



PVC-O PRESSURE PIPE TM
Apollo

PRODUCT CATALOGUE

iPLEX
Pipelines



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Lighter. Proven.**

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Apollo PVC-O Introduction and Origin

Iplex Apollo™ PVC-O is a biaxially orientated PVC pressure pipe, for use in water and waste water infrastructure pipelines. Iplex manufactures Apollo using two new processes known as *biaxial extrusion* and *super socketing*, both of which are patented. This method of production results in an exceptionally tough, high performance thermoplastic pipe with greatly enhanced physical characteristics. Increased hydraulic capacity is possible with Apollo owing to its exceptionally smooth, enlarged bore. Apollo has greater impact resistance, higher ductility, improved fatigue resistance and reduced weight when compared with traditional Iplex PVC-U pipes.

Oriented PVC pipe manufacture was first developed by Yorkshire Imperial Plastics in the UK during the 1970s. It was found that by orienting the molecular structure of extruded PVC material in the circumferential direction, in a pipe wall at elevated temperatures, there was a marked improvement in its physical properties; especially hoop strength. Further development has been carried out by Wavin UK. Their latest process uses biaxial orientation, that is, a combination of radial and longitudinal expansion, to enhance the overall pipe performance. Arising from a technology sharing arrangement, Iplex is now in a position to introduce this more advanced technology to the New Zealand and Australian markets.



Iplex uses the latest equipment for the manufacture of Apollo™.

Applications for Apollo PVC-O Pressure Pipe

Apollo PVC-O pressure pipes are suitable for a wide range of buried pipeline applications including:

- Major potable water supply trunk and reticulation mains
- Principal water mains
- Principal pressure sewer mains
- Industrial process lines
- Effluent pipelines for industrial and rural waste
- Irrigation and turf water systems

To readily distinguish between pipeline applications Apollo pipes may be colour coded.

Normally, Apollo Series 1 is coloured white, and ApolloBlue Series 2 is coloured blue. Other colours such as purple for recycled water and cream for pressure sewage must be specified at the time of ordering, and are subject to production availability.

White colour has been widely accepted and used for PVC sewer rising mains in New Zealand, when accompanied by appropriate identification tape marking above the pipe. Cream is another option for PVC-O pressure sewers to be included in AS/NZS4441.

Iplex do not recommend blue for sewer applications, for obvious asset identification reasons.



Joint sockets on white DN 200 Series 1 PN 10 Apollo PVC-O pipes with factory fitted, locked in place Blueseal rings.



Easy site handling of light weight DN 250 Series 2 PN 16 Apollo Blue PVC-O pipe, with factory fitted, locked in place Blueseal rings.

Apollo Manufacture and Biaxial Orientation

Processing for Molecular Orientation

PVC polymer molecules are extremely long, resembling long intertwined woollen threads with their shape comparable to balls of wool. They form the building blocks of the pipe.

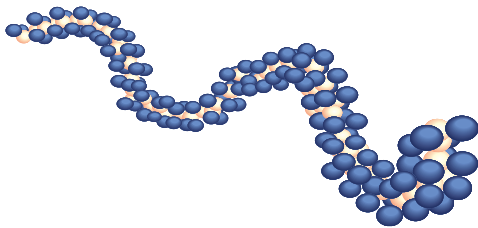


Figure 1: Short piece of a polymer molecule.

Figure 1 shows a model of a polymer molecule which on stretching would start to straighten but ultimately further stretching would result in rupture.

When a polymeric pipe is extruded in the traditional way a more or less spherical shaped molecular structure results. If the pressure capability is to be increased the pipe wall has to contain more building blocks (i.e. molecules) in the direction of the principle stress. Normally for higher design pressures, the wall of the pipe is made thicker to incorporate these additional building blocks.

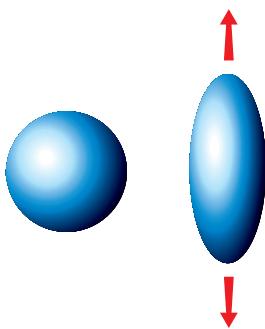


Figure 2: The diameter of the sphere decreases when stretched.

By stretching the pipe in the correct way the spherical polymer molecules are reshaped or oriented to the longitudinal direction. Because the cross section has become smaller, the oriented molecules now fit into a thinner wall section of pipe (Figure 3).

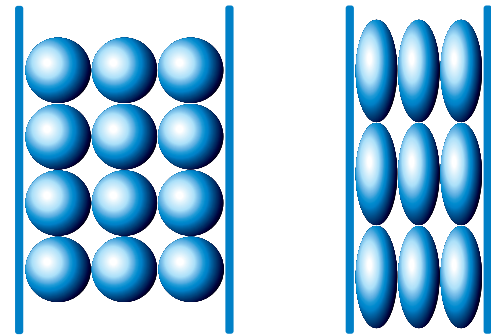


Figure 3: The oriented molecules now fit into a thinner wall section of pipe.

Biaxial Orientation

Biaxially oriented or “drawn” pipe is where both pipe circumference and length are extended after extrusion. Strength enhancement is achieved by drawing to elongate the PVC molecules, realigning them into the preferred directions.

If pipe stretching were done immediately behind the die-head where the temperature is approximately 190°C there would be no beneficial effect. The stretching process must take place at a temperature level where the PVC molecules can be distorted, but still low enough to freeze them immediately so as to keep their oriented shape. In other words drawing takes place at the lowest temperature possible, just above the molecular freezing point of about 85°C for PVC, to ensure the orientation remains permanent.



Figure 4: Wall cross-section of “pre-form” pipe with a small diameter and a large wall thickness being stretched circumferentially and axially into a pipe with larger diameter and a thinner wall.

An additional benefit of this process is the exceptionally smooth pipe bore which results from the “finishing” of the pipe bore as it is pulled over the polished steel expansion cone.

Product Information

Apollo Standards Compliance / Design MRS Pipe Standards

Apollo™ PVC-O pipe complies with Australia/New Zealand Standard AS/NZS 4441 “Oriented PVC (PVC-O) pipes for pressure applications”.

Apollo PVC-O pipes are independently certified in accordance with the test requirements of AS/ NZS 4441 under Standards Mark Licence number SMKP20682.



Apollo pipe is also manufactured under third party accredited quality assurance programs complying with AS/NZS ISO 9001, Licence No. QEC 4169.

Design Material Class and Pressure Class (PN)


Iplex has chosen to manufacture Apollo™ PVC-O using four design material classes. These are 315, 355, 400 and 450.

The Design material class is related to the Design MRS value and to the maximum allowed working pressure (PN), as shown in the pipe specification chart below.

To simplify pipe selection, Apollo Series 1 and ApolloBlue Series 2 are each available in only two PN classes.

These are either PN 12.5 or PN 10 for Apollo Series 1, and either PN 16 or PN 12.5 for ApolloBlue Series 2.

The resulting actual pipe stiffnesses are ideal for urban reticulation purposes where pipes may be laid, either at minimum covers, or at depth, under road pavements.

|  | | DESIGN MRS (MPa) | Design Material Class | Maximum working pressure @ 20° C (m head) | Maximum working pressure @ 20° C (PN) |
|---|------------------|------------------|-----------------------|---|---------------------------------------|
| Apollo | Series 1 PN 12.5 | 40 MPa | 400 | 125 | 12.5 |
| | Series 1 PN 10 | 31.5 MPa | 315 | 100 | 10 |
| Apollo Blue | Series 2 PN 16 | 45 MPa | 450 | 160 | 16 |
| | Series 2 PN 12.5 | 35.5 MPa | 355 | 125 | 12.5 |

AS/NZS 4441 allows manufacturers to choose from five material classifications with minimum required strengths (MRS) at 50 years ranging from 31.5 MPa (Material class 315) to 50 MPa (Material class 500).



Site handling and installation of light weight DN 100 Series 1 PN 12.5 Apollo, for water distribution in a Residential Subdivision near Martinborough.

