Vinidex Hydro® PVC-M

Modified PVC for Potable Water & Irrigation Applications
Available in Pipe Sizes 100mm to 575mm Series 1 & 2

- Improved Material Performance
- Hydraulic Efficiency
- Light Weight
- System Compatibility

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Quality
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Lic 570
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Introduction

Unplasticised Poly Vinyl Chloride (PVC) has established an enviable reputation as the material of choice for infrastructure applications in both pressure and non- pressure pipelines.

With a service history dating back to the 1930's, industry has recognised the many benefits of PVC, material stability, corrosion resistance, high strength to weight ratio, ease of handling and installation and excellent flow characteristics.

Development in plastics over the last 50 years has been rapid with developments in pipeline systems being at the forefront. The result is an improved PVC material, Modified Poly Vinyl Chloride or PVC-M. PVC-M is manufactured by Vinidex under the trade name Vinidex Hydro®.

Vinidex Hydro® PVC-M extends the proven benefits of PVC pipes with enhancements in fracture behaviour and hydraulic efficiency. Vinidex Hydro PVC-M pipes are manufactured to AS/NZS 4765: Modified PVC (PVC-M) pipes for pressure applications.

Applications

Vinidex Hydro® PVC-M is suitable for pressure applications for potable water, irrigation, fire fighting and general industrial applications in the temperature range 0 to 50° Celsius. Vinidex Hydro® is available in two diameter groups, Series 1 and Series 2, which denote the outside diameter of each group. In general the irrigation industry uses Series 1 and the potable water industry uses Series 2.

Vinidex Hydro® is available in sizes from DN 100 to 575 and pressure classes 6, 9, 12, 15, 16, 18 and 20 dependent on pipe series and diameter.

Material Characteristics

PVC is formed by the combination of chlorine, carbon and hydrogen in the form of polymer chains. PVC-M is formed by the addition of compatible modifying agents to the PVC matrix, forming an alloy rather than a copolymer. The addition of modifying agents increases the ductility while virtually retaining the same material strength.

The modifying agents significantly improve toughness and impact properties with resistance to crack growth a key performance requirement. The change in material matrix gives greater ductile behaviour and thus enables the factor of safety to be lower than PVC. Short and long term tests on Vinidex Hydro® pressure pipes have demonstrated consistently ductile behaviour, particularly in the presence of notches. The reduced factor of safety enables higher allowable stress levels, reduced wall thickness providing greater hydraulic efficiency.

Stabilisers are an integral component of PVC-M manufacture, maintaining thermal stability during the extrusion process. All Vinidex pressure pipes including Vinidex Hydro® PVC-M are manufactured using Calcium Zinc stabilisers.

AS/NZS 4765 details a broad range of material acceptance tests which guarantee achievement of ductile material characteristics.

Benefits

Improved Material Performance

The alloying of PVC with modifying polymers achieves improvement in resistance to cracking. The result is the minimisation of the effect of stress concentrators such as scratches. With a consequent reduction in the factor of safety, higher wall stresses are allowable which lead to reduced wall thickness.

Hydraulic Efficiency

The increased internal diameter for a given external diameter makes Vinidex Hydro® a more efficient conduit than PVC and ductile iron.

Light Weight

PVC is already recognised as the lightest and easiest of pipeline materials to handle.

Vinidex Hydro® further increases this advantage. Depending on size and class, weight savings in excess of 10% over PVC are available.

System Compatibility

Whether supplied in Series 1 for the irrigation industry or Series 2 for the water industry, Vinidex Hydro® is fully compatible with existing pipeline systems with the full range of valves and fittings available.

