Hot & Cold Water Distribution Systems

Spears® EverTUFF® Copper Tube Size (CTS) CPVC is a complete hot and cold water plumbing system consisting of pipe, fittings and solvent cement for plumbing applications. Spears® EverTUFF® CTS CPVC pipe is easily joined using solvent cement welding, is light weight, thermally efficient and code approved to provide cost-effective long-term system service.

Product Standards

Spears® EverTUFF® CTS pipe and fittings are manufactured in strict compliance to ASTM D 2846, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot and Cold-Water Distribution Systems. This standard defines requirements for materials, workmanship, dimensions, tolerances, pressure-bearing capability, and thermocycling resistance. Spears® EverTUFF® CTS SDR 11 plumbing pipe and fittings are manufactured to specifications in accordance with this standard. SDR series pipe is based on an outside-diameter-to-wall- thickness ratio. This is a constant regardless of pipe diameter, therefore all sizes of pipe carry the same pressure rating of 100 psi @ 180°F and is suitable for use with commercial hot water.

Performance Testing

Spears® EverTUFF® CTS CPVC pipe is tested and independently certified by NSF International to the requirements of ASTM D 2846 under NSF Standard 14 and for use in potable (drinking) water service under NSF Standard 61.

Code Approvals

Major building codes have approved the use of CPVC piping as an acceptable material for plumbing systems, provided that the piping conforms to applicable industry standards and has been listed by a third party for conformance to NSF Standard 14 and/or NSF Standard 61 requirements. Code bodies that accept the use of CPVC include BOCA National Plumbing Code, National Standard Plumbing Code, SBCCI Standard Plumbing Code, International Plumbing Code, and the Uniform Plumbing Code to name a few. The user should determine approval and installation requirements according to local code having jurisdiction prior to use.

Dimensions

CPVC CTS Series pipe shall be manufactured in strict accordance to the requirements of ASTM D 2846 to SDR 11 dimensions and tolerances. Each production run of pipe manufactured in compliance to this standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening resistance, and extrusion quality and dimensions as defined in ASTM D 2846. This pipe shall be produced in CTS diameters (1/2" through 2" sizes) to SDR 11 specifications.

Nominal Pipe Size (in.)	Average O.D.	O.D. TOL	Average I.D.	Min. Wall	Rating @ Wt./ft.	PSI Pressure Rating @ 73°F	PSI Pressure Rating @ 180°F
1/2	0.625	±.003	0.469	0.068	0.090	400	100
3/4	0.875	±.003	0.695	0.080	0.149	400	100
1	1.125	±.003	0.901	0.102	0.240	400	100
1-1/4	1.375	±.003	1.105	0.125	0.353	400	100
1-1/2	1.625	±.004	1.309	0.148	0.489	400	100
2	2.125	±.004	1.716	0.193	0.829	400	100

PIPE SIZES SHOWN ARE MANUFACTURED IN STRICT COMPLIANCE WITH ASTM D 2846 ASTM STANDARD D 1784 MATERIAL EQUIVALENTS:
Cell Classification 23447 = PVC Type IV Grade I CPVC = CPVC 4120

Pressure Ratings

The Spears® CPVC system, including the joint, has a continuous rated working pressure of 100 psi at 180°F or 400 psi at 73°F. CPVC systems have the capability to withstand short term temperature/pressure increases above 100 psi at 180°F, as evidenced by their ability to consistently surpass the 48-hour, 150-psi Uniform Building Code test at 210°F. CPVC pipe should not be used where temperatures will consistently exceed 180°F.

Pressure-Temperature De-Rating Factors
For CTS CPVC 4120 SDR 11 Piping Systems

°F	Factor	Rating, PSI
73	1.00	400
80	1.00	400
90	0.91	360
100	0.82	325
120	0.65	260
140	0.50	200
160	0.40	160
180	0.25	100

The pressure de-rating factor is the same for all pipe sizes. Example: Determine the maximum allowable operating pressure for a CTS CPVC piping system with an operating temperature of 140°F. Using de-rating factor of 0.50 for 140° from the above chart, the maximum allowable operating pressure = 400 x 0.50 = 200 psi.

Installation

Installation shall be in accordance with the requirements of the local code having jurisdiction, the solvent cement manufacturer recommendations, and Spears® publication CTS-3, CPVC CTS Products Design and Installation Manual.

Joining Methods

Spears® EverTUFF® CTS CPVC pipe is easily joined by standard solvent cementing process, threaded connections and flanges Solvent Cement Welding.

Solvent Cement Welding

This is the most common joining method used with CTS CPVC See Installation section for industrial pressure pipe for basic solvent cementing guidelines.

