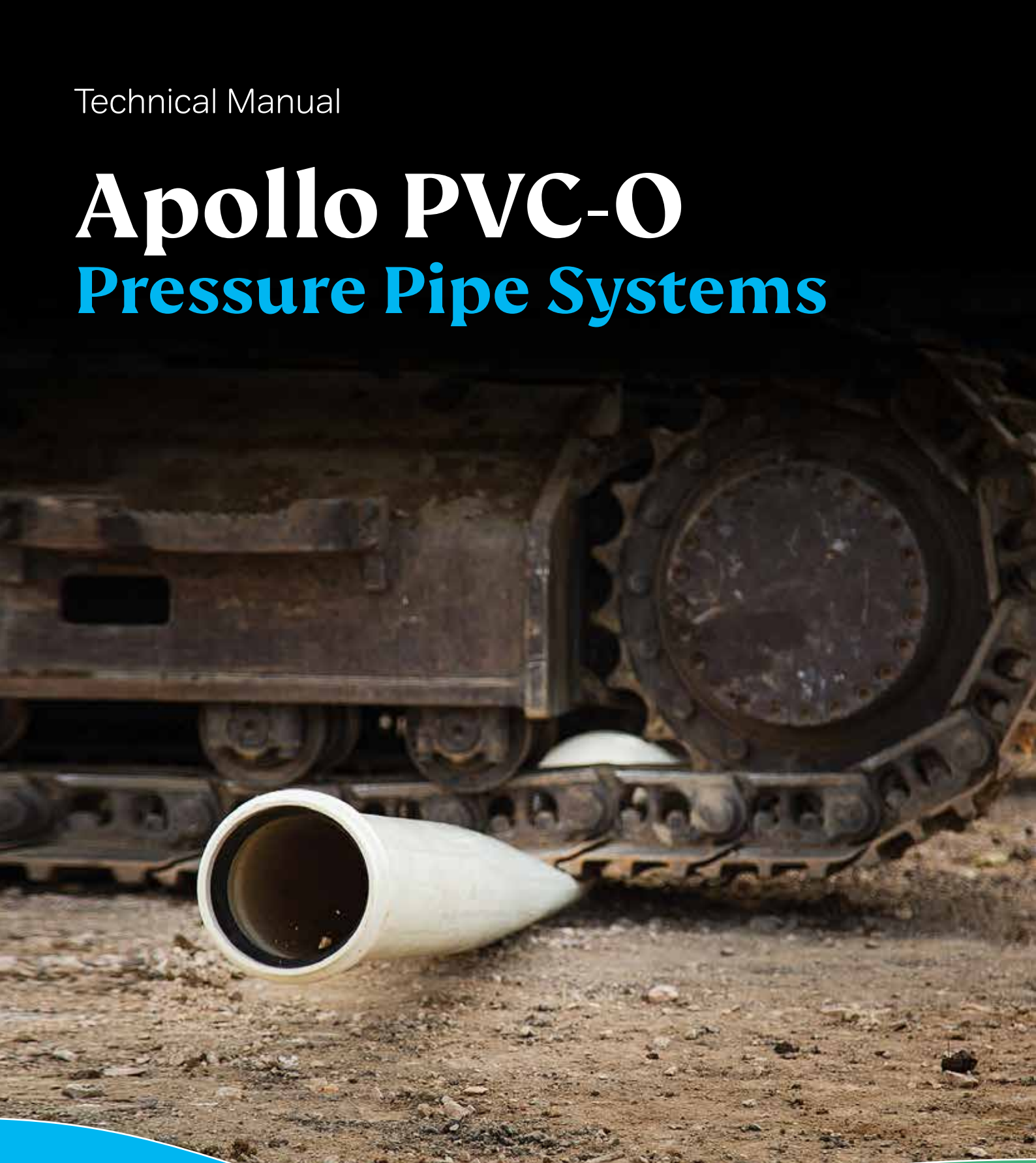
Technical Manual

Apollo PVC-O
Pressure Pipe Systems



wavin

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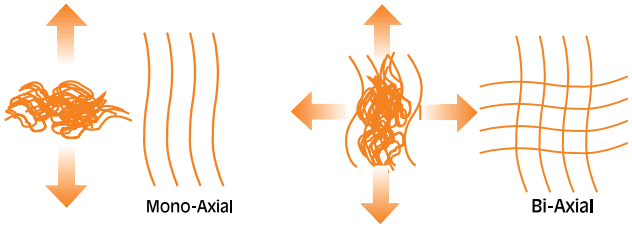
Apollo PVC-O Pressure Pipe Systems

PVC-O pipe production line

Apollo PVC-O Pipe Systems are produced by Wavin for use in pressurized water transport lines according to international standards. Thanks to its superior technical properties, it can be used in many different application areas.

- Potable water collection and distribution lines
- Agricultural and environmental irrigation lines
- Industrial applications - treatment
- Fire hydrant lines
- Pressure sewer lines
- Cable duct

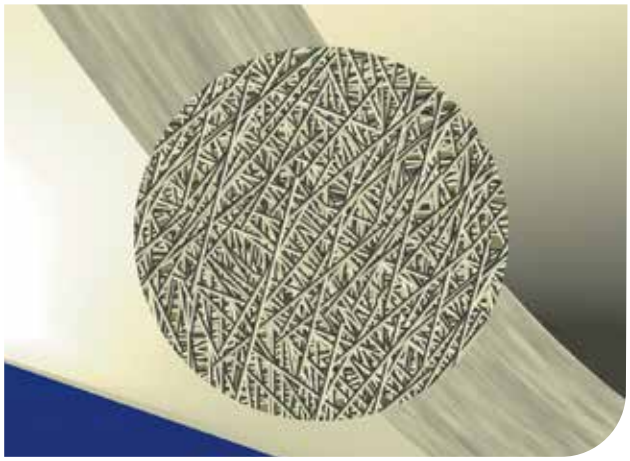
Normally, PVC molecules are randomly arranged. The polymer molecules are oriented in the same direction with material being produced at suitable pressure, temperature and speed. This process is called the molecular orientation. As a result, the new molecular structure can be seen even with the naked eye. The molecular orientation process improves all mechanical properties of PVC.

