

The slide features a header with an orange-to-yellow gradient background. On the left is a circular logo with a globe and the text 'WATER: Saving People and Places'. On the right, it reads '2013 ASIC National Conference' and 'Scottsdale, Arizona • April 20-22, 2013'. The main content area is white with a blue border, containing the title 'Doggonit, You're Doing It All Wrong!' in bold black text, and the presenter's name 'Larry Workman' and company 'Expert4PVC Consulting' below it. A solid orange bar is at the bottom of the slide.

Presented at:

American Society of Irrigation Consultants National Conference  
*www.ASIC.org*

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## Have you heard that before?

Because of:

- Threaded Fittings
- Solvent Welding
- Pressure Rating
- Surges
- Thrust blocking
- UV Resistance



Because of:

- Split threaded Female fittings or broken Male threads.
  - Like male adapters or nipples.
- Leaking solvent welded joints.
- Schedule 40 or 80 pipe & fittings.
- Fatigue failure of Tee's and Elbows.
- Thrust block
- Size or placement for gasket joints.
- UV resistance of PVC pipe and fittings



## Threaded Fittings

### Recommended only for transition of materials

- **PVC NPT Threads**
  - Male thread problems
  - Female thread problems
  - Tape or Paste
  - Tighten procedure
- **Specialty**
  - Follow manufacturer recommendation
  - ACME (Swing Joint)
    - » Lightly bottom; back-off 1 – 1½ turns



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### Threaded Fittings

- Highest % of fitting failures are Female threads
- Second is the Male adapter or nipple @ 1<sup>st</sup> exposed thread
- Use a non-hardening thread paste
  - Without Teflon®
  - Compatible with PVC and the other materials (plastics)
- Finger tighten then 1 – 1½ turns

### Specialty fittings

Follow the manufacturers recommendations for installation.

For instance Swings – lightly bottom; then back off 1 – 1½ turns



## Solvent Welding

- **Follow industry standards for procedure.**
  - ASTM D 2855
  - Cement manufactures.
- **Specify “in the trench” experience.**
  - Provided by pipe, fitting, or cement manufacturer.
- **Specify cure times**
  - Plowing, pulling or “into trench”.
  - Pressure testing.



### Solvent welded fittings

Solvent welded failures are the highest volume because they are the most common joint.

Specify to follow the “ASTM D2855 Standard Procedure of Solvent Welding”

- At a minimum follow the solvent cement manufacturers recommendation.

Specify experienced installers “in the trench” – Not Foremen nor Supervisors.

- Training is offered by the pipe, fitting and solvent manufacturers

Specify cure time of 24 hrs before pulling or plowing-in pipe.

Include pressure testing in the specification

- Who does it!
- When it is done
- Test parameters!



## Pressure Rating

- **PVC Pipe**
  - **SDR/ Class**
    - Relates to pressure rating
  - **Schedule 40 & 80**
    - Pressure rating varies with diameter
    - Larger diameter = Lower pressure rating
  - **Service factor of 2**
    - A measure of periodically overload capacity without damage.
    - Based on Hydrostatic Design Stress of PVC pipe @ 2000 psi.

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### PVC Pipe ratings

SDR 21 = 200 psi all sizes

SDR13.5 = 315 psi all sizes

### Schedule 40

1-inch = 450 psi

4-inch = 220 psi

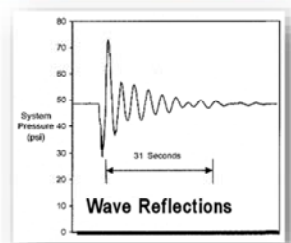
8-inch = 160 psi

The pressure ratings are based on:

- a Service Factor of 2.
- Periodic overload capacity – not a constant pressure
- Stress level of 2000 psi



## Pressure Rating



- **Schedule 40 & 80 fittings**
  - **DO NOT HAVE A PRESSURE RATING!!**
  - Irrigation/Golf systems have many surges.
    - Limit fittings to 60% of equivalent pipe pressure rating.
    - Keep system PEAK surge at or below pipe pressure rating.
- **Specialty fittings (pressure rated)**
  - Special fittings designed for frequent surges.
  - Swing Joints, Flanges etc.
    - ASTM F 1970
      - 2.5 Pressure rating for 1 hr , then
      - 3.2 Pressure rating in 60 sec.

Schedule 40, Schedule 80 and Insert fittings **ARE NOT PRESSURE RATED!**

Because of the cyclic activity on irrigation systems, you should limit fittings to 60% of the rated pressure of equivalent pipe.

It is recommended to keep peak surge pressures below the pressure of rating of the equivalent pipe.

Notice in the chart above the 2-3 reflections that accompany every surge.

