System Design & Installation

Product Ratings and Capability

Spears® low-extractable piping is produced to Schedule 80 dimensions in strict accordance with ASTM D 1785, and exhibits a Type II pressure rating. Fittings are produced to Schedule 80 dimensions per ASTM D 2467. Joining of product produced to the dimensional requirements of these standards ensures that strong connections with good pressure-bearing capability can be made up quickly and consistently using common, inexpensive tools. Utilizing these dimensions provides a higher pressure-bearing capacity compared to other "clean" systems on the market, and permits the use of standard socket dimensions.

Dimensions

Nominal Pipe Size (in.)	Average O.D.	Average I.D.	Minimum Wall	Nominal Weight Lbs./ft.	Max.W.P. PSI*
1/2	.840	.528	.147	.202	420
3/4	1.050	.724	.154	.273	340
1	1.315	.935	.179	.402	320
1-1/4	1.660	1.256	.191	.554	260
1-1/2	1.900	1.476	.200	.673	240
2	2.375	1.913	.218	.932	200
3	3.500	2.864	.300	1.903	190
4	4.500	3.786	.337	2.782	160
6	6.625	5.709	.432	5.313	140

*PSI water, non-shock @ 73°F with solvent-welded connections. System pressure rating dependent on component pressure ratings (i.e., flanges, all sizes = 150 psi max @ 73° F)

Temperature De-rating Factor

Operating Temprature (°F)	De-rating Factor
73	1.00
80	0.88
90	0.75
100	0.62
110	0.51
120	0.40
130	0.31
140	0.22

As with all schedules of thermoplastic pipe, pressure rating is dependent on the pipe diameter as well as the operating temperature of the system. As temperatures rise, the pressure rating of the system decreases. The maximum temperature rating of Spears® low-extractable piping is 140°F. **DO NOT** use with "hot" Deionized (DI) water. Smaller-diameter piping can withstand higher pressure than large-diameter piping at elevated temperatures. Use appropriate temperature de-rating factors to determine maximum allowable pressure at elevated temperatures.

Hangers and Supports

Proper support spacing is critical to ensure that deflection is kept to a minimum. Support location and spacing is dependent on the pipe diameter, operating temperature of the system, and the location of any concentrated stress loads (i.e., valves, flanges, test equipment and any other heavy system components). Hangers used must have an adequate load-bearing surface free of any rough or sharp edges that could damage the pipe during use. Hangers also must not restrict linear movement of the system due to the effects of thermal expansion and contraction as a result of temperature changes; over-tightening must be avoided.

Hanger Support Spacing

Pipe Size (in.)	Maximum Support Spacing in Feet				
	73°F	80°F	100°F	120°F	140°F
1/2	5	4-1/2	4-1/2	3	2-1/2
3/4	5-1/2	5	4-1/2	3	2-1/2
1	6	5-1/2	5	3-1/2	3
1-1/4	6	6	5-1/2	3-1/2	3
1-1/2	6-1/2	6	5-1/2	3-1/2	3-1/2
2	7	6-1/2	6	4	3-1/2
3	8	7-1/2	7	4-1/2	4
4	9	8-1/2	7-1/2	5	4-1/2
6	10	9-1/2	9	6	5

Thermal Expansion and Contraction

As with all thermoplastic piping materials, consideration must be given during the design of the system to the effects of thermal expansion and contraction. The coefficient of linear expansion for Spears® low-extractable pipe is 3.89 x 10^{-5} in./in./°F. The rate of expansion or contraction can be calculated as follows:

$\Delta L = 12\ y L\ (T)$

Where:

ΔL = Amount of expansion or contraction in inches
y =3.89 x 10^{-5}
L =Length of piping run in feet
ΔT = Temperature change °F
(T max. - T @ time of installation or lowest system temperature or maximum system temperature, whichever is greater.)

Storage and Handling

Reasonable care and common sense should be used when handling and storing Spears® low-extractable piping products. These products are tough and corrosion resistant, but they should not be dropped or have objects dropped on them. Care should be used when transporting and storing the product to prevent physical damage. Spears® low-extractable products should not be stored or installed close to heat-producing sources, subjected to external loads or over stacked when stored. The product should be inspected for any scratches, splits or gouges. Damaged sections must be cut out and discarded.