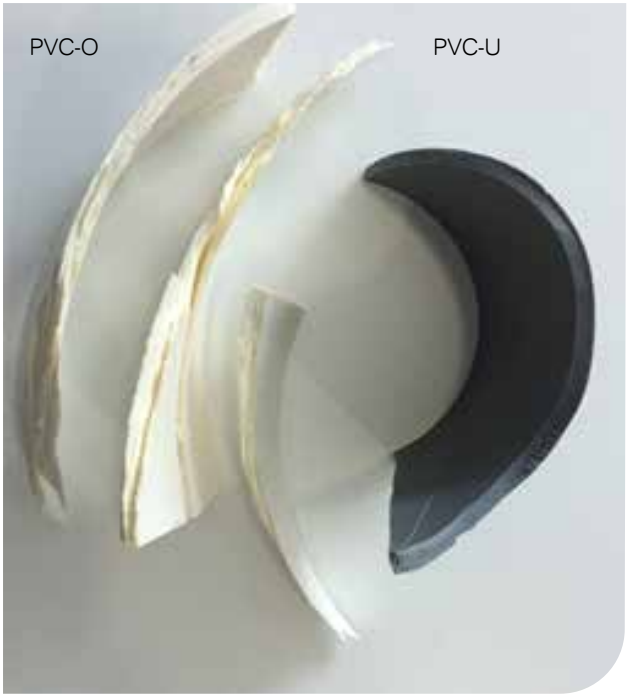


Molecular Orientation

Random molecular structure

Oriented molecular structure (molecular orientation)





The laminar molecular structure of Apollo PVC-O pipes and the random molecular structure of PVC-U pipes can be seen through the cross section.

Product Range

Apollo pipes (PVC-O) are manufactured from MRS450 class raw material in accordance with the international standard in our Adana factory. Pipes are manufactured in pressure class PN12,5 (SDR45,8) and PN16 (SDR37) from 110mm to 315mm. Pipes are integrated. It is also possible to produce without socket.

The pipe length can be at least 1,2 meters (excluding socket) and maximum 6 meters. Apollo pipes can be used with all types of socketed plastic and cast iron fittings.

There is an inspection report obtained from Turkish Standard Institution (TSE) for the use of Apollo pipes in potable water. In addition, Ministry of Environment and Urbanization Pos number is available: According to unit price list for item no: 10.450.2951-52-53

APOLLO PVC-O Pressure Pipe ISO 16422-2:2024	**MRS 450**	
	PN 12,5 C 1,6 SDR 45,8	PN16 C1,6 SDR 37
Diameter (mm)	Wall Thickness (mm)	Wall Thickness (mm)
Ø110	2,4	3,1
Ø125	2,8	3,5
Ø140	3,1	3,9
Ø160	3,5	4,4
Ø200	4,4	5,5
Ø225	5,0	6,2
Ø250	5,5	6,9
Ø280	6,2	7,7
Ø315	6,9	8,7

Technical Properties

The molecular orientation process improves the physical and mechan- ical properties of the produced pipe as well as the chemical properties provided by the raw material. PVC-O pipes have many technical advantages compared to standard pipes.

For example, while providing high impact strength compared to PVC-U, PVC-O pipes provide also more advantages over HDPE100 pipes due to its large internal flow area. As a result, Apollo pipes provide to the user the longest life of the pressurized water line.

Mechanical Advantages

- High impact resistance
- Ductility (Flexibility)
- High Long Term Hydrostatic Strength
- Low crack propagation rate

Hydraulic Advantages

- Large inner flow area
- Resistance to the effect of water hammer
- Flexible and sealed connection
- Low friction and pressure loss

Application Advantages

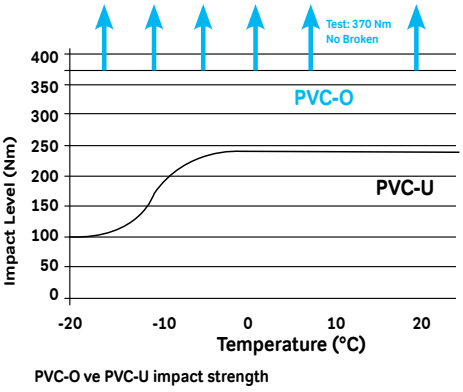
- Lighweight and easy to carry
- Socketed connection- fast installation
- Easy bedding and backfilling

Mechanical Advantages

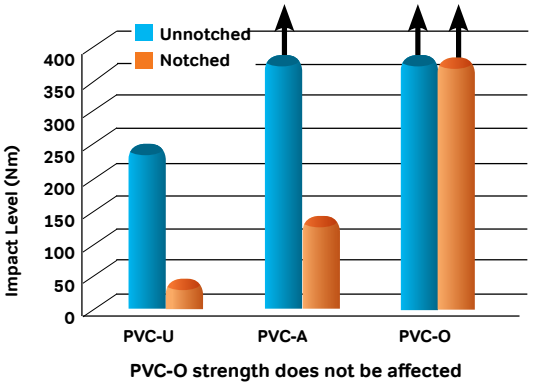
High impact resistance

Pipes are subjected to different types of impact. The most common situations of the impact exposure are improper applications during loading, unloading and applications during the transport. Apollo PVC-O pipes have high resistance to the impact. This feature prevents damages or fractures of the pipe during the application.
(Tested with TIR <%10 @0°C– ISO3127-EN744-315mm Diameter-PVC-U: 6,3kg,PVC-O: 12,5kg)

The impact resistance of PVC-O is at least 2 times higher than PVC-U. As the air resistance decreases the impact strength of PVC-O increases significantly compared to PVC-U. This difference increases up to 10 times below 0°C Therefore, Apollo pipes can be applied even in a very cold weather. Due to its high impact resistance, it is very difficult to form cracks on the PVC-O pipe. However, in case of the formation, this crack does not progress by means of to the laminer molecular structure. Strength problems caused by glaze cracks are not seen.