Product Data and Range

Apollo Product Range - Dimensions / Design MRS

| Nominal Size (DN) mm | Nominal Pressure Class (PN) Bar | Mean Outside Diameter (D _n) mm | Mean Inside Diameter mm | Mean Wall Thickness (e _n) mm | Design MRS (MPa) |
|---|---------------------------------|--|-------------------------|--|------------------|
| Apollo Series 1 Metric Pipe | | | | | |
| DN100 | 10 | 114.25 | 108.2 | 3.0 | 31.5 |
| DN150 | 10 | 160.25 | 151.6 | 4.3 | 31.5 |
| DN200 | 10 | 225.35 | 213.5 | 5.9 | 31.5 |
| DN300 | 10 | 315.50 | 299.1 | 8.2 | 31.5 |
| | | | | | |
| DN100 | 12.5 | 114.25 | 108.2 | 3.0 | 40.0 |
| DN150 | 12.5 | 160.25 | 151.6 | 4.3 | 40.0 |
| DN200 | 12.5 | 225.35 | 213.5 | 5.9 | 40.0 |
| DN300 | 12.5 | 315.50 | 299.1 | 8.2 | 40.0 |
| ApolloBlue Series 2 Imperial Ductile Iron OD | | | | | |
| DN100 | 12.5 | 121.90 | 114.5 | 3.7 | 35.5 |
| DN150 | 12.5 | 177.40 | 166.8 | 5.3 | 35.5 |
| DN200 | 12.5 | 232.25 | 218.4 | 6.9 | 35.5 |
| *DN225 | 12.5 | 259.30 | 244.1 | 7.6 | 35.5 |
| DN250 | 12.5 | 286.25 | 269.4 | 8.4 | 35.5 |
| *DN300 | 12.5 | 345.45 | 325.2 | 10.1 | 35.5 |
| | | | | | |
| DN100 | 16 | 121.90 | 114.5 | 3.7 | 45.0 |
| DN150 | 16 | 177.40 | 166.8 | 5.3 | 45.0 |
| DN200 | 16 | 232.25 | 218.4 | 6.9 | 45.0 |
| *DN225 | 16 | 259.30 | 244.1 | 7.6 | 45.0 |
| DN250 | 16 | 286.25 | 269.4 | 8.4 | 45.0 |
| *DN300 | 16 | 345.45 | 325.2 | 10.1 | 45.0 |

***Subject to minimum order quantity and availability.**

Note 1: Mean Internal diameter ID = D_n – (2 x e_n)

Note 2: The effective length of all pipes is 6 m

Note 3: Design E modulus is 4000 MPa

Note 4: Design coefficient = 1.6

Pipe Colour Coding

To readily distinguish between pipeline applications, Apollo pipes may be colour coded. Normally, Apollo Series 1 is coloured white, and ApolloBlue Series 2 is coloured blue. Other colours such as purple for recycled water and cream for pressure sewage must be specified at the time of ordering, and are subject to production availability.

Refer also to page 3.

BLUEseal Joint System

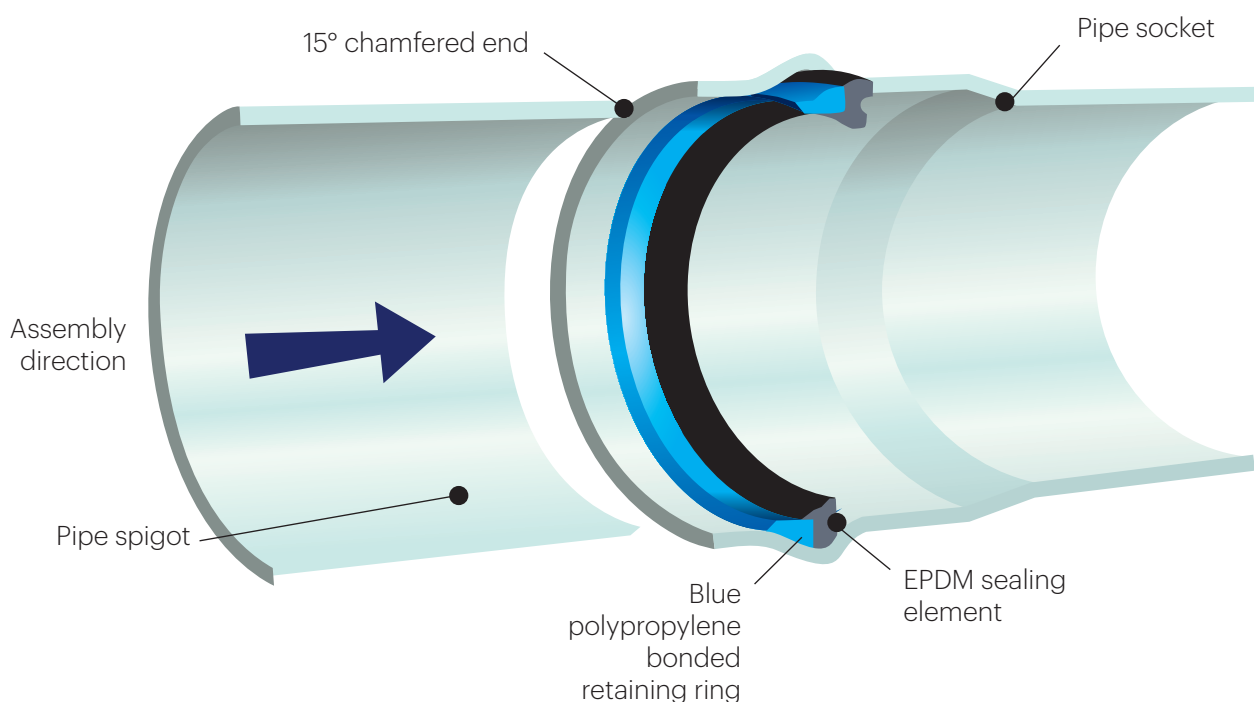
BLUEseal is a high performance, factory fitted EPDM rubber ring which provides security and ease of jointing (Super socketing patents apply, Australian patent situation A 01 286 329 and World: 0209926).

BLUEseal utilises the Forsheda Anger-lock™ EPDM rubber seal ring, a combined lip and compression seal that is positioned and locked inside the socket, at the time of manufacture. The seal design comprises an EPDM rubber sealing element, bonded to a distinctive blue coloured polypropylene retaining ring that holds the seal securely in position during transport and pipe joint assembly. Tool-assisted removal or installation in the field is possible in special circumstances.

The seals comply with BS EN 681 and have a UK Kitemark. Parts 1 and 3 of AS 1646 "Elastomeric seals for waterworks purposes" takes account of BS EN681. Test regimes used to certify the BLUEseal joint include those of ISO 13846 for pressure, ISO 13844 for vacuum performance and AS/NZS 4020 for drinking water applications.



Joint sockets on white DN 300 Series 1 PN 12.5 Apollo pipe, with factory fitted, locked in place blue seal rings.




Advantages of Apollo

Apollo pipe has increased strength, toughness and ductility which permits the use of a higher design stress, with improved overall performance, compared with traditional Iplex PVC-U or PVC-M pressure pipe, of equivalent/similar PN class.

