PowerSpout

WATER GOES IN POWER COMES OUT

Pipe selection guide

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Revisions history

1.0 Edited by H.P. July 2018
1.1 Revised by M.L. Nov 2018 with PVC pipe sizing Annex

Advert in New Zealand, July 2018 from Rural Direct

Introduction

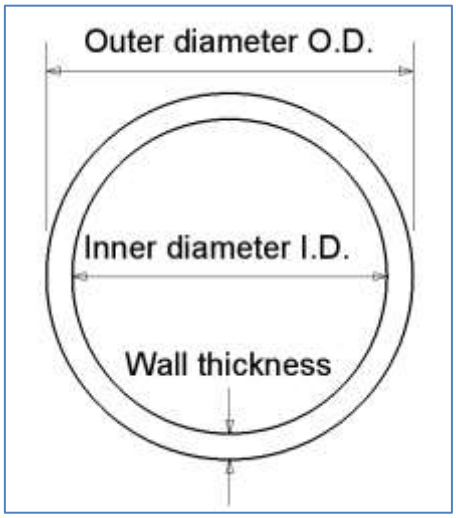
Whether you are hoping to generate 100W or 10,000W with a PowerSpout hydro turbine(s), the supply pipe (or "penstock") is often the most costly item in the budget.

This guide discusses various pipe options that may be available. Every location has different local options for supply, but there are some globally available pipe sizes and specifications too. The final choice is always your decision, taking account of the size, cost, longevity, local availability and accessibility of the site.

Some basic concepts

Pipe diameter

Every pipe has an outer (or overall) diameter and an inner diameter (or bore).



Often the fittings will connect on the outside, and so the pipe will be named according to the O.D. and sold in a range of wall thicknesses for this standard O.D.

"SDR" is the nominal ratio of outside diameter to wall thickness.

For calculating the headloss (pressure drop) and hence the efficiency of the pipe on your site you will need to use the internal diameter or I.D. in our calculation tools. Note our tool always assumes a new smooth bore plastic pipe when calculating friction loss.

Pipes that are rated for higher pressure will have thicker walls and smaller I.D.s which in turn leads to more pipe friction and pressure loss and hence lower pipe efficiency.

Pressure ratings

Pressure is measured in feet of head or in bar or in Pounds per Square Inch.

- As a rough guide we can say that 10m of vertical head creates 1 bar water pressure, although strictly we should say 9.8m = 1bar.
- 1 bar also equals 14.5 PSI.
- Maximum site pipe pressure for a PowerSpout PLT site will be 16bar, which is 157m head or 232 PSI.

We also need to consider surge pressure (also called water hammer) that occurs when the valves are closed and the momentum of the flow is stopped. Many pipe materials can withstand significant short duration pressure surges.

Higher-pressure pipes are generally good, except that they cost more, are heavier, and have smaller internal diameter.

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Materials

PowerSpout turbines will normally use plastic pipes. The commonest materials are Polyethylene (PE) or polyvinyl chloride (PVC). These have very similar friction properties so they can be used in the Advanced Calculator to predict performance. GRP will also have similar friction characteristics. Other materials such as steel, asbestos, etc may have higher friction and this may increase more with aging. Hence our calculation tool may only give approximate results when use with such pipes.