PVC-O ve PVC-U impact strength



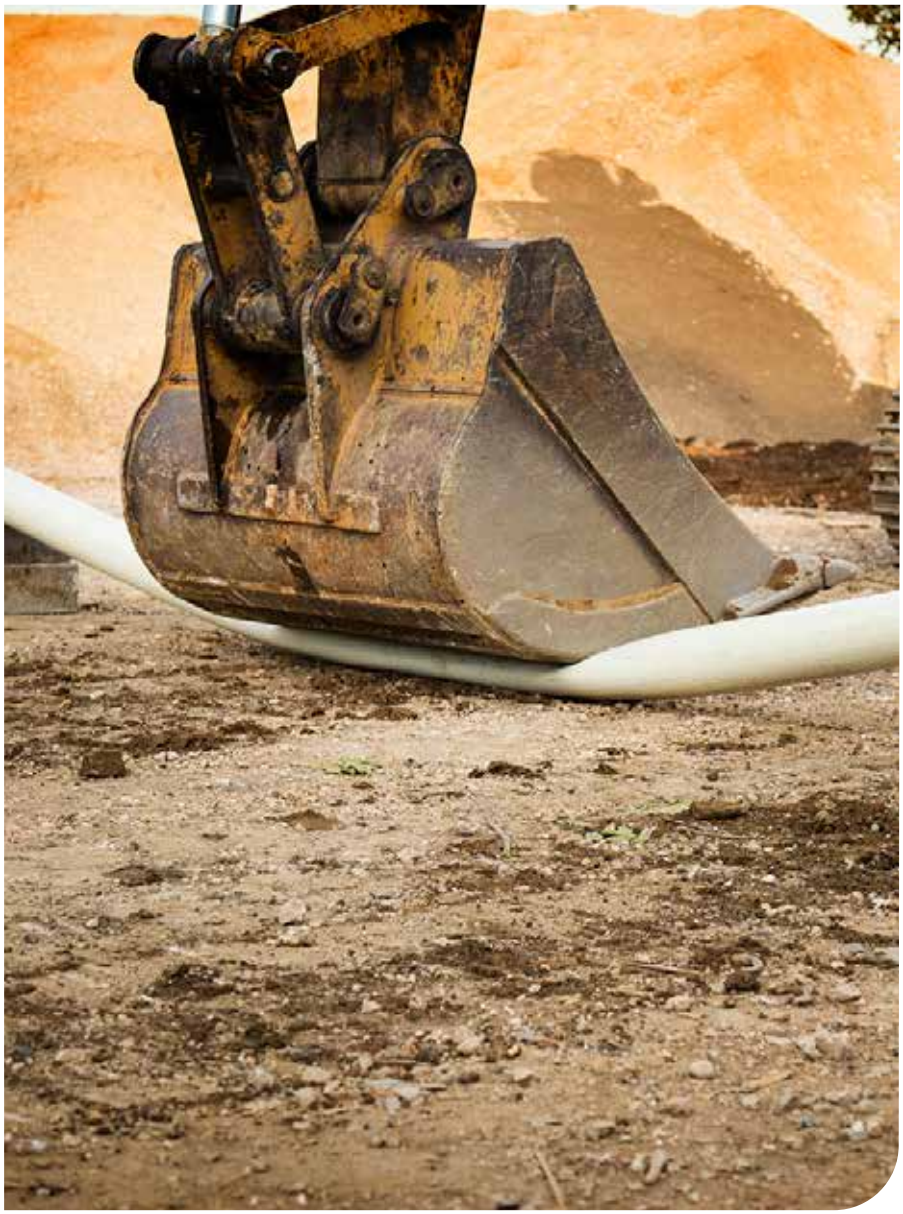
PVC-O strength does not be affected

Economic Bedding and Backfilling

Due to high resistance to impact, it provides the economical bedding and backfilling. There is no need to use fine sand in the backfilling process; however large stones or rocks should not be filled directly on them.

Ductility (Flexibility)

Apollo PVC-O pipes are produced by stretching both radial and axial (direction). Although the elasticity coefficients are same as PVC-U pipes, PVC-O pipes get thinner and the flexibility of the pipes increases because of this production method. Flexibility is the ability of the pipe deformation. Apollo PVC-O pipes are not deformed due to their superior flexible structure. Thus, pipes can be used safely against challenging site conditions.

