PVC Gasketed & Solvent Weld Pipe

ROYAL® Municipal, Plumbing & Industrial Solutions

About Royal Building Products

Royal Building Products has been in the pipe business for over 100 years when the Royal Abbotsford, Canada facility started producing clay pipe. With the shift in demand for modern pipe solutions, the site was transitioned to making PVC pipe in 1976. In addition, Royal Building Products has been producing PVC fittings for over 45 years with Plastic Trends, an industry leader who has been specified and installed in municipalities nationwide. Headquartered in Shelby Township, Michigan, our company has a long tradition of innovation in PVC fittings. We develop, design, manufacture, market and distribute gasketed and solvent weld fittings and pipe for the municipal, plumbing, industrial, irrigation and electrical markets. Leveraging our extensive PVC pipe offering allows us to offer an integrated pipe and fittings system that performs unlike any other on the market.

We supply pipe for the following applications:

- Pressure
- Sewer
- Drainage
- Electrical

Whatever the application, contractors can rest assured they made the right choice with Royal Building Products.

Royal has built its reputation on quality. We understand the contractor's expectations in choosing products for their installations, so we have designed our pipe and fittings for optimal performance. It starts with our in-house capability in product design. Pipe and fitting intersections hold the key to a reliable installation. Our joint designs have been optimized for improved dependability. Royal employs state-of-the-art manufacturing equipment and processes to achieve tight tolerances and dimensions which ultimately results in a simple installation. All of our products are thoroughly tested to meet internal standards before being shipped. Many products carry third party certification such as CSA, UL, NSF, or ASTM for the highest performing solution. Our PVC pipe and fittings are non-corrosive, requiring no maintenance, and they are also easy to transport and assemble in the field. All of this means fewer labor hours and a smoother, less costly installation. We strive to exceed the expectations of the contractor community and ensure quality pipe and fittings that will withstand the harsh environment of today's construction and perform on the job for years to come.

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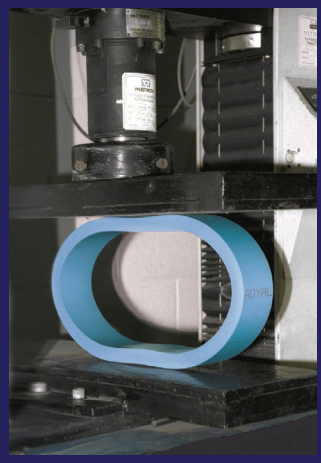


SDR 35 and SDR 26 pipe are tested to compress 40% without rupturing or cracking

IPS PVC Gasketed Pressure Pipe

Servicing many different water systems and applications

About IPS Pressure Pipe

Royal Municipal Solutions IPS pressure pipe is manufactured with Iron Pipe Size (IPS) diameters and is available with factory-installed Double Seal Locked-In (DSLI™) gaskets in the bells.

Our IPS pressure pipe is offered in Standard Dimension Ratios (SDR) 17, 21, 26, with Pressure Ratings of 250, 200, and 160 psi respectively. Royal Municipal Solutions IPS pressure pipe is available in 2 ½" to 16" diameters in 20' lengths.

Royal Municipal Solutions IPS Pressure Pipe can service the following applications:

- Potable water systems
- Irrigation piping
- Transmission pipe
- Sewer force mains
- Stormwater disposal
- Mechanical piping

Royal Municipal Solutions IPS Pressure Pipe shall be manufactured with iron pipe outside diameters and certified to CSA B137.3 Standard Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications and conform to all the requirements of ASTM D2241, Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).

Pipe Availability

(All CSA certified with the exception of SDR 17)

SDR 26: 2½, 3, 4, 6, 8, 10, 12, 14, 16
SDR 21: 3, 4, 6, 8, 10, 12, 14, 16
SDR 17: 2½, 3, 4, 6, 8, 10, 12

Product Quality

Royal Municipal Solutions is recognized for its high quality products. Our state-of-the-art extrusion equipment and computerized material handling system ensure consistency. Our quality control testing guarantees that the pipe you install will outperform the application.

In Royal Municipal Solutions extrusion facilities, each operator is responsible for quality. Pipe is continually tested in our quality control laboratory to ensure conformance with CSA requirements. No pipe enters our yard without the seal of approval from our quality control team.

Installation

Royal Municipal Solutions IPS pressure pipe is cost effective to install compared to traditional pipe products. Joint assembly can be handled in the trench with minimal manpower.

IPS PVC Gasketed Pressure Pipe

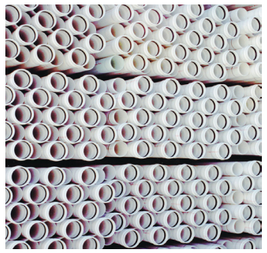
Joining

Gasketed Pipe

Clean the bell and spigot of all debris. Lubricant must be applied to the spigot end, it is recommend to put lubricant on the bell end as well. The lubricant should be non-toxic, water-soluble lubricant which is listed by the National Sanitation Foundation (NSF). The pipes are then placed in straight alignment and pushed to the insertion line marked on the spigot end of the pipe. Royal's factory-installed gaskets eliminate the problems of rolling or fish mouthing. Care should be taken to avoid over insertion into the pipe bell beyond the spigot insertion line.

Color Coding

Royal Municipal Solutions IPS Series Pressure Pipe is color coded white.



Design Advantages

There are many advantages for using our IPS Series pressure pipe. Our pipe is corrosion proof, has a smooth bore and is not affected by ultra violet aging or biological attack. The same pure water that enters the pipe leaves the pipe.

Corrosion Proof

One of the problems associated with a potable water system using conventional pipe materials is corrosion. Royal IPS pressure pipe is essentially inert and non-conductive, leaving it immune to electrolytic corrosion. Acidic and alkaline soils have no effect on Royal IPS Series pressure pipe.

The interior wall of PVC pipe is very smooth with a Hazen-Williams C-factor of 150 for the design of PVC piping systems. This factor reduces head loss, maintains pressure and excellent water quality throughout the life of the system as compared to conventional pipe materials.

IPS PVC Gasketed Pressure Pipe

Quality Control and Assurance

Royal IPS pressure pipe undergoes extensive testing and inspection in our manufacturing facilities. The following testing assures outstanding product quality.

Biological Attack

The performance of PVC pipe in severe environments has been studied since the 1950's. These studies have found that PVC pipe will not deteriorate or breakdown under biological attack from micro and macro-organisms. Investigations have failed to document a single case where buried PVC pipe products have suffered degradation or deterioration due to biological attack.

Effects of Ultra-Violet Aging

PVC pipe has been tested for exposure to sunlight for two years. After two years of exposure under some of the worst conditions in North America, the tensile strength, impact strength and pipe stiffness were then tested. The results showed that the effects of ultra-violet radiation on PVC pipe were considered to be negligible.

PVC Material

The PVC material used in the manufacture of our pipe meets the physical properties of PVC class 12454 as specified in ASTM D1784.

Hydrostatic Design Basis

The material has a Hydrostatic Design Basis of 4,000 psi for water at 73°F.

Extrusion Quality Test

Specimens are tested in accordance with ASTM D2152. The pipe shall not flake or disintegrate after being immersed in anhydrous acetone for 20 minutes.

Effects of Temperature

The working pressure rating of IPS pipe is reduced when the temperature of a pipeline exceeds 73°F. The table below shows the reduction factors that need to be applied to the working pressure rating for these situations.

Maximum Service Temperature °F	De-rating Factor
80	0.88
90	0.75
100	0.62
110	0.50
120	0.40
130	0.30
140	0.22

IPS PVC Gasketed Pressure Pipe

Impact Resistance Test

Samples of pipe to be tested for low temperature impact resistance are conditioned at 32°F ± 3.6° for a period of not less than 16 hours. After conditioning, five samples are tested in accordance with the values shown in the table below. There shall be no evidence of shattering, cracking or splitting when the pipe is tested in accordance with CSA B137.0 and B137.3 and ASTM D2241.

Nominal Pipe Size in.	Impact Force ft-lb.
1	29.5
1 1/4	40.6
1 1/2	51.6
2	70.0
2 1/2	81.1
3	88.5
4	99.6
6	118.0
8	129.1
10	140.1
12	151.2
14	166.0
16	177.0
18	199.1

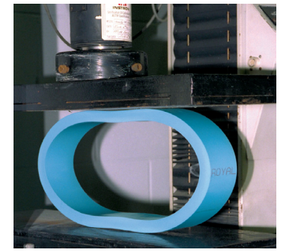
Joint Tightness Test

Joints must maintain a hydrostatic pressure equal to 2.5 times the rated pressure of the pipe for 60 minutes and a pressure level equal to the minimal burst pressure for 60 to 70 seconds.

Pressure Rating	Dimension Ratio	2.5 X Rated Pressure psi	Minimal Burst Pressure psi
160	SDR 26	400	512
200	SDR 21	500	640
250	SDR 17	625	800

Flattening Test

Three specimens of the pipe, each about 2" long are flattened between parallel plates in a suitable press until the distance between the plates is 5% of the original outside diameter of the pipe, or the walls of the pipe touch, whichever occurs first. The rate of loading shall be uniform and such that the compression is completed within 2 to 5 minutes. The specimens are examined for evidence of splitting, cracking or breaking. This test methodology is in accordance with CSA B137.3 and ASTM D2241.



