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- Delaware, OH 43015

# PVC Pressure Pipe Overview



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# HISTORY OF PRESSURE PIPE

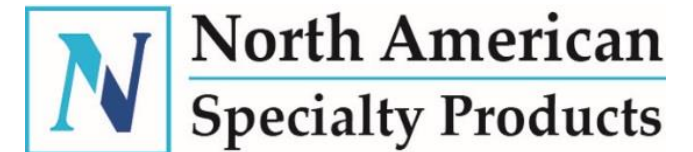
## TIMELINE FOR TYPE OF PIPE MATERIALS

Pipe Material	Joint Type	Internal Corrosion Protection	External Corrosion Protection	1890	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000
Steel	Welded	None	None	Commercially Available	Commercially Available	Commercially Available	Commercially Available	Commercially Available	Predominantly in Use					
Steel	Welded	Cement	None					Commercially Available	Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use
Cast Iron (pit cast)	Lead	None	None	Predominantly in Use	Predominantly in Use									
Cast Iron	Lead	None	None			Predominantly in Use	Predominantly in Use	Commercially Available	Commercially Available					
Cast Iron	Lead	Cement	None			Commercially Available	Commercially Available	Predominantly in Use	Predominantly in Use	Commercially Available	Commercially Available	Commercially Available		
Cast Iron	Lead	None	None			Commercially Available	Commercially Available	Commercially Available	Commercially Available					
Cast Iron	Lead	Cement	None			Commercially Available	Commercially Available	Predominantly in Use	Commercially Available	Commercially Available	Commercially Available			
Cast Iron	Rubber	Cement	None						Predominantly in Use	Predominantly in Use	Predominantly in Use	Commercially Available	Commercially Available	
Ductile Iron	Rubber	Cement	None								Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use
Ductile Iron	Rubber	Cement	PE								Commercially Available	Predominantly in Use	Predominantly in Use	Predominantly in Use
Asbestos Cement	Rubber	Material	Material				Commercially Available	Commercially Available	Commercially Available	Predominantly in Use	Predominantly in Use	Commercially Available	Commercially Available	
Reinforced Conc. (RCP)	Rubber	Material	Material	Commercially Available	Commercially Available	Commercially Available	Commercially Available	Commercially Available	Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use
Prestressed Conc. (PCCP)	Rubber	Material	Material					Commercially Available	Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use	Predominantly in Use
PVC	Rubber	Material	Material						Commercially Available	Commercially Available	Commercially Available	Predominantly in Use	Predominantly in Use	Predominantly in Use
High Density Polyethylene	Fused	Material	Material					Commercially Available	Commercially Available	Commercially Available	Commercially Available	Commercially Available	Commercially Available	Predominantly in Use
Molecularly Oriented PVC	Rubber	Material	Material								Commercially Available	Commercially Available	Commercially Available	Predominantly in Use

Commercially Available
  Predominantly in Use

# PVC Pressure Pipe Manufacturers

## Uni-Bell MEMBER COMPANIES





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### Global Headquarters

5200 West Century Blvd  
Los Angeles, CA 90045

### Regional Sales Office

Nine Peach Tree Hill Rd  
Livingston, NJ 07039

### Plants

#### Adel - PAD

2101 J-M Drive  
Adel, GA 31620

#### Kingman - PKI

4620 Olympic Way  
Kingman, AZ 86401

#### Stockton - PST

1051 Sperry Rd  
Stockton, CA 95206

#### Batchelor - PBA

2894 Marion Monk Rd  
Batchelor, LA 70715

#### Magnolia - PMA

2220 Duracrete Drive  
Magnolia, AR 71753

#### Sunnyside - PSU

1820 South First Street  
Sunnyside, WA 98944

#### Butner - PBU

2602 West Lyon Station Rd  
Creedmoor, NC 27522

#### McNary - PMC

31240 Roxbury Rd  
Umatilla, OR 97882

#### Tulsa - PTU

4501 West 49th Street  
Tulsa, OK 74107

#### Cameron Park - PCA

3500 Robin Ln, P.O.Box 386  
Cameron Park, CA 95682

#### Meadville - PME

15661 Delano Rd  
Cochran, PA 16314

#### Visalia - PVI

7501 W. Goshen Ave  
Visalia, CA 93291

#### Columbia - PCO

6500 North Brown Station Rd  
Columbia, MO 65202

#### Perris - PPE

23711 Rider Street  
Perris, CA 92570

#### Wharton - PWH

700 A Hwy 59 Loop  
Wharton, TX 77488

#### Fontana - PFO

10990 Hemlock Avenue  
Fontana, CA 92337

#### Pueblo - PPU

1742 E. Platteville Blvd  
Pueblo, CO 81007

#### Wilton - PWI

1314 W. Third Street, P.O.Box 99  
Wilton, IA 52778

#### Hastings - PHA

PO Box 229  
Hastings, NE 68902



DELIVERING GOOD WATER TO YOU

- 19 US Locations
- PME, PWI, PAD
  - C900/905
  - Gravity Sewer
  - HDPE
- PCO, PWH, PFO
  - C909



DELIVERING GOOD WATER TO YOU

# Express Service Trucks ESTs 250 Mile Range







# 63" HDPE within REACH

DELIVERING GOOD WATER TO YOU





## DELIVERING GOOD WATER TO YOU

THE WARRANTIES IN THIS LIMITED WARRANTY ARE THE ONLY WARRANTIES APPLICABLE TO THE PRODUCTS. THERE ARE NO OTHER WARRANTIES, REPRESENTATIONS OR CONDITIONS OF ANY KIND, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE, WITH RESPECT TO THE PRODUCTS SUPPLIED HEREUNDER INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ALL SUCH WARRANTIES ARE HEREBY SPECIFICALLY DISCLAIMED AND JM EAGLE™ SHALL NOT BE LIABLE IN THIS RESPECT NOTWITHSTANDING JM EAGLE'S™ ACTUAL KNOWLEDGE OF THE PRODUCT'S INTENDED USE OR ANY ADVICE OR REPRESENTATIONS THAT MAY HAVE BEEN RENDERED BY JM EAGLE™ CONCERNING THE DESIGN, MANUFACTURE, FABRICATION, SALE, USE, INSTALLATION OR PROVISION OF THE PRODUCTS. NO STATEMENT, CONDUCT OR DESCRIPTION BY JM EAGLE™ OR ITS REPRESENTATIVES, IN ADDITION TO OR BEYOND THIS LIMITED WARRANTY, SHALL CONSTITUTE A WARRANTY.