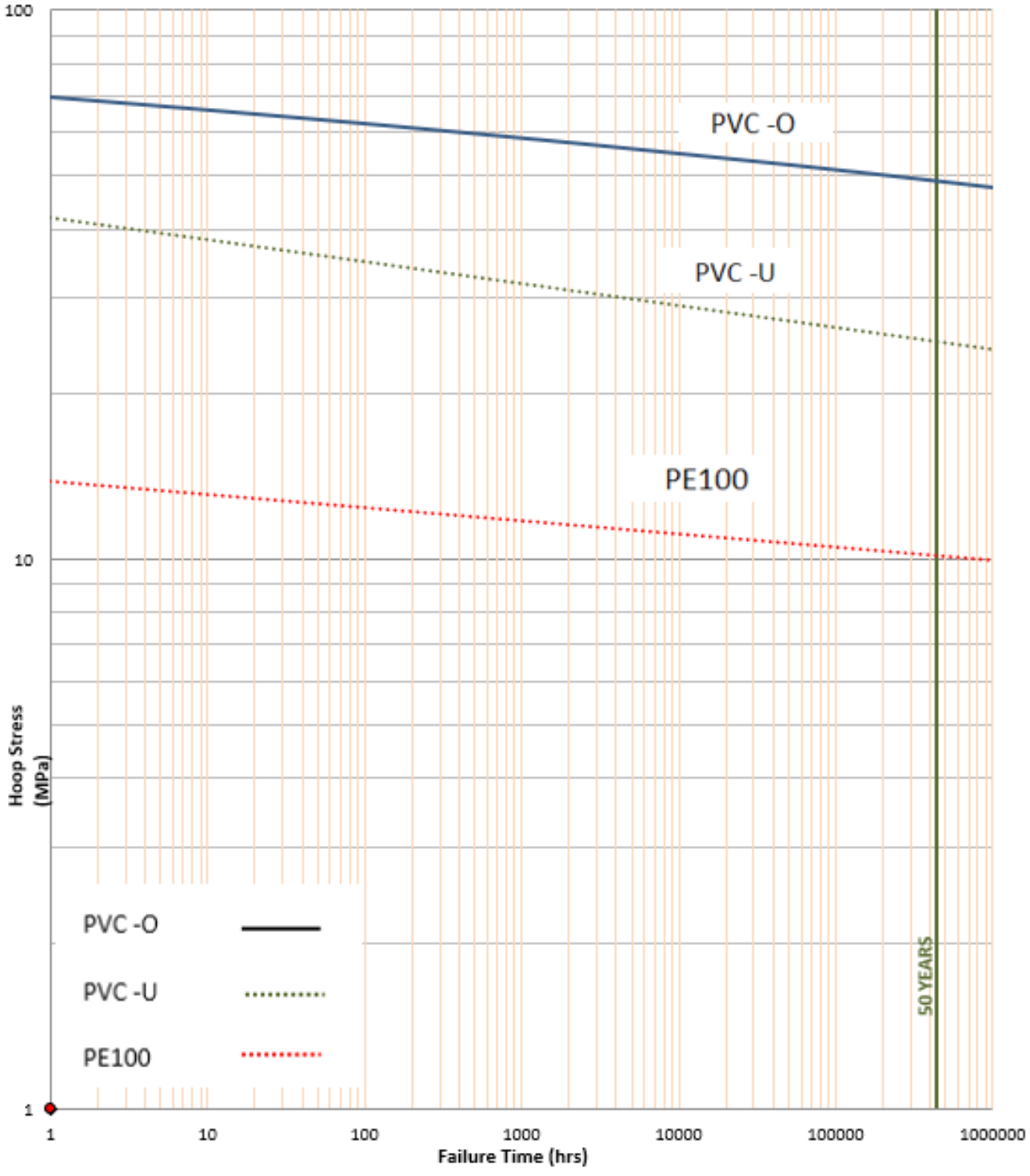


Because of the high flexibility of Apollo PVC-O it can be applied up to 11° without using elbow. So, fewer fittings are used. Apollo pipes can be used with socketed PVC-U and cast iron fittings. The important point is that the pipe needs to be entered to the socket completely. (*)

(*) See the User manual section

Hydrostatic Performance - internal pressure

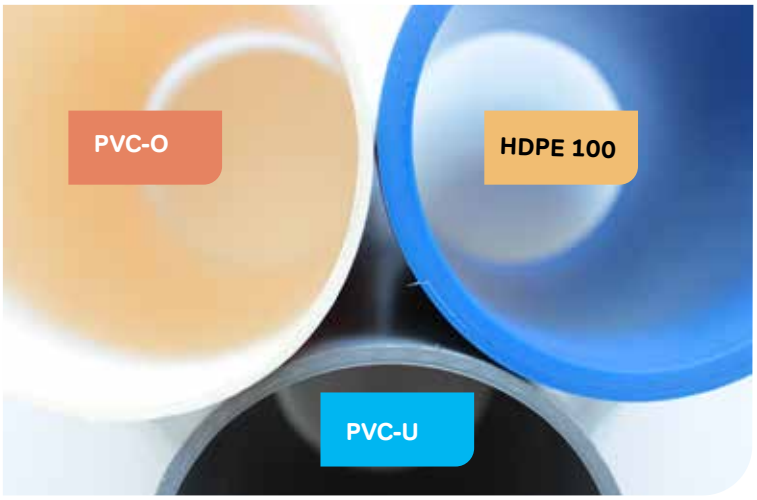
The strength of all presurized pipes have decreased over time. The pressure resistance of Apollo PVC-O pipes is higher than its competitors from the first time and maintain high strength property throughout the life cycle in both short and long terms.



Hydraulic Advantages

1- Large inner flow area

Apollo PVC-O pipes have a larger inner diameter than PVC-U and PE100 pipes. Therefore, when compared to pipes with the same pressure strength, more water can be selected the Apollo pipe In other words, or a smaller diameter pipe can be used due to the thin wall thickness. Apollo PVC-O pipes have an average of 10% higher flow area.



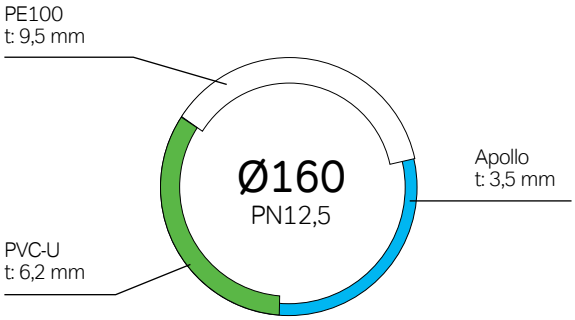
2- Energy friendly

Pressure losses will be less than other pipes in the large flow area. With this feature, a smaller pump can be selected when Apollo PVC-O pipe is used, resulting in lower energy consumption of the pump. Apollo PVC-O pipes are therefore energy friendly.

