



HOT AND COLD WATER PLUMBING SYSTEMS

Designed especially for contractors

PRODUCT INSTALLATION GUIDE



IMPORTANT NOTICE

Bow FlowGuard Gold® CPVC Systems are designed to be installed according to the local plumbing code. Please consult your local authorities for applicable code requirements.

Please read the entire guide before you proceed.

This is a step-by-step technical guide only. There are many ways in which to proceed based on building design requirements that must be considered in order to make an efficient system.

The installer shall be thoroughly familiar with the contents of this guide and the local code requirements before proceeding.

Information in this guide shall not be separated as it is often interrelated.

For additional information, contact:

- Local officials having jurisdiction (for codes)
- BOW (for specific product information and for general installation instructions)

BOW FLOWGUARD® GOLD CPVC INSTALLATION GUIDE

This system, assembled with solvent cemented joints, has proven reliable in more than 40 years of successful installations. BOW FlowGuard® Gold is used in hot- and cold-water plumbing systems. Potable water requirements for residential, modular housing, mobile home, commercial, and institutional structures are all admirably served by Bow FlowGuard Gold CPVC Plumbing Systems.

Bow FlowGuard Gold® CPVC Plumbing Systems conform to ASTM D2846, and CSA B137.6.

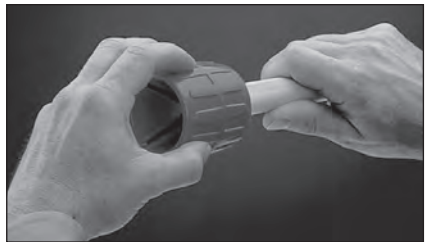
For more specific approvals, see Appendix "A"

JOINING BOW FLOWGUARD GOLD CPVC PIPE AND FITTINGS



1. Cutting

Cut the pipe with a pipe cutter or fine tooth saw. When using a saw, ensure ends are cut squarely. **NOTE:** Use of ratchet cutters is permitted under certain conditions, but to avoid pipe cracking, should NEVER be used when ambient temperature is below 50°F. **CUT OFF AT LEAST TWO INCHES BEYOND ANY VISIBLE DAMAGE OR CRACKING.**



2. Cleaning and Deburring

Remove all burrs and filings on the inside and outside of the pipe using sandpaper or a knife tool. A slight bevel on the end of the pipe eases joining of pipe and fittings and helps keep solvent cement from being pushed to the bottom of the joint. Wipe all dirt or moisture from the fitting socket and pipe end. Always check the dry fit of the pipe and fitting. At this stage the pipe should make contact with the socket about 1/3 to 2/3 of the way into the socket but should not bottom out in the socket.

DO NOT INSTALL PIPE IF BOTTOMING OCCURS.

NOTE: The following steps 3, 4 and 5 MUST BE COMPLETED IN LESS THAN 60 SECONDS.

APPLICATION OF PRIMER AND SOLVENT CEMENT



3. The use of primer prepares the bonding area for the solvent cement. Apply primer sparingly on pipe and fitting socket, and do not allow it to puddle inside fittings. Please note that there are "One-Step" cements for CPVC, which eliminate the need for primer. Both one-step and two-step methods are acceptable, but only cement labeled "One-Step" or "Single-Step" should be used without primer. "Two-Step" cements must be used with primer. Do not allow excess cement to puddle in the fitting and pipe assembly.



4. Using a dauber or natural bristle paint brush, apply solvent cement liberally on the pipe and sparingly in the fitting socket. Apply only CPVC cement conforming to CSA B137.6 and ASTM F493.

NOTE: NEVER USE AN ALL-PURPOSE CEMENT OR JOINT FAILURE MAY RESULT.

ASSEMBLY

5. Insert the pipe into the fitting socket, pushing together with a 1/4 turn. Cement only one fitting at a time.



Adjust alignment immediately before the solvent sets up. Hold the assembly together for 15 seconds so cement can set. An even bead of cement should be visible around the joint. If not, it may indicate that insufficient cement has been applied.

SET AND CURE TIMES

Solvent cement set and cures time are a function of pipe size, temperature, relative humidity and the type of cementing "system" being used. Drying time is shorter in drier environments with smaller size pipes and in higher temperatures. The use of primer in two-step cementing increases drying time. Refer to the following table as a guide for minimum cure times before pressure testing begins. **MINIMUM CURE TIME STARTS AFTER THE LAST JOINT HAS BEEN MADE UP.** Always consult the cement manufacturer's instructions regarding cure times and use those instructions should they differ from the table below.

MINIMUM CURE		
PRIOR TO PRESSURE TESTING @ 150 PSI		
AMBIENT TEMPERATURE DURING CURE PERIOD	PIPE SIZES	
	1/2 - 1"	1-1/4" - 2"
Above 60°F	1 hour	2 hours
40°F - 60°F	2 hours	4 hours
Below 40°F	4 hours	8 hours
Be prepared to allow extra time at temperatures below 50°F, for setting and curing. Keep cement warm to prevent thickening or freezing.		

TESTING

- A hydrostatic pressure test at a minimum of 150 psi for 1 hour is strongly suggested, but pressure up to 400 psi can be used if extra cure time, at least double the requirements in above table, are allowed.

Fill the system with water and bleed all air from the highest and farthest points in the run. **CUT OUT AND DISCARD ANY JOINTS WHERE LEAKS ARE DISCOVERED.** At temperatures below freezing, blow water out of the lines after testing has been completed to eliminate chance of freezing. **NEVER TEST WITH HIGH PRESSURE AIR OR COMPRESSED GAS.**

INSTALLATION TIPS TO INSURE A QUIET FLOWGUARD GOLD® INSTALLATION

FlowGuard Gold® Pipe and Fittings offer home buyers the most quiet and reliable plumbing system available. FlowGuard Gold®, like all piping systems, must be secured in place. However, slight movement must be allowed for in CPVC systems to accommodate normal thermal expansion. This "firm but loose" style of installation is simple to accomplish providing that correct materials and methods are employed. To ensure a quiet installation, contractors should follow these guidelines.