Product List

Vinidex Hydro® PVC-M Series 1 – SCJ

VX Code	Description				Approx. Mass (kg/length)
17040	100	PN9	SCJ	6m	9
17050	100	PN12	SCJ	6m	19
17085	150	PN9	SCJ	6m	37
17095	150	PN12	SCJ	6m	12
17115	200	PN9	SCJ	6m	24
17125	200	PN12	SCJ	6m	49

Vinidex Hydro® PVC-M Series 1 – RRJ

VX Code	Description				Approx. Mass (kg/length)
17035	100	PN9	RRJ	6m	9
17045	100	PN12	RRJ	6m	12
17080	150	PN9	RRJ	6m	19
17090	150	PN12	RRJ	6m	24
17100	200	PN6	RRJ	6m	31
17110	200	PN9	RRJ	6m	36
17120	200	PN12	RRJ	6m	47
17135	225	PN9	RRJ	6m	46
17140	225	PN12	RRJ	6m	58
17145	250	PN6	RRJ	6m	50
17150	250	PN9	RRJ	6m	56
17155	250	PN12	RRJ	6m	76
17160	300	PN6	RRJ	6m	62
17165	300	PN9	RRJ	6m	69
17170	300	PN12	RRJ	6m	96
17175	375	PN6	RRJ	6m	99
17180	375	PN9	RRJ	6m	115
17174	375	PN12	RRJ	6m	150
17171	450	PN6	RRJ	6m	155
17172	450	PN9	RRJ	6m	188
17173	450	PN12	RRJ	6m	247
17415	500	PN6	RRJ	6m	201
17416	500	PN9	RRJ	6m	236
17417	500	PN12	RRJ	6m	297
17418	575	PN6	RRJ	6m	245
17419	575	PN9	RRJ	6m	296
17420	575	PN12	RRJ	6m	388

Vinidex Hydro® PVC-M Series 2 – RRJ

VX Code	Description				Approx. Mass (kg/length)	Application	Colour
17181	100	12	RRJ	6m	14	Potable Water	Blue
17215	100	12	RRJ	3m	7	Potable Water	Blue
17182	100	16	RRJ	6m	19	Potable Water	Blue
17183	100	18	RRJ	6m	21	Potable Water	Blue
17184	100	20	RRJ	6m	22	Potable Water	Blue
17185	150	12	RRJ	6m	30	Potable Water	Blue
17186	150	16	RRJ	6m	39	Potable Water	Blue
17187	150	18	RRJ	6m	43	Potable Water	Blue
17188	150	20	RRJ	6m	48	Potable Water	Blue
17189	200	12	RRJ	6m	52	Potable Water	Blue
17190	200	16	RRJ	6m	66	Potable Water	Blue
17194	225	16	RRJ	6m	83	Potable Water	Blue
17197	250	12	RRJ	6m	79	Potable Water	Blue
17218	250	12	RRJ	3m	43	Potable Water	Blue
17198	250	16	RRJ	6m	103	Potable Water	Blue
17201	300	12	RRJ	6m	113	Potable Water	Blue
17202	300	16	RRJ	6m	145	Potable Water	Blue
17206	375	9	RRJ	6m	139	Potable Water	Blue
17207	375	12	RRJ	6m	173	Potable Water	Blue
17208	375	16	RRJ	6m	222	Potable Water	Blue
17411	450	6	RRJ	6m	161	Potable Water	Blue
17412	450	9	RRJ	6m	190	Potable Water	Blue
17413	450	12	RRJ	6m	249	Potable Water	Blue
17414	450	16	RRJ	6m	326	Potable Water	Blue
17281	100	12	RRJ	6m	14	Pressure sewer	Cream
17210	100	16	RRJ	6m	18	Pressure sewer	Cream
17217	150	16	RRJ	6m	38	Pressure sewer	Cream
17282	200	12	RRJ	6m	52	Pressure sewer	Cream
17212	200	16	RRJ	6m	66	Pressure sewer	Cream
17285	250	12	RRJ	6m	81	Pressure sewer	Cream
17284	300	12	RRJ	6m	112	Pressure sewer	Cream
17203	300	16	RRJ	6m	146	Pressure sewer	Cream
17199	300	20	RRJ	3m	94	Pressure sewer	Cream
17200	300	20	RRJ	6m	180	Pressure sewer	Cream
17205	375	12	RRJ	3m	91	Pressure sewer	Cream
17384	375	12	RRJ	6m	173	Pressure sewer	Cream