BUYER AGREES THAT ITS SOLE AND EXCLUSIVE REMEDY FOR BREACH OF THIS LIMITED WARRANTY, AND THE SOLE AND EXCLUSIVE OBLIGATION OF JM EAGLE™ IN RESPECT OF ANY CLAIMS FOR BREACH OF THIS LIMITED WARRANTY, SHALL BE (1) THE REPLACEMENT OF THE SAME TYPE, SIZE AND LIKE QUANTITY OF NON-DEFECTIVE PRODUCT, AT THE ORIGINAL POINT OF DELIVERY AND COSTS RELATED TO ITS REPLACEMENT\*\*\*, OR (2) CREDITS, OFFSETS, OR A COMBINATION THEREOF, FOR THE WHOLESALE PURCHASE PRICE OF THE DEFECTIVE PRODUCT. IN NO EVENT SHALL JM EAGLE™ BE LIABLE FOR LOST PROFITS, LOSS OF GOODWILL, LOSS OF BUSINESS OPPORTUNITIES, DAMAGE TO REPUTATION, SPECIAL DAMAGES, INDIRECT DAMAGES, DELAY DAMAGES, PUNITIVE DAMAGES, EXEMPLARY DAMAGES, CONSEQUENTIAL DAMAGES OR INCIDENTAL DAMAGES.

### 3. REQUIREMENTS FOR MAKING CLAIMS:

Every claim for breach under this warranty shall be void unless it is made in writing to JM Eagle™ and postmarked within five business (5) days of the date the defect was discovered or in the exercise of ordinary care should have been discovered and, in any event, the claim must also be made within fifty (50) years of the date of the JM Eagle™ invoice. As noted above, Products manufactured by JM Eagle™ are marked with a JM Eagle, PW Eagle or US Poly stencil. This limited warranty excludes any Product not manufactured by JM Eagle™, even if it is sold by JM Eagle™.

Any claim for breach of warranty must be sent to:

Product Assurance Department  
JM Eagle  
5200 W. Century Boulevard  
Los Angeles, CA, 90045

For questions regarding claims, the Product Assurance Department may be also contacted at 1-800-621-4404 or JMWebSupport1@jmeagle.com.

No claim under this limited warranty will be valid unless (1) proof of purchase with the date thereof as well as a description of the alleged defect in reasonable detail is presented to the satisfaction of JM Eagle™, (2) written permission and/or a Return Goods Authorization (RGA) is obtained from JM Eagle™, (3) JM Eagle™ is given a meaningful and reasonable opportunity to inspect the allegedly defective Product and its installation at the site and (4) at JM Eagle™'s request, representative samples of the allegedly defective Product are returned to JM Eagle™ in accordance with JM Eagle™'s instructions.

# 50 Year Warranty

## LIMITED WARRANTY

### 1. PERIODS AND SCOPE OF COVERAGE

### 2. EXCLUSIONS FROM COVERAGE AND EXCLUSIVE REMEDY:

Products manufactured by JM Eagle™ are marked with JM Eagle, PW Eagle or US Poly stencil markings. This limited warranty excludes any Product not manufactured by JM Eagle™, even if it is sold by JM Eagle™, and also excludes defects or failures caused after shipment by:

- improper installation (including, without limitation, misalignment),
  - use in improper applications or conditions or in conjunction with improper materials (including, without limitation, improper lubricants, pastes, solvents or sealants),
  - contact with aggressive chemical agents, freezing or overheating of liquids in the Product, or unusual pressure surges or pulsation,
  - vibration,
  - temperature shocking,
  - U.V. degradation,
  - failure to adhere to JM Eagle™'s instructions concerning the proper handling, installation, testing and use of the Product,
  - failure to adhere to applicable standards set forth by local laws, codes, or regulations and the applicable industry standards, or
  - any other improper activities not listed above or damage caused by the fault or negligence of anyone other than JM Eagle™.
- of being certified to ISO 9001 certification\*\* as part of our program to develop manufacturing processes that consistently produce high quality plastic pipe.

JM Eagle™ quality control programs encompass three critical aspects of the manufacturing process: the incoming raw material, pipe production, and the finished goods.

\* Products covered by this Limited Warranty include similar PW Eagle and US Poly products manufactured by JM Eagle after July 1, 2007.  
\*\* JM Eagle's Conroe Texas plant in the process of obtaining ISO 9001 certification. The other plants are already certified to ISO 9001.  
\*\*\* Replacement costs shall be reasonable and based on industry standard cost parameters such as those listed in the RS Means Assemblies Cost Data Book.



# STANDARDS

Standard	Performance Designation	Nominal Diameter Range	Outside Diameter Type	Pressure Class (PC) Pressure Rating (PR)	Safety Factor (SF)	Available Joint Systems
AWWA C900: PVC Pressure Pipe	Pressure Class (PC)	4" – 60"	Cast Iron Outside Diameter (CIOD) or Iron Pipe Size (IPS)	PC 80 psi – DR51 PC 100 psi – DR41 PC 125 psi – DR32.5 PC 150 psi – DR27.5 PC 160 psi – DR26 PC 165 psi – DR25 PC 200 psi – DR21 PC 235 psi – DR18 PC 250 psi – DR17 PC 305 psi – DR14	2.0	Gasket - Unrestrained Joint Gasket - Restrained Joint Butt Fusion
AWWA C905 : REPLACED WITH NEW AWWA C900 STANDARD EFFECTIVE AUGUST 2016 (SEE ABOVE)						
AWWA C909: PVC Pressure Pipe	Pressure Class (PC)	4" – 30"	Ductile Iron Outside Diameter (DIOD)	PC 165 psi PC 235 psi PC 305 psi	2.0	Gasket - Unrestrained Joint Gasket - Restrained Joint
ASTM D2241: PVC Pressure Pipe	Pressure Rating (PR)	1/8" – 36"	Plastic Irrigation Pipe (PIP) or Iron Pipe Size (IPS)	PR 50 psi – DR81 PR 63 psi – DR64 PR 80 psi – DR51 PR 100 psi – DR41 PR 118 psi – DR35 PR 125 psi – DR32.5 PR 160 psi – DR26 PR 200 psi – DR21 PR 250 psi – DR17 PR 315 psi – DR13.5 PR 400 psi – DR11	2.0	Gasket - Unrestrained Joint Gasket - Restrained Joint Solvent Cement Butt Fusion
ASTM F1483: PVC Pressure Pipe	Pressure Rating (PR)	4" – 16"	Cast Iron Outside Diameter (CIOD) or Iron Pipe Size (IPS)	PR 150 PR 160 PR 200 PR 250	2.0	Gasket - Unrestrained Joint Gasket - Restrained Joint