DO

- Allow CPVC tube slight movement with thermal expansion.
- Use plastic pipe straps.
- Drill holes 1/4" larger than the outside diameter of the tube when penetrating wood studs.
- Use protective pipe isolators when penetrating steel studs.
- Use metallic clevis or tear drop hangers when suspending tube from all thread rod.

DO NOT

- Overtighten or lock down the system. Slight movement should be permitted.
- Use single nail talon type straps that tend to overtighten the system.
- Use wood or plastic wedges that restrain tube as it passes through wood studs.
- Use protective pipe isolators as tube passes through wood studs.
- Bend CPVC tube around DWV stacks causing the two materials to bind against each other.
- Terminate a run of tube against an immovable object (e.g. floor joist).

HANDLING AND STORAGE

Exercise reasonable care in handling CPVC pipe and fittings. Although Bow FlowGuard Gold[®] CPVC is a tough, resistant material, it does not have the mechanical strength of metal. Cover CPVC with a non-transparent material when storing out-of-doors as prolonged exposure to sunlight is not advised. If CPVC pipe is to be installed out-of-doors, apply latex paint to it. Do not step on, drag or drop objects onto the pipe.

PRODUCT RATING AND CAPABILITIES

DIMENSIONS

Bow FlowGuard Gold[®] CPVC is produced in SDR 11 sizes from 1/2" to 2" with outside diameters being CTS (Copper Tube Size). SDR (Standard Dimensional Ratio) means the wall thickness is proportional to the outside diameter. This results in all diameters having the same pressure capability.

PRESSURE RATING

Bow FlowGuard Gold[®] CPVC Pipe and Fittings are produced to ASTM D2846 and CSA B137.6 specifications and this system has a rated continuous working pressure of 100 psi at 180°F (400 psi at 73°F).

FLOW VELOCITY LIMITATIONS

Traditional materials used in plumbing systems dictate that the flow velocity of the water inside the pipe be limited to 6 feet per second. In some areas this has been limited to 4 feet per second. This limit takes into account the problems of erosion corrosion and water hammer associated with metal pipes.

Bow FlowGuard Gold[®], on the other hand, is not affected by erosion corrosion and inherently eliminates water hammer in most plumbing systems. Consequently, Bow FlowGuard Gold[®] systems can operate with flow velocities in excess of 10 feet per second, although 4 to 8 feet per second velocities are recommended.

BOW FLOWGUARD GOLD PIPE DIMENSIONS				
SDR 11 (ASTM D2846) INCHES				
NOM.	AVG.	NOM.	WT. LB/ FT EMPTY	WT. LB/ FT WATER FILLED
1/2	.625	.485	.085	.166
3/4	.875	.713	.140	.310
1	1.125	.921	.218	.510
1-1/4	1.375	1.125	.330	.760
1-1/2	1.625	1.329	.460	1.060
2	2.125	1.739	.790	1.810

HYDRAULIC DESIGN

Hydraulic calculations should be made using the Hazen-Williams C value of 150. The following table can be used for calculating pressure loss of pipe and fittings. Losses for fittings are based on equivalent lengths of pipe. It should be noted that CPVC will not corrode or scale, so hydraulic losses will remain constant over the life of the pipe.

FRICITIONAL LOSSES FOR CTS CPVC PIPE AT DIFFERENT WATER VELOCITIES

V	1/2"		3/4"		1"	
	Q	P	Q	P	Q	P
2	1.14	1.86	2.47	1.20	4.11	0.90
4	2.29	6.75	4.94	4.34	8.22	3.24
5	2.87	10.25	6.17	6.55	10.27	4.89
6	3.44	14.34	7.40	9.18	12.32	6.85
8	4.59	24.45	9.87	15.65	16.43	11.68
10	5.74	37.00	12.34	23.66	20.54	17.66

V	1-1/4"		1-1/2"		2"	
	Q	P	Q	P	Q	P
2	6.14	0.71	8.58	0.58	14.72	0.44
4	12.29	2.57	17.17	2.10	29.44	1.60
5	15.36	3.89	21.46	3.17	36.81	2.41
6	18.43	5.45	25.75	4.44	44.17	3.38
8	24.57	9.29	34.34	7.57	58.89	5.76
10	30.71	14.04	42.92	11.44	73.61	8.71

V = Water Velocity, ft. per sec.

Q = Flow Rate, gal/min.

P = Pressure Loss, PSI per 100 ft.

EQUIVALENT LENGTH OF PIPE (FEET) FOR CPVC SDR 11 (CTS) PIPE FITTINGS

PIPE SIZE (INCHES)	90° ELBOW	45° ELBOW	THROUGH TEE RUN	THROUGH TEE BRANCH
1/2	1.6	0.8	1.0	3.1
3/4	2.1	1.1	1.4	4.1
1	2.6	1.4	1.7	5.2
1-1/4	3.5	1.8	2.3	6.9
1-1/2	4.0	2.1	2.7	8.0
2	5.5	2.8	3.4	10.3

WATER HAMMER

Water hammer is the pressure surge developed inside a pipe as a result of a rapid change in flow velocity, which usually accompanies a rapid closure of a valve in a system.