Suitable for Oil-Free air handling to 25 psi, not for distribution of compressed air or gas
See Spears® Product Sourcebook for product offerings

Joining Techniques

Spears® low-extractable piping products are easily joined by the solvent-cementing process. Unlike conventional PVC solvent-cementing techniques, this product utilizes a **one-step solvent-cement system specifically formulated for "clean" applications.** This solvent cement exhibits extremely fast set and cure times. When properly used, this system results in very short cure times prior to pressure testing, and produces a solvent-cemented assembly with an exceptionally low percentage of chemical additives, reducing the potential for system contamination.

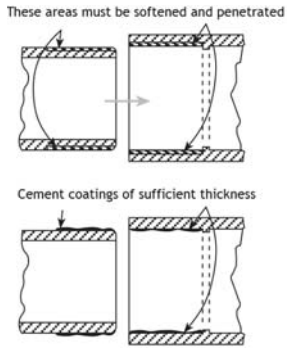
A thorough understanding of the solvent cement joining process and proper assembly techniques must be used during assembly of these products to ensure the highest system integrity. Installers must become familiar with this process prior to use.

Basic Principles of Solvent Cementing

Spears® low-extractable components are manufactured to the dimensional tolerances for Schedule 80 pipe per ASTM D 1785, and Schedule 80 socket-type fittings per ASTM D 2467. When fittings are produced to these dimensions, the ID of the fitting at the entrance of the socket is larger than the ID of the fitting at the socket bottom. The taper created by fitting socket dimensions provides an interference fit during assembly of the components. This provides a proven means for proper mating of components, ensuring adequate joint strength when properly assembled.

The following points must be clearly understood to ensure satisfactory joints are obtained consistently.

1. The joining surfaces must be softened and made semifluid.
2. Sufficient cement must be applied to fill the gap between the pipe and fitting.
3. Assembly of pipe and fitting must be made immediately while the surfaces are still wet and the cement is fluid.
4. Joint strength develops quickly as the cement dries. In the tight part of the joint, the surfaces will tend to fuse together; in the loose part of the joint the cement will bond to both surfaces.



Softening and Penetration

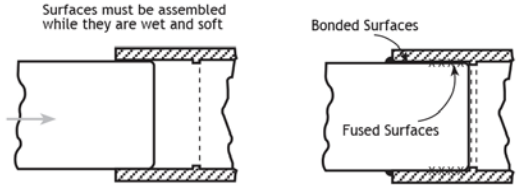
These areas must be softened and penetrated. (This can be achieved by the cement itself.)

Sufficient Application of Cement

More than sufficient cement to fill the gap in the loose part of the joint must be applied. In addition to filling the gap, adequate cement layers will penetrate the joining surfaces and remain fluid until the joint is assembled.

Joint Integrity

When the cement coating on the pipe and fittings are fluid during assembly, they will tend to flow together and become one cement layer. In addition, the surfaces beneath the cement coating will be soft from surface penetration of the cement. The softened surface areas in the tight part of the joint will tend to fuse together. As the solvent dissipates, the cement layer and the softened surfaces will harden with a corresponding increase in joint strength. The dissipation of the solvent from specially formulated one-step cement occurs very quickly due to its high evaporation rate. Joint strength develops more quickly in the tight (fused) part of the joint than in the looser (bonded) part of the joint. A properly assembled joint will take the required working pressure before the joint is fully dry and final joint strength is obtained.



Specially Formulated One-Step Cement

Use only specially formulated one-step cement for Spears® low-extractable applications using the appropriate size applicator. Carefully read and follow the label on the cement can, and application and cure time instructions thoroughly. **NOTE:** Dauber is supplied in pint-can lid (suitable for pipe sizes 1/2" - 1-1/4"). Dauber is supplied in quart-can lid (suitable for pipe sizes 1-1/2" - 3"). For pipe sizes 4" thru 6" use a roller equal in size to 1/2 the pipe diameter.