Hydrostatic Quick-Burst Pressure Test

Pipe is pressure tested for quick-burst strength by pressurizing the sample for the test time period of 60 to 70 seconds. Short-term quick-burst pressure requirements are as follows:

Pressure Rating	Dimension Ratio	Hydrostatic Pressure
Class 160	SDR 26	512
Class 200	SDR 21	640
Class 250	SDR 17	800

IPS PVC Gasketed Pressure Pipe

Dimensions				
Standard Dimension Ratio (SDR)	Nominal Size in.	Average Inside Diameter in.	Average Wall Thickness in.	Average Outside Diameter in.
SDR 17 (Class 250)	2 1/2	2.517	0.179	2.875
	3	3.064	0.218	3.500
	4	3.938	0.281	4.500
	6	5.799	0.413	6.625
	8	7.549	0.538	8.625
	10	9.410	0.670	10.750
	12	11.160	0.795	12.750
SDR 21 (Class 200)	3	3.146	0.177	3.500
	4	4.046	0.227	4.500
	6	5.955	0.335	6.625
	8	7.755	0.434	8.624
	10	9.667	0.541	10.749
	12	11.466	0.642	12.750
	14	12.610	0.707	14.000
	16	14.420	0.809	16.000
	18	16.190	0.909	18.000
SDR 26 (Class 160)	2 1/2	2.633	0.120	2.873
	3	3.210	0.145	3.500
	4	4.134	0.183	4.500
	6	6.085	0.270	6.625
	8	7.920	0.352	8.624
	10	9.872	0.439	10.750
	12	11.730	0.518	12.766
	14	12.858	0.571	14.000
	16	14.698	0.651	16.000
	18	16.532	0.734	18.000

IPS PVC Gasketed Pressure Pipe

Calculated Deflections (%) of Buried PVC Pipe for Prism and H20 Loads																		Height of Cover (ft)
SDR	Modulus of Soil Reaction (E'), psi	2		6		10		14		18		22		26		30		
		Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Load Type
SDR 17	50	0.2	1.4	0.7	1.0	1.2	1.2	1.7	1.7	2.2	2.2	2.7	2.7	3.2	3.2	3.7	3.7	
	200	0.2	1.2	0.7	0.9	1.1	1.1	1.5	1.5	1.9	1.9	2.4	2.4	2.8	2.8	3.2	3.2	
	400	0.2	1.0	0.6	0.8	0.9	0.9	1.3	1.3	1.7	1.7	2.1	2.1	2.4	2.4	2.8	2.8	
	1000	0.1	0.7	0.4	0.5	0.7	0.7	0.9	0.9	1.2	1.2	1.5	1.5	1.7	1.7	2.0	2.0	
	2000	0.1	0.5	0.3	0.4	0.5	0.5	0.6	0.6	0.8	0.8	1.0	1.0	1.2	1.2	1.3	1.3	
SDR 21	50	0.5	2.0	1.4	1.8	2.3	2.3	3.2	3.2	4.1	4.1	5.0	5.0	6.0	6.0	6.9	6.9	
	200	0.4	1.6	1.1	1.4	1.8	1.8	2.6	2.6	3.3	3.3	4.0	4.0	4.8	4.8	5.5	5.5	
	400	0.3	1.3	0.9	1.1	1.4	1.4	2.0	2.0	2.6	2.6	3.2	3.2	3.8	3.8	4.3	4.3	
	1000	0.2	0.8	0.5	0.7	0.9	0.9	1.2	1.2	1.6	1.6	1.9	1.9	2.3	2.3	2.7	2.7	
	2000	0.1	0.5	0.3	0.4	0.5	0.5	0.8	0.8	1.0	1.0	1.2	1.2	1.4	1.4	1.6	1.6	
SDR 26	50	0.8	3.6	2.5	3.2	4.1	4.1	5.8	5.8	7.5	7.5	9.1	9.1	10.7	10.7	12.4	12.4	
	200	0.6	2.5	1.7	2.2	2.9	2.9	4.0	4.0	5.1	5.1	6.3	6.3	7.4	7.4	8.5	8.5	
	400	0.4	1.7	1.2	1.5	2.0	2.0	2.8	2.8	3.6	3.6	4.4	4.4	5.2	5.2	6.0	6.0	
	1000	0.2	0.9	0.6	0.8	1.1	1.1	1.5	1.5	1.9	1.9	2.4	2.4	2.8	2.8	3.2	3.2	
	2000	0.1	0.5	0.4	0.5	0.6	0.6	0.8	0.8	1.1	1.1	1.3	1.3	1.6	1.6	1.8	1.8	

Modulus of Soil Reaction, E', values are determined based on pipe bedding material type, placement and compaction.
E' values for specific burial conditions can be found in Table 7.3 in the Handbook of PVC Pipe Design and Construction

Pipe Deflection values in the above table are calculated using the Modified Iowa Formula and the following:

Bedding Constant, K = 0.1
Deflection Lag Factor, DL = 1.0
Soil Unit Weight for Earth Load = 120 lb/ft3

% Deflection is 7.5% or less, Burial Conditions are Acceptable

% Deflection is more than 7.5%, Burial Conditions are Unacceptable

For estimates of pipe deflection outside of the parameters shown above, contact Royal Building Products, Pipe and Fittings Solutions

Certification

Royal Municipal Solutions IPS pressure pipe (SDR 26 and 21) is third party tested and listed by CSA and manufactured to meet specifications defined in ASTM D2241, NSF-14, NSF-61, and CSA B137.3.1. SDR 17 meets the above ASTM and NSF specifications, but is not CSA certified.

CIOD PVC Pressure Pipe

For use with CIOD PVC Pressure Fittings for potable water systems and applications

CIOD Pressure Pipe

We all need clean water and Royal Municipal Solutions CIOD PVC Pressure Pipe, used in potable water systems, eliminates the risk of clean water being contaminated during transmission to the end user. The benefits for using our CIOD PVC pressure pipe are numerous; it is easy to install, corrosion proof, has smooth interior walls and can withstand long-term hydrostatic pressure. These benefits reduce installation and maintenance costs and increase the service life of the system. Royal Municipal Solutions CIOD PVC Pressure Pipe installed today will supply clean, pure and essential water to future generations.

Royal Municipal Solutions CIOD PVC Pressure Pipe can service the following applications:

- Municipal watermains
- Industrial process lines
- Irrigation piping
- Sewer force mains

Royal Municipal Solutions CIOD PVC Pressure Pipe is manufactured with Cast Iron Outside Diameter (CIOD) and factory-installed Double Seal Locked-In (DSLI™) gaskets in the bell. Our pressure pipe is designed to withstand internal pressures typically encountered in transmission and distribution water mains. Our CIOD PVC Pressure Pipe is also available with factory-installed end caps to prevent dirt and debris from getting inside the pipe.

C & N Series

Pipe Availability

Royal Municipal Solutions CIOD PVC Pressure Pipe is available in 4" to 24" diameters and 20' lengths. Pipe with diameters 4" to 12" is available with Dimension Ratios (DR) of 14, 18 and 25, (Pressure Class of 305 psi, 235 psi and 165 psi, respectively). Pipe with diameters greater than 12" is available with Dimension Ratios (DR) of 18 and 25, Pressure Rating 235 psi and 165 psi, respectively.

Fittings

Royal Municipal Solutions carries a complete line of fabricated fittings, the C Series, to complement our pipe. Our fabricated fittings shall conform to AWWA C900 and C905 Standards.

We also carry a line of CIOD PVC fittings, the N Series, which is not pressure rated.

Quality

Royal Building Products is recognized for its high quality products. Our state-of-the-art extrusion equipment and computerized material handling system ensure consistency. Our quality control testing guarantees that the pipe you install will perform in the application.

CIOD PVC Pressure Pipe

Specification

4" - 12" Pipe and Fittings

Royal Municipal Solutions CIOD PVC Pressure Pipe and fabricated fittings with diameters from 4" to 12" shall be third party certified to CSA B137.3 Standard, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications and conform to AWWA C900 Standard, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4" through 12" for Water Distribution. The pipe shall have a Dimension Ratio (DR) of 14, 18 and 25 with Pressure Class of 305 psi, 235 psi and 165 psi, respectively. Fabricated fittings shall conform to AWWA C900 and C905 Standards.

14" and Larger Diameter Pipe and Fittings

Royal Municipal Solutions CIOD PVC Pressure Pipe and fabricated fittings with diameters from 14" and greater, shall be third party certified to CSA B137.3 Standard, Rigid Polyvinyl Chloride (PVC) for Pressure Applications and conform to AWWA C905 Standard, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14" through 48" for Water Transmission and Distribution. The pipe shall have a Dimension Ratio (DR) of 18 and 25 with Pressure Rating of 235 psi and 165 psi, respectively.

Installation

Royal Municipal Solutions CIOD PVC pressure pipe is cost effective to install compared to other pipe products. Joint assembly can be handled in the trench with minimal manpower. The pipe can be easily field cut and beveled. Our capped pipe helps prevent contamination of the inside of the pipe which reduces costly delays in cleaning out the pipe.