Bow FlowGuard Gold will develop much lower surge pressures than metal pipes under the same conditions because of its inherent ability to absorb the energy developed. As a result, a system piped with Bow FlowGuard Gold® will not normally require additional surge pressure control (arrestors) even for flow velocities up to 10 feet per second. In this range, surge pressures of less than 100 psi will be developed, and in most systems, the total surge pressure (surge + static pressure) will not exceed the generally accepted limit of 150 psi total. In all cases, however, local requirements must be respected with regards to arrestors.

WATER HEATER HOOK-UPS

When connecting to a gas heater, at least six inches of a metal nipple or appliance connector should be used so that the CPVC pipe cannot be damaged by the build-up of excessive radiant heat from the flue. CPVC can be piped directly to the heater tapping on an electric water heater.

NOTE: Some code jurisdictions require metal connectors on electric heaters. CPVC is acceptable for properly secured relief lines.

Due to its proven ability to withstand short term temperature/pressure excursions of 150 psi @ 210°F for 48 hours, CPVC is acceptable for properly secured T/P relief lines.

TRANSITIONS FROM CPVC TO OTHER MATERIALS



Transition fittings are available for connecting to other materials, valves and appurtenances and must be used for all hot water line connections. For cold water connections, male CPVC threaded adapters may be used. They are not recommended for hot water use as wide temperature fluctuations can result in a drip leak.

TFE (Teflon) thread tape should always be applied to the threads to improve the seal and ease installation. If you prefer to use a paste or pipe dope, always check with Bow regarding its compatibility with CPVC. (Some paste-type sealants contain solvents that may be damaging to CPVC.) Their use can significantly reduce the performance characteristics of CPVC system, and result in failure.

**See Annex for lists*

Care should be exercised to avoid over-torquing when connecting plastic to metal. Generally, two turns beyond finger tight is all that is required to make up a plastic threaded connection.

COMPRESSION CONNECTIONS UTILIZING BRASS FERRULES ON CPVC PIPE



Standard compression fittings which utilize brass ferrules can be used on CPVC, although we recommend the use of an O-ring transition (above). If a brass ferrule is used, teflon tape must be applied over the ferrule to compensate for the dissimilar thermal expansion rates of the brass and CPVC that could possibly result in a drip leak. Care should be exercised not to over-torque the compression connection.

HANGERS AND SUPPORTS

Because CPVC pipe is rigid, it requires fewer supports than flexible plastic systems. For vertical runs, provide a support at each floor level, plus a mid-story guide. For horizontal runs, support at three foot intervals for diameters of one inch and below and at four feet intervals for larger sizes. Piping should not be anchored tightly to supports, but rather secured with smooth straps or hangers that allow for movement caused by expansion and contraction. Most hangers designed for metal pipe are suitable for Bow FlowGuard Gold. Hangers should not have rough or sharp edges which come in contact with the pipe.

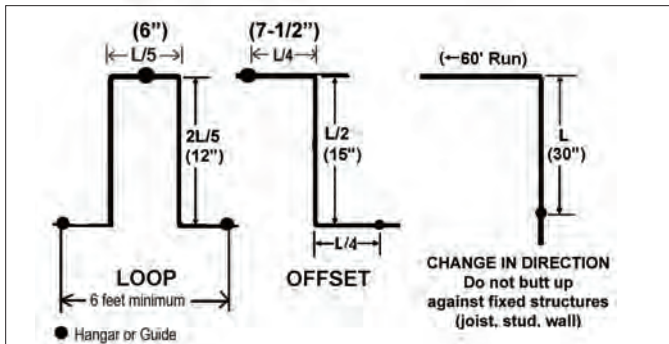
OTHER DESIGN CRITERIA

THERMAL EXPANSION

CPVC systems, like all piping materials, expand and contract with changes in temperature. The coefficient of linear expansion is: 0.0000340 inch/inch-°F. FlowGuard Gold® pipe will expand four (4) inches per 100 feet of length with a 100°F temperature change. Expansion does not vary with pipe size. Expansion is only of concern on hot water lines. The stresses developed in CPVC are generally much smaller than those developed in metal systems for equal temperature changes because of significant differences in elastic modulus. Therefore, expansion loop requirements are not significantly different than those recommended for copper pipe. Thermal expansion can generally be accommodated at changes in direction. On a long straight run, an offset or loop based on the following chart is required.

EXPANSION LOOP LENGTH (L) IN INCHES FOR 100°F TEMPERATURE CHANGE LENGTH OF RUN IN FEET				
NOMINAL SIZE	40	60	80	100
1/2"	24	30	34	39
3/4"	29	35	41	46
1"	33	40	46	52
1-1/4"	36	44	51	57
1-1/2"	39	48	56	62
2"	45	55	64	71

Example: Pipe Size – 1/2" Length of Run – 60' L=30" (from table)



For design of expansion loops where the anticipated temperature change (ΔT) is more or less than 100°F, the following factors can be applied to the table above. The correct factor should be chosen corresponding to the anticipated temperature change (ΔT), and multiplied by the value of L at $\Delta T=100^\circ\text{F}$ to determine the value of L at other values of ΔT e.g. from previous example:

$L=30'' @ \Delta T=100^\circ\text{F}$. At $\Delta T=50^\circ\text{F}$, $L=30'' \times 0.71=21''$.

