   | 4.0  | 5.1  | 8.0  | 10.6 | 13.5 | 15.5 |

### Pressure Drop In Valves & Strainer

Pressure drop calculations can be made for valves and strainers for different fluids, flow rates, and sizes using the CV values and the following equation:

Where:

$$P = \frac{(G)^2(S_g)}{(C_v)^2}$$

$$P = \text{Pressure drop in PSI; feet of water} = \frac{\text{PSI}}{.4332}$$

G = Gallons per minute

C<sub>v</sub> = Gallons per minute water per 1 PSI pressure drop

S<sub>g</sub> = Specific gravity of liquid (water = 1)

### C<sub>v</sub> Values for Select Spears® Valves and Strainers

| Nominal Size                            | 1/2 | 3/4 | 1   | 1-1/4 | 1-1/2 | 2   | 2-1/2 | 3    | 4    | 6    | 8    | 10   | 12   |
|---|-----|-----|-----|-------|-------|-----|-------|------|------|------|------|------|------|
| True Union 2000 Ball Valve <sup>1</sup> | 29  | 63  | 120 | 243   | 357   | 599 | 856   | 1416 | 2865 | 1952 | --   | --   | --   |
| True Union 2000 Ball Check Valve        | 6.3 | 17  | 25  | 65    | 86    | 130 | 200   | 275  | 500  | 800  | --   | --   | --   |
| Butterfly Valve (90° - Full Open)       | --  | --  | --  | --    | 81    | 109 | 192   | 345  | 411  | 1125 | 2249 | 4440 | 6309 |

1 - Full Port Ball Valve Cv based on equivalent length of Schedule 80 pipe

### Water Velocities

Velocities for water in feet per second at different GPM's and pipe inside diameters can be calculated as follows:

$$V = .3208 \frac{G}{A}$$

Where:

V = velocity in feet per secondr minute

G = gallons per minute

A = inside cross sectional area in square inches