Joining

Clean the bell and spigot of all debris. Lubricant must be applied to the spigot end and the gasket. The pipes are then placed in straight alignment and pushed to the insertion line by hand or by bar and block assembly marked on the spigot end of the pipe. Our Double Seal Locked-In (DSLI™) factory-installed gaskets eliminate the problems of rolling or fish mouthing. Care should be taken to avoid over insertion into the pipe bell beyond the spigot insertion line.

Color Coding

All Royal Municipal Solutions CIOD PVC Pressure Pipe and fittings are color coded blue.

Lubricant

Royal Municipal Solutions CIOD PVC Pressure Pipe should be assembled with non-toxic, water-soluble pipe joint lubricant which is listed by the National Sanitation Foundation (NSF-61).

Certification

Royal Municipal Solutions CIOD PVC Pressure Pipe is third party, certified by CSA, and manufactured to meet specifications defined in CSA B137.3, Factory Mutual (FM), NSF-14 and AWWA C900 C905.

FM APPROVED

CIOD PVC Pressure Pipe

Corrosion Proof

One of the problems associated with a potable water system using conventional pipe materials is corrosion. Royal Seal™ CIOD PVC pressure pipe is essentially inert and non-conductive, leaving it immune to electrolytic corrosion. Acidic and alkaline soils have no effect on Royal Municipal Solutions CIOD PVC Pressure Pipe.

Smooth Bore

The interior wall of PVC pipe is very smooth with a Hazen-Williams C-factor of 150 for the design of PVC piping systems. This factor reduces head loss, maintains pressure and excellent water quality throughout the life of the system as compared to conventional pipe materials.

Effects from Ultra-Violet Aging

PVC pipe has been tested for exposure to ultra-violet radiation from sunlight for two years. After two years of exposure under some of the worst conditions in North America, the tensile strength, impact strength and pipe stiffness were tested. The results showed that the effects of ultra-violet radiation on PVC pipe were considered negligible.

Biological Attack

The performance of PVC pipe in severe environments has been studied since the 1950's. These studies have found that PVC pipe will not deteriorate or breakdown under biological attack from micro and macro-organisms. Investigations have not documented a single case where buried PVC pipe has suffered degradation or deterioration due to biological attack.

PVC Material

The PVC material used in the manufacture of our pipe meets PVC cell classification 12454 as defined by ASTM D1784 and has a Hydrostatic Design Basis (HDB) of 4,000 psi at 73°F.

Quality Control and Assurance

Our pipe undergoes extensive testing and inspection in our manufacturing facilities. The following testing assures outstanding product quality.

Effects of Temperature

The working pressure rating of CIOD pipe is reduced when the temperature of a pipeline exceeds 73°F. The table below shows the reduction factors that need to be applied to the working pressure rating for these situations.

Maximum Service Temperature °F	De-rating Factor
80	0.88
90	0.75
100	0.62
110	0.50
120	0.40
130	0.30
140	0.22

CIOD PVC Pressure Pipe

Extrusion Quality Test

Specimens are tested in accordance with ASTM D2152. The pipe will not flake or disintegrate after being immersed in anhydrous acetone for 20 minutes.

Impact Resistance Test

Samples of pipe to be tested for low temperature impact resistance are conditioned at 32°F ± 3.6°F for a period of not less than 16 hours. After conditioning, five samples are tested in accordance with the values shown in the table below. There shall be no evidence of shattering, cracking or splitting when the pipe is tested in accordance with CSA B137.0 and B137.3 and AWWA requirements.

Nominal Pipe Size in.	Impact Force ft-lb.
4	99.6
6	118.0
8	129.1
10	140.1
12	151.2
14	166.0
16	177.0
18	199.1
20	221.3
24	221.3

Hydrostatic Sustained Pressure Test

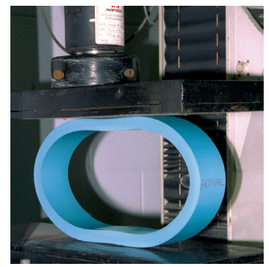
Pipe is pressure tested at two times its pressure rating for AWWA C900/C905 pipe. The tables below show the required testing data:

4"-12" diameter pipe

Pressure Class	Dimension Ratio	Hydrostatic Pressure
165	DR 25	350 psi
235	DR 18	500 psi
305	DR 14	650 psi

Flattening Test

Three specimens of the pipe, each about 2" long are flattened between parallel plates in a suitable press until the distance between the plates is 5% of the original outside diameter of the pipe, or the walls of the pipe touch, whichever occurs first. The rate of loading shall be uniform and such that the compression is completed within 2 to 5 minutes. The specimens are examined for evidence of splitting, cracking or breaking. This test methodology is in accordance with CSA B137.3 and AWWA requirements.



Hydrostatic Proof Test

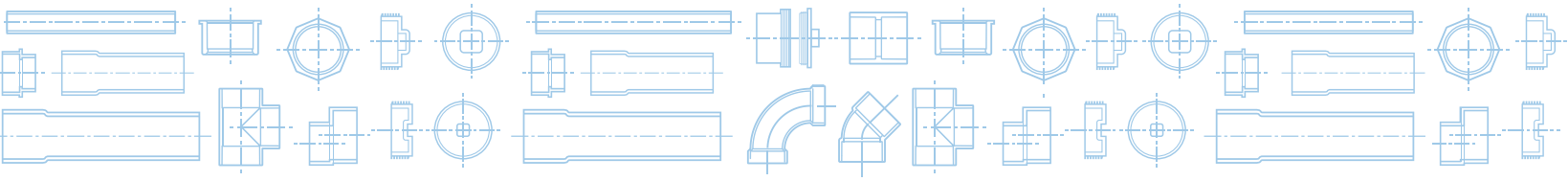
Each length of pipe is subjected to a Hydrostatic Proof Test. This test is conducted on the manufacturing line. It is a short term pressure test with a 5-second duration at the pressure listed below:

4"-12" diameter pipe

Pressure Class	Dimension Ratio	Hydrostatic Pressure
165	DR 25	330 psi
235	DR 18	470 psi
305	DR 14	610 psi

Product Properties

Our pipe is corrosion resistant, durable and cost effective. It has a smooth bore and is not affected by ultra violet aging or biological attack.



CIOD PVC Pressure Pipe

4" - 12"

Dimensions				
Pressure Class (Dimension Ratio)	Nominal Size in.	Average Inside Diameter in.	Average Wall Thickness in.	Average Outside Diameter in.
305 (DR 14)	4	4.077	0.362	4.801
	6	5.855	0.522	6.899
	8	7.684	0.684	9.052
	10	9.422	0.839	11.100
	12	11.202	0.999	13.200
235 (DR 18)	4	4.239	0.281	4.801
	6	6.087	0.406	6.899
	8	7.990	0.531	9.052
	10	9.794	0.653	11.100
	12	11.646	0.777	13.200
165 (DR 25)	4	4.395	0.203	4.801
	6	6.317	0.291	6.899
	8	8.286	0.383	9.052
	10	10.160	0.470	11.100
	12	12.082	0.559	13.200

14" and larger

Dimensions				
Pressure Class (Dimension Ratio)	Nominal Size in.	Average Inside Diameter in.	Average Wall Thickness in.	Average Outside Diameter in.
235 psi (DR 18)	14	13.496	0.901	15.298
	16	15.351	1.025	17.401
	18	17.206	1.147	19.500
	20	19.056	1.271	21.598
	24	22.773	1.513	25.799
165 psi (DR 25)	14	14.000	0.649	15.298
	16	15.925	0.738	17.401
	18	17.848	0.826	19.500
	20	19.764	0.917	21.598
	24	23.611	1.094	25.799

Bulldog PVC Pressure Pipe Integral Joint Restraint System

An ideal choice for municipal pressure pipe applications

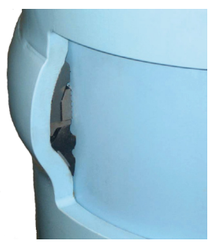
About the Bulldog Integral Joint Restraint System

The Bulldog Integral Joint Restraint System from Royal Building Products, Municipal Solutions is a unique internally built-in joint restraint system for PVC pressure pipe. It can be used in a wide range of municipal applications. Simple and easy to install, this offering eliminates the most common problems associated with external joint restraint devices.

Royal Building Products, Municipal Solutions Bulldog Integral Joint Restraint System is revolutionizing how gasketed bell and spigot PVC pipe is restrained in today's municipal water systems.

The restraining mechanism consists of an AquaArmor® protected casing that sits adjacent to the Rieber gasket in the bell. The casing is built into the bell during pipe belling and a gripper ring manually inserted into the casing after the pipe has been hydro-tested. All of these components are installed on the production line in the plant.

For the Contractor and the Municipal engineer, the BullDog Integral Joint Restraint System provides the peace-of-mind they require for their municipal water applications. Available in 6" - 12" diameters, DR 18.



When in the field, installers can assemble the joint by simply pushing the spigot into the bell of the pipe.