- These reflections must be considered in the system design.

Some manufacturers produce a **NON-STANDARD** fitting for improved surge resistance. Be sure to review and understand the test data.

**Swing Joints and Flanges are examples of pressure rated fittings.**

They are rated in accordance with ASTM F1970 ( different test criteria than pipe)

- Tested a 2½ times the pressure rating for 1hour, then
- Taken to 3.2 times the pressure rating in 60 seconds with no leak, deformation or failure.



## Cyclic Failure

- **PVC Pipe**
  - **AWWA (IBM)**
    - Est. 1 million cycles
- **PVC Fittings**
  - **Bliesner, FHA and Soil Conservation Services**
    - Suggests using 60% pipe pressure rating.
    - Keep **PEAK** surge below pipe pressure rating.
      - 125% of pipe pressure rating, will fail at about 140,000 surges
    - Lower surges will extend life of fittings.
      - 75% of pressure rating fatigue occurs at about 2.2 million surges.



### Cyclic Failure

AWWA using a study by IBM estimated that a pipe will withstand about 1 million cycles at the 2000 psi stress level

However Bliesner, FHA and Soil Conservation Services recommend:

- Fittings used in cyclic systems, like irrigation, use 60% of the equivalent pipe pressure rating as a limit.
  - Because at 125% of the pipe rating fittings are estimated to last about 140,000 cycles
    - Equivalent to 2 operations/day x 4 reflections x 365 days = about 3000/yr
    - or about 46 years of life
  - Whereas, at 75% of the pipe pressure rating the fitting is estimated to last 2.2 million cycles



## Thrust Blocks

- **Not Required on Solvent welded fittings.**
  - Joint has 2x lap shear strength of PVC.
- **Gasket /O-ring pipe and fittings**
  - Joint restraint fittings
  - Thrust blocks
    - **Specify correct size and installation based on:**
      - Soil
      - Pipe size
      - Pressure
      - Position

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Properly made solvent welded joints **DO NOT NEED THRUST BLOCKS!**

The lap shear strength of the joint is twice the strength of the PVC material.

Gasket Fittings **DO REQUIRE THRUST RESTRAINT** such as:

Joint restraint components

Thrust blocks

- Assure that they are the proper size shape and placement to be effective
- **NOT just a bag of ready mix dumped on the fitting**





## UVR PVC Pipe & Fittings

- **Long term exposure to UV PVC pipes?**
  - 2 yr exposure, with a slight reduction in impact resistance. (AWWA report)
  - 10 yr old above ground PVC on West facing side of Kailua-Kona, Hawaii.
  - Coffee plantation near Kailua-Kona, Hi.
  - Residential water service near S. Point, Hi.
    - Latitude about equal to Mexico City



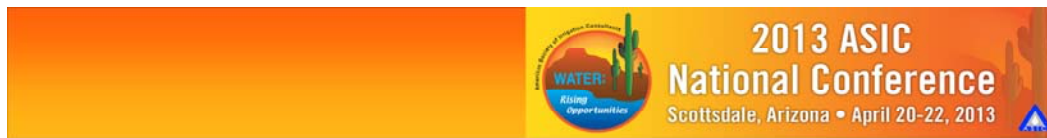
### UVR PVC Pipe and Fittings

Although there is some derogation of the piping surface from UV

- It is less than a few thousands of an inch; less than most surface scratches
- Multiple tests and everyday examples show that discoloration is the most obvious problem.
- There is a slight reduction of impact resistance of the very thin surface shell of the pipe
  - This may slightly effect the impact resistance of thin wall pipes (below SDR 21)

Shown above is a 10 yr old above ground irrigation system on the west side of the island of Hawaii.

- There is no evidence of degradation.
- A similar installation was found in an “over flow parking” a near by coffee farm.
- The 1-inch service line from a roadside meter to the residence, about 20 feet above was located near South Point Hawaii
  - This as about the same latitude as Mexico City, again on the western exposure



## **Simple steps will reduce the problems caused by:**

- **Threaded Fittings**
- **Solvent Welding**
- **Pressure Rating**
- **Surges**
- **Thrust blocking**
- **UV Resistance**

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### **These simple things will reduce the problems:**

- Use pipe thread paste without Teflon®
- Tighten joints “Finger tight plus 1- 1½ turns
- Solvent welding by experienced personnel following ASTM D2855
- Limit PVC fittings to 60% of equivalent schedule and size pipe.
- Restrict surges and water hammers peak pressure to the pressure rating of the schedule and size pipe .
- Gasket fittings require thrust restraint. Solvent welded fittings do NOT!
- PVC pipe and fittings are only slightly degraded by UV, about equivalent to surface scratches.



Thank you for your time!

**Larry Workman**

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