Vinidex Hydro® PVC-M Series 2 – RRJ

VX Code	Description				Approx. Mass (kg/length)	Application	Colour
17204	375	16	RRJ	6m	223	Pressure sewer	Cream
17288	450	16	RRJ	6m	320	Pressure sewer	Cream
17052	100	12	RRJ	6m	14	Recycled Water	Purple
17294	100	16	RRJ	6m	18	Recycled Water	Purple
17179	100	18	RRJ	6m	21	Recycled Water	Purple
17024	100	20	RRJ	6m	22	Recycled Water	Purple
17092	150	12	RRJ	6m	29	Recycled Water	Purple
17223	150	16	RRJ	6m	39	Recycled Water	Purple
17178	150	18	RRJ	6m	43	Recycled Water	Purple
17216	150	20	RRJ	6m	47	Recycled Water	Purple
17103	200	12	RRJ	6m	50	Recycled Water	Purple
17211	200	16	RRJ	6m	66	Recycled Water	Purple
17234	225	16	RRJ	6m	85	Recycled Water	Purple
17104	250	12	RRJ	6m	77	Recycled Water	Purple
17233	300	16	RRJ	6m	150	Recycled Water	Purple
17177	375	12	RRJ	6m	155	Recycled Water	Purple
17209	375	12	RRJ	6m	172	Recycled Water	Purple
17176	450	12	RRJ	6m	249	Recycled Water	Purple

Product Data

Standards and Dimensions

Vinidex Hydro® pipes are manufactured in accordance with AS/NZS 4765 with Standards Mark numbers 2560, 2561, 2562 and 2563.

AS/NZS 4765:2007 provides two manufacturing series relating to the outside diameter of the pipe. Series 1 is ISO compatible outside diameters (mostly metric) and Series 2 is ductile iron compatible outside diameters.

Refer to Table 1 and 2 for dimensional data.In general, the irrigation industry uses Series 1 and the potable water industry uses Series 2. Vinidex Hydro® is available in both Series 1 and 2 to suit these industries.

TABLE 1 – Dimensions for Vinidex Hydro® PVC-M Pipes Series 1

Normal Size DN	Outside Diameter Mean OD		PN6 (mm)		PN9 (mm)		PN12 (mm)	
	Dm min	Dn max	Tmean	ID	Tmean	ID	Tmean	ID
100	114.1	114.5	–	–	3.4	107.5	4.4	105.6
125	140.0	140.4	–	–	4.2	131.9	5.4	129.5
150	160.0	160.5	–	–	4.7	150.9	6.0	148.4
200	225.0	225.6	5.5	214.4	6.4	212.5	8.4	208.6
225	250.0	250.7	6.1	238.2	7.1	236.3	9.2	232.0
250	280.0	280.8	6.7	267.0	7.9	264.6	10.3	259.9
300	315.0	315.9	7.5	300.5	8.8	298.0	11.6	292.4
375	400.0	401.0	9.5	381.5	11.2	378.2	14.6	371.4
450	500.0	501.0	11.8	476.9	13.8	472.9	18.1	464.4
500	560.0	561.0	13.2	534.2	15.5	529.6	20.3	520.0
575	630.0	631.0	14.7	601.1	17.3	596.0	22.8	585.0

TABLE 2 – Dimensions for Vinidex Hydro® PVC-M Pipes Series 2

Normal Size DN	Outside Diameter Mean OD		PN6 (mm)		PN9 (mm)		PN12 (mm)		PN16 (mm)		PN18 (mm)		PN20 (mm)	
	Dm min	Dn max	T mean	ID	T mean	ID	T mean	ID	T mean	ID	T mean	ID	T mean	ID
100	121.7	122.1	-	-	-	-	4.7	112.5	6.1	109.7	6.7	108.6	7.3	107.2
150	177.1	177.6	-	-	-	-	6.6	164.2	8.7	160.1	9.6	158.2	10.6	156.2
200	231.9	232.6	-	-	-	-	8.6	215.2	11.3	209.8	12.5	207.3	13.7	204.8
225	258.9	259.6	-	-	-	-	9.5	240.3	12.6	234.2	13.9	231.5	15.3	228.6
250	285.8	286.6	-	-	-	-	10.5	265.2	13.7	258.8	15.3	255.6	16.9	252.4
300	344.9	345.8	-	-	-	-	12.7	320.1	16.5	312.4	18.4	308.5	20.3	304.7
375	425.7	426.7	10.1	406.1	11.8	402.6	15.6	395.1	19.9	386.4	22.7	380.9	25.0	376.2
450	506.5	507.5	11.9	483.2	14.0	479.1	18.4	470.3	24.2	458.7	26.9	453.2	29.7	447.6