Once the pipe is put into service, hydrostatic pressure will cause backward movement of the spigot, at which point the gripper ring will become evenly wedged into the wall of the spigot.

The full engagement of the restraint mechanism does not allow for withdrawal. The location of the restraint in the bell does not affect the functionality of the Rieber gasket in any way.

The Integral Joint Restraint System Value Proposition

Advantages of the Integral Joint Restraint System include:

- Durable – The system prevents surface damage and weakening of the PVC pipe surface commonly caused by manual tightening of external restraint devices.
- Better results the first time – The Integral Joint Restraint System eliminates the time, cost and human error that can be associated with installing external joint restraint devices.
- Cost-effective and efficient – The restraint located in the pipe bell allows for faster installations without the need for special equipment.
- Longer product lifecycle – Because the Integral Joint Restraint System is corrosion resistant it can easily outlast other systems. The internal design has minimal components exposed to the elements when compared to external joint restraint systems.

Bulldog PVC Pressure Pipe Integral Joint Restraint System

Pipe Assembly Bulldog

While Bulldog pipe does have a Rieber gasket, the assembly of this type of joint is different from Royal C900/C905 bell and spigot pipe.

1. Clean the bell thoroughly, make sure the grip ring, gasket and pipe spigot are free of any foreign material before assembling the pipe.

2. Lubrication is also very important. Only lubricate the Gasket in the bell. Do not lubricate the Bulldog grip ring or the spigot of the pipe. Lube can be applied sparingly to the chamfer or bevel of the pipe.

3. Joint Alignment is critically important for Bulldog. The pipe must be in straight alignment. Misaligned pipe requires a much higher force to complete the assembly. Properly aligned, the Bulldog joint can be assembled manually using a prybar, come-along or Eagle Claw tool.

4. Once aligned, a force pushes the chamfer through the bell lip and the bevel enters the grip ring. By slowly applying force the bevel will center the grip ring inside the casing and the grip ring will expand slightly.

5. The grip ring is pushed to the back of the casing and butts up against the back of the casing. The spigot then moves on to the lip of the Rieber gasket until it comes into contact with the gasket.

6. The spigot continues past the gasket until the first insertion line is past the lip of the bell. The second insertion line should still be visible in front of the bell lip.

For Open-cut Bulldog installations, an initial pressurization will set the joints and may cause some minor expansion of the system that will require makeup water prior to performing the actual pressure test. It is a good idea to pressurize the system up to the test pressure for a period of one (1) hour, then remove the pressure and add any makeup water before beginning the actual final pressure test.

Assembly of the joint can, under certain circumstances, cause the over-insertion of previously assembled joints. Backfilling the pipe prior to joint assembly can prevent over-insertion of previous joints. Also, embedment material can be used to center load the pipe and prevent movement.

For Directional drilling applications, the Bulldog Joints must be set prior to being pulled into the bore. The joint is set by applying a back pressure of 2 to 3 times the assembly force used to put the pipe together. When using Bulldog in a directional drilling application, please first consult with the Royal Technical Team for additional guidance.

Bulldog pipe utilizes a patented Double Seal Locked-In (DSLI™) gasket system.

Certification

The Integral Joint Restraint System is certified to CSA B137.3, as well as meets the ASTM F1674 Standard Test Method for Joint Restraint Products for use with PVC Pipe.

Cobra Lock® PVC HDD Pipe Solutions (Joint Restraint)

A high strength and versatile joint restraint system for municipal installations

A Revolutionary Joint Restraint Solution

Cobra Lock® Horizontal direction drilling (HDD) Pipe Solutions from Royal Building Products, is a non-metallic PVC joint restraint system for use in a wide range of municipal applications. Easy to install and handle, this unique offering reduces labor requirements, speeds installation time and minimizes disruptions to local communities.

Potential applications for Cobra Lock® HDD Pipe Solutions include:

- Municipal water systems
- Horizontal direction drilling (HDD Trenchless)
- Fire protection systems
- Force main sewer systems
- Gravity sewer systems
- Joint restraints for fittings in open cut situations
- Locations where soils cannot support concrete thrust blocks
- Congested utility corridors
- Regions where seismic action is a concern
- Inside pipe casings

COBRA LOCK®
HDD PIPE SOLUTIONS BY ROYAL

About the Cobra Lock® HDD Pipe Solution

This easily installed and flexible system consists of a CIOD PVC C900 pressure pipe, a coupling and two locking splines. The pressure pipe and coupling have precision-machined grooves for easy alignment when the pipe is inserted into the coupling. The coupling's factory-installed o-ring gaskets provide a hydraulic pressure seal.

The thermoplastic nylon spline is then inserted into the groove creating a full 360° restraining connection. This high strength connection guarantees even load distribution around the entire joint when pulling the pipe into position.

Cobra Lock® PVC HDD Pipe Solutions (Joint Restraint)

The Cobra Lock® HDD Pipe Solution benefits include:

- Easy to assemble – The machined grooves enable easy alignment and precision.
- Reduces costs – Cobra Lock® HDD Pipe eliminates costly concrete thrust blocks and is also ideal for installing in congested areas.
- Cost-effective and efficient – The ease of handling and lighter weight means faster installations without the need for special equipment. The system also reduces the need to lay out long lengths of pipe for HDD applications.
- Choices to suit every need - Cobra Lock® HDD Pipe is available in 4" to 12" in Pressure Class 235 (DR 18) in 20-foot lengths.
- Longer product lifecycle – Because Cobra Lock® HDD Pipe is completely non-metallic and corrosion resistant, it can easily outperform metal systems.
- Impact resistant – The ruggedness of the system means less damage and waste on the job site.
- Improved performance – PVC construction provides a larger inside diameter versus PE Pipe for comparable products, while the joint achieves full strength in all weather conditions. (No fusion required)

Tapping

Cobra Lock® HDD Pipe has CIOD dimensions and therefore uses the same procedure for installing service connections as on regular bell and spigot PVC pressure pipe. Service connections are tapped through direct tapping, service clamps or saddles. Remember, do not install service taps of any kind into bent pipe. Refer to the Royal PVC Pressure Pipe and Fittings Installation Guide or the Uni-Bell Handbook of PVC Pipe for complete details on tapping pressure pipe.

Hydrostatic Design Basis

The PVC compound used in the extrusion of Cobra Lock® has a Hydrostatic Design Basis of 4,000 psi for water at 73°F.

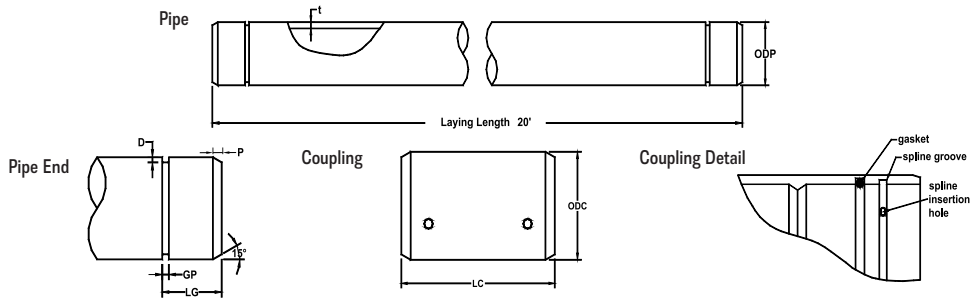
Certification

Cobra Lock® HDD Pipe is certified to CSA B137.3, Factory Mutual (FM), NSF-61 and ULC Standards, as well as meets the performance requirements of AWWA C900. The PVC material used in the manufacture of our pipe meets the PVC cell classification 12454 as specified in ASTM D1784. For special request applications, Cobra Lock® HDD Pipe is also available as a non-certified Pressure Class 305 (DR 14) system.

FM APPROVED NSF

Cobra Lock® PVC HDD Pipe Solutions (Joint Restraint)

Dimensions of Pipe and Coupling - Pressure Class 235 (DR 18)



Nominal Size in.	Avg. Outside Diameter Pipe (ODP) in.	Avg. Wall Thickness (t) in.	Length of Chamfer (P) in.	Avg. Insertion Length (LG) in.	Avg. Groove Width (GP) in.	Avg. Coupling Length (LC) in.	Avg. Outside Diameter Coupling (ODC) in.	Groove Depth (D)	
		Class 235	Minimum					Minimum	Maximum
4	4.80	0.28	0.26	3.00	0.38	8.25	5.96	0.13	0.13
6	6.90	0.41	0.26	3.00	0.38	8.25	8.37	0.13	0.13
8	9.05	0.53	0.30	3.16	0.50	10.5	10.95	0.14	0.15
10	11.1	0.65	0.61	3.50	0.50	11.13	13.36	0.21	0.21
12	13.2	0.78	0.61	3.50	0.50	12.0	15.84	0.21	0.21

Maximum Pulling Forces:
The pulling force used to pull the pipeline into place shall not exceed the pulling forces shown in the table below:

Nominal Size in.	Maximum Pulling Force Class 235 (DR 18)	
	Tightest Bending	Straight (No bending)
4	6,700	8,200
6	9,000	12,800
8	18,000	25,200
10	25,600	35,200
12	26,400	41,100

DR 18 Installation Curvature:
The pipeline shall not be bent to a radius less than shown in the table below:

Nominal Size in.	Minimum Radius of Curvature ft.
4	100
6	150
8	200
10	250
12	300

PVC Gasketed SDR 26 & 35 Sewer Pipe

Storm and Sanitary pipe for use with Gasketed Sewer Fittings

Gasketed Sewer Pipe

Royal Municipal Solutions Gasketed Sewer Pipe, with our specially designed Double Seal Locked-In (DSLI™) gasket, is an extremely durable pipe with a leak proof joint. The combination of chemical resistance, long term strength and high stiffness account for why PVC is the most popular pipe material for sanitary and storm sewer applications.