CORRECTION FACTOR FOR EXPANSION LOOP LENGTH TABLE FOR ANTICIPATED TEMPERATURE CHANGE (ΔT) OTHER THAN 100°F			
TEMP CHANGE ΔT (°F)	CORRECTION FACTOR	TEMP CHANGE ΔT (°F)	CORRECTION FACTOR
50°F	0.71	110°F	1.05
70°F	0.84	130°F	1.14
90°F	0.95	150°F	1.22

THERMAL CONDUCTIVITY

CPVC Material: 0.95 BTU/HR-Ft2. °F/in *

**Note: This is the heat transfer per hour through a one foot square by one inch thick piece of CPVC. It is not the conductivity of the pipe, which varies by size.*

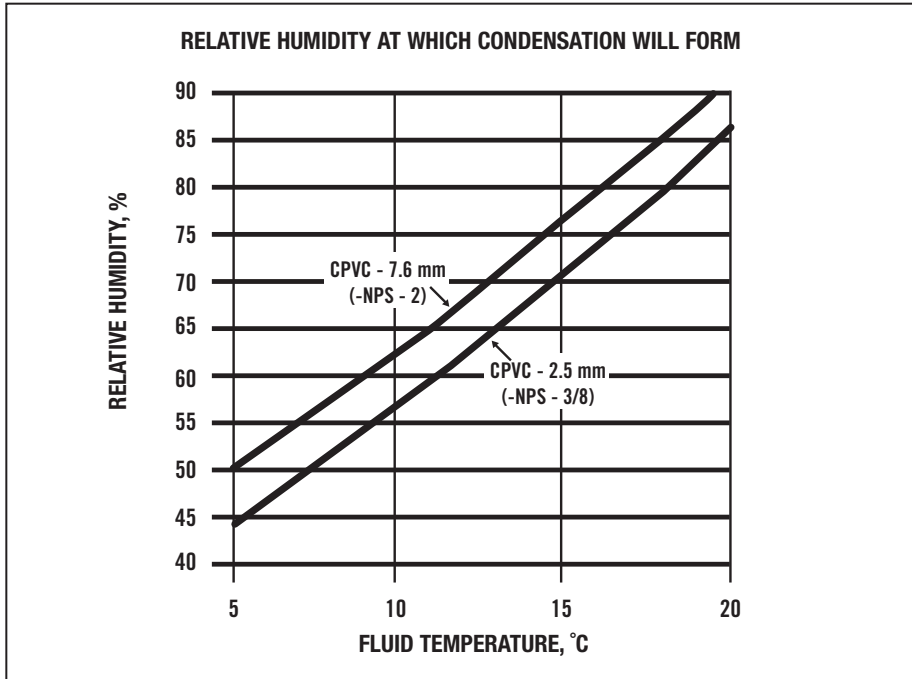
MODULUS OF ELASTICITY AND STRESS VS. TEMPERATURE

Temperature °C	20	25	30	35	40	45	55	65
Modulus of Elasticity E, Mpa	2979	2886	2792	2699	2606	2513	2326	2140
Working Stress Sd, Mpa	14.09	13.19	12.99	11.39	10.48	9.58	7.78	5.97

SWEATING

- “Sweating” of pipes is the formation of water droplets on the pipe’s exterior surface, the result of condensation of water vapor from the surrounding air. Sweating requires a cold surface with warm, humid surrounding air. This cold surface can be found on any metal pipe carrying cold water. Typically, the problem is controlled by insulating the cold exterior pipe surface from the air.

Because Bow FlowGuard Gold[®] is inherently several thousand times less thermally conductive than metal pipes, it is effectively self-insulating. As a result, it has a much greater resistance to sweating, and will require additional insulators only under the most extreme circumstances, i.e. very humid air in combination with very cold, flowing water inside the pipe. It will not sweat where metal pipes normally do.



NOTE: This figure is included only as a guide. Whenever the Fluid Temperature/Relative Humidity, point is located to the left of the appropriate data line, (eg. 10°C/70%RH), condensation may form on the pipe.

ESTIMATING PRIMER AND CEMENT REQUIREMENTS

The following guidelines are provided to allow estimation of primer and cement quantities needed.

FITTING SIZE (INCHES)	SOLVENT CEMENT (JOINTS/QUART)	PRIMER (JOINTS/QUART)
1/2	400	1200
3/4	270	810
1	180	540
1-1/4	130	390
1-1/2	100	300
2	70	210

FIRE RATED CONSTRUCTION DESIGN CRITERIA

Before penetrating fire-rated walls or partitions with CPVC piping, consult the local building official in your area. Plastic water piping systems typically are less of a concern with respect to their use in fire-rated construction than DWV pipes. Bow FlowGuard Gold® typically meets the 25/50 flame spread/smoke developed requirements for use in plenums and fire rated construction, and may penetrate fire walls if used with an approved fire stop system.

CONTINUE THE PROFESSIONAL ART OF PLUMBING WITH BOW FLOWGUARD GOLD® CPVC SYSTEMS

Bow FlowGuard Gold® is everything a contractor needs to provide water distribution systems he can be proud of. It's a rigid, professional-looking system that will last and last, providing your customer with superior plumbing. No rust, no corrosion, no scale – even in the harshest water areas. Quiet, resistant to condensation. Keeps hot water hot longer, saving energy in the process. Tested and certified by the NSF International as meeting strict public health requirements. The better system for water distribution plumbing.

CHEMICAL COMPATIBILITY

REVISION DATE: AUGUST 2018

CPVC piping systems have been chosen for more than 50 years. Ideally suited for use in new construction, re-piping and repair projects within domestic plumbing, and industrial and fire sprinkler piping, CPVC products are unsurpassed in their corrosion resistance and ease of installation.

In order for CPVC piping systems to achieve peak performance, they must be properly matched with complementary construction products like thread sealants, leak detectors and firestops, among others.

Lubrizol, the FlowGuard Gold[®] licensee holder and resin supplier, understands the complex dilemma and possible legal ramifications a mismatch can create for contractors and manufacturers alike. To ease the burden associated with researching and selecting accompanying construction products, Lubrizol developed the FBC[™] System Compatible Program.