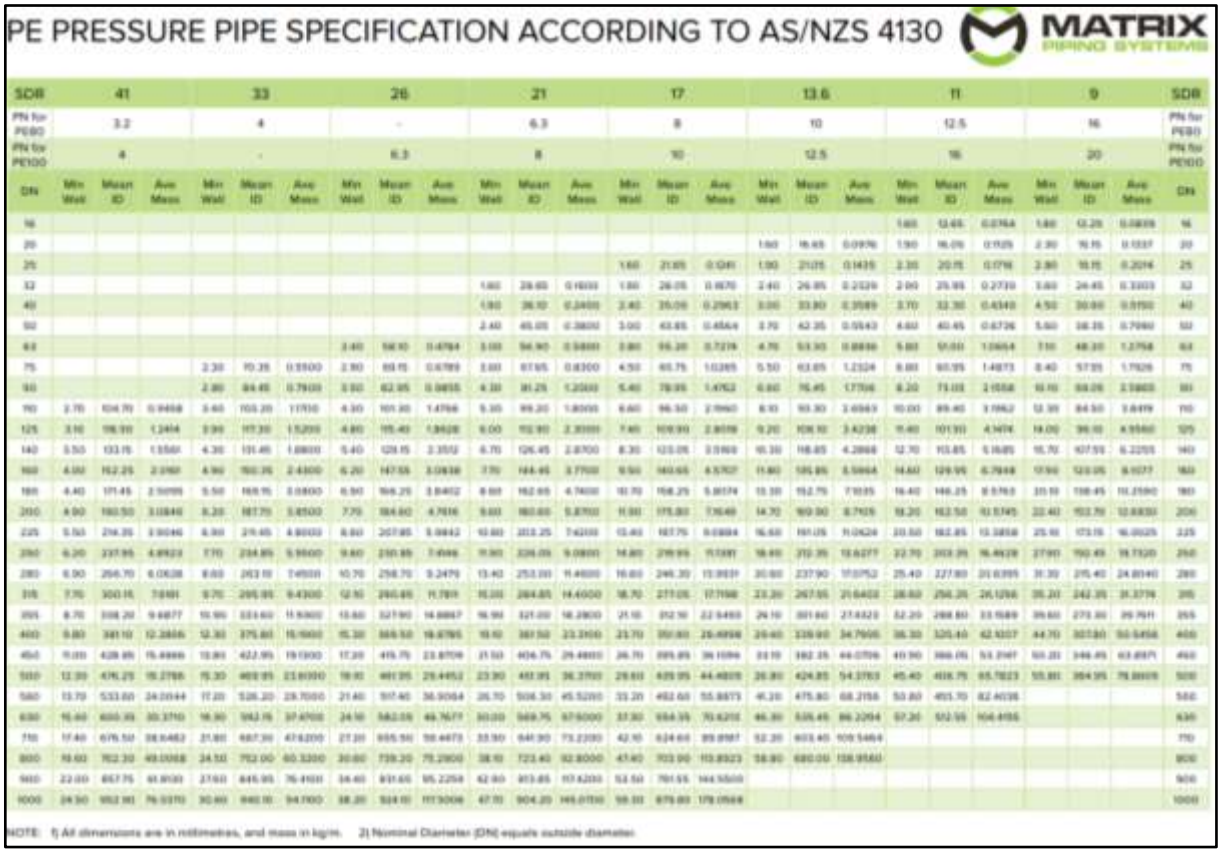
PE pipe comes in various densities that reflect the strength of the plastic, so Low density LDPE is only suitable for low pressure, Medium density MDPE is stronger for the same wall thickness and High density HDPE can withstand higher pressure with thinner walls and larger internal diameter.

Here is a useful table of properties of MDPE (=PE80) and HDPE (=PE100) at various SDR (ratio of OD to wall).

SDR	41	33	26	21	17	13.6	11	9	7.4
PE80	PN3.2	PN4	-	PN6.3	PN8	PN10	PN12.5	PN16	PN20
PE100	PN4	-	PN6.3	PN8	PN10	PN12.5	PN16	PN20	PN25

(The PN is the working pressure rating in bar.)

Say for example we want to use 90mm HDPE pipe at 16bar.
PE100 with SDR11 is shown above to be PN16. So the SDR we need is 11.
Wall thickness will be 90/11 = 8.2mm and therefore the pipe ID will be 90 - (2x8.2) = 73-74mm approximately.
See also the table below where 73mm ID is quoted.