Gasketed Sewer pipe can service the following applications:

- Gravity storm and sanitary lines
- Gravity industrial lines
- Private drain connections

Our Gasketed Sewer Pipe is available in Standard Dimension Ratios (SDR) 26 and 35 in the following sizes: SDR 26 in 4" to 18", SDR 35 in 4" to 27" and in 14' lengths. The gasket is a Double Seal Locked-In (DSLI™) gasket that is installed during the manufacturing process. Royal Municipal Solutions offers a complete line of fabricated and injection molded fittings to complement our Gasketed Sewer Pipe.

Royal Municipal Solutions Gasketed Sewer Pipe shall be manufactured with a nominal size of 4" to 27" and with Standard Dimension Ratios (SDR) 26, or 35, and shall be certified to the requirements of ASTM D3034, Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings and F679, Poly Vinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings and CSA B182.2 (PVC) Sewer Pipe and Fittings PSM Type.

Royal Building Products, Municipal Solutions is recognized for its high quality products. Our state-of-the-art extrusion equipment and computerized material handling system ensure consistency. Our quality control testing guarantees that the pipe you install will outperform the application.

Installation

Royal Municipal Solutions Gasketed Sewer Pipe weighs a fraction of the weight of traditional pipe products, therefore handling and installation costs are reduced substantially. Our pipe can be easily cut in the field and the joint assembly can be handled in the trench without using heavy equipment.

PVC Gasketed SDR 26 & 35 Sewer Pipe

Color Coding

Royal Municipal Solutions SDR 26 and SDR 35 pipe is color coded green. Fabricated fittings are green or white, and injection molded fittings are white.

Joining

Both bell and spigot shall be clean of all debris. Lubricant must only be applied to the spigot end of the pipe (do not lubricate the gasket). The pipes are then placed in straight alignment. Push the spigot into the bell to the insertion line marked on the pipe. Pipe assembly can be completed by hand using a bar and block, lever pullers or hydraulic jacks. Royal's factory-installed gaskets eliminate the problems of rolling or fish mouthing. Care should be taken to avoid over insertion into the pipe bell beyond the spigot insertion line.

Lubricant

Royal Municipal Solutions Gasketed Sewer Pipe should be assembled with non-toxic, water-soluble lubricant which is listed by the National Sanitation Foundation (NSF).

Fittings

Royal Municipal Solutions carries a complete line of fabricated and injection molded fittings to complement our Gasketed Sewer Pipe. Our injection molded fittings are triple certified to CSA, NSF and UPC.

Fabricated Fittings

Fabricated fittings shall be manufactured with a nominal size of 4" to 36" from SDR 26 or SDR 35 pipe and shall conform to the requirements of ASTM F1336 Poly Vinyl Chloride (PVC) Gasketed Sewer Fittings.

H Series / SDR 26

G Series / SDR 35

Injection Molded Fittings

Our gasketed H & G Series injection molded sewer fittings are light weight and easy to handle. They are available in 4" to 12" diameters and have a Standard Dimension Ratio (SDR) of 26 or 35. Our injection molded fittings are certified by NSF and UPC to meet the requirements of ASTM D3034 and F1336 Standards and are CSA certified to the CSA B182.1 and/or B182.2 Standards.

Certification

Royal Municipal Solutions Gasketed SDR 35 and SDR 26 Sewer pipe is third party tested, certified by CSA, and manufactured to meet specifications defined in ASTM D3034, ASTM F679 and CSA B182.2.

PVC Gasketed SDR 26 & 35 Sewer Pipe

Benefits to Using Gasketed Sewer Pipe

There are many advantages for using our Gasketed Sewer Pipe. Our pipe is corrosion resistant, durable and cost effective.

Toughness and Durability

Gasketed Sewer Pipe is both tough and resilient, this pipe will not allow root penetration and will not be damaged by the impacts associated with normal field handling. Its resistance to abrasion, scouring and gouging is superior to that of other pipe materials. Gasketed Sewer Pipe is corrosion resistant and not affected by sewer gases, chemicals and hydrogen sulphide acids normally found in domestic sewer effluent or legally discharged industrial fluids.

Smooth Interior

Gasketed Sewer Pipe has smooth interior walls with a Manning's coefficient "n" of 0.009. The resulting higher flow rates allow for the usage of smaller diameter pipe and flatter grades than would be possible with other pipe materials.

Abrasion

Based upon years of experience, PVC pipe has proven to have exceptional resistance to abrasion. Studies in Europe and North America have established PVC pipe's abrasion resistance. While the testing methods have varied substantially, the results have been consistent. The nature and resiliency of PVC pipe cause it to gradually erode over a broad area, rather than develop the characteristic localized pitting and rapid failure of most other piping materials.

System Integrity

Gasketed Sewer Pipe, when properly installed, helps to eliminate infiltration and leakage associated with the sewer system. Gasketed Sewer Pipe joints are tested for joint tightness up to 50 psi hydrostatic pressure. Our water tight joints help to eliminate costly extraneous flows entering the sewer system and contamination from leakage of the sewer systems.

Biological Attack

The performance of PVC pipe in severe environments has been studied since the 1950's. PVC pipe will not deteriorate or break down under biological attack from micro and macro-organisms. There has not been a single documented case in which buried PVC pipe products have suffered degradation or deterioration due to biological attack.

Product Quality

In Royal's extrusion facilities, each operator is responsible for quality. Our operators check the wall thickness and outside diameter of every length of pipe produced. Every two hours, random samples are cut from the production line and sent to our quality control laboratory for testing in accordance with CSA and ASTM requirements. No pipe enters our yard without the seal of approval from our quality control team.

PVC Gasketed SDR 26 & 35 Sewer Pipe

PVC Material

The PVC material used in the manufacture of our pipe meets the physical properties of PVC cell class 12364 as specified in ASTM D1784.

Quality Control and Assurance

Our Gasketed Sewer Pipe undergoes extensive testing and inspection in our manufacturing facilities. The following testing assures outstanding product quality.

Extrusion Quality Test

Specimens shall be tested in accordance with ASTM D2152. The pipe will not flake or disintegrate after being immersed in anhydrous acetone for 20 minutes.

Joint Tightness Test

Elastomeric gasket joints made for pipe and fittings exceed the requirements of ASTM D3212, with internal hydrostatic pressure tested to 50 psi.

Compression Test

Three specimens of the pipe, each about 2" long are flattened between parallel plates in a suitable press until the distance between the plates is 40% of the original outside diameter of the pipe. The rate of loading is uniform and the compression is completed within 2 to 5 minutes.

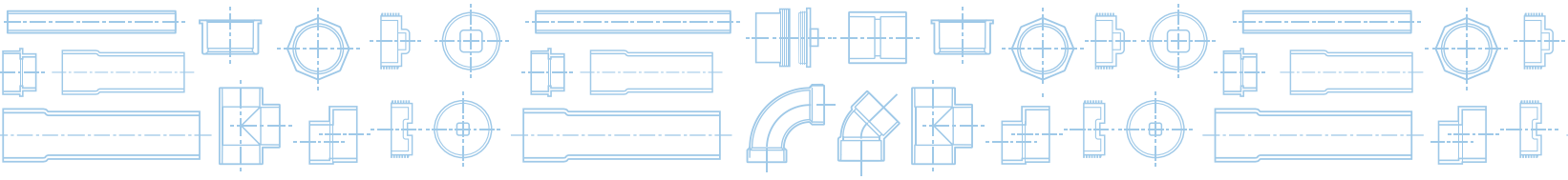
Upon removal of the load, the specimens are examined for evidence of splitting, cracking or breaking. This test methodology is in accordance with ASTM D3034 and CSA B182.2.

Impact Resistance Test

Samples of pipe to be tested for low temperature impact resistance are conditioned at 32°F ±3.6°F for a period of at least 16 hours. After conditioning, five samples are tested. There shall be no evidence of shattering, cracking or splitting of the wall when the pipe is tested in accordance with ASTM D3034 and CSA B182.2.

Pipe Stiffness

The minimum pipe stiffness for SDR 26 pipe shall be 115 psi, and for SDR 35 pipe, 46 psi, when tested at 5% deflection in accordance with ASTM D2412.