Design

System Life

It is a common misconception that plastics pipes have a design life of 50 years, arising from the use of regression curves and adoption of the 50 year point for classification purposes.

In relation to hydrostatic stress analysis and pipe life, AS/NZS 4765 states the following: "The analysis adopts the 50 years extrapolation point on the regression curve as the reference for design purposes. This is consistent with long standing international practice.

It should not be taken that either –

(a) the pipes weaken with time; or

(b) the predicted life is 50 years

Actual system life is dependent on manufacture, transport, handling, installation, operation, protection from third party damage and other external factors. For water supply applications, the actual life can logically be expected to be well in excess of 100 years before major rehabilitation is required."

Hydraulic

The principles of closed conduit flow and behaviour of fluids is well established. Vinidex recommend the use of the Colebrook-White formula for the analysis of flow parameters for Vinidex Hydro® pipe. A roughness coefficient k = 0.003mm is recommended and all computations are based on water at 20° C.

Additional background information on hydraulic design can be found in the Vinidex Water Supply Manual for PVC Pipe Systems. Computational assistance is available in the Vinidex program "Fluff", which can provide an analysis of a wide range of pipeline materials.

Flow Charts for Vinidex Hydro® Series 1 and Series 2 are shown on pages 7 and 8.

Structural

Under general pressure pipe installation conditions, including under roads, detailed calculations predicting pipe performance are not necessary. Following an extensive study of installed pipe performance, a joint project conducted by the European Plastic Pipe and Fitting Association (TEPPFA) and independent experts concluded that final deflection of pipes was controlled by the settlement of the soil after installation.

Where installation was controlled, or self-compacting granular material was used, pipe deflections were consistently low regardless of installation depth and traffic or other loads.

For unusual conditions, or depths greater than 6 metres, design calculations may be performed in accordance with AS/NZS 2566.1. The structural design aspects of buried flexible pipes to be considered are vertical deflection, ring bending strain and buckling.

Differential pressure conditions between the inside and outside of a pipe can cause a pipe to buckle inwards leading to collapse. Such conditions can arise from high external loading or negative internal pressure transients as a consequence of pipeline operating conditions. A pipes resistance to buckling is directly proportional to ring bending stiffness.