PE PRESSURE PIPE SPECIFICATION ACCORDING TO AS/NZS 4130

MATRIX PIPING SYSTEMS

SDR	41			33			26			21			17			13.6			11			9			SDR
PN for PE80	3.2			4			-			6.3			8			10			12.5			16			PN for PE80
PN for PE100	4			-			6.3			8			10			12.5			16			20			PN for PE100
DN	Min Wall	Mean ID	Ave Mass	Min Wall	Mean ID	Ave Mass	Min Wall	Mean ID	Ave Mass	Min Wall	Mean ID	Ave Mass	Min Wall	Mean ID	Ave Mass	Min Wall	Mean ID	Ave Mass	Min Wall	Mean ID	Ave Mass	Min Wall	Mean ID	Ave Mass	DN
16																			1.80	12.65	0.0764	1.80	12.20	0.0839	16
20																			1.90	16.65	0.0976	1.90	16.05	0.1037	20
25													1.60	21.85	0.1241	1.90	21.25	0.1435	2.30	20.75	0.1716	2.80	19.15	0.2014	25
32										1.80	28.60	0.1933	1.90	28.05	0.1870	2.40	26.85	0.2329	2.90	25.95	0.2733	3.60	24.45	0.3203	32
40										1.90	36.10	0.2455	2.40	35.05	0.2363	3.00	33.80	0.2939	3.70	32.30	0.4349	4.50	30.60	0.3755	40
50										2.40	45.05	0.3800	3.00	43.85	0.4564	3.70	42.35	0.5543	4.60	40.45	0.6726	5.60	38.35	0.7060	50
63							2.40	58.10	0.4784	3.00	56.90	0.5880	3.80	55.20	0.7274	4.70	53.50	0.8836	5.80	51.00	1.0654	7.10	48.30	1.2758	63
75				2.30	70.35	0.5500	2.90	69.15	0.6789	3.60	67.95	0.8300	4.50	65.75	1.0265	5.50	63.65	1.2324	6.80	60.95	1.4873	8.40	57.55	1.7526	75
90				2.80	84.45	0.7910	3.50	82.95	0.9855	4.30	81.25	1.2000	5.40	78.95	1.4752	6.60	76.45	1.7704	8.20	73.05	2.1358	10.10	69.05	2.5803	90
110	2.70	104.70	0.9458	3.40	103.20	1.1700	4.30	101.30	1.4756	5.30	99.20	1.8000	6.60	96.50	2.1960	8.10	93.30	2.6063	10.00	89.40	3.1962	12.30	84.50	3.8499	110
125	3.10	118.30	1.2494	3.90	117.20	1.5200	4.80	115.40	1.8628	6.00	112.90	2.3000	7.40	109.90	2.8078	9.20	106.10	3.4238	11.40	101.30	4.1474	14.00	96.10	4.9560	125
140	3.50	133.15	1.5561	4.30	131.45	1.8800	5.40	129.15	2.3552	6.70	126.45	2.8700	8.30	123.05	3.5163	10.30	118.85	4.2868	12.70	113.85	5.1685	15.70	107.55	6.2255	140
160	4.00	152.25	2.0160	4.90	150.35	2.4300	6.20	147.55	3.0438	7.70	144.45	3.7700	9.50	140.65	4.5707	11.80	135.85	5.5464	14.60	129.95	6.7948	17.90	122.05	8.1077	160
180	4.40	171.45	2.5099	5.50	169.15	3.0800	6.90	166.25	3.8402	8.60	162.65	4.7600	10.70	158.25	5.8074	13.30	152.75	7.1035	16.40	146.25	8.5763	20.10	138.45	10.2590	180
200	4.90	190.50	3.0846	6.20	187.70	3.8500	7.70	184.60	4.7616	9.60	180.60	5.8700	11.90	175.80	7.1640	14.70	169.50	8.7419	18.20	162.50	10.5745	22.40	153.70	12.6830	200
225	5.50	214.35	3.9046	6.90	211.45	4.8600	8.60	207.85	5.9442	10.80	203.25	7.4200	13.40	197.75	9.0884	16.60	191.05	11.0624	20.50	182.85	13.3858	25.10	173.15	16.0025	225
250	6.20	237.95	4.8923	7.70	234.85	5.9500	9.60	230.85	7.4496	11.90	226.05	9.0800	14.80	219.95	11.1581	18.40	212.35	13.6277	22.70	203.25	16.4628	27.90	192.45	19.7320	250
280	6.90	266.70	6.0638	8.60	263.10	7.4500	10.70	258.70	9.2479	13.40	253.00	11.4600	16.60	246.30	13.9931	20.60	237.90	17.0752	25.40	227.80	20.6395	31.30	215.40	24.8040	280
315	7.70	300.15	7.6981	9.70	295.95	9.4300	12.10	290.85	11.7191	15.00	284.85	14.4000	18.70	277.05	17.7098	23.20	267.55	21.6403	28.60	256.25	26.1256	35.20	242.35	31.3774	315
355	8.70	338.20	9.6877	10.90	333.60	11.9300	13.60	327.90	14.8867	16.90	321.00	18.2800	21.10	312.90	22.5493	26.10	301.60	27.4323	32.20	288.80	33.1589	39.60	273.00	39.7931	355
400	9.80	381.10	12.3886	12.30	375.80	15.1900	15.30	369.50	18.8785	19.10	361.50	23.3100	23.70	351.80	28.4958	29.40	339.90	34.7905	36.30	325.40	42.1027	44.70	307.60	50.5458	400
450	11.00	428.85	15.6866	13.80	422.95	19.1300	17.20	415.75	23.8709	21.50	406.75	29.4800	26.70	395.85	36.1094	33.10	382.35	44.0706	40.90	366.05	53.3167	50.20	346.45	63.8971	450
500	12.30	476.25	19.3786	15.30	469.85	23.6300	19.10	461.95	29.4452	23.90	451.95	36.3700	29.60	439.95	44.4809	36.80	424.80	54.3783	45.40	406.70	65.7823	55.80	384.90	78.8809	500
560	13.70	533.60	24.0944	17.20	526.20	29.7000	21.40	517.40	36.9064	26.70	506.30	45.5200	33.20	492.60	55.8873	41.20	475.80	68.2158	50.80	455.70	82.4038				560
630	15.40	600.30	30.3710	19.30	592.70	37.4700	24.10	582.00	46.7677	30.00	569.70	57.5000	37.30	554.10	70.6210	46.30	535.45	86.2264	57.20	512.55	104.4155				630
710	17.40	676.50	38.5482	21.80	667.30	47.6200	27.20	655.50	59.4473	33.90	641.90	73.2200	42.10	624.60	89.8987	52.20	603.40	109.5464							710
800	19.60	762.20	49.0368	24.50	752.00	60.3200	30.60	739.20	75.2900	38.10	723.40	92.8000	47.40	703.90	113.8923	58.80	680.00	138.9580							800
900	22.00	857.75	61.9030	27.60	845.95	76.4100	34.40	831.65	95.2254	42.90	813.85	117.6200	53.50	791.55	144.5000										900
1000	24.50	952.90	76.5370	30.60	940.10	94.7000	38.20	924.10	117.9006	47.70	904.20	146.0700	59.30	879.60	179.0568										1000