3- Wall thickness comparison of Apollo pipes

PN12,5	Wall Thickness mm				
	Apollo PVC-O	PVC-U	PVC-O PVC-U	HDPE100	PVC-O HDPE
110	2,4	4,2	-%43	6,6	-64%
125	2,8	4,8	-%42	7,4	-62%
140	3,1	5,4	-%43	8,3	-63%
160	3,5	6,2	-%44	9,5	-63%
200	4,4	7,7	-%43	10,7	-59%
225	5,0	8,6	-%42	11,9	-58%
250	5,5	9,6	-%43	13,4	-59%
280	6,2	10,7	-%42	14,8	-58%
315	6,9	12,1	-%43	16,6	-58%

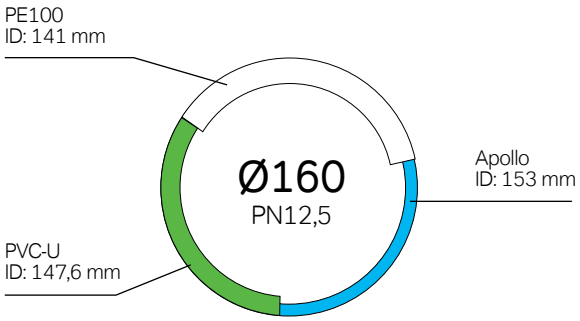
PN16	Wall Thickness mm				
	Apollo PVC-O	PVC-U	PVC-O PVC-U	HDPE100	PVC-O HDPE
110	3,1	6,6	-%53	10,0	-69%
125	3,5	7,4	-%53	11,4	-69%
140	3,9	8,3	-%53	12,7	-69%
160	4,4	9,5	-%54	14,6	-70%
200	5,5	11,9	-%54	16,4	-66%
225	6,2	13,4	-%54	18,2	-66%
250	6,9	14,8	-%53	20,5	-66%
280	7,7	16,6	-%54	22,7	-66%
315	8,7	18,7	-%53	25,4	-66%



Apollo PVC-O pipes are 40-50% thinner than PVC-U pipes and 60-70% thinner than HDPE100 pipes.

PN12,5	Inner Diameter mm				
	Apollo PVC-O	PVC-U	PVC-O PVC-U	HDPE100	PVC-O HDPE
110	105,2	101,6	4%	96,8	8,7%
125	119,4	115,4	3%	110,2	8,3%
140	133,8	129,2	4%	123,4	8,4%
160	153,0	147,6	4%	141,0	8,5%
200	191,2	184,6	4%	178,6	7,1%
225	215,0	207,8	3%	201,2	6,9%
250	239,0	230,8	4%	223,2	7,1%
280	267,6	258,6	3%	250,4	6,9%
315	301,2	290,8	4%	281,8	6,9%

PN16	Inner Diameter mm				
	Apollo PVC-O	PVC-U	PVC-O PVC-U	HDPE100	PVC-O HDPE
110	103,8	96,8	7%	90,0	15,3%
125	118,0	110,2	7%	102,2	15,5%
140	132,2	123,4	7%	114,6	15,4%
160	151,2	141,0	7%	130,8	15,6%
200	189,0	176,2	7%	167,2	13,0%
225	212,6	198,2	7%	188,6	12,7%
250	236,2	220,4	7%	209,0	13,0%
280	264,6	246,8	7%	234,6	12,8%
315	297,6	277,6	7%	264,2	12,6%

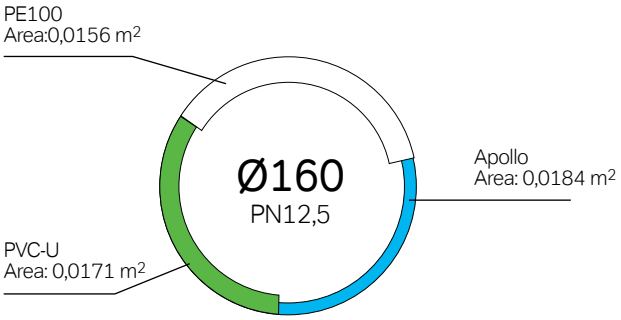


The inner diameter of Apollo PVC-O pipes is 4-7% wider than PVC-U pipes and 9-12% wider than HDPE100 pipes.

4- Flow area comparison of Apollo pipes

PN12,5	Flow Area m^2				
	Apollo PVC-O	PVC-U	PVC-O PVC-U	HDPE100	PVC-O HDPE
110	0,0087	0,0081	7,2%	0,0074	18,3%
125	0,0112	0,0105	7,1%	0,0095	17,4%
140	0,0141	0,0131	7,2%	0,0120	17,6%
160	0,0184	0,0171	7,5%	0,0156	17,7%
200	0,0287	0,0268	7,3%	0,0251	14,6%
225	0,0363	0,0339	7,0%	0,0318	14,2%
250	0,0449	0,0418	7,2%	0,0391	14,7%
280	0,0562	0,0525	7,1%	0,0492	14,2%
315	0,0713	0,0664	7,3%	0,0624	14,2%

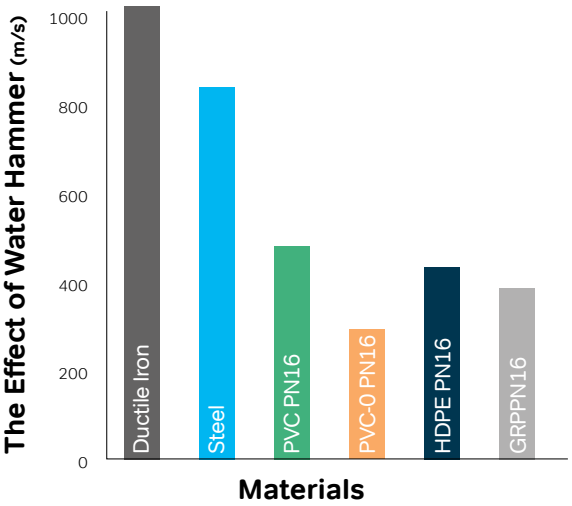
PN16	Flow Area m^2				
	Apollo PVC-O	PVC-U	PVC-O PVC-U	HDPE100	PVC-O HDPE
110	0,0085	0,0074	15,0%	0,0064	33,0%
125	0,0109	0,0095	14,7%	0,0082	33,3%
140	0,0137	0,0120	14,8%	0,0103	33,1%
160	0,0180	0,0156	15,0%	0,0134	33,6%
200	0,0281	0,0244	15,1%	0,0220	27,8%
225	0,0355	0,0309	15,1%	0,0279	27,1%
250	0,0438	0,0382	14,9%	0,0343	27,7%
280	0,0550	0,0478	14,9%	0,0432	27,2%
315	0,0696	0,0605	14,9%	0,0548	26,9%