Specially formulated one-step cement is listed by NSF International and conforms to the requirements of ASTM D 2564.

Safety Precautions:

Before applying cement, appropriate safety precautions should be taken. Solvent cement should be stored in the shade between 40°F and 110°F. Eliminate all ignition sources. Avoid breathing of vapors. Use only with adequate ventilation; mechanical ventilation or local exhaust is recommended to maintain vapor concentrations below exposure limits. In confined or partially enclosed areas an organic vapor respirator is recommended. Containers should be kept tightly closed when not in use, and covered as much as possible when in use. Avoid frequent contact with skin. Wear clean rubber gloves; do not perform work with bare hands.

Component Preparation:

All pipe, fittings and tools used for joining must be clean and free of dirt, moisture, grease or other contamination prior to and during the joining process.

1. Cutting:

Cutting the pipe as squarely as possible (90°) is required, as it maximizes the bonding area of the joint. Only sharp wheel-type cutters with blades specifically designed for cutting plastic shall be used. Cutters should be rotated slowly to provide optimum cut. Cutting speeds should be further reduced at lower temperatures. The use of a saw is not recommended as filings and shavings will cause particulate contamination.

2. Deburring:

All pipe ends shall be properly chamfered by providing a 10° to 15° bevel (1/16" to 3/32" in width). A chamfering tool designed for this purpose shall be used. A proper bevel will aid in assembly and prevent solvent cement being pushed from the wall of the fitting during assembly. Burrs and filings can prevent contact between the pipe and fitting and must be removed from the outside and inside of the pipe during this process. A common practice is to place sterile gauze in the pipe end to prevent shavings from entering the pipe. The gauze is then removed prior to cement application.

3. Joining Preparation:

A. Prior to assembly, all components shall be inspected for any damage or irregularities. Mating components shall be checked to assure that tolerances and engagements are compatible. Do not use components that appear irregular or do not fit properly.

B. Check the dry fit - The pipe should enter the fitting socket easily 1/3 - 2/3 of the way. If the pipe bottoms in the fitting with little interference, use extra solvent cement in making the joint.

C. Measure the socket depth of the fitting and mark this distance on the pipe end. This reference mark can be used when joining to ensure the pipe is completely bottomed into the fitting during assembly.

4. Solvent Cement Application:

Specially formulated one-step cement shall be applied to the joining surfaces using a dauber or natural-bristle brush approximately half the diameter of the pipes being joined. Working quickly, apply a heavy, even coat of solvent cement to the pipe end on the surface equal to the depth of the fitting socket. Apply a light coat to the fitting socket. If there was little interference during the dry fit, apply a second coat of cement to the pipe end at this time. Great care must be used to prevent cement from coming into contact with the interior waterway of the fitting or pipe.

5. Assembly:

Immediately insert the pipe into the fitting socket while rotating one-quarter turn. Properly align the fitting for the installation at this time. The pipe must bottom completely to the fitting stop. Hold the assembly for approximately 30 seconds to ensure initial bonding. Due to the taper on the interference fit, the pipe can back off the fitting stop if steady pressure is not held on the joint during initial bonding. A bead of cement should be evident around the pipe and fitting juncture. If the bead is not continuous, it may indicate that insufficient cement was applied. Due to the unique translucency of Spears® low-extractable products, visual inspection of the cemented joint can be conducted utilizing a flashlight or alternate light source. Joint integrity can be readily verified by visually inspecting the cemented surfaces for uniformity. If insufficient cement is applied, the joint must be cut out, discarded and begun again. Excess cement must be wiped off from the pipe OD using a clean rag at this time.

Assembly Instructions

Set and Cure Times:

Set and cure times are a function of pipe size, temperature, pressure, humidity and tightness of fit. The initial ***set time*** is the recommended waiting period prior to handling a newly assembled joint. After the initial set time, the joints will withstand the stresses of normal installation. (Misalignment of components during assembly will cause excessive stress in the joint, which can affect joint integrity). The ***cure time*** is the recommended waiting period prior to pressurizing newly assembled joints. Minimum cure time prior to pressure testing is dependent on pipe size, temperature, humidity, tightness of fit and test pressure required. Longer cure times must be allowed when working at higher humidity and colder temperatures.