NOTE: 1) All dimensions are in millimetres, and mass in kg/m. 2) Nominal Diameter (DN) equals outside diameter.

Pipe options

Corrugated single wall PE pipe

This pipe is typically used on farms for field drains, it is low cost hence we see many clients keen to use this pipe. The corrugated inside surface makes calculating friction loss difficult and uncertain. The main issue is how to join them and what is the pressure rating. In recent years single wall pipe has been significantly displaced by double wall. We are not aware of any clients using this type of pipe for hydro turbines despite many requests seeking our advice over the years. If you have tried such pipe and it has worked well please contact us.

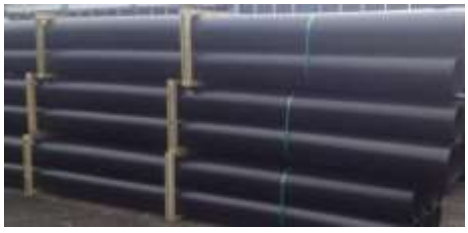
Corrugated twin wall PE pipe

We get many new clients asking about this pipe. It has a smooth inner bore (unlike single wall above), and the price is reasonable.

The main issue is how to join the lengths together, and what is the pressure rating. We have seen them used to great effect for supply pipe flumes for PowerSpout LH turbines, but to our knowledge no client has used them in pressure applications for say a PowerSpout TRG or PLT turbine. If you have tried such pipe and it has worked well please contact us.

Outside Diameter	Inside Diameter	$NZ/m approx.
110	95	12
160	137	18.33
230	195	23.33
250	225	46.67
333	290	64.17

Culvert Pipe (made from recycled HDPE)



This pipe is robust and UV resistant. It is ideal for PowerSpout turbines for sites up to 30m head. It is best joined with a PE pipe welding machine - which can be difficult if you do not have one.

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These PE culvert grade pipes are not pressure-rated pipes but will be fine for up to 30m static heads.

Outside Diameter	Inside Diameter	$NZ/m approx.
110	102	From 10.00
160	149	From 13.00
200	186	14.35
250	232	19.56
315	293	32.61
375	349	44.20
450	419	61.59

PVC Culvert Pipe (made from new and recycled PVC)

This pipe often has no formal pressure rating, but is good for up to 30m heads. It glues together, so have a low joining cost compared with large PE pipes. The sizes below are also common (in NZ) sizes for Chinese PVC waste and pressure pipe, so large fittings can be purchased cost effectively if needed.