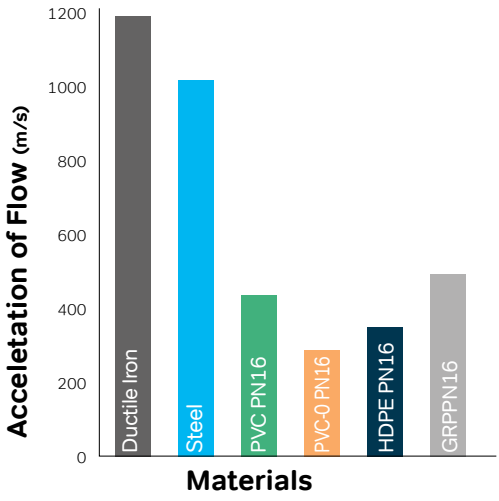


The flow area of Apollo PVC-O pipe is 7-15% higher than PVC-U pipes and 15-30% higher than HDPE100 pipes.

5- Resistance to the effect of water hammer

In case of sudden stopping of the pump or closing of a valve in a pressurized operated line sudden pressure rises suddenly in the installation called water hammer. These sudden pressure increases damage the system. Due to its large internal flow area, Apollo PVC-O pipes are more resistant to water hammer impact than other standard pipes.





6- Flexible and Sealed Connection

Pipes are integrated-socketed and sealed. It is easy to assemble. It also eliminates the risk of the leakage. It is both easy and watertight. It adheres to the gasket housing under the pressure and provides the highest level of sealing.

Flat Gasket Design

Gasket

The flat gasket designed for Apollo consists of a combined compression gasket and lip, which are firmly fixed in the pipe socket.

The flexible EPDM rubber seal provides sealing..

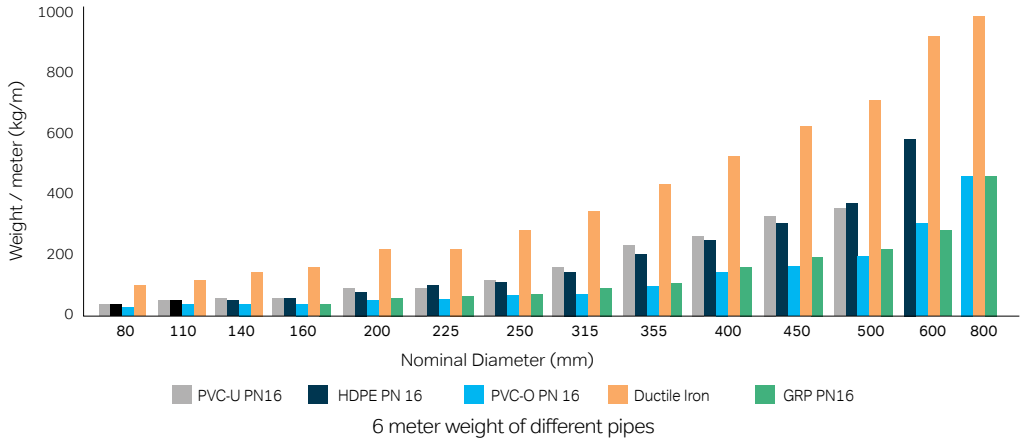
The reinforced polypropylene lip adhered to EPDM rubber seal ensures that the seal is firmly in place.

One of the biggest problems that can be encountered in infrastructure systems is that tree roots enter the pipe over time. The custom design flat gasket prevents the penetration of the root into the APOLLO pipes

Application Advantages

The most important advantage of Apollo PVC-O pipes due to its superior production technology is the advantages for the user on site.

01 It provides the desired pressure strength at much lower wall thicknesses compared to standard pipes by means of its molecular structure which is oriented during production. Low wall thicknesses make the pipe more lighter. Pipes are easy to handle at the application site.



6 meter weight of different pipes

02 Pipes are integrated-socketed and sealed. Consequently, the pipe joint is simple and does not cause any waste of time like the joints that are made with fusion welding. There is no need for operations such as shaving before joining. Time-consuming steps, such as welding time or cooling are beyond the scope.

03 The pipe joint with seal is made outside the excavation area and then the pipe can be carried to the excavation area. There is no need to make the welding in the excavation.

04 Since it is not necessary to enter to the excavated pit, the width for burying the pipe may be narrower.

05 The application is made with minimum scrap due to its high impact resistance.

06 Due to its flexibility, fewer fitings are used.

07 The application is completed in short time with fewer installer. Labor costs are minimum.

Application Area : Fire Hydrant Lines

According to the related regulation, the fire hydrant line is obligatory in the buildings with a building area over 5.000 m2 Today; intalled fire hydrant lines are applied under ground HDPE100-PN16 pipes due to the corosion risk of metal.

Apollo pipes have many advantages over HDPE100 pipes. The following statements shows the advantages compared to connectional system.

- The pipes are light. It is quick to carry and lay.
- Pipes are rod-shaped and straight. There is no need to lay before the application and wait for it to flatten.
- Joints are rubber ring socket joint. It is no need for pipe shaving and long lasting welding processes.
- The pipe can be cut by suitable methods and used as parts. Fitings are fiting socket. No special labor is required.
- Since the pipe connections can be made outside the ground and lowered into the pit, the application can be made in a narrower excavation area. There is no need to enter into the pit.