PVC Gasketed SDR 26 & 35 Sewer Pipe

Calculated Deflections (%) of Buried PVC Pipe for Prism and H20 Loads

SDR	Modulus of Soil Reaction (E'), psi	2		6		10		14		18		22		26		30		Height of Cover (ft)
		Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Load Type
SDR 35	50	1.7	9.3	5.1	6.7	8.4	8.4	11.8	11.8	15.2	15.2	18.5	18.5	21.9	21.9	25.2	25.2	
	200	0.9	4.8	2.6	3.5	4.4	4.4	6.1	6.1	7.9	7.9	9.6	9.6	11.4	11.4	13.1	13.1	
	400	0.5	3.0	1.6	2.1	2.7	2.7	3.7	3.7	4.8	4.8	5.9	5.9	6.9	6.9	8.0	8.0	
	1000	0.3	1.4	0.7	1.0	1.2	1.2	1.7	1.7	2.2	2.2	2.7	2.7	3.2	3.2	3.7	3.7	
	2000	0.1	0.7	0.4	0.5	0.7	0.7	0.9	0.9	1.2	1.2	1.4	1.4	1.7	1.7	1.9	1.9	
SDR 26	50	0.8	4.6	2.5	3.3	4.1	4.1	5.8	5.8	7.4	7.4	9.1	9.1	10.7	10.7	12.4	12.4	
	200	0.6	3.1	1.7	2.3	2.8	2.8	4.0	4.0	5.1	5.1	6.3	6.3	7.4	7.4	8.5	8.5	
	400	0.4	2.2	1.2	1.6	2.0	2.0	2.8	2.8	3.6	3.6	4.4	4.4	5.2	5.2	6.0	6.0	
	1000	0.2	1.2	0.6	0.9	1.1	1.1	1.5	1.5	1.9	1.9	2.4	2.4	2.8	2.8	3.2	3.2	
	2000	0.1	0.7	0.4	0.5	0.6	0.6	0.8	0.8	1.1	1.1	1.3	1.3	1.6	1.6	1.8	1.8	

Modulus of Soil Reaction, E', values are determined based on pipe bedding material type, placement and compaction.
E' values for specific burial conditions can be found in Table 7.3 in the Handbook of PVC Pipe Design and Construction.

Pipe deflection values are calculated using the Modified Iowa Formula and the following:

Bedding Constant, K = 0.1
Deflection Lag Factor, DL = 1.0
Soil Unit Weight for Earth Load = 120 lb/ft3

% Deflection is 7.5% or less, Burial Conditions are Acceptable

% Deflection is more than 7.5%, Burial Conditions are Unacceptable

For estimates of pipe deflection outside of the parameters shown above, contact Royal Building Products, Pipe and Fittings Solutions.

Dimensions

Standard Dimension Ratio (SDR)	Nominal Size in.	Average Inside Diameter in.	Average Wall Thickness in.	Average Outside Diameter in.
SDR 35	4	3.957	0.129	4.215
	5	5.298	0.171	5.640
	6	5.893	0.191	6.275
	8	7.894	0.253	8.400
	10	9.866	0.317	10.500
	12	11.740	0.380	12.500
	15	14.378	0.461	15.300
	18	17.573	0.564	18.701
	21	20.713	0.667	22.047
	24	23.303	0.750	24.803
	27	26.263	0.845	27.953
SDR 26	4	3.873	0.171	4.215
	5	5.298	0.217	5.640
	6	5.769	0.253	6.275
	8	7.716	0.342	8.400
	10	9.652	0.424	10.500
	12	11.488	0.506	12.500
	15	14.392	0.604	15.300
	18	17.205	0.748	18.701

PVC Solvent Weld SDR 35 Sewer Pipe

For use in Building Drainage and Sewer Applications

Solvent Weld Sewer Pipe

Solvent Weld PVC Sewer pipe and fittings from Royal Building Products, Plumbing Solutions are the ideal choice for building drainage and sewer applications. Available in 3 to 6-inch diameters, our solvent weld sewer pipe comes with solid or perforated walls. Solid Wall pipe is designed for collecting wastewater and storm water from building drains and conveying it to the municipal sewer lateral at the property line. Perforated pipe is used in septic field and foundation drainage applications.

We carry a complete line of injection molded fittings, including bends, tees, wyes, couplings, adapters, cleanouts, bushings and p-traps. Our P & M Series fittings are available in 3" to 12" diameters in SDR 35 and SDR 26 Heavy Wall.

P-Series / SDR 35 M-Series / SDR 26

Installation

For installation information, refer to the Royal Building Products Solvent Cementing Instructions for Pipe and Fittings brochure.

Solid Wall

Perforated

Pipe Availability

Royal Building Products, Plumbing Solutions distributes two types of Solvent Weld Sewer pipe: SDR 35 Solid Wall/Perforated Pipe and PS 40 Perforated Pipe.

Solvent Weld Sewer pipe is available in:

- Diameter: 3" to 6" (Color: white or green)
- Length: 10'

PVC Solvent Weld SDR 35 Sewer Pipe

Why Solvent Weld Sewer Pipe

Benefits of Solvent Weld Sewer pipe & fittings include:

- Corrosion resistant – Solvent Weld Sewer pipe and fittings resist damage from environmental elements.
- Quick and easy installation – There are no special tools required to install, reducing time and labor.
- Excellent flow properties – The smooth interior walls ensure optimized flow performance. (Manning's Coefficient, n=0.009)
- Lightweight – Easy to transport and carry.
- Built to last – The impact-resistant and durable product can withstand extreme temperatures.
- Cost effective – PVC pipe and fittings cost less than comparable metal pipe systems.

SDR 35 Solvent Weld Solid and Perforated Sewer Pipe (PS 46)			
Nominal Pipe Size (in)	Avg. Wall Thickness (in)	Avg. Outside Diameter (in)	Approx. Weight (lb/100ft)
3	0.100	3.249	64
4	0.130*	4.215	108
6	0.195	6.275	241

*MEETS 46 PSI PIPE STIFFNESS

Solvent Weld Perforated Sewer Pipe (PS 40)			
Nominal Pipe Size (in)	Avg. Wall Thickness (in)	Avg. Outside Diameter (in)	Approx. Weight (lb/100ft)
3	0.090	3.249	55
4	0.112	4.215	108
6	0.122	6.275	153

Certification

Royal Plumbing Solutions Solvent Weld SDR 35 Sewer pipe is third party tested and listed by CSA, and manufactured to meet specifications defined in ASTM D3034 and CSA B182.1/B182.2.

Kor-Flo® PVC Corrugated Profile Sewer Pipe

Storm and Sanitary pipe for use with K-Series PVC Profile Fittings

A Revolutionary Joint Restraint Solution

Royal Municipal Solutions Kor-Flo® PVC Profile Pipe is a dual wall corrugated pipe. It is lighter than solid wall SDR 35 gasketed sewer pipe, but has the same strength and flow properties. Our Kor-Flo® PVC Profile Pipe is cost effective and easy to install.

Kor-Flo® PVC Profile Pipe has many applications, including:

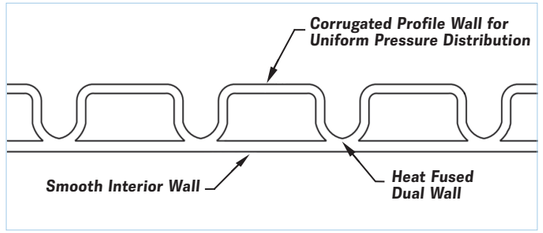
- Storm and sanitary sewers
- Gravity industrial lines
- Highway and road drainage

Royal Municipal Solutions Kor-Flo® PVC Profile Pipe is a heat fused dual wall pipe with a corrugated exterior wall to provide greater stiffness and limit deflection. The interior wall is smooth, ensuring superior flow characteristics. Gaskets are installed on the spigot end of the pipe during the manufacturing process.

Kor-Flo® PVC Profile Pipe and Fittings shall be manufactured with a nominal diameter of 8" to 36" and Pipe Stiffness (PS) of 46 psi and shall be certified to CSA B182.4 Profile PVC Sewer Pipe and Fittings and conform to the requirements of ASTM F794 Polyvinyl Chloride (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter. The elastomeric gasket joints shall hold a minimum internal hydrostatic pressure of 15 psi.

Pipe Availability

Kor-Flo® PVC Profile Pipe is available in 8" to 36" diameters in 13' lengths. We also have a complete line of fittings and adapters, the K-Series, to offer the most effective sewer system possible.



Royal Building Products is recognized for its high quality products. Our state-of-the-art extrusion equipment and computerized material handling system ensure consistency. Our quality control testing guarantees that the pipe you install will perform in the application.

Benefits to Using Kor-Flo® PVC Profile Pipe

There are many advantages for using our Kor-Flo® PVC Profile Pipe. Our pipe is lightweight and easy to handle.

The corrugations will not lock together when pipe lengths are lying beside one another and will not dig into the bedding when the pipe is placed in the trench.

Kor-Flo® pipe is a durable and cost effective solution.

Kor-Flo® PVC Corrugated Profile Sewer Pipe

Color Coding

All Royal Municipal Solutions Kor-Flo® PVC Profile Pipe is color coded green. K-Series Profile fabricated fittings are green or white.

Installation

Royal Kor-Flo® pipe weighs less than solid wall sewer pipe, therefore handling and installation costs are reduced substantially. Our pipe can be easily cut in the field, and the joint assembly can be handled in the trench without using heavy equipment.