This unique and invaluable resource tests and monitors ancillary products to ensure their chemical compatibility with Lubrizol's FlowGuard Gold[®] CPVC piping systems

All ancillary construction products coming into direct contact with FlowGuard[®] pipe & fittings systems must be chemically compatible. This ensures proper performance and functionality.

If an ancillary product is to come into direct contact with a FlowGuard Gold[®] pipe & fittings system and is not included in the FBC[™] System Compatible Program, Lubrizol recommends that chemical compatibility be confirmed with that product's manufacturer prior to use.

The following products have been deemed to be incompatible with FlowGuard pipe & fittings systems

UNACCEPTABLE PRODUCTS - DO NOT USE WITH FLOWGUARD GOLD

CATEGORY	COMPANY	PRODUCT
CAULKS	British Gypsum	Gyproc Sealant
	OSI Sealants (Dartworth Company) (Ohio Sealants)	Polyseamseal Tub & Tile Adhesive Caulk Polyseamseal All Purpose Adhesive Caulk Pro Series PC-158 Caulk
	John Wagner Associates	Grabber Acoustical Sealant GSCS
	No Nonsense Limited	Nemesis Fire Rated Hybrid Sealant 290ML
	Pecora	AC-20 Acrylic Latex Caulk & Silicone
	Sika Corporation	Sikaflex [®] Self-Leveling Sealant
	Specified Technologies, Inc.	SpecSeal [®] Smoke 'N' Sound Sealant
	United States Gypsum	Sheetrock Brand Acoustical Sealant
	White Lightning	3006 All Purpose Adhesive Caulk
FIRE STOPPING SYSTEMS	3M	Fire Barrier 2003 Silicone, Fire Barrier CP25WB+ Fire Barrier Sealant FD 150+ Fire Barrier Tuck-in Wrap Strips
	BritChem Ltd.	FR Intumescent & Acoustic Acrylic Sealant
	Everbuild	Everbuild Fire Mate Sealant C3
	Firetherm	Intumastic HP
	Flame Stop	Flame Stop V
	Hilti	CP506 Smoke and Acoustic Sealant CP606 Flexible Firestop Sealant
	No Nonsense Ltd.	No Nonsense Intumescent Acrylic Sealant
	Promat	Grafitex
	Proset	Proseal Plug, Black Proseal Plug, Red
	LEAK DETECTOR (SEE ALSO OTHER COMPATIBILITY CONCERNS)	Federal Process Co.
G. F. Thompson Co., Ltd.		Masters Leak Detector
Unipak A/S		Multitec leak detecting spray
Radnor Welding Products		Radnor [®] Leak Test Regulator Temperature
Rectoseal		RectoSeek [™] Low Temp
MISCELLANEOUS	WD 40	WD40 Lubricant
	Victaulic	Silicone Pipe Lubricant
	N/A	Peppermint Oil / Roofing Tar / Vaseline / Vegetable Oils

UNACCEPTABLE PRODUCTS - DO NOT USE WITH FLOWGUARD GOLD

CATEGORY	COMPANY	PRODUCT
MOLD CLEANERS	Anabec Systems	Anabec Advanced Cleaning Solution
	Coating Systems Laboratories, Inc	Zoocide
	Fiberlock Technologies	ShockWave IAQ Advanced Peroxide Cleaner No. 8314
	Microban Systems	Microban QCG
	X-M Industries	Structure-Guard Mold and Mildew Resistant Coating
MOLD INHIBITORS	Fiberlock Technologies, Inc.	Fiberlock IAQ200
	Serum Products, LLC	Serum 1000
PIPE CLAMP	LSP Specialty Products	Acousto Clamp, Acousto-Plumb System
	Naylon Products	Naylon vinyl-coated wire pipe hangers
PIPE TAPE	Christy's	Pipe Wrap Tape
	Pro Pak, Inc.	Pipe wrap tape (black)
	Pasco	All Weather PVC Pipe Wrap
	Wonder	No. 413 Pipe Wrap Tape
THREAD SEALANTS	Allied Rubber & Gasket Company (ARGCO)	Super Dope
	Anti-Seize Technology	TFE Paste
	Devcon	Super Lock Hi-Strength, Stud Lock Grade 2271
	General Sealant	GS-600
	G.F. Thompson Co., Ltd.	Masters™ Pro-Dope™ with Teflon®
	Hercules	Brush-on/Blue Block
	Hernon Mfg. Inc.	Powerseal #932
	IPS	White Seal
	JC Whittam Mfg. Co.	Seal Unyte Thread & Gasket Sealer
	Jet Lube, Inc.	Jet Lube V-2
	Jomar	Tighter-than-Tite
	Locktite	Threadlocker 242; 577
	Lyn-Car Products Ltd.	Proseal
	National Starch & Chemical, Perma-bond Division	Perma-bond LH-050 Perma-bond LH-054
	Permatex Company, Inc.	Permatex 14H
	Rule	High Performance Teflon Thread Sealing Compound
Saf-T-Lok Chemical	Saf-T-Lok TPS Anaerobic Adhesive/Sealant, Industrial Grade TPS	
SOS Products	Teflon Pipe Dope	
Swagelock Company	SWAK	
WATERPROOFING	Tremco	TREMproof 250GC single component polyurethane
<p>Chemically incompatible products are added to this list as they are brought to Lubrizol's attention. A product's absence from this incompatibility listing does not imply nor insure CPVC chemical compatibility.</p> <p>Always CHECK the FBC™ System Compatible Program for the most up-to-date compatibility listings. http://www.fbcssystemcompatible.com</p>		

OTHER CHEMICAL COMPATIBILITY CONCERNS**Acetone in Primers, Cleaners and Solvent Cements**

- Primers, cleaners, and solvent cements containing appreciable amounts of acetone may cause rapid environmental stress cracking of CPVC metal insert parts during installation at freezing temperatures. Contact your primer/cleaner/solvent cement manufacturer for more information or recommendation of alternatives.