C900 available up to 60"  
C909 6, 8, 12, 16, 24"





# Standards and Manufacturing

## AWWA Standards

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**C900**

Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)

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**C909**

Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 In. (100 mm) and Larger

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**C605**

Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

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**C907**

Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service

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# Standards and Manufacturing

## ASTM Standards

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<b>D3034</b>	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
<b>F679</b>	Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
<b>D2241</b>	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
<b>D2321</b>	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
<b>D2774</b>	Standard Practice for Underground Installation of Thermoplastic Pressure Piping

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# Standards and Manufacturing

## Pipe Extrusion



PVC compound is fed into extruder

Compound is forced through die under high pressure (2,000 psi to 5,000 psi)

Pipe exits at roughly 400°F and water cooled





# Standards and Manufacturing

## Pipe Belling

One end of pipe is heated until pliable

End is placed over mandrel and expanded, forming bell

Gasket is integrally formed with the bell



# Standards and Manufacturing

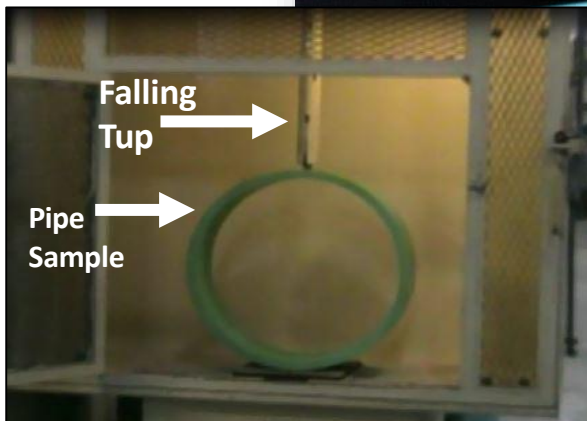
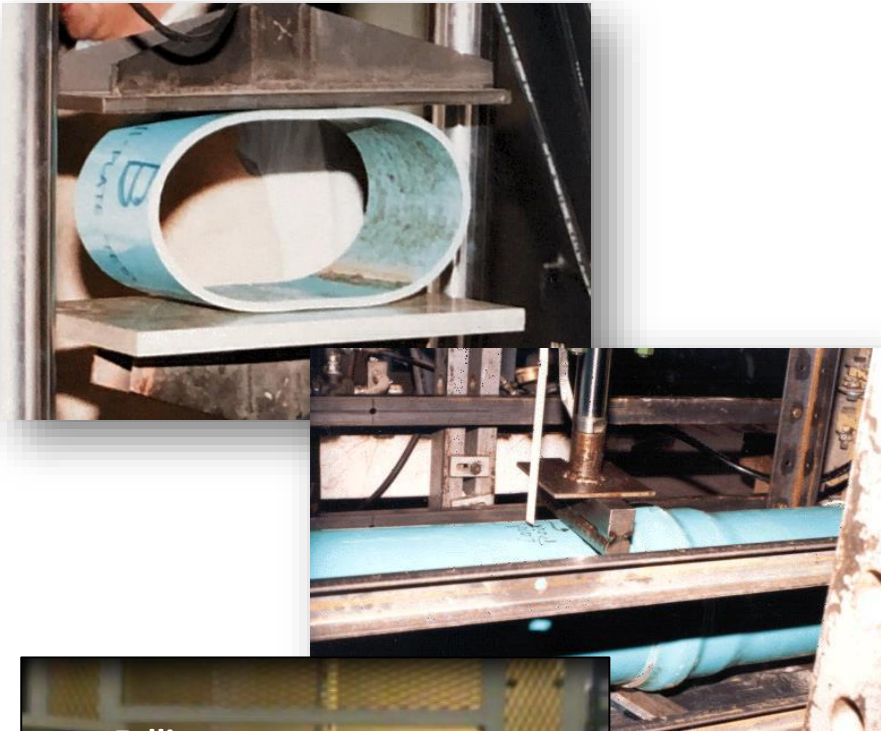
## Pressure Testing



DR	Pressure Class (psi)	Hydrostatic Pressure Test (psi)	1000 Hour Sustained Pressure Test (psi)	Quick Burst Pressure Test (psi)
25	165	330	350	535
21	200	400	420	630
18	235	470	500	755
14	305	610	650	985

# Standards and Manufacturing

## Quality Assurance Testing



### Flattening Test: ASTM D2412

- 30% deflection before reverse curvature
- 60% deflection without splitting, cracking, or breaking
- Installed deflection  $\leq 7.5\%$   $\rightarrow$  SF = 4.0

### Joint Test, Pressure Applications: ASTM D3139

- Vacuum pressure of -10.8 psi for 1 hr
- Sustained pressure equal to 2.5 x PC for 1 hr
- Minimum burst pressure test to 3.2 x PC for 60-70 sec

### Joint Test, Gravity Applications: ASTM D3212

- Vacuum pressure of -10.8 psi (22 in. Hg) for 10 min
- Internal pressure of 25 feet of head (10.8 psi) for 10 min
- At maximum offset and at arbitrary 5% vertical ring deflection

### Impact Test: ASTM D2444

- Sewer pipe must withstand up to 220 ft-lb impact strength
- Water pipe UL and FM certified must withstand minimum 100 ft-lb impact strength



# Typical Installation

## Handling and Storage

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When unloading, care should be given so that forklifts do not damage pipe

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Avoid severe impact blows and abrasion damage

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Use straps instead of chains for lifting

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Unload and store pipe bundles as they were shipped

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Ensure stored pipe is resting on dunnage, not other pipe

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Pipe should be stacked no more than 8ft high