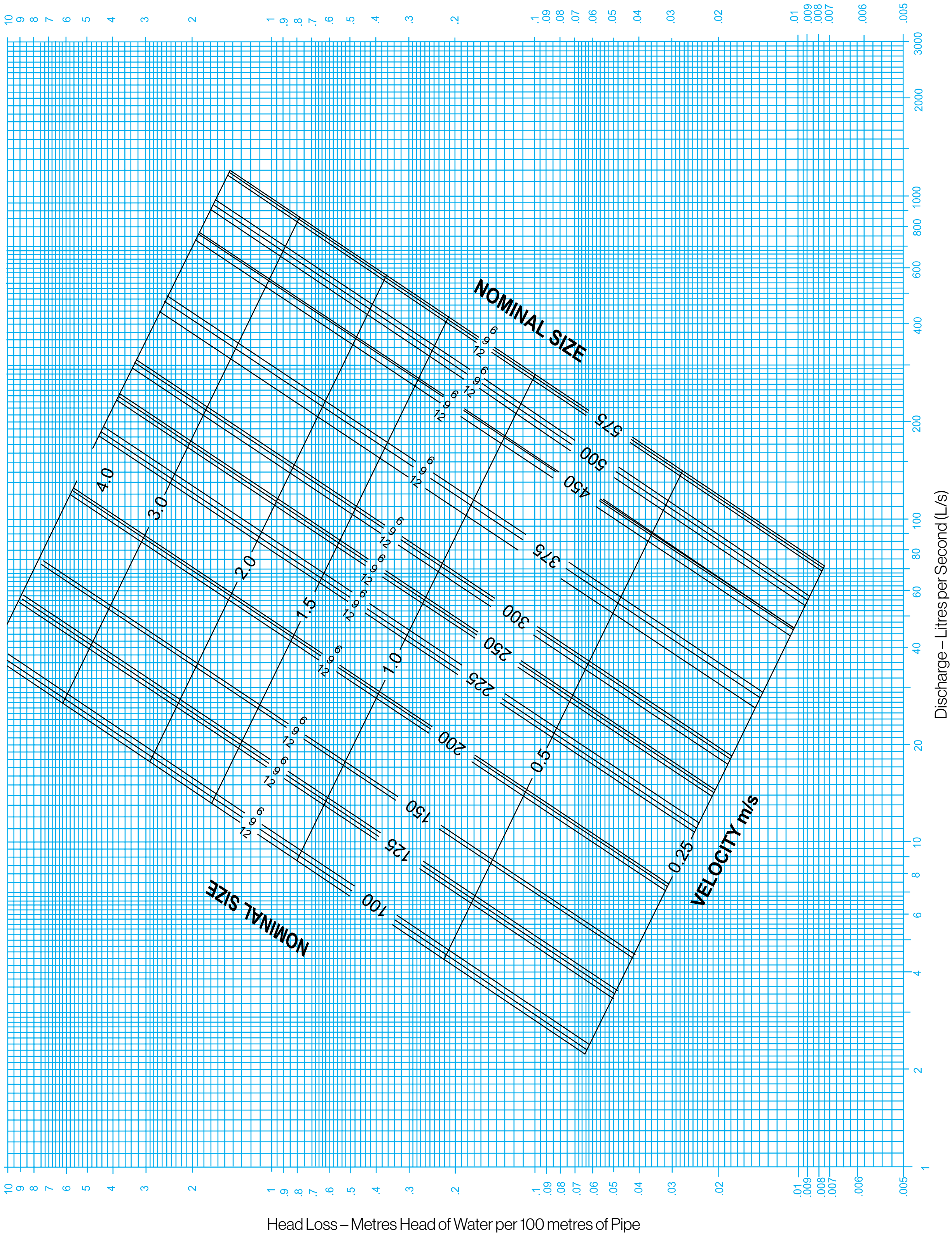
As PVC-M pipes have reduced wall thickness compared to PVC of the same PN rating, the ring bending stiffness is significantly reduced. Consequently the resistance to buckling of PVC-M is also significantly reduced. Designers should be aware of pipeline operating criteria and consult appropriate design material including AS/NZS 2566.1 to ensure the suitability of PVC-M in such applications.

For buried pipes the soil surround provides additional support against buckling providing the minimum cover height exceeds 500mm. Such support can only be realised where the embedment is properly placed and compacted with no voids around the pipe and the embedment cannot subsequently be removed or leached away.

In general where sustained negative pressures or full vacuum conditions are likely to occur, e.g. suction lines, Vinidex recommends that PN 12 pipe or higher be selected based on an appropriate factor of safety against buckling.