Apollo's larger bore can reduce pumping costs or, for the same head there will be greater flow carrying capacity than for the equivalent Iplex PVC-U or PVC-M pipe. These advantages can be summarised as follows:

| Features | Benefits |
|---|--|
| PRESSURE CLASS Only two pressure classes per diameter Series | Simplifies pipe selection. |
| DIAMETERS Series 1 Diameters Series 2 Diameters | Compatible OD size with all Series 1 PVC-U and PVC-M water mains in current use. Compatible OD size with all Series 2 PVC-U and PVC-M watermains in current use, and the majority of AC/CI/DI dimension water mains in use. |
| IMPACT STRENGTH Higher Impact strength, toughness and ductility compared with Iplex uPVC pressure pipe (higher impact mass, and test conducted at zero Deg C) | Improved resistance to accidental impact during handling and installation. |
| FLOW CAPACITY Increased internal diameter and flow capacity | Has a significantly larger bore and associated higher flow capacity compared with Iplex PVC-U and PVC-M of the same Series, and equivalent or similar PN class and diameter. |
| SEAL RING LOCKED IN POSITION Factory fitted EPDM jointing seal ring "locked in the socket" with bonded blue coloured polypropylene retaining element | Eliminates potential seal ring displacement during joint assembly. |
| PIPE STIFFNESS | Pipe stiffness has been optimised to withstand both radial and axial loadings, together with internal vacuum in normal buried applications. |
| FATIGUE RESISTANCE | Provides extended fatigue resistance when designed according to PIPA Fatigue guidelines |
| DURABILITY Excellent internal/external corrosion resistance | Normal pipe asset design life of at least 100 years for Principal Watermains and Principal Pressure sewer pipelines, in accordance with relevant WSAA Codes. (WSA 02 and WSA 03) |
| LIGHT WEIGHT PIPE Apollo is lighter in weight than Iplex PVC-U or PVC-M of the same OD size and similar pressure class | Relative improvements in ease and cost of transportation, handling and installation |



Sustainability

Iplex Apollo™ PVC-O, is a sustainable infrastructure pressure pipeline asset.

It has low Embodied Energy, can utilise re-processable PVC from its manufacture, and is fully recyclable at the end of its service life.

Apollo's light weight requires relatively less non-renewable energy (eg ; diesel) during transportation. Light weight also means significantly more length of pipes per tonne of raw material can be produced, compared with almost any other pressure pipe of similar diameter and pressure class

Apollo has no additives containing toxic heavy metal compounds, such as lead based materials. This actively prevents more of these compounds entering the environment, and positively reduces industry demand for these compounds, upstream of the manufacturing process.

Apollo manufacture produces less greenhouse gases, than for traditional non-plastic pressure pipe manufacture. Recycled cooling water resources are used during production.

Apollo is chemically inert. There is no corrosion or chemical or gas emissions during its normal long service life as a public watermain or sewer.

Apollo is also extremely durable, meaning that the one-off energy consumption in manufacture to create the pipe asset, is only required to be used once, possibly up to every 100 years if installed and operated according to the relevant codes and standards.

Refer also to the PIPA website

www.pipa.com.au/environment

Embodied Energy

Construction industries are starting to embrace concepts of Life Cycle Analysis (LCA) and Whole of life Costing (WOLC). Embodied Energy Analysis (EEA) is a method of comparison of the total energy used to manufacture and install different materials.

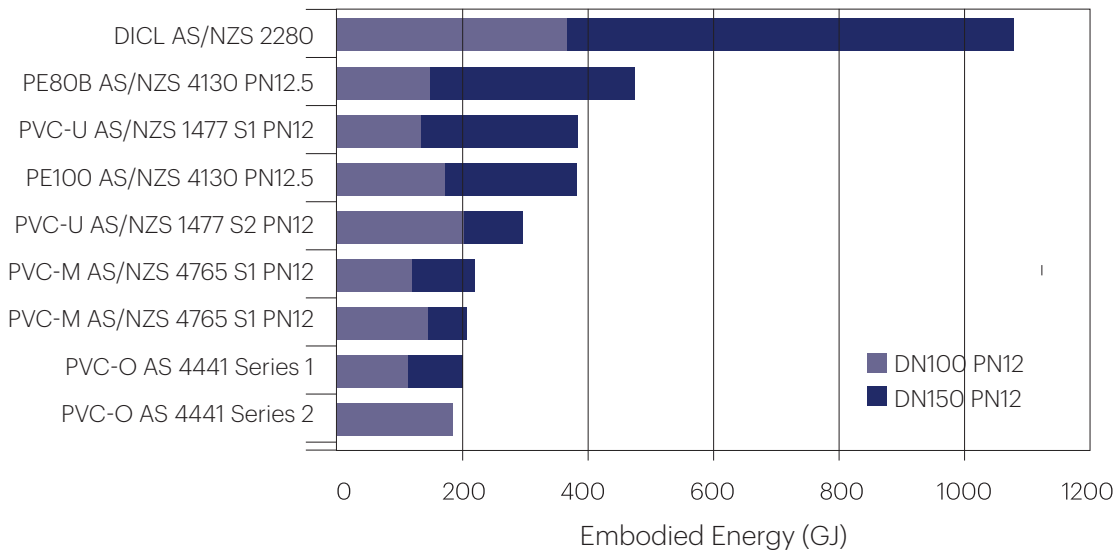
The manufacture of various pipes utilises different processes and materials, with differing energy requirements. Identifying how much total energy is needed, should account for the direct energy needs of the actual manufacturing process, as well as the indirect energy that comes from all the associated processes that contribute to creating a pipe.

This energy is called Embodied Energy, and can be used to determine the overall energy impact of a particular piping system.

The study by CSIRO in Australia “Piping Systems Embodied Energy Analysis” M.D. Ambrose, G.D. Salomonsson and S. Burn (2002) has demonstrated the significant reduction in embodied energy for PVC-O pipes compared to other pipe materials, based upon the same hydraulic performance conditions.

Example of Embodied Energy Comparison

Chart based on Scenario 1 Figure 2 for PVC-O pipe, refer M.D. Ambrose, G.D. Salomonsson and S. Burn (2002) “Piping Systems Embodied Energy analysis”



Note: This graph arises from a report carried out for a manufacturer of PVC-O pipe and is not a report of tests conducted on Iplex Apollo™. It is included to illustrate the possible capability of PVC-O product generically. As this test was not conducted by or for Iplex Pipelines, Iplex accepts no responsibility for its accuracy.

Renewable Energy and Recycling

Renewable Energy

The manufacturing process for Apollo™ pipe in New Zealand, uses electrical energy, including that from major wind farms located near Iplex's production site in Palmerston North, geothermal generation and hydro-electric sources.

Recycling

Iplex Apollo can utilise re-processable PVC material from the PVC-O process, as permitted by the manufacturing Standard.

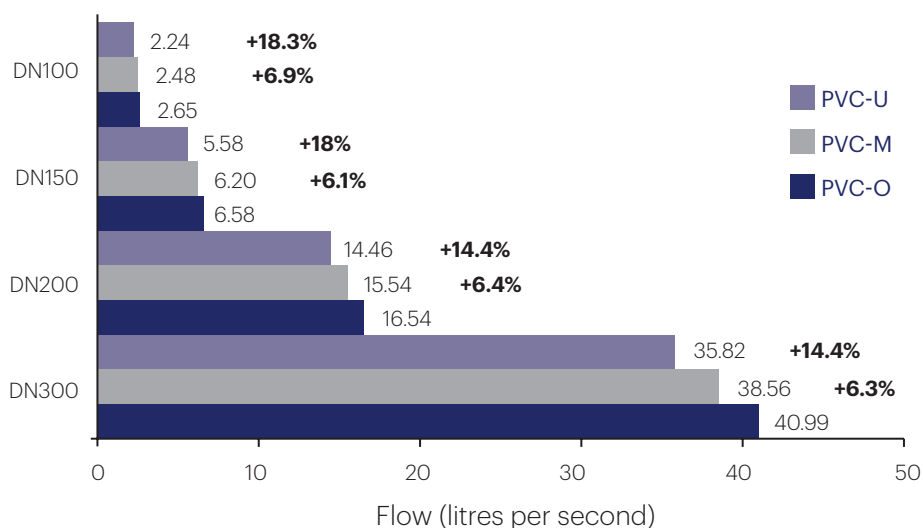
Processes and methods exist in New Zealand for collection and recycling of thoroughly cleaned and separated PVC pipe offcuts from the market place. Iplex Apollo PVC-O material is 100% recyclable at the end of its long service life.