Do you know that you can use Apollo PVC-O pipes in fire hydrant lines?

Installation Manual

Transport, Storage and Installation Standards

01 Delivery of pipes

As soon as Apollo plastic pipes are delivered to the construction site they should be checked and determined whether the requested products are delivered or not.

02 Transportation

In order to prevent damages, it is necessary to use load vehicles with smooth surfaces free of protruding nails or screws.

If pipes of different diameters are transported on the same shipment the pipes with the largest diameter should be placed first at the bottom of the truck's platform.
It is recommended to connect pipes with non-metallic elements so that no cuts will occur.

03 Storage and Stacking

Apollo plastic pipes should be stored horizontally in a flat area insulated with 1.5 meter interval support. In this way, the bending of the pipes is prevented and the ends do not contact each other.

It should be stacked to a height of 1.5m by placing the heaviest pipe type down and making sure that it does not cause to any deformation on other pipes. (Stacking socket end/spigot end is important in term of protecting the socket ends.)

If an open storage is to be carried out for a long time, it should be protected from direct sunlight with an opaque material. However, a proper ventilation must be provided.

04 Carrying

Apollo plastic pipes should be carried carefully to the place of use and then lowered. Impact and abrasions should be avoided during the carrying. There is no equipment needed for carrying. The weight of the pipes allows the transport to be carried out by hand, but if it is necessary to lift several pipes at the same time the lifting elements that come into contact with the pipe should not be metallic..

05 Installation

A suitable installation is essential for the successful performance of Apollo plastic pipes.

06 Excavation

The pipes for the pressurized water system are normally installed at a depth of at least 1 meter. The excavation width will be 60 cm for large tranches, 30 cm for standard excavations or 10 cm for narrow excavations.

NOTE: If there is water at the bottom of the trench, the trench must be drained to keep the trench dry until the pipe is laid., at least 1 meter of filling should be made on the pipe to prevent it from moving.

07 Back-filling

The bottom of the trench must be prepared in a stable, tight and evenly distributed manner along the pipe support. If the bottom of the trench is unstable, the additional depth should be dug and filled with a suitable material (sand or gravel). In the presence of sharp and large rocks they should be removed and a minimum of 100 mm of support should be provided. Never lay pipes directly on rocks and large stones.

Suitable materials for the bed as filling material can be crushed rock (angular) with a maximum size of 3/4, eroded rock fragments with a maximum size of 1.1/2, washed sand, sand and fine pebbles. The choice of the filler depends on the supervisor and the decision-maker.

For the pipe bedding it is necessary to use a fine material free of stones up to 100 m. These materials must be properly compacted using a hand tamper. Then 300 mm of filling is done, a mechanical tamping tool can be used.

Special installations

When the pipe is to be exposed to sunlight, the stacking area must be covered with an opaque roof that is sun proof or protected with a paint that meets the following appropriate criteria:

- Thinner or solvent based paint may not be used.
- Paint containing aluminum or a similar material containing reflective component may be used.
- Before painting the pipe the surface should be prepared to ensure an adhesion. It should be lightly polished dry, cleaned with a cleaner and then applied the paint.

Pipe Installation

01 Cleaning

Clean the inside of the pipe and the socket carefully before joining.

02 Lubricant application

Lubricant or similar quality vegetable oil lubricant should be applied to half of the socket length. Then connect the socket and the pipe with the vertical pushing force.

03 Safety connection

Push the socket up to the entry mark on the pipe. This should be done with a quick movement because the acceleration between the inlet and the rubber will help the coupling. As shown on the figure, support the pipe by placing a wooden rod in the middle of the pipe.

Fittings

Since the outer diameters of Apollo pipes and the outer diameters of PVC-U pipes are same, cast and fittings sockets used in PVC-U systems can also be used in Apollo systems.

Maintenance

Equipment for the maintenance of PVC-U pipes can also be used in Apollo pipes.

System Commissioning

Hydrostatic Test

The purpose of this test is to verify the material and the labor.

To find out if there is trapped air in a test tube, the following can be done:

1. Pressurize with water at the desired pressure
2. Allow the pressure to be reduced to a certain level.
3. Measure the desired amount of water to return to the desired pressure.
4. Repeat steps 2 and 3.

If the amount of the water required to pressurize the line for a second time is considerably less than the desired amount of the first time, then, there is a trapped air in the pipeline.

Pressure Test

The pressure test can be 1,5 times the operating pressure. The test pressure shall not exceed the design pressure of the fittings and valves. The pressure shall be checked at the lowest point of the section to be tested and shall not be higher than the designed pressure of the pipe.

Leakage Test

The purpose of this test is to check the system for leaks. The test pressure is maintained for a certain period of time. The leakage is suspected if the pressure drops.

The installed system must be tested in lengths not exceeding 500 meters. Ensure that the sections to be tested are sufficiently covered, that the fittings and valves are sufficiently supported and that the movement at the end pads is restricted as necessary.

Filling the pipeline with water

The pipeline must be filled slowly starting from the lowest point. The amount of water required to fill the line must be calculated.

Extraction of air

Before starting the pressure test all air must be extracted from the pipeline during the filling process. It is recommended to install automatic air relief valves or vacuum at the high points of the section to be tested. A drain valve should be installed at the bottom points.

The presence of air in the pipeline during the test may cause to the excessive pressure due to the compression of the water. This may cause an error in the experiment and cause failure on the test.