CTS Solvent Cement Selection

Codes require use of solvent cement conforming ASTM F 493 and designated specifically for use with CTS CPVC products in accordance with ASTM D 2846. Spears® EverTUFF® CTS-5 CTS CPVC "One-step" (primerless) cements may be used without primer if codes permit, or may be used with a primer where required by code - always CHECK LOCAL CODES.

Set and Cure Times

Pipe and fitting joint assembly must be allowed to set without any stress on the joint for one to five minutes depending on the pipe size and temperature. Following the initial set period, the assembly can be handled carefully.

FOLLOW THE CEMENT MANUFACTURER'S RECOMMENDED CURE TIMES PRIOR TO PRESSURE TESTING – FAILURE TO DO SO WILL RESULT IN JOINT FAILURE.

Minimum Cure Time Prior to Testing at 150 psi with Cold Water (based on use of one-step CPVC cement or two-step cement systems)

Pipe Size (in.)	Ambient Temperature During Cure Tim		
	>60°F	40°F - 60°F	<40°F
3/8	1 hr	2 hrs	4 hrs
1/2	1 hr	2 hrs	4 hrs
3/4	1 hr	2 hrs	4 hrs
1	1 hr	2 hrs	4 hrs
1-1/4	2 hrs	4 hrs	8 hrs
1-1/2	2 hrs	4 hrs	8 hrs
2	2 hrs	4 hrs	8 hrs

NOTE Wait 24 hours prior to putting system into hot water service when installed at cure temperatures above 60°F; wait 48 hours prior to putting system into hot water service when installed at cure temperatures below 40°F Solvent Cement Joining

Wall Penetration

Building codes require that a fire-rated wall or floor must be sealed back to its original integrity when penetrated. Several sealants and materials are suitable for use with Spears® EverTUFF® CTS CPVC pipe to construct an appropriate UL Classified fire-rated penetration system. (When installed properly, these systems will provide a two-hour fire rating. Consult local building code requirements.

NOTE Caution: Certain fire-stopping sealants and components contain stress cracking agents and other chemicals which may cause damage to CPVC piping; contact the appropriate manufacturer for compatibility with CPVC prior to use.

NOTE When installing CPVC in areas where the system must be drained to protect it from freezing, the lines must be sloped to drain.

Underslab Installations

Spears® EverTUFF® CTS CPVC products are approved for underslab installations (with joints) in all model-plumbing codes. When performing underslab installations, it is important to support the tube evenly on a smooth surface. The bedding and backfill should be sand or clean soil that is free from sharp rocks and other debris that could damage the pipe.

Underslab installations that contain joints must be pressure tested before pouring the slab. **NOTE:** IAPMO IS 2098, "Installation Standard for CPVC Solvent Cemented Hot and Cold Water Distribution Systems," requires a test at 150 psi for 2 hours. The pipe should be sleeved where it penetrates the slab, along with construction joints within the slab. Spears® EverTUFF® CTS pipe is also manufactured in coils for underslab installations to eliminate joints. When turning coiled pipe up through a slab, into walls, etc., make sure the pipe does not kink. Sections of pipe that contain kinks must be cut out and replaced.

Freeze Protection/Sunlight Exposure

CPVC piping must be protected from freezing in all installation locations. Attention shall be paid to local insulating techniques and codes that require a particular method. Use only methods and materials suitable for use with CPVC piping. Where freezing is not an issue, CPVC shall not be installed so as to be subject to direct sunlight after installation and not installed on the surface of a building, unless protected by a covering or a chemically compatible paint, such as water based Latex.

Hose Bibb Installation

Hose bibbs are to be connected only to metal system components which are adequately anchored to the building structure. CPVC plastic systems must terminate in the wall.

Water Heater Connections

Before attempting to use Spears® EverTUFF® CTS CPVC in water heater connections, determine if local plumbing codes contain detailed requirements for connections to gas or electric storage-type heaters.

DO NOT use Spears® EverTUFF® CTS CPVC products with commercial-type, non-storage water heaters.

For areas where local plumbing codes do not have requirements, the following information can be used as a guide for water heater connections:

• On electric water heaters, CPVC can be joined directly to the heater, using metal-to-CPVC transition fittings.

• On high-efficiency gas water heaters that use plastic vent piping, CPVC can be joined directly to the heater in the same way as an electric water-heater connection.

• On all other gas water heaters, there should be at least 6" of clearance between the exhaust flue and any CPVC tubing. A minimum of 6" metallic pipe should connect directly to the heater so that the CPVC tubing cannot be damaged by the buildup of excessive, radiant heat from the flue.

• A temperature/pressure relief valve should be installed so that the sensing element contacts the water at the top of the heater.