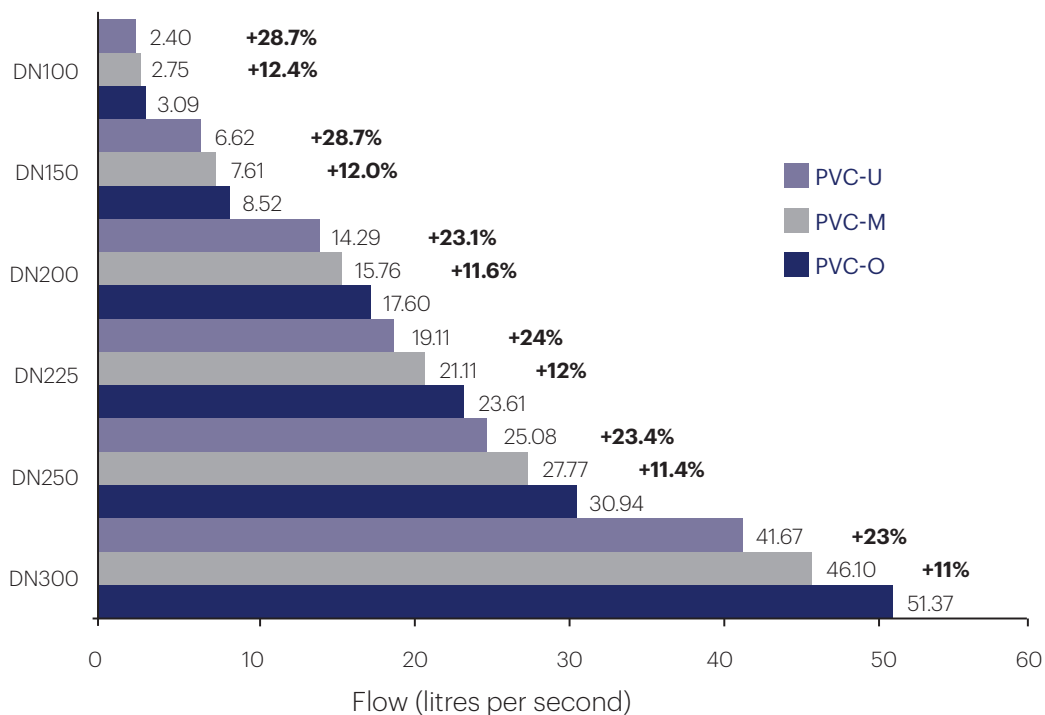
Performance – Flow Comparison

Iplex Apollo Flow Rate Comparison
with Iplex PVC-U and PVC-M*

Apollo Series 1 (PN12.5/PN10) versus PVC-U (PN12) and PVC-M (PN12)



ApolloBlue Series 2 (PN16/PN12.5) versus PVC-U (PN16) and PVC-M (PN16)

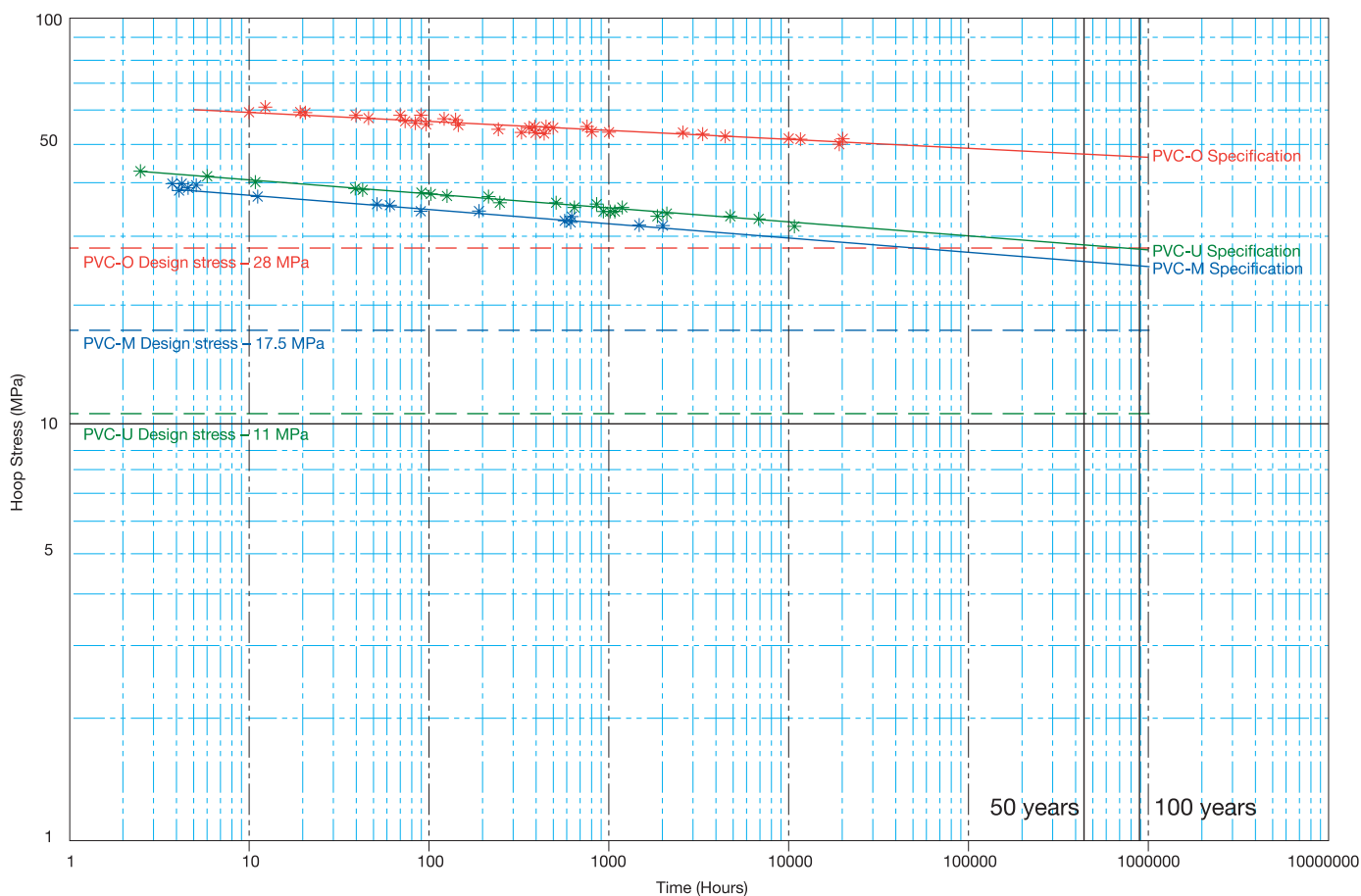


*Based on mean pipe internal diameters and hydraulic gradient (i) - 0.001
Flow rate percentages compare Iplex PVC-U or PVC-M against Apollo PVC-O.

Performance – Tensile Strength

The long-term hydrostatic design stress of Apollo PVC-O is significantly greater than either Iplex PVC-M or Iplex PVC-U. This superior strength allows Apollo to be manufactured with a larger bore for a similar pressure class.

