UNDERSTANDING MOLDED PIPE FITTING "PRESSURE RATINGS"

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TECHNOLOGY UPDATE

The Facts About Pressure Ratings —

- **Pressure Rating Standards For Pipe Do Not Apply to Fittings**
- **Pipe & Fittings Respond Differently to Internal Pressure**
- **Claims for "Pipe-Pressure Rated Fittings" Neglect Sound Design Principles**
- **Independent Research Supports Reduced Fitting Pressure Handling Capacity**

The Dilemma - Applying a "Pressure Rating" to Plastic Pipe Fittings

Pressure ratings for injection molded PVC and CPVC thermoplastic pipe fittings are a frequently misunderstood and confusing topic. Let's start with a simple fact: A pressure handling capability, or "pressure rating", for any product is that which the manufacturer declares and warrants. The basis for applying such ratings becomes the question of concern. Unlike pipe, no industry standard exists that specifies a working pressure for *Fittings*. Reputable fitting manufacturers meet applicable ASTM standards that establish a minimum burst conformance that is equal to that of plastic pipe. Historically, the resulting conclusion is that fittings are therefore suitable for use at the pipe's pressure rating. However, this does not take into account long-term performance in relation to fitting geometry, system operating hydraulics, and fitting design. Independent research studies by engineering firms including Keller–Bliesner, Broutman & Associates, and IBM have concluded that thermoplastic fittings require consideration of pressure handling capabilities lower than pressure ratings established for pipe.

The Effects of "Change of Direction" Under Pressure

The internal pressure effect on pipe is primarily a radial stress due to its uniform, cylindrical shape. Fitting geometry, on the other hand, provides change-of-direction in a piping system. In simple terms, this internal pressure attempts to "straighten out" the fitting angle thereby inducing additional stress on the fitting. Such stresses have a multiplied effect on fittings due to the kinetic energy of system thrust-loads, pressure surges and cyclic operating conditions.

Fitting Design - "Thicker" Does Not Necessarily Mean "Stronger"

The myth exists that simply increasing wall sections is the solution to fitting pressure handling limitations. In truth, increased wall thickness without consideration of proper material placement can be detrimental to performance. For example, some manufacturers claim that a heavier hub design on the fitting socket allows a full pipe-pressure rating for fittings! In truth, this may actually reduce fitting performance. Finite Element Analysis (FEA) studies have shown that abrupt changes in fitting wall sections, such as between a heavy socket hub and body wall, concentrates stress at the transition point. Normal stresses from flex, pressure and expansion-contraction in a plastic piping system can literally break the fitting at this point. Don't be misled - claims that neglect sound product and system design principles should be avoided.

The Spears® Solution – Material Selection, Design Principles & Research Findings

Not all PVC & CPVC materials are the same. Spears® careful selection and testing of molding compounds is the essential foundation for optimum fitting pressure handling capability. Through the use of FEA, design studies and product testing, Spears® R&D activities have found that by focusing on proper material placement, elimination of abrupt changes and further "streamlining" of fitting design, reliability and long-term performance can be significantly enhanced. At the same time, findings of the various independent research studies mentioned should be adhered to for best fitting performance. This forms the basis of Spears® recommendations for reduced fitting pressure handling capability over that of pressure rated plastic pipe.

PVC & CPVC Schedule 40 and Schedule 80 Fittings
Suggested Maximum Internal Working Pressures @ 73°F

The following information is derived from studies by Keller-Bliesner Engineering, Logan Utah, and is provided as a guide only. Actual allowable working pressures may vary widely according to field conditions. Additionally, pressure de-rating at elevated temperatures must be taken into account. Certain fitting configurations may have other assigned pressure limitations (i.e., Wyes, Unions, Flanges, etc). Contact Spears® Technical Services for additional information and details of the Keller-Bliesner report.

Nominal Size (in.)	Schedule 40 (psi)			Schedule 80 (psi)		
	Pipe[1]	Solvent Cemented Joint & Spears® SR Threaded Joint[2]	Standard Threaded Joint[3]	Pipe[1]	Solvent Cemented Joint & Spears® SR Threaded Joint[2]	Standard Threaded Joint[3]
1/4	780	468	390	1130	678	565
3/8	620	372	310	920	552	460
1/2	600	360	300	850	510	425
3/4	480	288	240	690	414	345
1	450	270	225	630	378	315
1-1/4	370	222	185	520	312	260
1-1/2	330	198	165	470	282	235
2	280	168	140	400	240	200
2-1/2	300	180	150	420	252	210
3	260	156	130	370	222	185
3-1/2	240	144	120	350	210	175
4	220	132	110	320	192	160
5	190	114	95	290	174	145
6	180	108	90	280	168	140
8	160	96	80	250	150	125
10	140	84	70	230	138	115
12	130	78	65	230	138	115

Notes:

1 – Water pressure Ratings At 73°F (23°C) for Schedule 40 and Schedule 80 Plastic Pipe, ASTM D 1785 for PVC, ASTM F441 for CPVC.

2 – Spears® patented Special Reinforced (SR) plastic thread. Patented design reinforcement allows recommended fitting working pressure equal to solvent welded joints.

3 – Threading of Schedule 40 plastic pipe is not permitted. Recommended pressures apply to molded fittings only.

Not For Use With Compressed Air or Gas

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