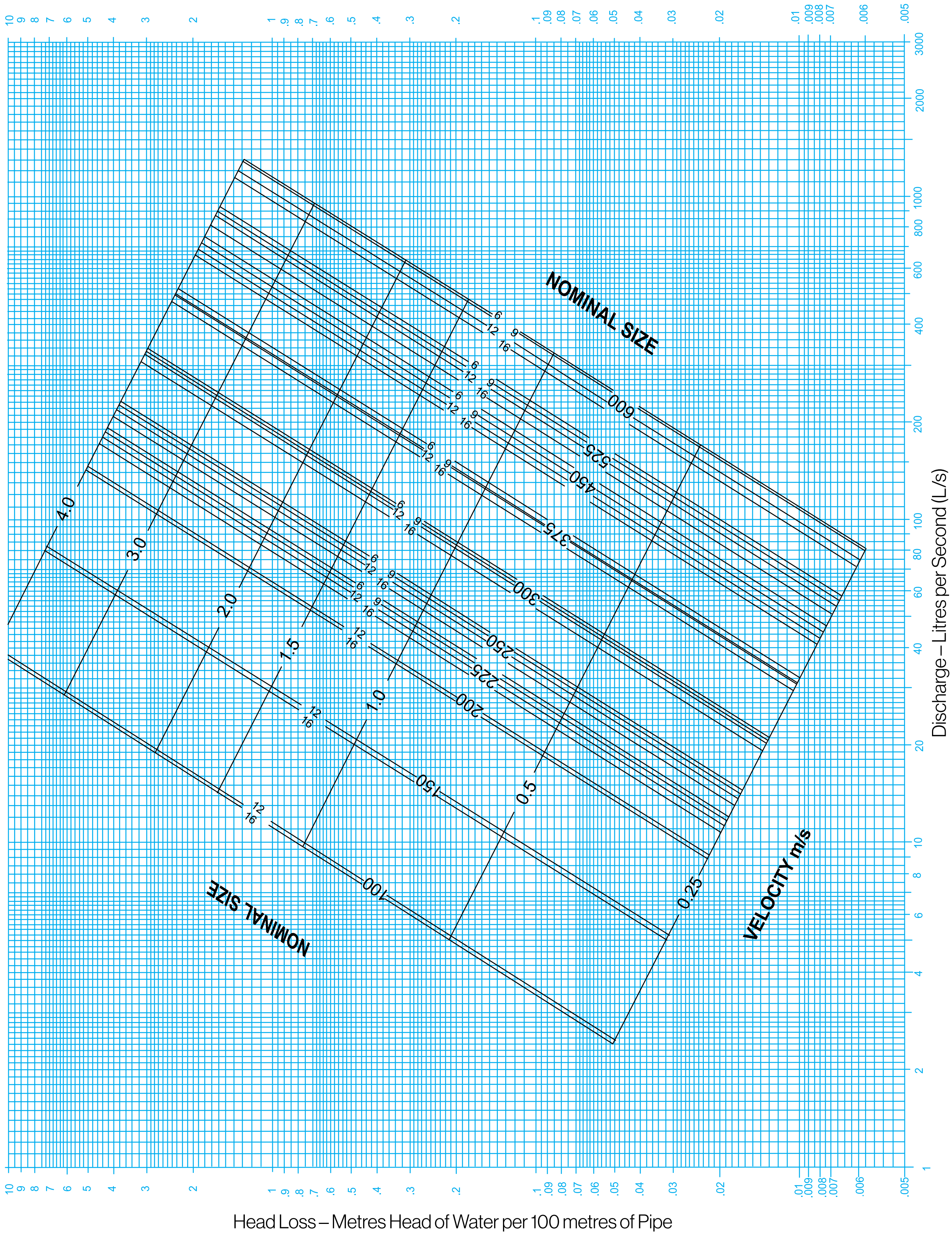
Design

FLOW CHART – Vinidex Hydro® PVC-M Pressure Pipe Series 1 PN6, PN9 and PN12



Design

FLOW CHART – Vinidex Hydro® PVC-M Pressure Pipe Series 2 PN6, PN9, PN12 and PN16



Design

Fatigue

Materials subject to repetitive or cyclic loads can fail at lower stress levels than materials subject to constant load. This is known as fatigue failure. For thermoplastics pipe materials, fatigue only becomes a design parameter when very high numbers of cycles are applied.

The behaviour of thermoplastic materials in cyclic operation conditions has been extensively studied. Vinidex has developed an appropriate design procedure for such applications.