Antifreeze: Glycerin from Biodiesel

- Crude glycerin from biodiesel manufacturing is not recommended for use as an antifreeze or heat transfer fluid in CPVC piping systems. Crude glycerin from biodiesel manufacturing may be contaminated with the biodiesel, its intermediary chemicals, and/or waste products from the biodiesel manufacturing process. NFPA 13D calls for the use of USP (United States Pharmacopoeia) or CP (Chemically Pure) grades when glycerin is used as an antifreeze in fire sprinkler systems. For a listing of glycerin products that have been determined to be compatible with Lubrizol brand CPVC, refer to FBC System Compatible Program.

Cleaning CPVC Pipe

- While common ordinary soaps are not detrimental to CPVC, most modern dishwashing liquids contain synthetic detergents, some of which may cause environmental stress cracking of fittings. A mild ionic detergent solution to remove incompatible oils or chemicals is recommended. A rinse with clean water to completely clean the system is advisable as a final flushing. Contact your dishwasher detergent manufacturer for more information or a recommendation of alternatives. For a listing of ancillary products that are compatible to Lubrizol CPVC, refer to FBC System Compatible Program.
- Household bleach solutions may be used for cleaning and disinfecting piping systems. The bleach used should be plain, without added thickeners, detergents, scents, etc.

Drains

- CPVC should not be used to connect a dishwasher drain to the sanitary drain due to incompatibility with food oils and surfactants in the dishwasher wastewater. This incompatibility could lead to premature failure in the CPVC.

Dry Wall Compound

- Joint Compound/Taping Compound/Mud/Finishing Compound used with Gypsum board is generally not incompatible with CPVC

Fireproofing

- Cementitious or gypsum-based fireproofing material is not incompatible with CPVC.

Flexible Wiring & Cable

- Direct contact with flexible wire and cable that utilize insulation containing plasticizers is not recommended. Section 334.30 of the National Electric Code (2002 Edition) requires wire and cable to be secured by staples, cable ties, straps, or hangers. Air ducts, pipes and ceiling grid are not acceptable supports for wire and cable. Also see section titled "Rubber & Flexible Materials containing plasticizers."

Fragrances – Perfumes

- Scented products such as cologne, perfume, or essential oils (peppermint oil, orange oil, spearmint oil, etc.) should not be put into a CPVC piping system for the purpose of being able to detect leaks by odor. Most fragrance chemicals and essential oils are strong solvents and/or environmental stress cracking agents for CPVC.

Fungicides & Mold Inhibitors

- When performing repairs to leaks in existing systems, care should be taken to isolate CPVC pipe from direct contact with heavy concentrations of fungicide products which may be applied during cleanup of water damage. Vinyl piping materials such as PVC or CPVC may be damaged by fungicides when fungicides are sprayed on surrounding drywall and wood framing to prevent the growth of mold and mildew in the affected area. Common sense precautions will prevent problems with repairs to existing systems. When repairs are made to an existing system, and the possibility exists that fungicides will be applied to treat damp drywall and wood framing surrounding the repair site, exposed piping should be sleeved with a compatible plastic sleeving or pipe insulation material to prevent direct contact of the fungicide with the plumbing system.

Gap Filling

- General-Purpose Gap Filling: For general-purpose filling of small gaps around CPVC pipes in wall or floor penetrations (not fire-rated constructions), either RTV silicone sealant or polyurethane "foam-in-a-can" may be used. Other types of general purpose sealants may or may not be compatible. Always check with the product's manufacturer for recommendations. See also Lubrizol's list of caulks and sealants known to be incompatible.
- If spaces larger than small gaps in wall or floor penetrations are anticipated to be filled with polyurethane foam around CPVC pipes and fittings, see also Lubrizol's published information concerning foamed-in-place polyurethane insulation. For sealing gaps in fire-rated constructions, a compatible firestopping product must be used.

Grease & Cooking Oils

- When CPVC pipe is installed in kitchen areas the pipe must be protected from contact with grease or cooking oils. Consideration must be given to not only protecting the pipe from direct contact with grease or oil but also contact that may occur from airborne grease or oil.

Heat Trace

- It is acceptable to heat trace FlowGuard Gold, pipe and fittings provided the temperature of the heat tracing material does not exceed 180°F (82°C). Steam heat tracing should not be used. Chemical compatibility of the heat tracing material with CPVC should be confirmed with the product manufacturer. The heat tracing material should comply with all applicable codes and be installed per manufacturer's instructions.

Hangers and Straps

- Plastic hangers and straps made of 100% polypropylene, polyethylene or nylon may be used.
- Most metal hangers and straps designed for metal pipe are likely suitable for use. Hangers and straps should not have rough or sharp edges that come in contact with the pipe. Hangers and straps with a flexible coating or pads may contain incompatible plasticizers and are not preferred. Also see section titled "Rubber & Flexible Materials Containing Plasticizers".
- See pipe manufacturer's installation instructions for proper use of hangers and straps.