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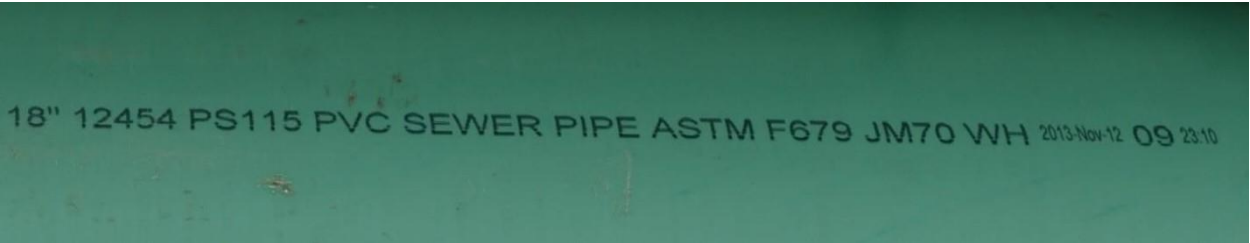
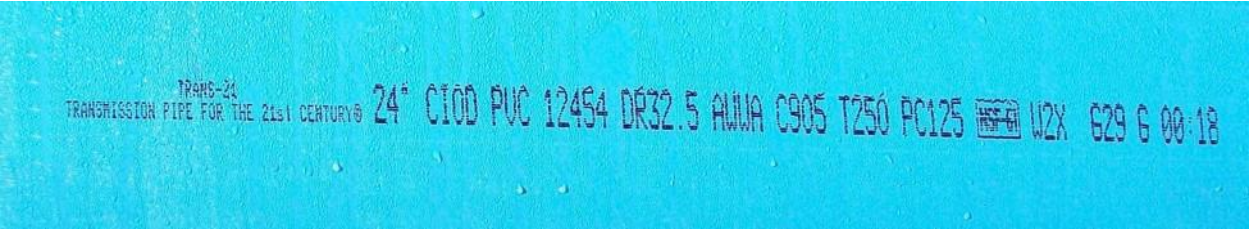
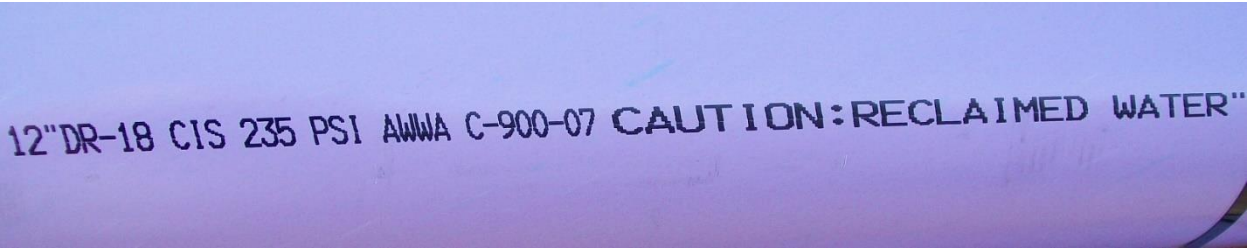
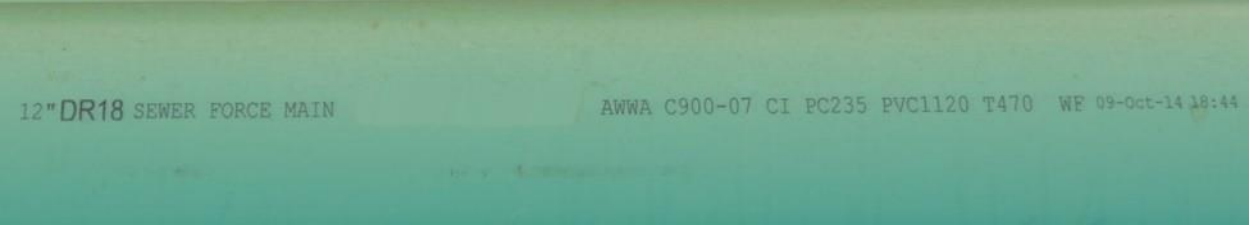
Any pipe with problems should be noted and set aside and the supplier contacted



# Typical Installation

## Print Line

- Size
- OD Type
- Manufacturer
- Standard
- Class/Type
- Certifications
- Date Code
- Allowable Pull





# Typical Installation

## Pipe Assembly

---

Provide a worker at both ends

---

Clean the spigot and bell

---

Position in straight alignment



---

Lube per instructions

---

Insert spigot into bell

---

Push together to insertion line

---

**DO NOT OVER-INSERT PIPE**

---

Insertion line(s) must be visible



# Typical Installation

## Pipe Assembly



← Bar-and-Block



Mechanical Puller →



← Hydraulic Puller



Excavator/Backhoe →

# Typical Installation

## Changes in Direction



### Joint Deflection

- 1 to 1.5° Joint Pull Typically Available

### Fabricated Fitting

- Available in 1-5° Sweeps or Angled Couplings
- Fittings for angles over 5° (5 5/8°, 11 1/4°, 22 1/2°, 45°, 90°)

### Longitudinal Bending

- Within limits of *Contractor's Guide for Installation of Gasketed PVC Pipe*

# 1 degree of Deflection

C900 Pressure Pipe

Force Required

PIPE SIZE (inches)	MINIMUM RADIUS (feet)	OFFSET (in)
4	100	24.08
6	150	16.02
8	200	12.01
10	250	9.61
12	300	8.00

PIPE SIZE (inches)	DR 25	DR 18	DR 14
4	16.36	21.62	26.32
6	47.21	60.85	74.25
8	102.77	135.79	165.29
10	185.35	245.54	299.27
12	309.09	407.09	498.65

SDR 35 Gravity Sewer

PIPE SIZE (inches)	MINIMUM RADIUS (feet)	OFFSET/20 FEET (inches)	OFFSET/14 FEET (inches)
4	100	23.9	11.7
6	150	16.0	7.8
8	200	12.0	5.9
10	250	9.6	4.7
12	300	8.0	3.9



# Deflection Calculations – External Load

## Design Calculator

### TRENCH CROSS-SECTION SHOWING TERMINOLOGY

$$\% \frac{\Delta Y}{D} = \frac{K_X(T_L W_E + W_L + W_S)}{0.149PS + 0.061E'}$$

Where:

$\Delta Y/D$  = Percent Deflection, %

$K_X$  = Bedding Constant

$T_L$  = Time Lag Factor

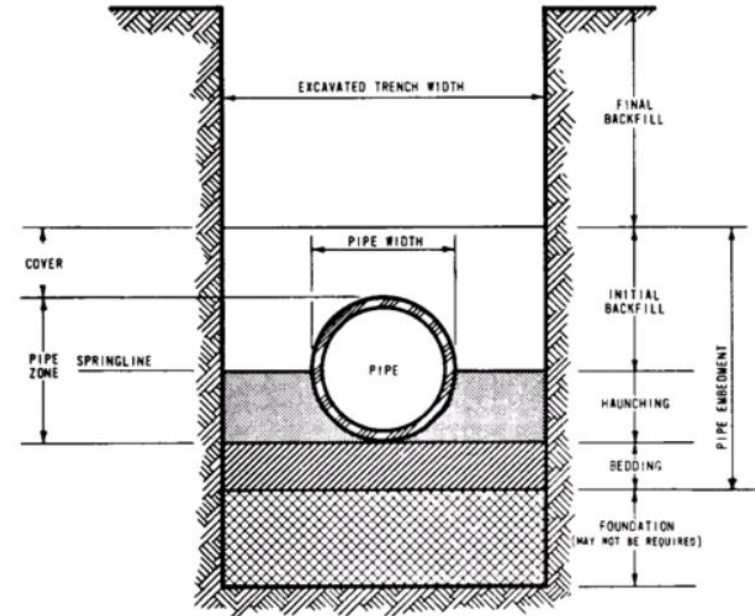
$W_E$  = Prism Earth Load, psi

$W_L$  = Live Load on the Pipe, psi

$W_S$  = Additional Surcharge Load on the Pipe, psi

$PS$  = Pipe Stiffness, psi

$E'$  = Modulus of Soil Reaction, psi



<https://www.uni-bell.org/External-Load-Design-Calculator>

# Tapping

## Coupons

- Coupon: Cylindrical piece of PVC wall removed during tapping
- Coupon should be examined after removal from the cutter head
- Smooth coupon indicates feed rate was correct and cutter was functioning properly



***Smooth Coupons***

# Tapping

## Coupons

### Striations

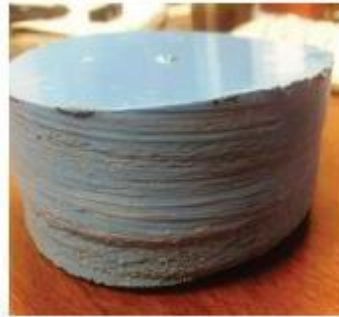
- Indicate a dull cutter, too rapid feed rate, or lack of lubrication on cutting tool

### Crown

- Indicates feed rate was excessive

### Punch-Through

- Excessive feed rate, dull cutter, or cutter is of insufficient depth for the pipe wall thickness



*Coupon with Striations*



*Coupons Showing "Crown" at Outer Surface*

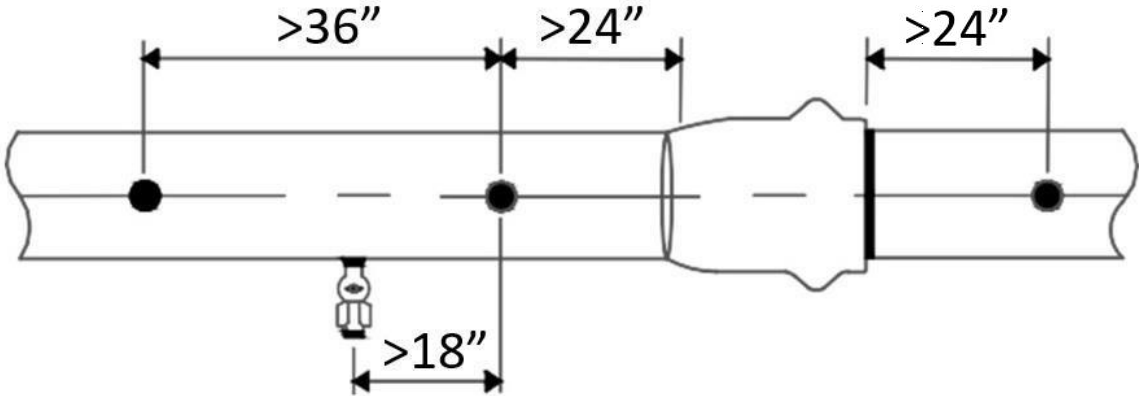


*Coupons Showing "Punch-Through" at Inner Wall*



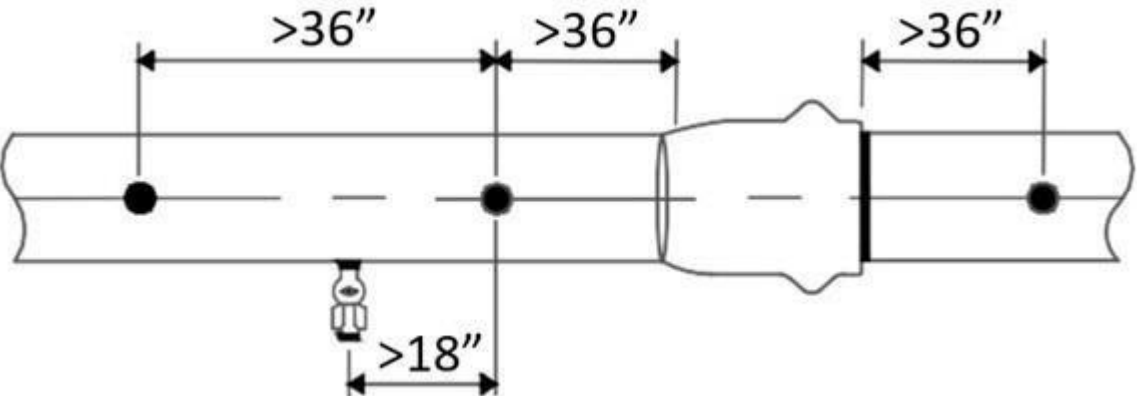
# Tapping

## Spacing



12" and Smaller

14" and Larger



# LONGEVITY OF PVC PIPE

## WATER PIPE

- **AWWA Water Research Foundation study confirms life expectancy of PVC water pipe in excess of 110 years.**
  - *Long-Term Performance Prediction for PVC Pipes*, Stewart Burn and Alan J. Whittle
- **European tests on PVC water pipe excavated in Germany in 2004 determined PVC pipe's longevity at 170 years.**
  - *70 Years of Experience with PVC Pipes*, Thomas Hülsmann and Reinhard E. Nowack



# Topics with PVC

- **Fusible - 1100' break on 30" DR 25 in Orange County FL**
- **Tap Failures**
  - Is pipe Deflected
  - Tapping with dull tap bit
- **Poor handling**
  - Improper loading and unloading
- **Installation issues**
  - Improper Backfill material/procedures
  - Over Belling – Over Insertion is a huge issue “What Homing Line”
    - Pressure test works but when reduced to working pressure bells can leak
  - TOO MUCH Deflection – 1 degree max
  - Rolled Gaskets – too much deflection introducing spigot into bell
- **Restraining PVC - Eagle Loc vs. RieberLok**



Collier County, FL, fused PVC failure during pressure test.