The two design parameters are the magnitude of the pressure range and the frequency of the application, leading to the calculation of the number of cycles applied over the design life of the pipeline. In cases where lifetime cycles exceed 26,000, a higher class of the pipe may be required than indicated by the static or maximum pressure.

Extensive studies into the fatigue behaviour of thermoplastics have been used to establish a relationship between pressure range, defined as the difference between maximum and minimum pressure (see Figure 1) and the number of cycles to failure.

This relationship yields a load factor which is applied to the operating pressure to enable the selection of the appropriate class of pipe.

The approach adopted by Vinidex is conservative recognising that the experimental data demonstrates a degree of scatter. This ensures an appropriate factor of safety given potential changes in the pipeline operating conditions over the life of the pipe and other operational conditions such as installation and maintenance standards.

For simplicity, the pressure range is defined as the maximum pressure minus the minimum pressure including all transients experienced by the system during normal operations as per Figure 1. The effect of accidental conditions such as power failure may be excluded. Figure 1 illustrates the definition of a cycle as a repetitive event.

In some cases the cycle pattern may be complex and it may be necessary to consider the contribution of secondary cycles.

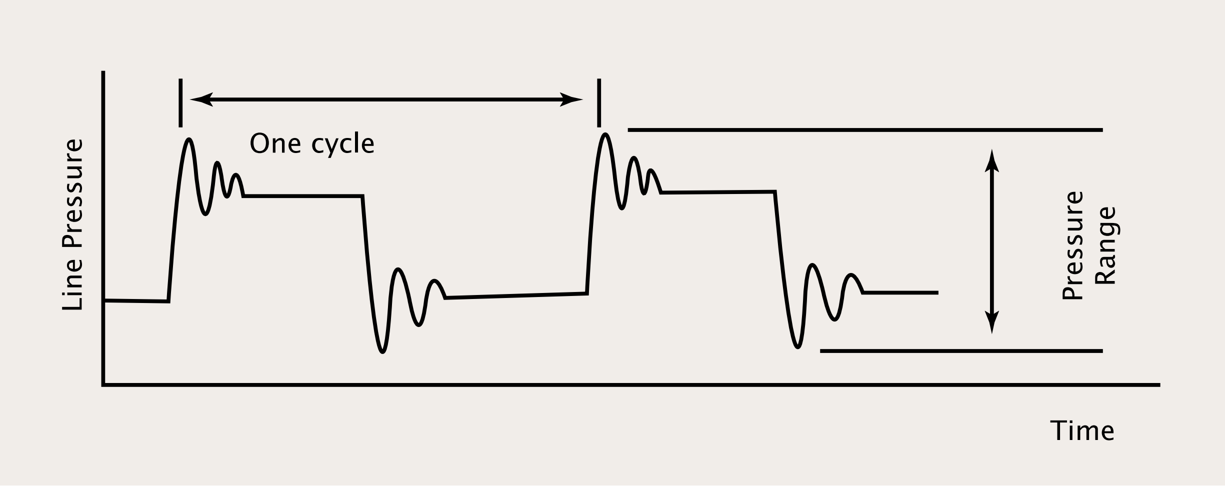
The Maximum Cyclic Pressure Range (MCPR) for a pipe can be calculated using the Fatigue Cycle Factors in Table 3:

MCPR = PN/10 x f

This should not exceed the predicted pressure range in the pipeline.

Alternatively, follow the procedure and use the design graph in Figure 2 to select the correct class of pipe.

FIGURE 1 – Pressure Cycle



Design

Fatigue Design 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, which 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 Figure 2, draw a vertical line up from the x-axis at delta P and a horizontal line from the y-axis at the total number of cycles in the pipe lifetime.
5. Find the intersection point between the horizontal and vertical lines.
6. Select the pipe class that bounds the region of this intersection point as the minimum required for these fatigue conditions.