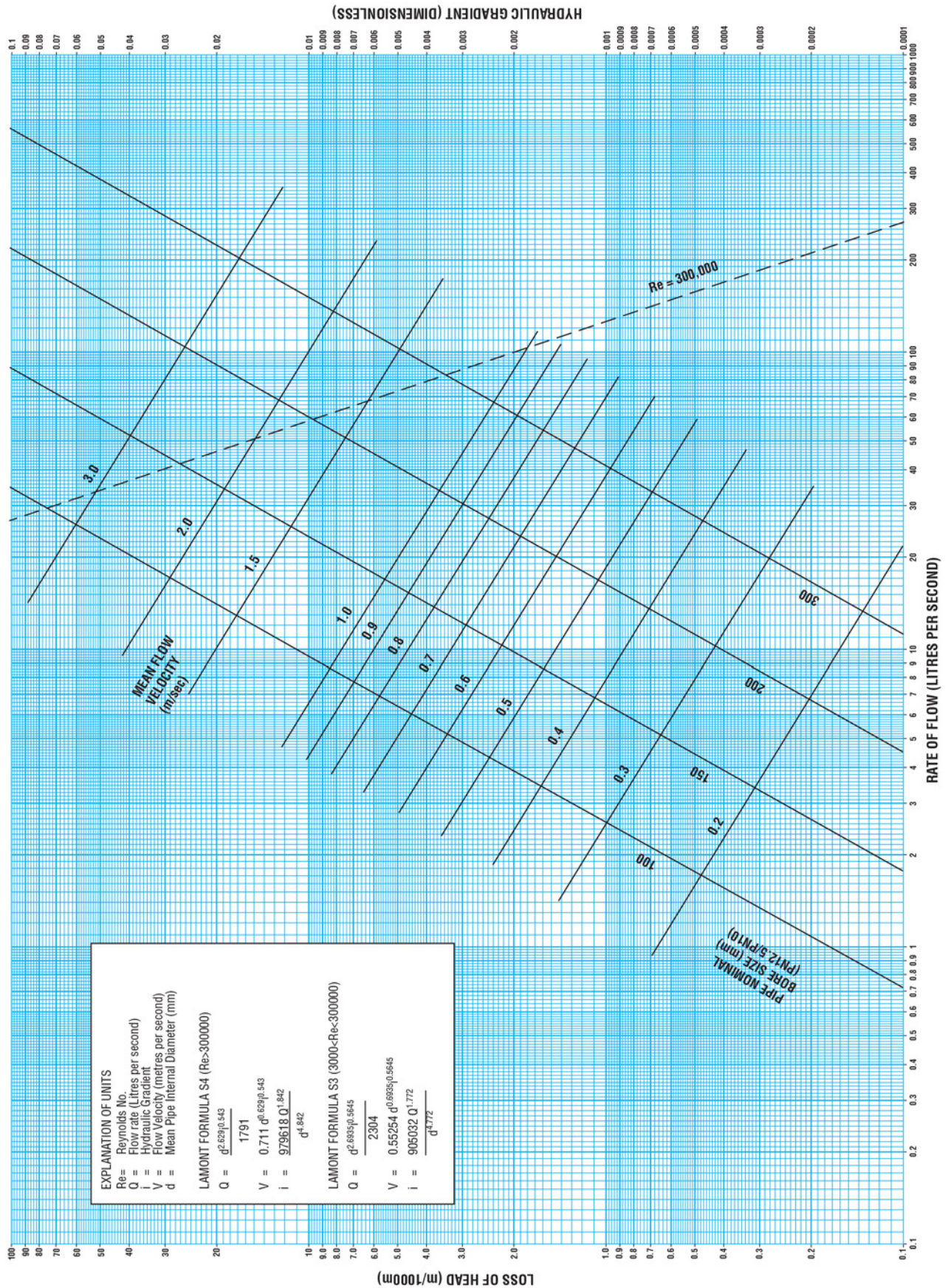
Stress Regression Lines PVC-O, PVC-U, PVC-M



The long-term hydrostatic design stress of Apollo is derived from long-term stress regression analysis and using the design coefficient (1.6) nominated in AS/NZS 4441. The stress regression lines for Apollo PVC-O compared with Iplex PVC-U and Iplex PVC-M are shown in the graph above.

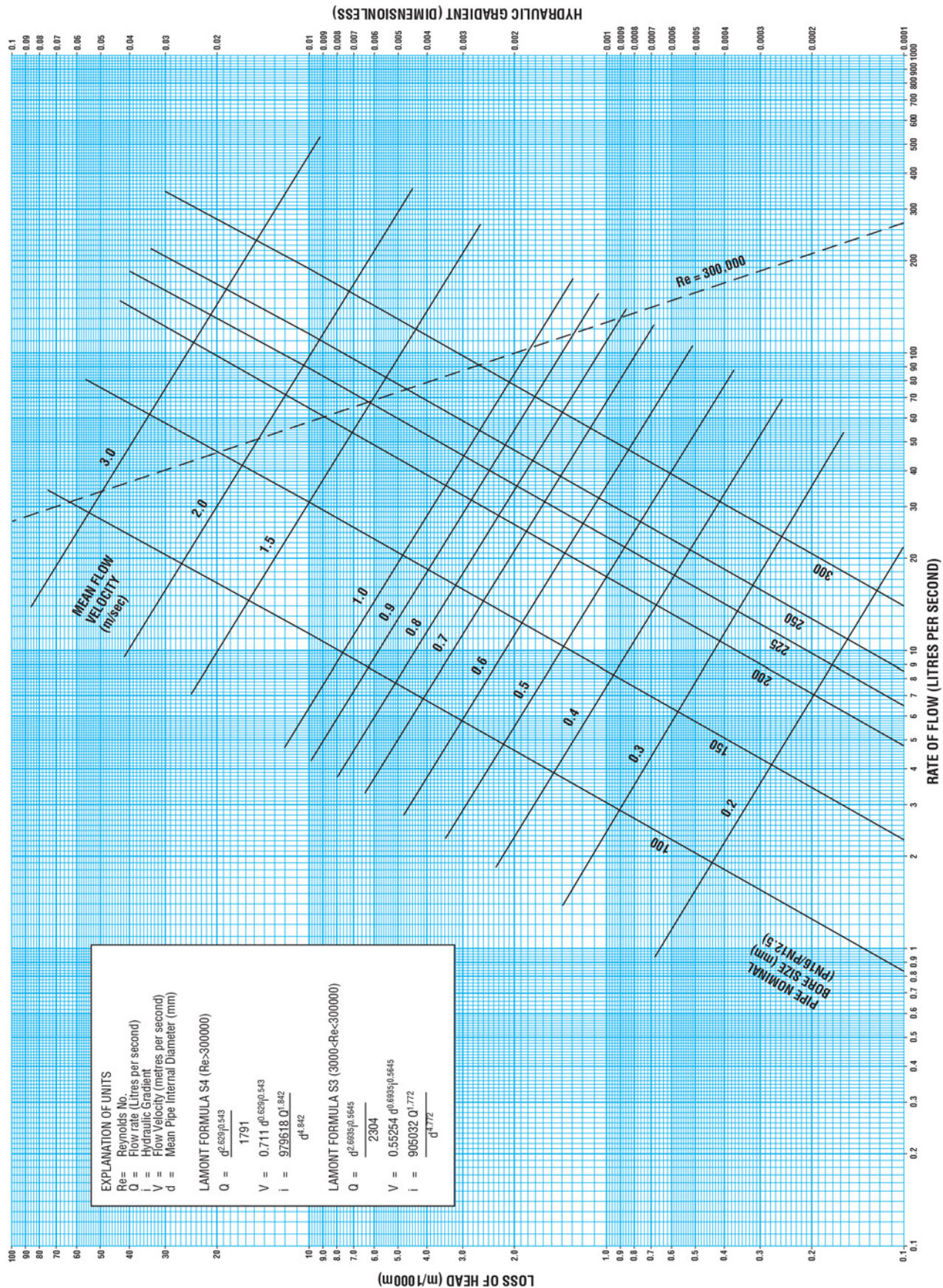
Headloss Chart – Apollo Series 1

Apollo Series 1 PN12.5 (Design MRS40) and PN10 (Design MRS31.5)



Headloss Chart – ApolloBlue Series 2

ApolloBlue CIOD/DI equivalent diameters (Series 2) PN16 (Design MRS45) and PN12.5 (Design MRS35.5)



Fatigue Performance

Fatigue design

Apollo™ pipelines can be designed to provide long-term fatigue performance under cyclical pressures. The designer should take account of the frequency of pressure fluctuations during the life of the pipeline, (ie number of pressure cycles and the size of each pressure variation).

The amplitude of the pressure change between the maximum and minimum steady state operating pressures plus water hammer effects, when divided by the fatigue cycle factor given in the table below should not exceed the nominal class (PN) pressure rating of the pipeline.