Insulation

- Tubing insulation for use with CPVC should be fiberglass, foamed polyolefin (polyethylene), foamed polyisocyanurate or phenolic. Foamed rubber tubing insulation may contain incompatible plasticizers and is not preferred. Foamed polyolefin, foamed polyisocyanurate and phenolic insulations should not have any oil lubrication applied to the interior surface.
- Paper Faced Batt, Unfaced Batt and Fill insulation made of Fiberglass, Glass Mineral Wool, Mineral Fiber, Stone Wool, Silica Aerogel and Cellulose may come into contact with CPVC.
- Fiberglass Duct insulation with aluminum, paper, metalized polyester, polypropylene and polyethylene facing may come into contact with CPVC.

Leak Detectors

- If it is necessary to use leak detectors on CPVC systems, only leak detectors that are included in the FBC System Compatible Program should be used. While common ordinary soaps are not detrimental to CPVC, most modern dishwashing liquids contain synthetic

detergents, some of which may cause environmental stress cracking of fittings. For a listing of ancillary products that are compatible to Lubrizol CPVC, refer to FBC System Compatible Program.

- Scented products such as cologne, perfume, or essential oils (peppermint oil, orange oil, spearmint oil, etc.) should not be put into a CPVC piping system for the purpose of being able to detect leaks by odor. Most fragrance chemicals and essential oils are strong solvents and/or environmental stress cracking agents for CPVC.

Metal Piping connected to or Installed Alongside CPVC Piping

- CPVC may be damaged by torches and/or chemicals used to install metal piping. When metal piping is installed in proximity to CPVC piping systems, care should be taken to protect the CPVC from burning with torches or contact with molten solder and solder flux, as well as incompatible thread sealants, leak detectors, lubricants, or other chemical products which may be used on metal piping.
- Transitions from steel pipe to CPVC pipe can be made through a variety of methods such as threaded connections, flanges, and grooved adapters. Occasionally the steel pipe may contain residual oils that were used to aid in the cutting process. Some of the oils used for this purpose, especially those marketed as "environmentally friendly" or "vegetable based" may be incompatible with CPVC. These cutting oils should be removed from the steel pipe prior to connecting to CPVC pipe. If a cutting oil is used, consult with the manufacturer of the cutting oil for a specific recommendation as to compatibility with CPVC. Those cutting oils which are listed in the FBC System Compatible program have been tested and confirmed to be compatible with FlowGuard Gold®.
- Dye penetrants used to test the quality of welds in metal piping may contain plasticizers or other chemicals incompatible with CPVC. Dye penetrants left on the inside surface of welded metal pipes may later wash into CPVC piping connected to it. This situation could create environmental stress cracking in CPVC wherever collections of the penetrant chemical might lodge. These penetrants should be removed from the steel pipe prior to connecting to CPVC pipe or the manufacturer of dye penetrant should be consulted with regarding recommending proper penetrant for use with steel I CPVC piping systems.

Paint

- If paint must be used on CPVC, water-based latex paint is the recommended type of paint to use on pipe and fittings manufactured from Lubrizol CPVC. Two-part epoxy paint should not be used. Other types of paint have not been known to be detrimental to CPVC provided

OTHER CHEMICAL COMPATIBILITY CONCERNS

- continuation

that it is applied in a light coating that dries quickly. Paint should not be allowed to puddle on or around CPVC pipe or fittings. Antimicrobial additives in paint do not change this guidance.

Polyurethane (Spray-On) Foams

- In understanding spray polyurethane foams there are two general areas of concern for CPVC pipe and fittings: (1) chemical compatibility and (2) potential damage to pipes and fittings due to high exothermic temperatures during installation. These spray polyurethane foams have different cell structures, different flame retardants, reach different curing temperatures and require different installation thicknesses to obtain the required r-value. All of these factors must be considered when using spray foams.
- In 2009, Lubrizol assisted the Spray Polyurethane Foam Alliance (SPFA) to determine if chemical compatibility issues exist with FlowGuard Gold® CPVC pipe and fittings. SPFA findings, although not comprehensive, conclude that those spray polyurethane foams tested did not pose a chemical compatibility problem. In addition, Lubrizol is unaware of a CPVC failure that was the result of chemical incompatibility with spray polyurethane foams. For more information on the SPFA testing, please contact them at (800) 523-6154 or visit their web site at www.sprayfoam.org. With respect to chemical compatibility, one must always check with the spray foam manufacturer to have them provide assurance that the formulation that they are manufacturing is not incompatible with CPVC.
- In a separate, unrelated study also in 2009, Lubrizol conducted testing with a manufacturer of spray polyurethane foam to better understand the effects of high exothermic temperatures on FlowGuard Gold and BlazeMaster CPVC pipe and fittings. These findings demonstrated that temperatures can exceed the softening point of dry CPVC pipe and fittings.
- This study found that, for the products tested, the spray pass thickness of the manufacturer's nominal two pound density spray polyurethane closed cell foam should not exceed a maximum of two inches per single pass. Lubrizol also found in this study that repeated two inch passes (layers) separated by 10 minute intervals provided sufficient time for the spray polyurethane foam to cool. For the manufacturer's nominal half pound density spray polyurethane open cell foam, Lubrizol found that spray pass thickness should not exceed a maximum of six inches per single pass. Heat generated and trapped inside foam layers applied too thickly may cause ballooning of pipe or excess flexural stresses on pipe and fittings due to thermal expansion. Because

polyurethane spray foams' resulting exothermic temperatures and chemical compatibility characteristics can vary to some extent, Lubrizol recommends that you consult with the manufacturer of the polyurethane spray foam to be installed.

- For more information on the compatibility study conducted by SPFA or on the effects of the curing exotherm on CPVC, visit the Spray Polyurethane Foam Alliance website at <http://www.sprayfoam.org/component/content/article/39-technical/5153-spf-and-cpvc-pipes-and-fittings>.
- California State Fire Marshal Information Bulletin 14-004 Non-Metallic Piping Systems, Fire Sprinklers and Spray Polyurethane Foam Applications.