Joining

Clean the bell and spigot of all debris. Lubricant must be applied to the interior of the bell end only. The pipes are then placed in straight alignment, push the spigot into the bell to the insertion line marked on the pipe. Pipe assembly can be completed by hand using a bar and block, lever pullers or hydraulic jacks.

Our factory-installed gaskets eliminate the problems of rolling or fish mouthing. Care should be taken to avoid over insertion into the pipe bell beyond the spigot insertion line.

Lubricant

Kor-Flo® PVC Profile Pipe should be assembled with non-toxic, water-soluble lubricant which is listed by the National Sanitation Foundation (NSF).

Fittings

Royal Municipal Solutions carries the K-Series line of fabricated fittings to complement our Kor-Flo® PVC Profile Pipe. Our fittings shall conform to ASTM F794 Standard. K-Series Profile Fittings have been designed for use with both Kor-Flo® PVC Profile Pipe and other types of profile pipe. The fittings are fabricated from sections of certified pipe. Royal Municipal Solutions also offers a complete range of adapters for joining Royal Kor-Flo® pipe to other types of sewer pipe; making connections to laterals, sewer stubs, and sewer and storm mains quick and simple.

K Series

Kor-Flo® PVC Corrugated Profile Sewer Pipe

Dual Wall System

Royal Kor-Flo® pipe is a dual wall pipe that provides an extremely smooth interior wall which allows excellent flow rates and resists the build up of solids. This smooth interior yields a Manning's flow coefficient of n=0.009.

Cost Savings

When compared to solid wall SDR 35 pipe, Royal Kor-Flo™ pipe is lightweight thereby greatly reducing the time, manpower, and heavy equipment normally associated with storm and sanitary pipe installations.

Superior Pipe Stiffness

Royal Kor-Flo® pipe has a concentrically corrugated exterior wall that acts as a reinforcing support, therefore providing exceedingly high stiffness. Royal Kor-Flo® pipe has a minimum pipe stiffness of 46 psi when tested at 5% deflection in accordance with ASTM D2412, and works in conjunction with embedment materials to minimize deflection after installation.

Toughness

Manufactured from the highest quality PVC, Kor-Flo® PVC Profile Pipe is resistant to abrasion, scouring, root penetration, and acidic and alkaline soil conditions. Kor-Flo® PVC Profile Pipe is not affected by chemicals normally found in sewage and will not be damaged by normal sewer cleaning practices.

Product Quality

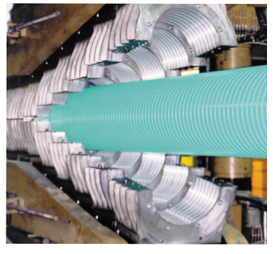
Royal Municipal Solutions extrusion facilities make each operator responsible for quality. Our pipe is continually tested in our quality control laboratory to ensure conformance with CSA and ASTM requirements. No pipe enters our yard without the seal of approval from our quality control team.

Quality Control and Assurance

Royal Kor-Flo® pipe undergoes extensive testing and inspection in our manufacturing facilities in accordance with CSA B182.4 and ASTM F794. The following testing assures our outstanding product quality.

Bond Strength

It shall not be possible to cleanly separate the inner and outer walls at the corrugation valley with a sharp probe or knife point when a sample is tested at eight points equally spaced around the circumference of the pipe.



Kor-Flo® PVC Corrugated Profile Sewer Pipe

Extrusion Quality Test

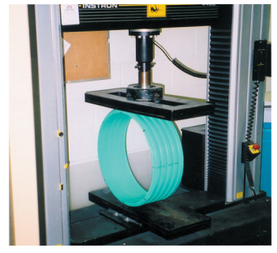
The pipe will not flake or disintegrate after being immersed in anhydrous acetone for 20 minutes. There is no separation of the two walls in dual wall corrugated pipe. Specimens are tested in accordance with ASTM D2152.

Impact Resistance Test

Samples of pipe to be tested for low temperature impact resistance are conditioned at 32°F (±3.6°F) for a period of not less than 16 hours. After conditioning, five samples are tested in accordance with the values required. There shall be no evidence of shattering, cracking or splitting of the waterway wall when the pipe is tested. There shall be no separation of the two walls in dual wall corrugated pipe.

Flattening Test

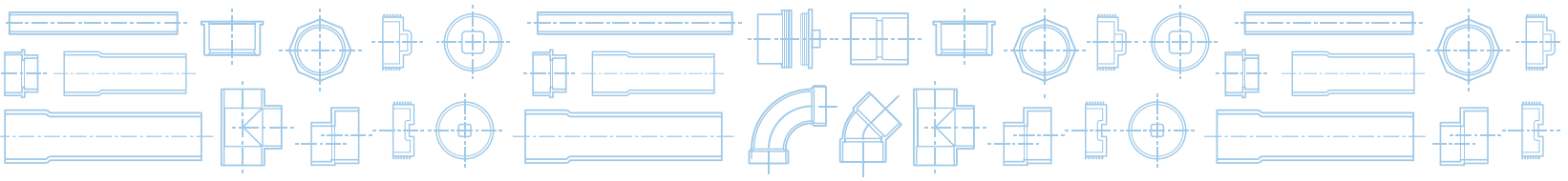
Three specimens of the pipe, each about 6" long are to be flattened between parallel plates in a suitable press until the distance between the plates is 40% of the original outside diameter of the pipe. The rate of loading is uniform and such that the compression is completed within 2 to 5 minutes. The specimens shall be examined for evidence of splitting, cracking or breaking.



Dimensions

Nominal Size in.	Average Inside Diameter in.	Average Outside Diameter in.
8	7.89	8.60
10	9.86	10.79
12	11.73	12.80
15	14.37	15.66
18	17.65	19.15
21	20.75	22.58
24	23.51	25.59
30	29.50	32.15
36	35.44	38.76

Visit our web site royalbuildingproducts.com for additional marketing materials as well as other innovative and industry leading products.



Kor-Flo® PVC Corrugated Profile Sewer Pipe

Calculated Deflections (%) of Buried PVC Pipe for Prism and H20 Loads																		Height of Cover (ft)
Pipe Stiffness	Modulus of Soil Reaction (E'), psi	2		6		10		14		18		22		26		30		
		Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Prism	H20	Load Type
46 psi	50	1.7	9.3	5.1	6.7	8.4	8.4	11.8	11.8	15.2	15.2	18.5	18.5	21.9	21.9	25.2	25.2	
	200	0.9	4.8	2.6	3.5	4.4	4.4	6.1	6.1	7.9	7.9	9.6	9.6	11.4	11.4	13.1	13.1	
	400	0.5	3.0	1.6	2.1	2.7	2.7	3.7	3.7	4.8	4.8	5.9	5.9	6.9	6.9	8.0	8.0	
	1000	0.3	1.4	0.7	1.0	1.2	1.2	1.7	1.7	2.2	2.2	2.7	2.7	3.2	3.2	3.7	3.7	
	2000	0.1	0.7	0.4	0.5	0.7	0.7	0.9	0.9	1.2	1.2	1.4	1.4	1.7	1.7	1.9	1.9	

Modulus of Soil Reaction, E', values are determined based on pipe bedding material type, placement and compaction
E' values for specific burial conditions can be found in Table 7.3 in the Handbook of PVC Pipe Design and Construction

Pipe Deflection values in the above table are calculated using the Modified Iowa Formula and the following:

Bedding Constant, K = 0.1
Deflection Lag Factor, DL = 1.0
Soil Unit Weight for Earth Load = 120 lb/ft3

% Deflection is 7.5% or less, Burial Conditions are Acceptable

% Deflection is more than 7.5%, Burial Conditions are Unacceptable

For estimates of pipe deflection outside of the parameters shown above, contact Royal Building Products, Pipe and Fittings Solutions

Certification

Royal Municipal Solutions Kor-Flo® PVC Profile Pipe is third party tested, certified by CSA, and manufactured to meet specifications defined in ASTM F794 and CSA B182.4.

PVC DWV Solvent Weld Drain, Waste, Vent Pipe

Superior performance and lower lifecycle cost

PVC DWV Pipe and Fittings

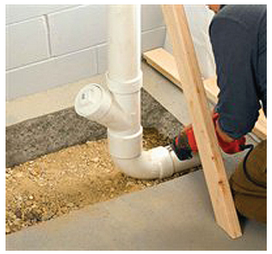
The building construction industry has long embraced PVC as the preferred piping system over cast iron and copper for Drain, Waste and Vent plumbing systems. More and more contractors turn to PVC (Polyvinyl Chloride) pipe systems for residential, commercial and institutional projects. Easy to install, PVC pipe is approved for use in both combustible and non-combustible buildings.

Mechanical contractors and engineers are increasingly turning to Royal Building Products, Plumbing Solutions for rugged and durable PVC DWV solutions that deliver results on all counts:

- Efficiency
- Lower lifecycle cost
- Compliance with code requirements
- Longer product life
- Reduced environmental impact

Typical use for DWV pipe include:

- Removing sewage and gray water from a building
- Removing waste from fixtures in a residential application
- Roof venting which helps regulate air-pressure in waste-system pipes and facilitates flow



PVC DWV

With a PVC DWV installation, contractors never have to worry about rusting, pitting, scaling or degradation, even when the system is exposed to moisture, salts and acids. Whatever the environment, interior and exterior walls remain smooth and deliver uninterrupted flow for many years. Since PVC is corrosion-proof, it requires less maintenance. PVC DWV is also lightweight and easier to handle, making installation faster and safer, especially when working in restricted or awkward spaces. There's no need for special equipment or additional manpower.