Outside Diameter	Inside Diameter	$NZ/m approx.
110	102	6.09 to 13.28
160	152	13.44 to 26.87
200	190	35.44
250	232	41.35
315	293	84

Pressure Grade Pipe in LDPE, MDPE and HDPE

PE ID 50mm pipe (57mm OD)

There is a common **LDPE** pipe made is NZ with a 50mm **ID** from $3.72NZ/m and only rated for 50 PSI (35m head). You can see it advertised above. The same pipe is available in a higher grade PE for 70m head (called Enduroflex by Marley).

For sites with heads above 70m then you need to look at pipes sized according to their OD. The above PE pipes can be used for the first 35m and 70m of fall respectively.

PE OD pipe sizes

PE pipes are common globally and supplied in 50 or 100m rolls and shorter straight lengths. They have common OD sizes that can be connected via standard external joiners:

- 63mm
- 75mm
- 90mm
- 110mm

They are available in wide range of PE grades and wall thicknesses.

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63 mm OD PE pipe

This pipe is common in 9 bar (90m rated) with 55mm ID and 12.5 bar (120m rated) with a 53mm ID.

Drag hose

Drag hose is a specifically designed PE pipe available in 63 and 75mm outside diameter. This pipe is designed to be flexible with a thick wall to resist abrasion while towing. It has 6 bar (60m) pressure rating at a similar cost to the 50mm ID LDPE but has a larger ID.

Effluent pipe

Effluent Pipe is manufactured from MDPE and is typically rated for 8 bar (80m).

- 75mm OD 66mm ID
- 90mm OD 79mm ID
- 110mm OD 96mm ID

In general the above PE pipes are very cost effective as they are **mass produced** for farmers.

HPDE pipes

All the above are also available in 16 bar (160m) HDPE pipe, but the cost can increase quickly due to the thicker wall and lower volumes produced.
We are not that interested in pipes above 16 bar rating as this is the static pressure limit of our PowerSpout PLT turbine.

Surplus pipe options

Surplus pipe is surprisingly common if you are not in a rush to locate it. Some examples include:

- PE pipe surplus from fish farms in Scotland
- Fire hose pipe – example link

We do not advise fire hose because we do not believe that it will last long enough, and it is prone to kinks.

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Surplus PVC

We have also had a number of clients who have secured larger PVC pipes that were used as floating booms on large hydro lakes. These booms are used to stop floating logs from jamming up against the intake screens. These large intakes will have automatic rake cleaners which can be damaged if they become entangled with the branches of a large floating tree - hence the need for the PVC boom.

The booms are often replaced every 10 years as they get weakened with UV light exposure. You can often get them for free if you know where to look. Due to UV weakening they will only be suitable for lower head sites.

Surplus steel pipes

A quick search on the internet (whilst writing this article) in NZ located secondhand 100mm ID galvanised steel pipe (rated for 400m head) for $45NZ per 6.5m lengths, within 15km of our base, with bolt joiners available.

The same company was also offering 160mm ID galvanised steel pipe for $67 per 6m length. 300m head rated.

Steel is heavy, but for sites that have good access for lifting equipment to position them and if the price is good - then why not?

Galvanized pipes will only last about 20 years before they rust out unless some of the electrical generation is used to provide cathodic protection via a DC power supply. Such surplus steel pipe are great if you are planning a small hydro with more than 160m head, but as PowerSpout turbines are only approved for sites under 160m head we do not see many clients using steel pipes.

Most clients living in remote locations will not be able to secure surplus pipe locally, so they will have to buy new pipe. The cost of moving surplus pipe large distances is prohibitively costly.

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Transporting pipes

Site access considerations are critical before making a final decision about which pipe to use. We have become involved with many very remote installations over the years. Some have had no choice but to hand-carry all the equipment and pipe needed through dense forest for many km, as no vehicle access was possible.

The strength, flexibility and long-term durability offered by polyethylene pipe have seen it become the material of choice for a wide range of hydro applications.

For remote low head sites short lengths of large PE pipe are carried in and fusion welded together.
On higher head sites 50 or 100m rolls of smaller diameter pipe are carried on site and joined with pipe joiners. 100m rolls of 110mm PE pipe can weight up to 380kg each, you can only move it by hand if it is unrolled and carried in as shown opposite.

Example: remote location high head village site

For very remote locations in the 3-10kW class (remote village power) where there are falls of up to 160m utilizing smaller PE pipes there can these **disadvantages:**

- High shipping bulk – as 100m rolls of pipe are mainly air
- High roll mass makes manual handling difficult (7-10 people needed to move 1 roll)
- Rolls often do not fit into a standard shipping container (2.4m high) and where they do fit into a high-cube container (2.7m high) you cannot fit in many 100m rolls (normally 8)

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PE pipes have some **advantages**, being flexible, resilient, and UV resistant.