Residual Oils with HVAC Applications

- Some heat exchangers or condenser coils may contain residual oils from the manufacturing process which can cause cracking of CPVC. Caution should be exercised when installing CPVC in combination hot water/air heating units or as condensate drain lines for air conditioning systems. Confirm the compatibility of CPVC with the residual oils prior to installation. The interior of heat exchangers or the exterior of condenser coils may be thoroughly flushed with mild ionic detergent solution to remove incompatible oils prior to piping installation. A rinse with clean water to completely clean the system is advisable as a final flushing.

Rubber & Flexible Materials Containing Plasticizers

- CPVC is not compatible with some rubber and flexible plastic materials containing certain types of plasticizers. Incompatible plasticizers include, but are not limited to, phthalates, adipates, trimellitates, dibenzoates, etc. Compatibility should be confirmed before selecting rubber or flexible vinyl materials for direct contact with CPVC. Examples of materials which may contain incompatible plasticizers include, but are not limited to, caulks, rubbery hanger padding, vinyl dip coating on metal parts, rubber gaskets, electrical wire jacketing, electrical tape, flexible hoses or tubes, etc. Further, plasticizers may leach from rubber or flexible vinyl materials, such as hoses or tank linings, into the process fluid which contacts them. Plasticizer contamination in the process fluid may also cause environmental stress cracking of CPVC used elsewhere in the system. This can include both CPVC process piping, through which the contaminated fluid may flow, or CPVC ducting drawing fumes from contaminated fluid. Also see section titled "Flexible Wiring & Cable."

Sleeving Material

- In situations where sleeving is required, the pipe should be protected with a compatible sleeving material extending at least 12" above and below the soil. The top of the sleeving should be securely taped to the pipe with a compatible tape product. Backfill over underground piping prior to termiticide spraying. Also see section titled "Termiticides & Insecticide."

Spray-On Coatings

- Certain types of spray-on coatings which form a peelable film to protect fixtures during construction may be incompatible with CPVC. Care should be used to protect exposed piping from overspray when this type of protective coating is applied.

Teflon® Tape

- Teflon® tape is recommended as a preferred thread sealant.

Termiticides & Insecticides

- When performing installations underslab or where the presence of insecticides or termiticides are likely, care should be taken to isolate CPVC pipe from direct contact with large quantities of these chemicals. Vinyl piping materials such as PVC or CPVC may be damaged when termiticides or insecticides are injected into the annular space between the pipe wall and sleeving material trapping the termiticide against the pipe wall. Termiticide applications per label instructions in an open-air environment, such as slab pretreat applications, should not pose a problem. However, puddling of termiticides

on or near CPVC pipe may cause failures. In areas where puddling is more likely, such as areas near tub boxes and retreat applications, extra care should be taken to avoid puddling of termiticides. Exercising caution and common sense should prevent installation problems. Before using an insecticide or termiticide, be sure to consult the manufacturer's installation guide for proper application instructions. For a listing of insecticides or termiticides that are included in the FBC System Compatible Program, refer to FBC System Compatible Program.

- Additional precautions need to be taken when retreat applications are required. Termiticide retreatment is usually required when the concrete slab has been broken to relocate a pipe. The following recommendations should be followed in retreat applications:
 - Remove all the plastic barrier material that was installed prior to the initial concrete pour from the area to be retreated. Do not reinstall the plastic barrier material
 - After the pipe has been relocated, the soil should be pretreated before it is placed in hole around the pipe. Do not apply termiticide directly to the retreat area. Also see section titled "Sleeving Material."- After the pipe has been relocated, the soil should be pretreated before it is placed in hole around the pipe. Do not apply termiticide directly to the retreat area. Also see section titled "Sleeving Material".

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LEGAL DISCLAIMER:

The FBC™ System Compatible Program is a resource made available to manufacturers of ancillary products intended to be used with CPVC to help determine whether a product is chemically compatible with Lubrizol's FlowGuard®, CPVC piping systems. Other manufacturers and/or brands of CPVC piping have not been tested as part of the FBC™ System Compatible Program. The FBC™ System Compatible program is, therefore, only applicable to the chemical compatibility of ancillary products with the Lubrizol brands of FlowGuard, CPVC piping systems. This distinction is made because every brand of CPVC piping is made with unique compounds, some of which may contain resins with different molecular weights and varying chlorine content. These characteristics directly impact the performance of the resulting product. Similarly, various CPVC products contain different performance additives. This too affects the performance characteristics of the ancillary product. For these reasons, Lubrizol has no responsibility for any failures occurring as a result of using products in the FBC System Compatible Program with CPVC products other than FlowGuard.

For the most up-to-date chemical compatibility listings, please visit:
www.lubrizol.com/CPVC/FBC-System-Compatible-Program

Appendix "A"

Bow FlowGuard Gold CPVC Systems conform to the following:

BOCA	(Building Officials and Code Administrators International Inc.)	National Building Code
IAPMO	(International Association of Plumbing and Mechanical Officials)	Uniform Plumbing Code
SBCCI	(Southern Building Code Congress International Inc.)	Standard Plumbing Code
ICC	(International Code Council Inc.)	International Plumbing Code
CABO	(Council of American Building Officials)	1- and 2-Family Dwelling Code
PHCC	(Plumbing, Heating, Cooling Contractors Association)	National Standard Plumbing Code
NRC	(National Research Council)	National Plumbing Code of Canada
NSF International		STD14 and STD61
CSA International		STD B137.6
ASTM International		STD D2846