Fatigue load factors for different PVC materials

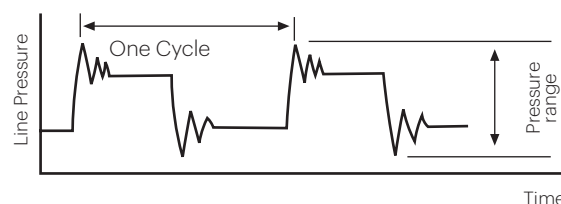
| Total Cycles | Approx. No. Cycles / day for 100y life | Fatigue Cycle Factors, f | | |
|--------------|--|--------------------------|-------|-------|
| | | PVC-U | PVC-M | PVC-O |
| 26,400 | 1 | 1 | 1 | 1 |
| 100,000 | 3 | 1 | 0.67 | 0.75 |
| 200,000 | 5.5 | 0.81 | 0.54 | 0.66 |
| 500,000 | 14 | 0.62 | 0.41 | 0.56 |
| 1,000,000 | 27 | 0.50 | 0.33 | 0.49 |
| 2,500,000 | 82 | 0.38 | 0.25 | 0.41 |
| 5,000,000 | 137 | 0.38 | 0.25 | 0.41 |
| 10,000,000 | 274 | 0.38 | 0.25 | 0.41 |

In practice the pressure changes in water reticulation systems are seldom of sufficient amplitude and frequency for fatigue to affect pipe class selection, but they can be an important consideration for sewer rising mains*. For practical purposes the pressure range will be the difference in the hydraulic gradients for when the pump is running and when stopped.

The frequency is defined as the number of combined pump start and stop cycles. If an allowance is considered necessary to allow for attenuation of water hammer oscillations, the frequency can then be taken as twice the number of start/stop cycles. (It can be shown mathematically that this is appropriate for the exponential decay typical of pressure surge oscillations.)



*DN 200 S1 Apollo pipe used for a pressure sewer rising main in Kaiapoi – this PVC-O pipeline endured undamaged, the major Christchurch earthquake of 2011.



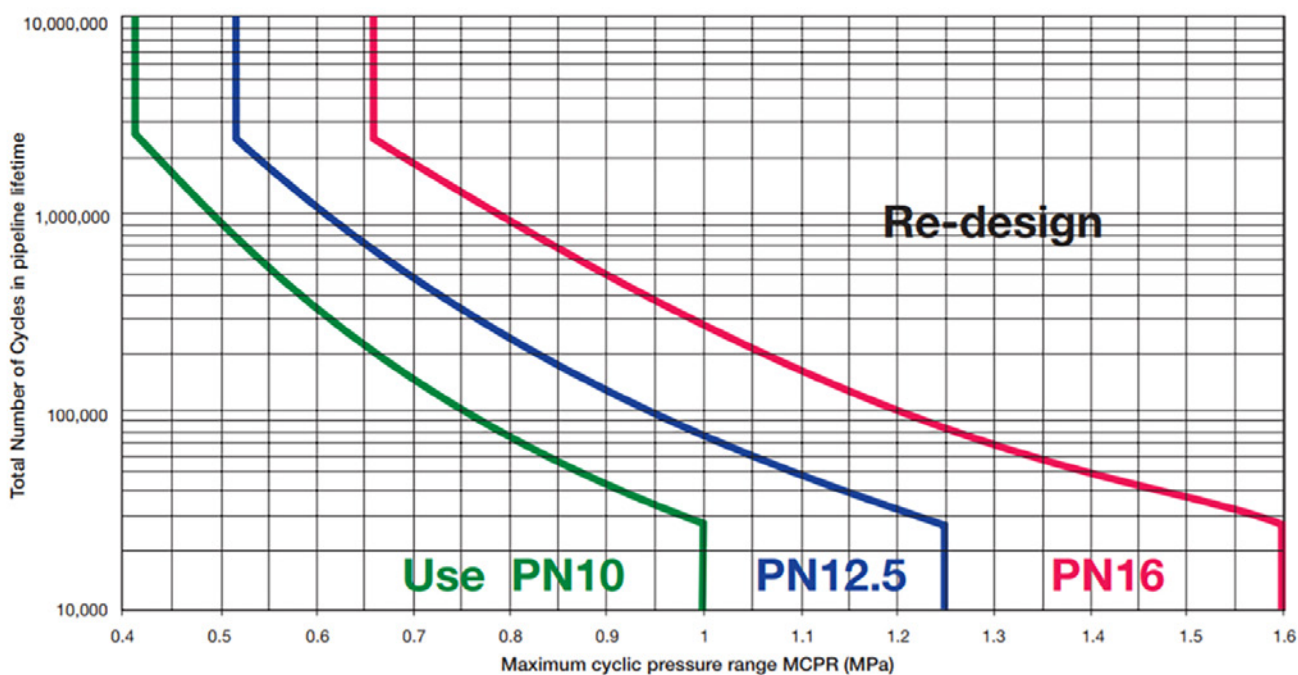
Designers are strongly recommended to refer to PIPA Industry Guideline POP101 – PVC Pressure Pipes Design For Dynamic Stresses for more complete information. www.pipa.com.au

Fatigue Performance and Water Hammer Effects

Procedure

To select the appropriate pipe class for fatigue loading, the following procedure should be adopted:

1. Estimate the likely pressure range, ΔP , i.e., the maximum pressure minus the minimum pressure.
2. Estimate the frequency or the number of cycles per day that are expected to occur.
3. Determine the required service life and calculate the total number of cycles which will occur in the pipe lifetime.
4. Using the fatigue load factors table on the previous page or the chart below, find the fatigue cycle factor, f , for PVC and the number of cycles.
5. Divide the pressure range by the fatigue cycle factor to obtain an equivalent operating pressure.
6. Use the equivalent operating pressure to determine the class of pipe required.



Water hammer surges and cyclical effects

Water hammer effects are considerably reduced in thermoplastic materials including Apollo™ when compared with ductile iron and steel due to their much lower modulus of elasticity. Typical values for celerities for Apollo™ and DI are shown in the table opposite.

For more information please contact the Iplex Technical Services Team on freephone: 0800 800 262.

Water hammer celerity comparison (at 20°C)

| Material | Approximate Celerity (m/s) |
|----------|----------------------------|
| PVC-O | 340 |
| DI | 1150 |

Temperature Conditions and Thermal Re-rating

Apollo™ pipes are suitable for service temperatures between 0°C and 50°C. For temperatures above 20°C, provision must be made for pressure re-rating in accordance with the table opposite. These re-rating factors are the same as for PVC-M or PVC-U.

Chemical Resistance

Apollo PVC-O pipe has excellent resistance to a wide range of chemical reagents. Please contact the Technical Services Team on freephone: 0800 800 262 for specific information on chemical resistance performance.

Negative Pressure Effects

Calculated using Timoshenko's relationship, and allowing for Poisson's effect.

$$P_{CR} = \frac{2.E}{1-\nu^2} \times \left[\frac{t}{D-t} \right]^3$$

Where

P_{CR} = critical buckling pressure (MPa)

E = short term Flexural Ring Modulus = 4000 MPa

ν = Poissons Ratio = 0.38

D = Pipe Outside Diameter (mm)

t = Pipe wall section (mm)

| Critical buckling Pressure, P_{CR} , (MPa), for Short term loading at 20°C | | | | |
|---|------|------|------|------|
| APOLLO PVC-O DESIGN CLASS | | | | |
| Design Class | 315 | 355 | 400 | 450 |
| P_{CR} | 0.14 | 0.20 | 0.14 | 0.20 |

Thermal re-rating factors

| Maximum Service Temperature (°C) | Multiplication Factor For Pressure Re-rating |
|----------------------------------|--|
| 20 | 1.00 |
| 25 | 0.94 |
| 30 | 0.87 |
| 35 | 0.78 |
| 40 | 0.70 |
| 45 | 0.64 |
| 50 | 0.58 |



Installing a DN 150 S2 Apollo PVC-O Sewer Rising Main near Oakura, Taranaki.