But often in such situations, PVC pipe can be a better option with these **advantages:**

- Often lower cost than PE pipe of the same size and pressure rating
- Larger inside diameter for same OD (as PVC is stronger than HDPE)
- 5.5m lengths will fit in a standard shipping container
- Available in many pressure grades; Culvert grade <30m, <63m, <80m, <100m, <125m, <160m and <250m
- Available in OD sizes; 63,75,90,110,125,140,160,180,200 and larger
- You can design a solution for a site starting with say low pressure 110mm pipe and then convert to high pressure 90mm pipe that fits inside the 110m for cost effective transportation.
- Standard PVC fittings are normally rated for 160m head. They are common and low-cost compared to PE pipe fittings

If logistical costs are high and local labour costs are free (often part of the deal in getting power for the first time to remote villages) then PVC can be much more cost effective. If it can be buried or covered to keep off UV, it will then last almost as long as PE pipe (typically 50+ years).

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Example with specific numbers

For example, say we need 2500m of 110mm OD PE pipe for a job with 160m of static head and a flow rate of 7l/s.

PE pipe options

Rating	Wall thickness	Pipe ID	kg/100m roll
PN4	3.9	102.2	116
PN5	4.9	100.2	145
PN6.3	6.0	98.0	177
PN8	7.4	95.2	216
PN10	9.1	91.8	262
PN12.5	11.1	87.8	311
PN16	13.7	82.6	378

https://www.marley.co.nz/wp-content/uploads/2016/04/Marley-Polyethylene-Manual.pdf

PVC Pipe options

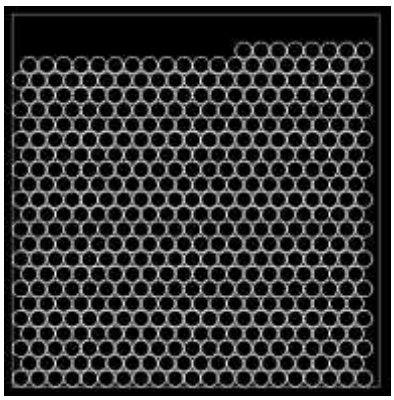
Rating	Wall thickness	Pipe ID	kg/5.5m length
PN6.3	2.7	104.6	7.3
PN8	3.4	103.2	9.1
PN1.0	4.2	101.6	11.1
PN1.25	5.3	99.4	13.9
PN1.6	6.6	96.8	17.1

Pipe data from www.xiongsu.cn

As PVC has higher tensile strength than PE, the PVC pipe will have thinner walls, and so it can generate more power due to reduced pipe friction loss.

To keep this example simple, let's assume the average pipe ID is 92mm.
3 x PLT HP turbines can do 4.8kW on 7.0 l/s.
Click here to view this example in the calculator.

PE pipe:
25 x 110mm OD 100m rolls of PE pipe of 7 grades with a mass of almost 6 tonnes. This will require about 3 shipping containers **if** these larger rolls will fit in a high-cube.



PVC pipe:
460 lengths (5 spares) at 5.5m x 110mm OD of PVC pipe of 5 grades with a mass of almost 5.5 tonnes.
All of this PVC pipe will fit into 1 shipping container with sufficient spare room for all the PVC fittings needed.

Note. PE pipes can also be purchased in lengths that will fit into a standard 20ft (<5.9m) or 40ft (<12.1m) shipping container. In such cases it is likely that portable fusion welding (powered by a small generator set) will be more cost

effective than having to purchase hundreds of costly PE pipe joiners.

PVC Pipe installation advice

All pipes must be laid on a descending grade to avoid high points where air can get trapped. Having a large vertical air riser soon after the intake can be helpful in allowing air bubbles to escape. Air bubbles are often drawn in via turbulence at the intake and will soon settle to the top of the pipe where they can be vented with a short vertical riser pipe.

The image opposite shows a timber support bridge for a 160mm PVC culvert pipe supplying 2 x TRG turbines. The process involves digging shallow cuttings to bury the pipe through high points and timber support bridges at low points. You cannot eliminate every pipe high/low point but you can greatly reduce the number of vents that may be needed later. Imagine you a installing a train track from the intake to the turbine and you will not go far wrong.