• Spears® EverTUFF® CTS CPVC products are approved by all model codes for use as relief-valve drain lines. A metal-to-CPVC transition fitting should be used to connect the tubing to the relief valve, with the tubing continued to the outlet. Both horizontal and vertical pressure relief drain should be supported every 3 feet. For horizontal runs, slope the tubing toward the outlet. Pipe must discharge to the atmosphere at an approved location.

• Instantaneous water heaters (i.e., under sink units) require at least 6" of metallic pipe connected to heater inlet and no CVPC installed down stream.

TRANSITION JOINTS AND FITTINGS

Spears® EverTUFF® CTS CPVC pipe can be connected to copper, brass, valves, and other materials using a variety of transition fittings including unions, compression fittings, specially reinforced male and female adapters, flanged joints, grooved joints and other readily available transition fittings.

Do not thread CPVC pipe and do not use regular CPVC female threaded fittings. Regular CPVC male threaded fittings shall only be used on cold water applications. Special reinforced male adapters, female adapters and other fittings with brass threads are recommended for hot water applications and threaded transitions to metal pipe. All approved threaded CPVC joints must be accessible. (See also Water Heater Connections section for additional installation details).

Standard compression fittings with brass ferrules can be used; however, TFE tape must be applied over the brass ferrule to compensate for the dissimilar thermal expansion rates between the brass and CPVC. Caution must be exercised to prevent over tightening of compression fittings. Use extreme care when soldering any metal system to prevent flame contact with or heat distortion in CPVC pipe and fittings .

Assembling Threaded Connections

Threaded connections require the application of a thread sealant that is compatible with CPVC material. Spears® recommends the use of Spears® Blue 75 Thread Sealant. Apply sealant to the male threads only. Make sure all threads are covered. DO NOT clog the waterway with excess sealant. If TFE tape is used, Spears® recommends a thickness of at least .0025" that meets or exceeds military specification, MIL-T-27730A. DO NOT use a combination of tape and thread sealant on the same joint. Apply TFE tape in the direction of the threads by starting with the first full thread and continuing over the entire thread length. Make sure all threads are covered. Generally, 2 - 3 wraps are sufficient to produce a watertight connection.

DO NOT over-torque any threaded connections. Generally, one to two turns beyond finger-tight are required for a threaded connection. Factory testing has indicated that 10 - 25 ft-lbs of torque is adequate to obtain a leak-free seal. Spears® recommends the use of a strap wrench when installing threaded connections.

Hanger/Support Spacing

Spears® EverTUFF® CTS CPVC pipe is rigid, it requires fewer supports than flexible, plastic systems.

Vertical runs should be supported at each level so that the weight of the run is not placed on a fitting or a joint. Horizontal runs require support every 3 feet for 1/2" - 1" diameter pipe and every 4 feet for 1-1/4" and larger diameters. Support spacing should be in accordance with applicable local codes. Horizontal runs must be braced so that the stress loads (caused by bending or snaking) will not be placed on a fitting or a joint. Hanger support spacing information is shown in Table A.

Spears® recommends that hangers, designed for supporting CPVC, be used to support CPVC piping. However, some hangers, designed for steel pipe, may be used if their suitability is clearly established. These hangers must be selected to accommodate the specific pipe size. In addition, they cannot contain rough or sharp edges that contact the pipe, and they must not bind the pipe from axial movement that is caused by expansion and contraction.

Pipe Size (in.)	Maximum Hanger Support Spacing
3/8	3 ft
1/2	3 ft
3/4	3 ft
1	3 ft
1-1/4	4 ft
1-1/2	4 ft
2	4 ft

Thermal Expansion

All piping systems expand and contract with changes in temperature. This issue must be addressed with appropriate system design to prevent damage to the system. Spears® EverTUFF® CTS CPVC pipe will expand or contract approximately 3.8 inches per 100 feet of pipe with every 100°F of temperature rise or fall. The effects of expansion/contraction are usually absorbed by the system at changes of direction in the piping. In other words, long, straight runs of piping are more susceptible to experiencing measurable movement with changes in temperature. As with other piping materials, the installation of an expansion loop or offset is required on long, straight runs which will allow the piping system to absorb the forces generated by expansion/contraction without damage. The rate of expansion does not vary with pipe size. The effects of expansion/contraction are more pronounced on hot water lines. See Thermal Expansion & Contraction section under Engineering and Design Data for Industrial Piping in this manual for information on calculating movement and expansion loops.

System Testing

Once the system has been installed and allowed to cure properly the system shall be tested in accordance with applicable code requirements. When testing with water (hydrostatic testing), the system must be slowly filled with water and the air bled from the highest and furthest points in the system before test pressure is applied. Air must be removed from piping systems to prevent it from being locked in the system when pressure is applied. Failure to do so could be harmful to job site personnel should a failure occur. If a leak is found, the affected product must be cut out and discarded. A new section can be installed using couplings or other approved means.