Less expensive than conventional iron piping, our tough, impact-resistant PVC DWV can deliver years of uninterrupted service.

When you do the math, the bottom line is clear: PVC DWV is a smart investment choice for your current and long-term drain, waste and vent needs.

Pipe Availability

Royal Building Products Plumbing Solutions DWV pipe is available in:

- Diameter: 1 1/2" to 12"
- Length: 10' and 20'

PVC DWV Solvent Weld Drain, Waste, Vent Pipe

Why DWV Pipe

Designed to last – PVC DWV delivers proven high-impact strength in colder temperatures.

- Cost-effective and efficient – Ease of handling and lighter weight means faster installations without the need for special equipment. Overall that translates into significant project cost savings.
- Choices to suit every need - PVC systems with several size options for pipe and fittings.
- Longer product lifecycle – PVC DWV is corrosion-proof it can easily outperform metal piping systems for longer periods of time.
- Impact resistant – The ruggedness of the PVC DWV system means less damage and waste on the job site.
- Safe handling – The solvent cementing application eliminates the need for specialized tools and the risks associated with torches.
- A system for all seasons – PVC DWV eliminates the need to work with other pipe materials at grade level because it can be used for both above and below grade applications.

D-Series

Fittings

We carry an extensive line of PVC DWV fittings, including bends, wyes, couplings, adapters, bushings and cleanouts. Our injection molded D Series fittings are available in sizes through 12" and are triple certified by CSA, NSF and UPC. Our fabricated fittings are available from 10" to 24" diameters.

Certification

Royal Plumbing Solutions PVC DWV pipe is third party tested and listed by CSA, NSF-14 and manufactured to meet specifications defined in ASTM D2665 and CSA B181.2.

PVC Schedule 40 & 80 Pressure & Non-Pressure Pipe

Corrosion and impact resistant solutions for Pressure and Non-Pressure Applications

Schedule 40 Pipe and Schedule 80 Pipe

Royal Building Products, Plumbing Solutions Schedule 40 and 80 PVC pipe is the ideal choice for pressure and non-pressure applications, such as potable water systems, irrigation piping, wastewater disposal, mechanical piping and industrial processing.

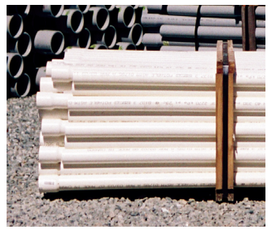
Durable and easy to install, our Schedule 40 and 80 PVC pipe systems are tested to the highest performance standards.

Schedule 40 pipe is typically used for low water-pressure applications such as:

- Home repair projects
- Sprinkler systems
- Pools, spas, hot tubs
- Light industrial

Schedule 80 pipe has thicker walls and withstands higher pressure than Schedule 40. It's many applications include:

- Chemical processing
- High purity systems
- Water and wastewater
- Industrial applications
- Agricultural
- Processes involving corrosive liquids



Pipe Availability

Schedule 40 and 80 PVC pipe is available in:

- Diameter: ½" to 18" diameter (Note: 14", 16" & 18" only available in Schedule 40)
- Length: 10' and 20'
- With or without solvent weld bell ends
- White or grey (Schedule 40 PVC pipe)
- Dark grey (Schedule 80 PVC pipe)

Installation

For installation information, refer to the Royal Building Products Solvent Cementing Instructions for Pipe and Fittings brochure in the Additional Information section.

PVC Schedule 40 & 80 Pressure & Non-Pressure Pipe

Why Schedule 40 and 80 PVC Pipe

Benefits of the Schedule 40 and 80 PVC pipe include:

- Corrosion resistant – Schedule 40 and 80 PVC pipe resists electrolytic corrosion, as well as acidic and alkaline soils, making it maintenance free
- Easy to transport – As a lightweight product, the system reduces the risk of injury and transportation costs.
- Easy to install – Because Schedule 40 and 80 PVC pipe is easy to handle and assemble, installations can be performed in less time with less effort.
- Cost effective – Schedule 40 and 80 PVC costs less than comparable metal pipe.
- High Performance – Smooth interior walls provide efficient flow of material and prevent contamination

Schedule 40 Pipe				
Nominal Pipe Size (in)	Pressure Rating (psi)	Avg. Wall Thickness (in)	Avg. Outside Diameter (in)	Approx. Weight (lb/100ft)
½	600	0.119	0.840	0.16
¾	480	0.123	1.050	0.22
1	450	0.143	1.315	0.32
1¼	370	0.150	1.660	0.43
1½	330	0.155	1.900	0.52
2	280	0.164	2.375	0.70
2½	300	0.215	2.875	1.11
3	260	0.229	3.500	1.45
4	220	0.251	4.500	2.05
6	180	0.297	6.625	3.62
8	160	0.341	8.625	5.51
10	140	0.387	10.750	7.79
12	130	0.430	12.750	10.40
14	130	0.464	14.000	12.28
16	130	0.530	16.000	15.92
18	130	0.595	18.000	20.19

Schedule 80 Pipe				
Nominal Pipe Size (in)	Pressure Rating (psi)	Avg. Wall Thickness (in)	Avg. Outside Diameter (in)	Approx. Weight (lb/100ft)
½	850	0.157	0.840	0.21
¾	690	0.164	1.050	0.28
1	630	0.189	1.315	0.41
1¼	520	0.202	1.660	0.57
1½	470	0.212	1.900	0.69
2	400	0.231	2.375	0.96
2½	420	0.292	2.875	1.46
3	370	0.318	3.500	1.96
4	320	0.357	4.500	2.87
6	280	0.458	6.625	5.48
8	250	0.530	8.625	8.32
10	230	0.628	10.750	11.81
12	230	0.728	12.570	16.98

Certification

Royal Building Products, Plumbing Solutions Schedule 40 and 80 PVC pipe is certified to CSA Standard B137.3, NSF Standard 14 and certified to ASTM D1785.

DSLI™ Gasket System

Royal Building Products uses the patented DSLI™ Gasket System on the following pipe products:

- IPS pipe
- CIOD pipe
- Bulldog pipe
- Gasketed sewer pipe

DSLI™ Gasket System

Royal Municipal & Plumbing Solutions uses the Double Seal Locked-In (DSLI™) Gasket System on our Gasketed Pipe. This gasket joint is the most reliable in the marketplace.

One of the most critical components of a sewer system is the integrity of the gasketed joint. For this reason, Royal Municipal Solutions has chosen the highest quality gasket seal available. Our factory installed elastomeric gaskets create a joint that has a superior seal. There is no need to worry about the gasket twisting or flipping when the spigot end of the pipe is inserted.

The patented Double Seal Locked-In (DSLI™) gasket provides two major benefits:

1. The Double Seal gasket increases joint tightness with an increase of pressure.

2. The patented steel reinforced Locked-In gasket provides an error-free installation preventing fall-out, rollover or fish mouthing, even when joining under adverse conditions.

Nitrile gaskets available upon request.

PVC Electrical Fittings, Components & Conduit

Royal is pleased to offer a broad portfolio of complementing PVC electrical solutions. All of these are designed and tested to the same extremes as our municipal and plumbing products so that you are guaranteed a quality product.

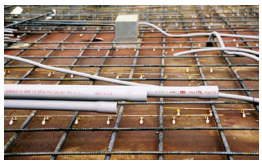
Custom Enclosure Boxes - NEMA 4X and ETL Rated. Lightweight and watertight enclosures that offer heavy duty performance while providing easier installation and reduced life cycle costs.

Corrosion resistant and non-conductive. Size and pre-punch cutouts to your specifications. For applications where internal wiring needs to be protected from exposure to water, liquids and debris.

Rigid Conduit Fittings – UL listed. Lightweight, durable and concrete tight. Non-metallic and non-corrosive. A complete assortment of gang boxes, entrance fittings, access fittings, couplings and Schedule 40 and 80 elbows.

Designed to integrate with Rigid Conduit for commercial and industrial applications.

Conduit Pipe – UL listed. FT-4 rated. Lightweight, non-conductive, long lasting and low maintenance. Easy to install, cut and join, reducing labor cost.



ENT Fittings and Tubing – UL listed. A family of fittings and flexible pipe that can be used in many applications. Fittings are designed with external removable and replaceable clip rings for a concrete tight fit.

Flexible corrugated conduit is lightweight and durable. Used in electrical raceways in encased concrete, walls, ceilings and other general purpose applications.

Our various pipe and fittings solutions have been manufactured to meet the needs of our customers and their applications.

Contact the below Sales Center for more information.

- Municipal Pipe & Fittings Solutions
- Plumbing Pipe & Fittings Solutions
- Industrial Pipe & Fittings Solutions
- Electrical Pipe & Fittings Solutions

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Pub No. 1306P
November 2013
Printed in USA

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