Shallow dips in the ground can be filled using rocks (from the nearby stream as shown opposite). In this way the pipe meanders along the river bank (above maximum flood level) avoiding:

- large trees
- large rocks (small ones can be winched out of the way)
- steep banks
- high ground
- low ground

Avoidance is not always possible, so attempt to minimize the number of cuttings, bends and support structures that you will need to make.

Installing large PVC pipes

Some tips:

- 1 large glue pot per person.
- Clean all surfaces to be glued.
- Liberal application of PVC glue to both mating surfaces.
- Work quickly – you may need to practice first.

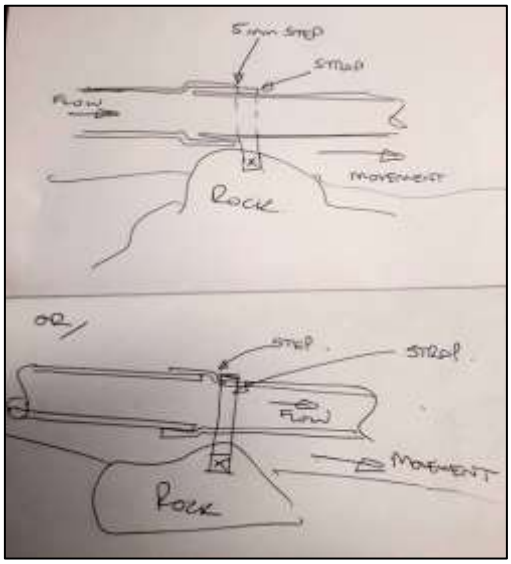
- Push pipe fully home.
- Have paper towels handy to clean up excess glue.
- Wear gloves – you do not have time with large pipes to avoid contact with the glue.

Some tips on bending (to avoid obstacles):

- Place a heat shield on the compression (inner) side of the pipe bend.
- Heat the tension (outer) side of bend evenly and slowly with a heat gun or LPG gas torch.
- Bend no more than 10 degrees.
- Cool with water to set the bend.

Some tips on strapping at the joins and securing against floods:

- Often the pipe joins (fittings or socket ends) create a bulge that you can take advantage of to restrain the pipe from slipping down the hill or being washed down the stream bed during floods.
- Where you have a 5mm step at the join, you can use stainless builders strap and secure with dyna bolts to rocks either side of the pipe or drive in steel pegs.
- You can also use short screws to attach the strap to the PVC at the 10mm thick joins.



Crossing water ways

In this example a 200mm PVC culvert pipe had to cross the river. At the crossing point the PVC pipe was flanged and joined to a steel pipe bridge. This is a costly undertaking, avoid pipe crossings if possible. A lower cost method is to make a small cable suspension bridge.

Avoid unnecessary bends

With good route planning you can avoid unnecessary pipe connections like this. Use heat setting to align the pipes and avoid the need for large bends and specially made fittings. This increases friction loss, air entrapment and costs.

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Connecting to several turbines via a manifold

For more details of manifold connections read our manifold guide.

International jobs using PVC pipe

It is not uncommon for us to supply both the turbine(s) and manifold connections to international destinations. The advice in the Annex that follows will help in your understanding of PVC pipe sizing where PVC parts are arriving from several countries.

Annex I: Common PVC pipe sizes

The tables will assist in the understanding of the PVC pipe sizes available in your country. Countries that have sizes very similar to each other are shown colored the same so they are easy to spot.

NZ PVC culvert pipe sizes (not pressure rated but suitable for up to 30m head)

OD of pipe	Culvert grade Wall mm	ID pipe mm
90	2.4	85
110	3	104
160	4.3	151
200	5	190
250	6.5	237
315	8.2	299
400	10.3	379

Note that fittings for NZ culvert grades match well with fittings for Chinese pressure pipe.