Refer to the following tables for minimum set and cure times:

Initial Set Time

Temp.	Pipe Size 1/2 - 1-1/4	Pipe Size 1-1/2 - 2	Pipe Size 2-1/2 - 6
60° - 100°F	2 minutes	3 minutes	30 minutes
40° - 60°F	5 minutes	8 minutes	2 hours
0° - 40°F	10 minutes	15 minutes	12 hours

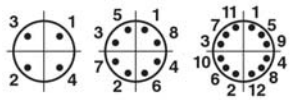
Joint Cure Schedule

Relative Humidity 60% or less*	Pipe Size 1/2 - 1-1/4		Pipe Size 1-1/2 - 2		Pipe Size 2-1/2 - 6
Temp range during assembly and cure periods	up to 160 psi	160 to 360 psi	up to 160 psi	160 to 315 psi	up to 160 psi
60° - 100°F	15 min	6 hrs	25 min	12 hrs	1-1/2 hrs
40° - 60°F	20 min	12 hrs	30 min	24 hrs	4 hrs
0° - 40°F	30 min	48 hrs	45 min	96 hrs	72 hrs

* If damp or humid weather allow 50 percent longer cure time.

Flange Installation:

1. Solvent cement flange to pipe.
2. Piping runs joined must be installed in straight-line position to the flange and supported to avoid stress and damage.
3. Rotate ring into position with gasket in place to align holes.
4. Insert all bolts, washers and nuts.
5. Mating surfaces of flanges must be flush against gasket prior to bolting.
6. Tighten by hand until snug. Tighten bolts in 5 ft.-lb. increments according to opposing sequence shown below.
7. Do not use bolts to bring improperly mated flanges together.



Bolt Torque Sequence

Flange Size (in)	Recommended Torque
1/2 - 1-1/2	12 ft-lbs
2 - 4	25 ft-lbs
6	40 ft-lbs

Installation Notes:

Installers should verify for themselves that they can make satisfactory joints under varying conditions.

Use the appropriate size applicator. Avoid puddling of solvent cement on or within fittings and pipe. This will cause excessive softening of materials, resulting in damage to the product and excessive system contamination.

Spears® low-extractable solvent-cemented assemblies cure very quickly when properly constructed, enabling pressure-bearing capability in a short time. This is a positive attribute of the system for scheduling pressure tests and repair work. However, Spears® Manufacturing Company recommends that newly assembled systems be allowed to cure for a minimum period of 24 hours prior to system rinsing/activation procedures. This reduces the potential for TOC contamination.

Spears® low-extractable piping products should not be connected directly to UV light sources that would expose system components to ultraviolet radiation.

Other Design Considerations

Proper system engineering, design, construction practices and operation are the responsibility of the design authority. Consideration must be given to ensure the Spears® low-extractable system is not exposed to any conditions that will exceed the product limitations regarding temperature, pressure, chemical compatibility, and mechanical strength. Detailed chemical resistance and other design information is available from Spears® Manufacturing Company.

DO NOT use with "hot" Deionized (DI) water as this may have a detrimental effect on the system. Spears® recommends that Low Extractable PVC systems used with deionized water should be limited operating temperatures of no more than 80°F.

Spears® Manufacturing Company does not recommend the use of this product for the transportation or storage of compressed air or gases.