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# Eagle Insertion Stop



DELIVERING GOOD WATER TO YOU



## INTRODUCING THE EAGLE INSERTION STOP

*JM Eagle, the industry's leader in exclusive innovation and engineered products, announces our latest technological advancement.*

Installing the Eagle Insertion Stop will greatly reduce the possibility of over-insertion of the spigot into the bell when assembling JM Eagle PVC Pipe and Eagle Loc.

- Easy to install / use
- Effective
- Low Cost
- Strong
- Greatly Reduces installation errors
- Patent Pending

Will ship standard with all Eagle Loc Internal Joint Restraint orders (8"-16").

Also available for separate ordering with all C900/905 & C909 PVC shipments

- 8" - 16" available immediately
- 4", 6" & 24" availability TBD



Scan our QR Code or use the following link to view a video about this product:

<https://www.youtube.com/watch?v=5hCRXbjFpwQ>

**AVAILABLE NOW**



# Restraining PVC

<b>MAXIMUM PULL FORCE FOR HDD APPLICATIONS</b> <b>*CONTACT RIEBERLOK PRIOR TO HDD INSTALLATION*</b>		
<b>NOMINAL DIAMETER AWWA C900</b>	<b>MAXIMUM APPLIED PULLING FORCE (POUNDS)</b>	
	<b>CIOD-DR 18 CLASS 235</b>	<b>CIOD-DR 14 CLASS 305</b>
4"	4,300	5,500
6"	8,800	11,000
8"	15,000	20,000
10"	23,000	30,000
12"	32,000	42,000
16"		
	<b>IPS-SDR26 CLASS 160</b>	<b>IPS-SDR 21 CLASS 200</b>
3"	2,500	1,900
4"	2,500	3,200
6"	5,500	6,900
8"	9,400	11,700



# LOKX System Ductile Iron Fitting – Restrained Joints



# MULTI/JOINT® 3000 Plus



AC

PE

PVC/PVCO

(Stainless) Steel

Grey cast iron

(Ductile) cast iron



## Couplings

Size (inch)	Part number	Pipe OD Range (inch)	Pipe OD Range (mm)	Working pressure
2"	709305610	1.811 - 2.795	46 - 71	232 psi
2½"	709305612	2.480 - 3.543	63 - 90	232 psi
3"	709305614	3.307 - 4.133	84 - 105	232 psi
4"	709305616	4.094 - 5.196	104 - 132	232 psi
5"	709305618	5.196 - 6.102	132 - 155	232 psi
6"	709305620	6.062 - 7.559	154 - 192	232 psi
8"	709305624	7.559 - 9.133	192 - 232	232 psi
9"	709305626	9.050 - 10.551	230 - 268	232 psi
10"	709305628	10.511 - 12.204	267 - 310	232 psi
12"	709305632	12.401 - 14.015	315 - 356	232 psi
14"	709305636	13.858 - 15.472	352 - 393	232 psi*
16"	709305640	15.433 - 17.047	392 - 433	232 psi*
17"	709305642	17.007 - 18.267	432 - 464	150 psi
18"	709305672	17.716 - 18.976	450 - 482	150 psi
19"	709305673	18.937 - 20.196	481 - 513	150 psi
20"	709305674	19.685 - 20.944	500 - 532	150 psi
22"	709305676	21.574 - 22.834	548 - 580	150 psi
24"	709305678	23.818 - 25.078	605 - 637	150 psi
25"	709305680	24.803 - 26.063	630 - 662	150 psi
27"	709305681	26.181 - 27.441	665 - 697	150 psi
28"	709305682	27.913 - 29.173	709 - 741	150 psi
30"	709305685	29.331 - 30.591	745 - 777	150 psi
32"	709305683	31.456 - 32.716	799 - 831	150 psi
34"	709305684	32.952 - 34.212	837 - 869	150 psi

\* 150 psi for plastic pipe materials



## Reduced Couplings

Size (inch)	Part number	Pipe OD Range (inch)	Pipe OD Range (mm)	Working pressure
2" x 2½"	709405618	1.811 - 2.795 / 2.480 - 3.543	46 - 71 / 63 - 90	232 psi
2½" x 3"	709405620	2.480 - 3.543 / 3.307 - 4.133	63 - 90 / 84 - 105	232 psi
3" x 4"	709405624	3.307 - 4.133 / 4.094 - 5.196	84 - 105 / 104 - 132	232 psi
4" x 5"	709405632	4.094 - 5.196 / 5.196 - 6.102	104 - 132 / 132 - 155	232 psi
4" x 6"	709405636	4.094 - 5.196 / 6.062 - 7.559	104 - 132 / 154 - 192	232 psi
5" x 6"	709405638	5.196 - 6.102 / 6.062 - 7.559	132 - 155 / 154 - 192	232 psi
6" x 8"	709405648	6.062 - 7.559 / 7.559 - 9.133	154 - 192 / 192 - 232	232 psi
10" x 12"	709405686	10.511 - 12.204 / 12.401 - 14.015	267 - 310 / 315 - 356	233 psi
12" x 14"	709405688	12.402 - 14.015 / 13.858 - 15.472	315 - 356 / 352 - 393	232 psi*
16" x 17"	709405693	15.433 - 17.047 / 17.000 - 18.267	392 - 433 / 432 - 464	150 psi
17" x 19"	709405695	17.000 - 18.267 / 18.937 - 20.196	432 - 464 / 481 - 513	150 psi
20" x 22"	709405696	19.685 - 20.944 / 21.574 - 22.834	548 - 580 / 605 - 637	150 psi

\* 150 psi for plastic pipe materials



# ULTRA BLUE™

MEETS AWWA C909 OR ASTM F1483



*Building essentials  
for a better tomorrow™*



- \* Largest ID in Industry
- \* Lower Pumping Costs
- \* Greater Flow Area
- \* Lower Surge Pressures
- \* Lightest Weight in industry
- \* 4 X Impact Strength of Regular PVC
- \* Greater Cyclic Strength
- \* One of the Safest & Easiest Pressure Pipes to Tap



**DELIVERING GOOD WATER TO YOU**



# 24" C909 PVCO – NEW 2024





# What is AWWA C909?

**Ultra-Blue** is PVC pipe that due to its unique manufacturing process has additional benefits over conventionally extruded PVC pipe.