TABLE 3 – Fatigue Load Factors by number of Cycles

Total cycles	Approx No. cycles/ day for 100 year life	PVC-M Fatigue Load Factors
26,400	1	1.00
100,000	3	0.67
500,000	14	0.41
1,000,000	27	0.33
2,500,000	82	0.25
5,000,000	137	0.25
10,000,000	274	0.25

Temperature

The nominal working pressure rating of Vinidex Hydro® pipes is determined at 20°C. However, Vinidex Hydro® pipes are suitable for use at temperatures up to 50°C. Where the service temperature exceeds 20°C, use Table 4 to determine appropriate pipe class.

FIGURE 2 – Fatigue Design Chart for PVC-M Pipes

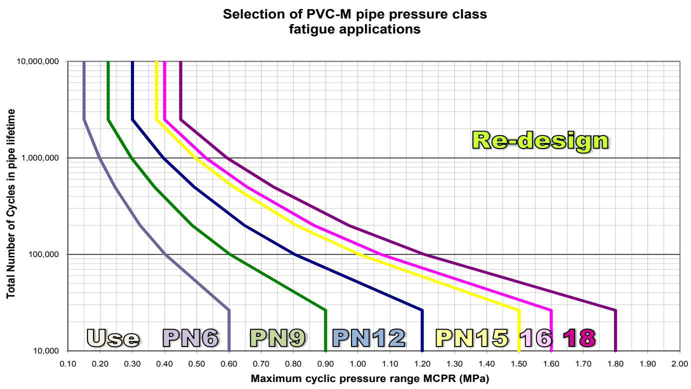


TABLE 4 – Temperature Rating of Vinidex Hydro® PVC-M Pipes

Maximum Allowable Pressure (MPa).

	Temperature °C					
	≤ 25	30	35	40	45	50
PN6	0.60	0.52	0.47	0.42	0.38	0.35
PN9	0.90	0.78	0.71	0.63	0.54	0.46
PN12	1.20	1.04	0.95	0.84	0.77	0.70
PN16	1.60	1.44	1.26	1.12	1.02	0.93
PN18	1.80	1.57	1.42	1.26	1.15	1.04
PN20	2.00	1.74	1.58	1.40	1.28	1.16

Installation

Vinidex recommend that Vinidex Hydro® PVC-M pipes are constructed in accordance with AS 2032 – Installation of PVC pipe systems and Vinidex recommendations.

Installation techniques for Vinidex Hydro® pipes are similar to those used for standard PVC pipes and the same degree of care and caution must be exercised.

Quality non-cohesive material should be used for pipe bedding, side support and overlay. In general 1° deflection for rubber ring joints, is available at each socket-spigot joint. The pipe side support material should be placed evenly on both sides of the pipeline to two thirds the height of the pipe diameter and compacted by hand tamping.

Side fill material should be worked under the sides of the pipe to eliminate all voids and provide maximum pipe haunching.

The pipe overlay material should be levelled and compacted in layers to a minimum height of 150mm above the crown of the pipe or as specified.

For above ground installations the support spacings recommended in AS 2032 can also be used for Vinidex Hydro® pipes.
These support spacing result in negligible deflection in PVC pipes full of water.

The field testing procedures specified in AS2032 and Vinidex recommendations.

Vinidex by aliaxis

Leading the way, from the ground up.

For over six decades, we've been leading the way – setting the industry benchmark for pipeline systems and solutions. Our legacy spans across building, infrastructure, and agriculture sectors. We make life flow with groundbreaking, high-quality products, connecting everything from water, gas and energy throughout Australia.

Today, we maintain our commitment to innovative solutions that meet our customers' needs and exceed their expectations. Core to our approach are smarter solutions that are more sustainable throughout the manufacturing process and over their lifetime. Globally backed by Aliaxis, and a wide-reaching national footprint, our team of passionate technical experts support our customers throughout their projects – working to deliver solutions for today and the future.

Vinidex. We make life flow.

Vinidex Pty Limited
ABN 42 000 664 942

HEAD OFFICE
Level 4, 26 College Street
Darlinghurst NSW 2010
PO Box 747, Darlinghurst, NSW, 1300

Customer Service
Phone: 13 11 69
Fax: 13 24 43
Email: sales@vinidex.com.au
Web: www.vinidex.com.au

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