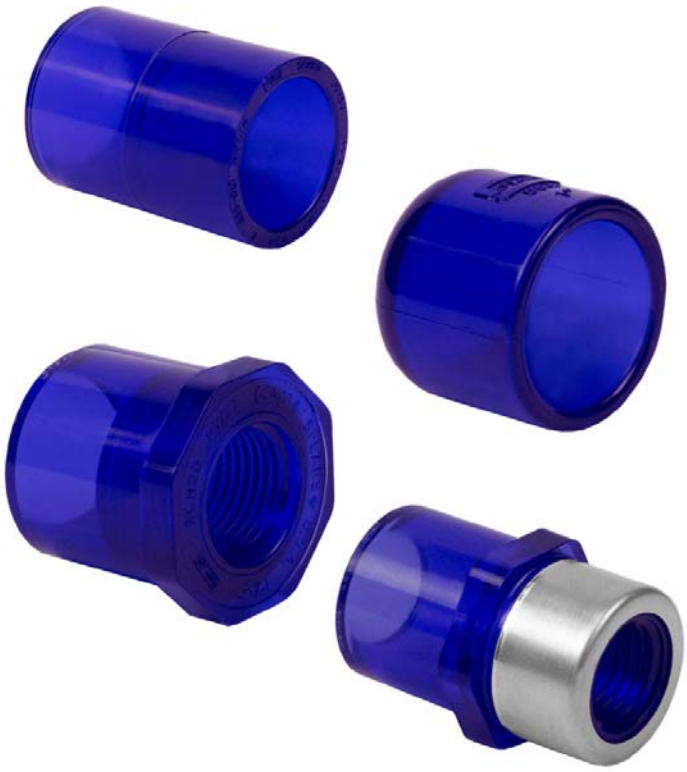
Excessive surge pressure must be avoided. The system must be designed to ensure that surge potentials generated by pump operation, entrapped air, flow velocity, and valve closure are kept to a minimum. Spears® does not recommend flow velocities in excess of five feet per second.

Spears® low-extractable piping systems are not formulated for outdoor use. Prolonged exposure to ultraviolet radiation (UVR) will affect physical properties.

Spears® Manufacturing Company recommends that newly installed systems be allowed to cure for a minimum period of 24 hours prior to rinsing procedures to reduce the potential for TOC contamination. Rinsing procedures, chemical rinse and other cleanup/disinfection procedures to be used are at the discretion of the system design authority. Note: Spears® low-extractable piping is compatible with hydrogen peroxide at concentrations up to 30% at 73°F. Contact Spears® for additional chemical compatibility information concerning the use of these products with various substances prior to use.

Sample Specifications

UPW process piping and fittings shall be manufactured from a specialty low-extractable, Polyvinyl Chloride (PVC) compound with a Cell Classification of 12343 per ASTM D 1784. All pipe and fittings shall be produced to Schedule 80 dimensions, manufactured in strict compliance to ASTM D 1785 (pipe), and ASTM D 2467 (fittings). These products shall carry a Type II pressure rating and consistently meet or exceed the applicable Quality Assurance test requirements of these standards with regard to dimensions, workmanship, burst pressure, flattening resistance and end-product quality. All UPW process valves shall be True Union-style diaphragm or True Union-style quarter-turn ball valves produced from the same low-extractable PVC compound. All valve diaphragms and seats shall be PTFE; valve O-rings shall be EPDM or FKM as applicable. All valve union nuts shall have buttress-style threads. All valve components shall be replaceable. System components shall be joined utilizing specially formulated one-step cement for joining the system. All system components shall be manufactured in the USA by an ISO-certified manufacturer. All UPW piping shall be bagged and sealed immediately after manufacture to maintain cleanliness, and boxed and stored indoors at the manufacturing facility until shipped from the factory. UPW process pipe and UPW piping components shall be those as provided by Spears® Manufacturing Company.



The data furnished herein is provided as a courtesy and is based on past experience, limited testing, and other information believed to be reliable. This information may be considered as a basis for recommendation only. No guarantee is made as to its accuracy, suitability for particular applications, or the results to be obtained therefrom. Materials should be tested under actual service conditions to determine suitability for a particular purpose.

"Lead Free" low lead certification - Spears® Low-Extractable One-Step Solvent Cement is certified to NSF/ANSI 372 lead content requirements for "lead free" plumbing defined as having a weighted average lead content <=0.25% by California (California's Health & Safety Code Section 116825 - commonly known as AB1953), Vermont (Vermont Act 193), Maryland, and Louisiana state laws and the U.S. Safe Drinking Water Act.