NZ PVC pressure pipe sizes

OD of pipe	PN6 Wall mm	PN6 pipe mm	PN9 Wall mm	PN9 pipe mm	PN12 Wall mm	PN12 pipe mm	PN15 Wall mm	PN15 pipe mm	PN18 Wall mm	PN18 pipe mm	NB
48.3	1.7	44.9	2.1	44.1	2.8	42.7	3.4	41.5	3.9	40.5	40
60.4	1.8	56.8	2.6	55.2	3.4	53.6	4.1	52.2	5.0	50.4	50
75.4	2.2	71.0	3.3	68.8	4.2	67.0	5.2	65.0	6.1	63.2	65
88.9	2.6	83.7	3.8	81.3	5.0	78.9	6.1	76.7	7.2	74.5	80
114.3	3.3	107.7	4.9	104.5	6.3	101.7	7.8	98.7	9.2	95.9	100
140.2	4.0	132.2	5.9	128.4	7.7	124.8	9.5	121.2	11.3	117.6	125
160.3	4.5	151.3	6.7	146.9	8.8	142.7	10.8	138.7	12.8	134.7	150
225.3	5.8	213.7	8.4	208.5	11.1	203.1	13.7	197.9	16.2	192.9	200
250.4	6.4	237.6	9.4	231.6	12.3	225.8	15.2	220.0	18.0	214.4	225
280.4	7.1	266.2	10.5	259.4	13.8	252.8	17.0	246.4	20.2	240.0	250
315.5	8.0	299.5	11.8	291.9	15.5	284.5	19.1	277.3	22.7	270.1	300
400.5	10.1	380.3	14.9	370.7	19.7	361.1	24.3	351.9	28.9	342.7	375

NB refers to nominal bore which is the approximate inside diameter of the pipe series

China PVC pressure pipe sizes

OD of pipe	0.63 Mpa Wall mm	0.63 Mpa ID pipe mm	0.8 Mpa Wall mm	0.8 Mpa ID pipe mm	1.0 Mpa Wall mm	1.0 Mpa ID pipe mm	1.25 Mpa Wall mm	1.25 Mpa ID pipe mm	1.6 Mpa Wall mm	1.6 Mpa ID pipe mm	2.0 MPA Wall mm	2.0 Mpa ID pipe mm	2.5 MPA Wall mm	2.5 Mpa ID pipe mm
50	2.0	46.0	2.2	45.6	2.4	45.2	3.0	44.0	3.7	42.6	4.6	40.8	5.6	38.8
63	2.0	59.0	2.5	58.0	3.0	57.0	3.8	55.4	4.7	53.6	5.8	51.4	7.1	48.8
75	2.3	70.4	2.9	69.2	3.6	67.8	4.5	66.0	5.6	63.8	6.9	61.2	8.4	
90	2.8	84.4	3.5	83.0	4.3	81.4	5.4	79.2	6.7	76.6	8.2	73.6	10.1	69.8
110	2.7	104.6	3.4	103.2	4.2	101.6	5.3	99.4	6.6	96.8	8.1	93.8	14.6	80.8
160	4.0	152.0	4.9	150.2	6.2	147.6	7.7	144.6	9.5	141.0	11.8	136.4	18.2	123.6
200	4.9	190.2	6.2	187.6	7.7	184.6	9.6	180.8	11.9	176.2	14.8	170.4		
250	6.2	237.6	7.7	234.6	9.6	230.8	11.9	226.2	14.9	220.2				
315	7.7	299.6	9.7	295.6	12.1	290.8	15.0	285.0	18.7	277.6				
355	8.7	337.6	10.9	333.2	13.6	327.8	16.9	321.2	21.1	312.8				
400	9.8	380.4	12.3	375.4	15.3	369.4	19.1	361.8	23.7	352.6				

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USA PVC pressure pipe sizes

OD of Pipe	Schedule 40 Pipe ID mm	Schedule 80 Pipe ID mm	OD of pipe	Schedule 40 Pipe ID inch	Schedule 80 Pipe ID inch
48.3	40.4	37.5	1.9	1.6	1.5
60.3	52.0	48.6	2.4	2.0	1.9
73.0	62.1	58.2	2.9	2.4	2.3
88.9	77.3	72.7	3.5	3.0	2.9
101.6	89.4	84.5	4.0	3.5	3.3
114.3	101.5	96.2	4.5	4.0	3.8
141.3	127.4	121.1	5.6	5.0	4.8
168.3	153.2	145.0	6.6	6.0	5.7
219.1	201.7	192.2	8.6	7.9	7.6
273.1	253.4	241.1	10.8	10.0	9.5
323.9	302.0	286.9	12.8	11.9	11.3
355.6	332.1	315.2	14.0	13.1	12.4
406.4	379.5	361.0	16.0	14.9	14.2
457.2	426.9	406.8	18.0	16.8	16.0
508.0	476.1	452.5	20.0	18.7	17.8
609.6	572.6	544.0	24.0	22.5	21.4

Provided in metric and imperial

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