Ductile Iron Fittings

Service Connections

Iplex recommends the use of PVC compatible, full circle supported tapping bands with Apollo pipe. These include Milnes Gunmetal, Crevet Taptite or other tapping bands manufactured to AS/NZS 4793 "Mechanical Tapping Bands for Water Works Purposes". Either O or V type tapping band seals are suitable for use with Apollo.

"Universal" tapping bands that use U-bolt support straps have been found to be inadequate and are not recommended.

Tapping bands must be installed centrally positioned over the drilled service hole. **This hole should be drilled using a fine-tooth hole saw.**

Fittings

Iplex recommends the use of ductile iron socketed fittings manufactured to AS/NZS2280 :2014 "Ductile Iron pipes and fittings", and compliant with Table 3.1 "of this Standard – "fittings with plastics pipes" for use with any Iplex PVC pressure pipe, including Apollo™ PVC-O.

Appropriate Series 1 "metric" OD transition rubber rings may be used in conjunction with PVC-compatible Series 2 ductile iron fittings. Socket spacers may be required in some fitting brands with Series 1 pipe to centrally locate and support the pipe. Iplex recommends you contact your fitting supplier for specific advice on the need for socket spacers.

Ductile iron fittings require suitable corrosion protection. Iplex recommends all fittings to be coated with a polymeric coating applied in accordance with AS/NZS4158 - "Thermal Bonded Polymeric Coatings" and fitted with stainless steel nuts, bolts and washers.

Iplex recommends the use of unrestrained mechanical couplings manufactured to AS/NZS 4998 "Unrestrained Mechanical Couplings" for Water Works Purposes.

Solvent Cement Joints

Solvent Cement Joints have been used successfully between Apollo PVC-O Series 1 pipe and conventional PVC-U Series 1 solvent weld joint fittings, utilising the Iplex Novakey Brand pressure solvent cement and cleaner primer system.



Installing a Milnes gunmetal tapping saddle and UPT ferrule with a Plasson lateral adapter, on DN 150 S2 PN 12.5 Apollo PVC-O pipe.



Ductile iron socketed bend and AVK flange adapters being installed on a DN 250 S2 PN 16 Apollo PVC-O watermain near Nelson.

Refer to the Iplex Installation Guide "How I Solvent Cement Joint PVC Pipes".

Installation and Pressure Testing

Installation methods for Apollo pipes are the same as those used for Iplex PVC-U and PVC-M pipes.

Buried pipe installation should generally be in accordance with the following standards:

General Installation

AS / NZS 2032, "Installation of PVC pipe systems"

Buried Structural Design

AS / NZS 2566 Part 1 and Supplement 1 "Buried Flexible Pipelines – Structural Design"

Detailed Installation and Site Pressure Testing AS / NZS 2566 Part 2 "Installation"

Site pressure testing

Refer to the Iplex Installation Guide "How I Field Test PVC Pipelines".



Assembling a joint on DN 150 S2 PN 16 Apollo PVC-O in Wellington City.



Installation, Bedding and Backfill

Bedding particle size

Bedding material in direct contact with the pipe, including directly under, alongside and directly above the pipe must be compactible, non-cohesive material, not exceeding 20mm maximum particle size. This may include approved imported aggregate or approved selected screened as-dug material, compliant to the Contract Specification.

Backfill materials

Trench backfill material may include approved imported compactible aggregate, or other approved selected as-dug material, compliant to the Contract Specification

Backfill compaction

As with any buried flexible pipe, including any type of PVC or PE pipe, compaction of the backfill under and alongside the pipe barrel is important to ensure good structural performance of the backfill and also of the completed pipeline.

The correct sequence of backfill actions includes placement and compaction of the bedding, under the pipe and secondly, beside and surrounding the pipe barrel, BEFORE placement and compaction of trench backfill above the bedding zone

(Refer this picture of a DN 200 S2 PN 16 Apollo trunk watermain, being installed south of Oamaru, for the correct installation sequence with PVC pipe)..

Trench backfill placement and compaction ABOVE the bedding zone

Bedding placement and compaction ABOVE the pipe

Bedding placement and compaction BESIDE the pipe

Bedding placement and compaction UNDER the pipe



Site handling of light weight DN 250 S2 PN 16 Apollo in 6m lengths, near Nelson.



How to specify Apollo PVC-O Pipe and Installation

Iplex Apollo and ApolloBlue pressure pipe should be specified as follows, for inclusion in project Tender Documents and Local Authority engineering specifications.

Pipe Identification - Series 1 PN 12.5

Iplex Apollo Bi-axially-orientated PVC (PVC-O) pressure pipe, DN...(100 / 150 / 200 / 300), Pressure class PN 12.5, Design Material Class 400, Design Coefficient 1.6, conforming to AS / NZS 4441, coloured...(white = potable water / raw water / industrial/ pressure sewer*, purple = recycled water, cream = pressure sewer).

Pipe Identification - Series 1 PN 10

Iplex Apollo Bi-axially-orientated PVC (PVC-O) pressure pipe, DN...(100 / 150 / 200 / 300), Pressure class PN 10, Design Material Class 315, Design Coefficient 1.6, conforming to AS / NZS 4441, coloured...(white = potable water / raw water / industrial / pressure sewer*, purple = recycled water, cream = pressure sewer).

Pipe Identification - Series 2 PN 16 DI OD compatible

Iplex ApolloBLUE Bi-axially-orientated PVC (PVC-O) pressure pipe, DN...(100 / 150 / 200 / 225 / 250 / 300), Pressure class PN 16, Design Material Class 450, Design Coefficient 1.6, conforming to AS / NZS 4441, coloured...(blue = potable water / raw water / industrial, purple = recycled water, cream = pressure sewer).

Pipe Identification - Series 2 PN 12.5 DI OD compatible

Iplex ApolloBLUE Bi-axially-orientated PVC (PVC-O) pressure pipe, DN...(100 / 150 / 200 / 225 / 250 / 300), Pressure class PN 12.5, Design Material Class 355, Design Coefficient 1.6, conforming to AS / NZS 4441, coloured...(blue = potable water / raw water / industrial, purple = recycled water, cream = pressure sewer).

*White colour has been widely accepted and used for PVC sewer rising mains in New Zealand, when accompanied by appropriate identification tape marking above the pipe. Cream is another option for PVC-O pressure sewers, in the Standard. Iplex do not recommend blue for sewer applications, for obvious asset identification reasons.

Pipe Installation

- General Installation
AS / NZS 2032, "Installation of PVC pipe systems"
- Buried Structural Design
AS / NZS 2566 Part 1 and Supplement 1 "Buried Flexible Pipelines – Structural Design"
- Detailed installation and on-site Testing
AS / NZS 2566 Part 2 "Installation"

Site Pressure Testing

On site pressure testing of pressure pipes to be in accordance with AS / NZS 2566 Part 2, Appendix M, including sections M1, M2, M3 and M4. The recommended test pressure should not be less than the maximum design operating pressure, and at the same time not exceed 1.25 times the pipe pressure rating (PN) at any point along the line.

Refer to the Iplex Installation Guide "How I Field Test PVC Pipelines".



Site handling of light weight Apollo DN300 S1 PN12.5 in 6m lengths, Timaru city.