**Ultra-Blue** is to PVC pipe what Ductile Iron is to Cast Iron.



# What is Ultra-Blue?

**Ultra-Blue is high molecular weight PVC that is:**

- conventionally extruded
- expanded in a mold

**Ultra-Blue expansion:**

- Molecular reorientation in hoop direction
- Improving pipe properties



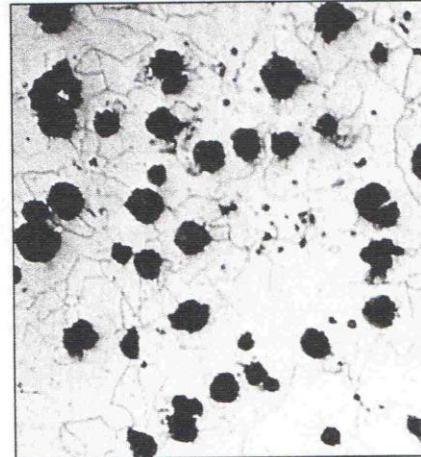
<https://www.youtube.com/watch?v=IMaoj1RYS7k>



THE ADVANCEMENT OF DUCTILE IRON PIPE



Photomicrograph of gray cast iron (100x) showing carbon in the form of graphite flakes.



Photomicrograph of Ductile Cast Iron (100x) showing carbon in the form of graphite nodules.

Cast Iron Pipe has long been the standard material for conveying water and sewage in municipal, utility and industrial piping systems.

The real life expectancy of cast iron pipe is unknown, but is usually estimated at 100 years or more. The oldest operating cast iron main is that at Versailles, France, installed in 1664. In this country and in Canada there are more than 500 members of the Cast Iron Pipe Century Club, a unique organization composed of cities or utilities who have cast iron pipe still in service after 100 years.

Ductile Iron Pipe, a product of advanced metallurgy, offers unique properties for conveying water under pressure, and other piping uses. It combines the physical strength of mild steel with the long life of gray cast iron.

Ductile iron offers the greatest possible margin of safety against service failures due to ground movement and beam stresses. Virtually unbreakable in ordinary service, it also provides increased resistance to breakage caused by rough handling in shipping and installation.

The corrosion resistance of ductile iron pipe has been proved in a wide variety of accelerated tests to be at least the equal of gray cast iron.

Ductile iron is produced by adding a closely controlled amount of magnesium alloy to a molten iron of low phosphorous and low sulfur content. The magnesium alloy addition produces a remarkable change in the microstructure by causing the carbon in the iron to assume a spheroidal or nodular shape, (as contrasted to the flake form of graphite in gray cast iron), and at the same time producing a finer grained iron matrix in the surrounding ferrite structure. As a result of this remarkable change, a far stronger, tougher, and ductile material is obtained.

In addition to the benefits of long life, corrosion resistance, high structural strength, and tight joints, ductile iron is also readily machinable, an important requirement in any pipe that must be drilled, tapped or cut.

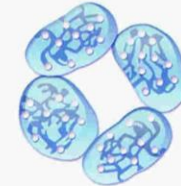
The McWane Companies manufacture Ductile Iron Pipe in strict accordance with design criteria that have been developed by the American National Standards Institute, and which equals or exceeds the requirements of all published standards of the American Water Works Association.

# AND IPS 6"-12" ASTM F1483

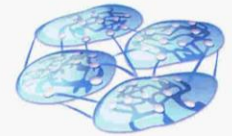
## Exclusive Technology at its Strongest

- The highest-performing, lightest-weight, most cost-effective pressure pipe for potable water and force main systems.
- Molecularly oriented to be lighter yet stronger—as much as four times stronger than conventional PVC.
- The only molecularly oriented plastic pipe made in the United States.
- Delivers HDB of 7,100 psi vs. HDB of 4,000 psi of conventional PVC pipe.
- Has a higher cyclic fatigue strength, greater impact strength and a larger interior diameter than conventional PVC.
- Offers maximum flow capacity and is pressure tough, crush resistant and non-corroding.

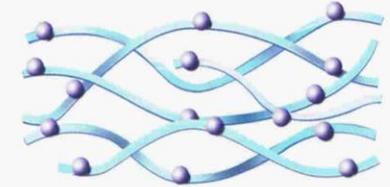
### Ultra Blue PVC0—Molecular Orientation for Superior Strength



CONVENTIONAL PVC PIPE CLUSTERS THE MOLECULES, REQUIRING A THICKER WALL FOR STRENGTH.



PVC0 PROCESS BINDS THE MOLECULES FOR A TIGHTER, STRONGER BOND.



ULTRA BLUE'S EXPANSION PROCESS CHANGES THE PIPE'S MOLECULAR ORIENTATION, RESULTING IN SUPERIOR STRENGTH AND IMPACT RESISTANCE.

Meets AWWA C909-09 or ASTM F1483, and UL 1285; Gaskets meet ASTM F477; Joints meet ASTM D3139.