Cleaning and Disinfection

1. Close the pipe. Inject the water into the pipe section to be disinfected. Drain the water to wash the pipe.
2. Calculate the amount of water required to fill the pipe section to be disinfected and specify the amount of the disinfectant to be injected to achieve a concentration of 50 mg/l chlorine.
3. After a few minutes, inject potable water from the outlet to the disinfected area. Add the disinfectant and the liquid chlorine or the sodium hydrochloride to provide a concentration of 50mg/l. This can be pre-diluted in the filing water or injected separately. Leave for a few more minutes and block the inlet and outlet when a concentration of 50mg/l is achieved.
4. 4) Leave to rest for 24 hours while the chlorine concentration should be at least 25 mg/l. If it is below this value, more disinfectants should be added.
5. Take the water sample from the pipes during the disinfection process. Have the analysis made in a laboratory. Water should be free from coliform organisms.
6. Wait another 24 hours and take another sample by performing the same experiment.
7. If the results are satisfactory, the disinfection water should be drained and final connection should be performed.

Apollo Plastic Pipes should be installed near the trench and then carefully laid at the bottom of the trench with the help of the installer inside the trench as shown in the below pictures.

Reference Cases

Nowadays, when water resources are rapidly depleted in the world it is very important to transport the clean water safely from one point to another. Apollo pipes perform this job in the most efficient way.

By means of its production technology, the mechanical and hydraulic properties gained by the pipe give to the mechanic an advantage in the application. It provides advantages to water and sewage administrations in the operation and municipalities due to its log life and sustainability.

Adıyaman Municipality

Apollo pipes are used not only for the supply of water to new places, but also for the renewal of existing old lines. Apollo pipes were preferred for these reasons in a renovation application in Adiyaman Municipality. Since the clean water line that was built many years ago can no longer function, the municipal authorities have reached to Wavin to select the appropriate system.

Because of the old line, water wasn't be supplied to the city network and users had problems. The repair of the line was not possible due to insufficient fittings and high repair costs. It was decided to change the line.

The application should be completed within a limited time and the traffic should not be interrupted in places passing through the city. Wavin proposed a system that could meet the demands of the municipality with Apollo pipe.

Kayseri KASKİ

In the potable water project, APOLLO pipes were preferred for the installation of service lines from the main line to houses.

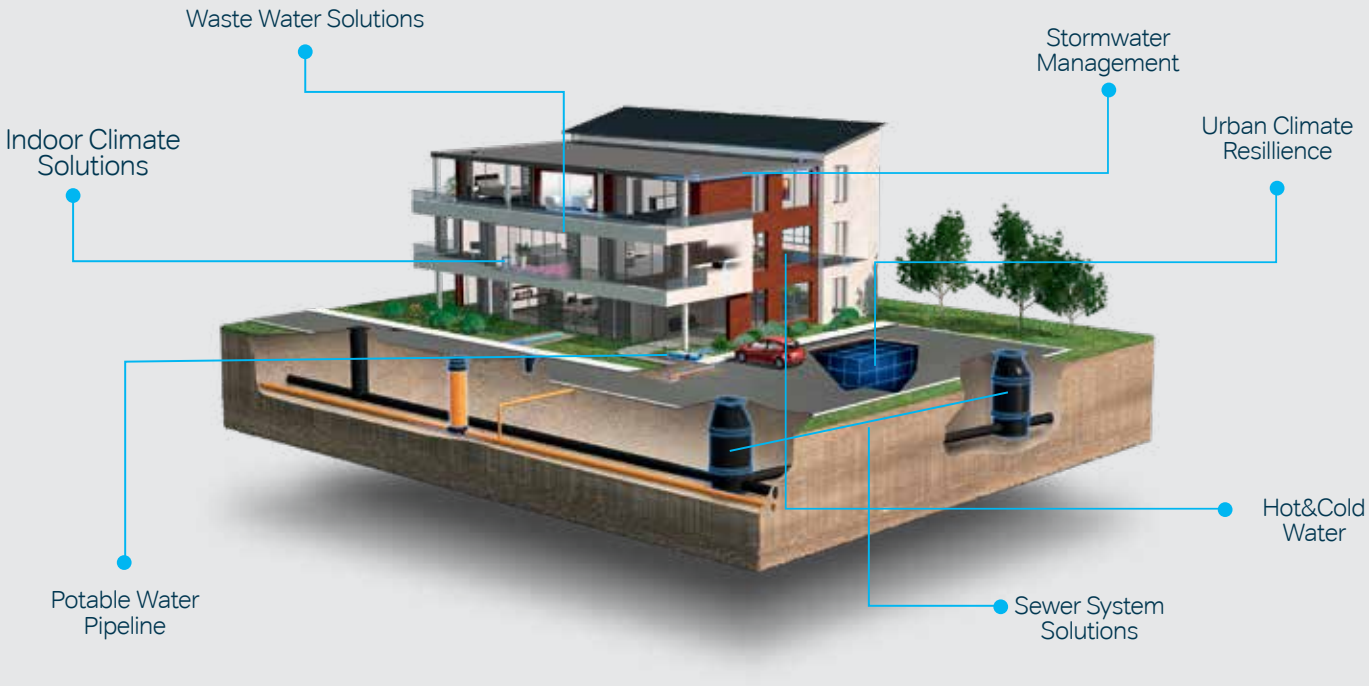
Malatya Maski

The continuation of the ductile and HDPE lines used before in the project was ensured by Apollo pipes. Apollo pipes offer significant cost advantages over ductile and HDPE100 pipes, as well as time saving for installers with ease of installation.

What Wavin Apollo can provide to Projects

- Fast shipping
- Easy transport with lightweight pipes
- Quick installation with self socketed pipes
- Narrow excavation area due to the possibility of joining outside the trench.
- Easy bedding due to the high impact resistance.
- Minimum number fittings are used in turns due to its flexibility.
- More water transportation due to the inner diameter.
- It can be applied in all seasons even in cold weather due to its high impact resistance and there is no need to wait.
- Full comapatibility with other systems.

Notes



Hot&Cold Water | Indoor Climate Solutions | Stormwater Management | Waste Water Solutions
Potable Water Pipeline | Sewer System Solutions

Wavin is part of Orbia, a community of companies working together to tackle some of the world's most complex challenges.

We are bound by a common purpose:
To Advance Life Around the World.

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