How to order Apollo

You can order Apollo PVC-O pipe products using the Iplex Apollo product codes below.

| Nominal Size | Product Code | Description | Pressure PN Bar | Effective Pipe Length (m)* |
|--|-------------------------|--|-----------------|----------------------------|
| APOLLO Series 1 Pipe | | | | |
| DN100 | Z880.100PN10.6 | Apollo™ PVC-O Pressure Pipe | 10 | 6.0 |
| DN150 | Z880.150PN10.6 | Apollo™ PVC-O Pressure Pipe | 10 | 6.0 |
| DN200 | Z880.1200PN10.6 | Apollo™ PVC-O Pressure Pipe | 10 | 6.0 |
| DN300 | Z880.300PN10.6 | Apollo™ PVC-O Pressure Pipe | 10 | 6.0 |
| | | | | |
| DN100 | Z880.100PN12.5.6 | Apollo™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| DN150 | Z880.150PN12.5.6 | Apollo™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| DN200 | Z880.200PN12.5.6 | Apollo™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| DN300 | Z880.300PN12.5.6 | Apollo™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| APOLLOBLUE Series 2 Ductile Iron Compatible | | | | |
| DN100 | 1880.100PN12.5.6 | ApolloBlue™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| DN150 | 1880.150PN12.5.6 | ApolloBlue™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| DN200 | 1880.200PN12.5.6 | ApolloBlue™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| *DN225 | 1880.225PN12.5.6 | ApolloBlue™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| DN250 | 1880.250PN12.5.6 | ApolloBlue™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| *DN300 | 1880.300PN12.5.6 | ApolloBlue™ PVC-O Pressure Pipe | 12.5 | 6.0 |
| | | | | |
| DN100 | 1880.100PN16.6 | ApolloBlue™ PVC-O Pressure Pipe | 16 | 6.0 |
| DN150 | 1880.150PN16.6 | ApolloBlue™ PVC-O Pressure Pipe | 16 | 6.0 |
| DN200 | 1880.200PN16.6 | ApolloBlue™ PVC-O Pressure Pipe | 16 | 6.0 |
| *DN225 | 1880.225PN16.6 | ApolloBlue™ PVC-O Pressure Pipe | 16 | 6.0 |
| DN250 | 1880.250PN16.6 | ApolloBlue™ PVC-O Pressure Pipe | 16 | 6.0 |
| *DN300 | 1880.300PN16.6 | ApolloBlue™ PVC-O Pressure Pipe | 16 | 6.0 |

***Subject to minimum order quantity and availability.**

Explanation of Product Code

e.g. Z880.150 PN12.5.6

Z880 = Series 1 PVC-O with BlueSeal Ring Joint

150 = Nominal bore size

PN12.5 = Pressure class in Bar

6 = 6 metre effective pipe length

e.g. 1880.150 PN12.5.6

1880 = Series 2 PVC-O with BlueSeal Ring Joint

150 = Nominal bore size

PN12.5 = Pressure class in Bar

6 = 6 metre effective pipe length

* Apollo PVC-O is normally supplied only in 6 metre effective lengths. Apollo can be supplied in maximum 6.5 metre lengths for special projects, strictly subject to prior agreement and minimum economic order quantities.

Iplex – The Company

Iplex Pipelines is a major Australasian manufacturer and distributor of a wide range of plastics-based pipeline systems for the plumbing, infrastructure, mining, irrigation and cable conduit markets.

Iplex Pipelines operates as part of the Fletcher Building global community with more than 20,000 people across 40 countries. Fletcher Building is an integrated manufacturer and distributor of infrastructure and building products, whilst including subsidiaries Fletcher Construction and Fletcher Residential, New Zealand's leading general contractor and residential home builder respectively.

Iplex is well placed for accessing the latest overseas products, technologies and service initiatives and has become a recognised leader in plastics pipes and associated fittings together with related water engineering expertise.

Manufacturing and Standards

Iplex Pipelines operates modern manufacturing facilities in New Zealand and every mainland Australian state.

All factories operate under stringent requirements of local equivalents to International Standard ISO 9001.

Where applicable Iplex products also have StandardsMark third party quality assurance accreditation.

Sales and marketing teams are backed by advanced technical, communication and distribution systems to ensure prompt and effective service.

Products and Brands

Iplex products and brand names in New Zealand include APOLLO PVC-O pressure pipes, RHINO PVC-M pressure pipes, NOVAKEY PVC-U pressure pipes and fittings, BLUE BRUTE PVC-U pressure pipes, NOVADRAIN DWV pipes and fittings, POLIplex polyethylene pressure pipes, RESTRAIN drillable PVC-U gravity sewer pipe, NEXUS subsoil drainage pipe and fittings and FARMTUFF culvert pipe.

Markets and applications for the Iplex product range in New Zealand include water reticulation and transmission mains, sewerage reticulation and carrier mains, stormwater drainage, trenchless pipe systems, chemical and process water circuits, slurry and tailings pipe systems, drain, waste and vent plumbing, domestic hot and cold water plumbing, Subsoil drainage systems, turf watering, stock watering, horticultural irrigation systems and broad acre irrigation systems.

Apollo PVC-O

Apollo PVC-O pipes represent the latest in PVC manufacturing and technology. Apollo is the result of sharing technology developed by Wavin UK. The strength, ductility and overall performance of Apollo pipes represent significant advances compared with older watermain pipes.



Iplex Pipelines manufacturing plant and distribution hub in Palmerston North City, New Zealand.

Product Limitations

Apollo and ApolloBlue PVC-O pressure pipes should not be used:

- With aromatic and chlorinated hydrocarbons, ketones, esters and ethers
- At continuous service temperature above 50°C
- Where provision for temperature derating has not been made above 20°C
- With compressed air
- Without adequate support to the pipe both in above ground and below ground applications
- Without adequate thrust support
- Where depth of cover is less than:
 - 300mm where pipeline is not subject to vehicular loadings
 - 450mm where pipeline is subject to vehicular loadings not in roadways
 - 600mm where pipeline is subject to vehicular loading in sealed roadways
 - 750mm where pipeline is subject to vehicular loading in unsealed roadways
 - 750mm where pipeline is subject to construction equipment loadings
- Without provision for fatigue design where appropriate
- Where working pressure plus surge/cyclic pressure exceeds the nominated pressure performance rating of the pipe
- When exposed to direct sunlight above ground for long-term applications without protection. This protection may include pale coloured UV resistant paint systems or physical shading

Important Disclaimer

The information, opinions, advice and recommendations contained in this publication are put forward with the main objective of providing a better understanding of technical matters associated with pipeline design using Iplex Pipelines. Whilst all reasonable care has been made in ensuring that the information contained in this publication is accurate, this publication should not be used as the only source of information by the reader. Reference should also be made to established textbooks and other published material, and readers should not rely on the information contained in this publication without taking appropriate professional advice for their particular circumstances. Pipes and fittings have been shown as typical configurations, however, in some cases product dimensions may vary or be changed without notice. In all instances, the reader should contact Iplex Pipelines for clarification that the specific product is appropriate for their circumstances. Some photos are illustrative only and may not include Apollo Product. Iplex Pipelines NZ Limited.



More products from Iplex Pipelines

NOVADRAIN

DRAIN WASTE & VENT SYSTEMS

SUPERSTORM™ & STORMFIT

PVC STORMWATER DUCT SYSTEM

NEXUS™ HI-WAY

ROAD DRAINAGE SYSTEM

NOVAKEY™

uPVC PRESSURE SYSTEMS

WHITE & BLUE RHINO™

HIGH IMPACT mPVC PRESSURE PIPE

BLUELINE

MEDIUM DENSITY POLYETHYLENE PIPE

POLIPLEX

POLYETHYLENE PRESSURE PIPE

ALKATHENE™

LOW DENSITY POLYETHYLENE PIPE

NOVATUBE

HORTICULTURAL LATERAL TUBE

GREENLINE, REDLINE™, RURAL BLACK & BLACKLINE

MEDIUM DENSITY POLYETHYLENE PIPE

PLASSON

METRIC COMPRESSION FITTINGS

NEXUS™FLO, NEXUS™COIL, NOVAFLO™ & NOVACOIL

LAND DRAINAGE SYSTEMS

IPLEX EFFLUENT PIPE

MEDIUM DENSITY POLYETHYLENE PIPE

FARMTUFF™ & NEXUS™ CULVERT

CULVERT PIPE

RAINWATER SYSTEMS

SPOUTING & DOWNPIPE

POLIGAS™

POLYETHYLENE GAS SYSTEMS

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