# Why was Ultra-Blue developed?

- **For PVC Users**

- Retains benefits of PVC
- Adds improved properties
- PVC Alternative to Ductile
- Eliminate Tapping Failures

- **For Ductile Iron Users**

- Eliminates corrosion
- Eliminates perceived disadvantages of PVC pipe



# When and Where?

## History

- Technology
  - Europe: Early 1970s
  - North America: Early 1990s
  - Spread worldwide in the 1990s
- Standards:
  - ASTM F1483: First published 1993
  - AWWA C909: First published 1998







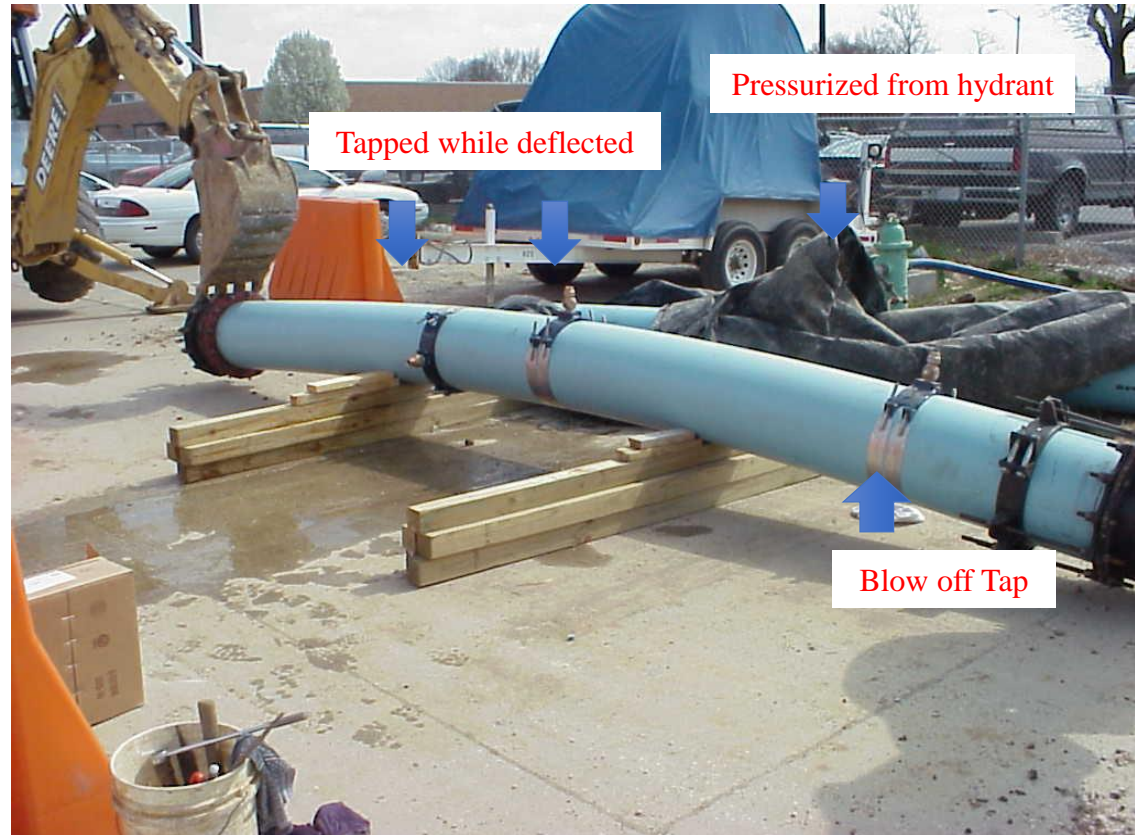
**AWWA C909 has superior notch resistance, virtually eliminating tap failures.**

# Ultra Blue

16" AWWA C909

Pressure Rated 165 psi

Pressurized to 78 psi, Deflected Then Tapped Twice On Deflected Area







**Backhoe did full tooth impact on pressurized line. Pipe took 5 full impacts before breaking.**

**Due to Biaxial Orientation pipe does not split longitudinally but breaks locally where repairs can be made easier.**





**Pipe breaks in layers similar to plywood. You can see where the backhoe struck the pipe 5 times before rupture.**



**AWWA C909 PVCO has 4 times the impact strength of conventional PVC and 3 times the cyclical strength.**

This piece of AWWA C909 Ultra Blue PVC0 was crushed then pressurized to its rated pressure with no leaks, cracks or splits.





# Ultra Blue – Why this is the Super Pipe

## Just a few examples of Ultra Blue benefits

- Increased Hoop Strength
- Higher Impact resistance, even in freezing temperatures
- Lighter weight
- No Longitudinal Cracks
- Great Cyclic Fatigue resistance
- Large ID – more flow
- Eliminate tapping failures
- Engineered for Seismic applications
- Best properties for elevation changes

# Issues with C909

- **Gaskets**

- **Loose Gaskets are installed by hand after pipe is made so they are necessarily looser than C900 gaskets**
- **Debris in Gasket**
- **Over Lubing**

- **Short Stubs**

- **Thin Walls do not hold up to cyclical strength required on shorter stubs**
- **Recommend Anchor Couplings to connect Hydrants to Valves (Clear Water)**

- **Direct Tapping – Not allowed**

- **Over deflecting is much easier with C909**

# Supply Concerns

- **Only 3 Manufacturers in North America**
  - **JM Eagle in US**
  - **IPEX and NAPCO in Canada (NAPCO in 2022)**
- **Only 3 of JM Eagle's 17 PVC plants can currently produce C909**
- **Major Supply is 6" – 12" Class 235 (DR 18 Equiv)**





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# Restraining PVCO

**PRESSURE-RATED PVC INTERNAL RESTRAINT  
FOR ANGER GROOVE APPLICATIONS**



**FOR ANGER GROOVE APPLICATIONS**



Potable



Irrigation

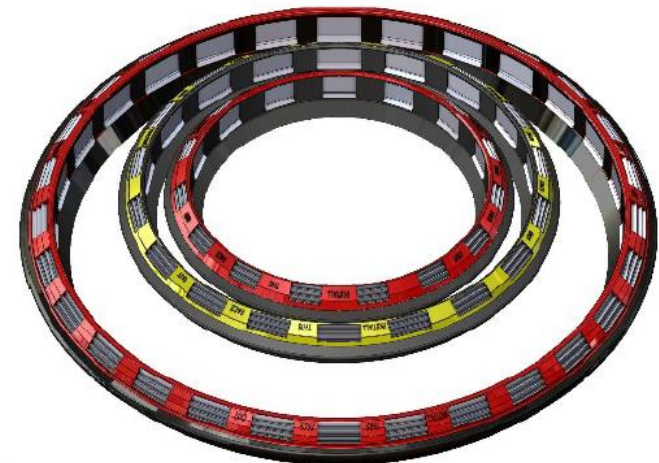


Reclaim



Sewer Force Main

AVAILABLE PIPE & FITTING SIZES (SBR OR EPDM)			
	6"	8"	12"
CIOD	✓	✓	✓



## STAINLESS LOCKING SEGMENTS

Locking segments engage progressively as load increases

## RIBERLOK AG

Proprietary seal tolerates dimensional variation of pipe bells and deflection