Marshalls

Installation Guidelines for Perfect Manhole System

Introduction

This manual gives guidance on how to install the Marshalls Perfect manhole system, incorporating a load bearing elastomeric seal known as a 'sealed manhole' system.

The system provides a manhole whereby all joints and connections have elastomeric seals enabling a watertight manhole to be constructed quickly and easily with a minimal amount of site work. ***For installations that may be subject to a high water table, please refer to the technical guidance in this document.***

Manholes are consequently installed in a similar manner to pipes, requiring a different technique to traditional manhole construction.

With a wide wall thickness that exceeds 125mm, generally a concrete surround will not be required unless installed in an area with a high water table, unstable ground, subjected to abnormally wheel loads or if specified by the Client/Consulting Engineer. The system is Kitemarked to BS EN 1917 and BS 5911-3

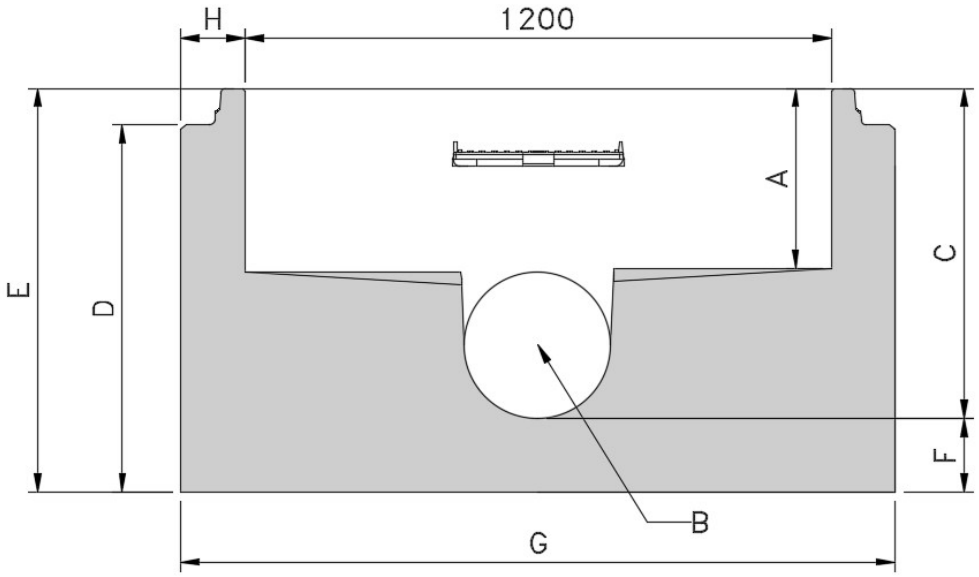
Components

The Perfect manhole system will typically comprise of a combination of the following products

Base Unit

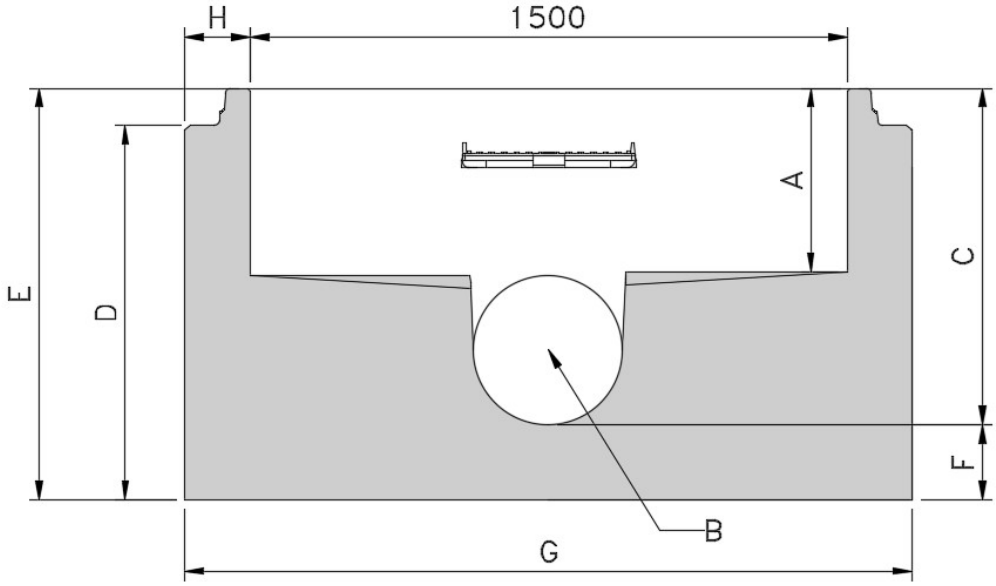
Typical Perfect Base unit with preformed benching, available with no steps, steps, 150mm ladder or 200mm ladder. Each base has 3No. lifting pins spaced at 120°.

1200mm Bases have a nominal fall of 1:60 (20mm) ±10mm on the main channel.
1500mm Bases have a nominal fall of 1:60 (25mm) +10mm/-13mm on the main channel.
1500mm Bases have a nominal fall of 1:60 (25mm) +10mm/-15mm on the main channel.
Alternative falls are available at no extra cost or change of lead time.
The invert levels on the manhole schedule are designed to the centre of the manhole.



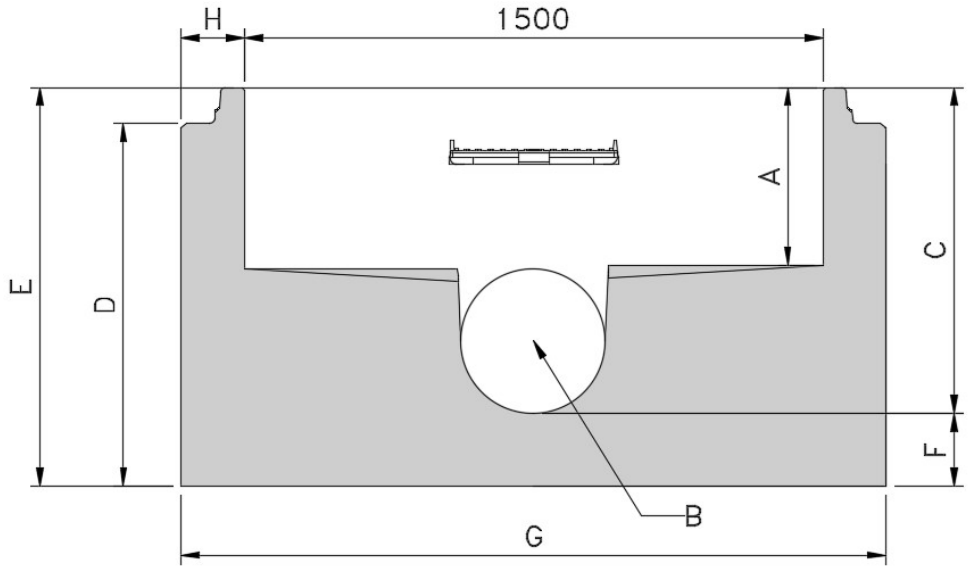
1200mm Base Unit (Concrete & Non-Concrete Pipes)								
A	B	C	D	E	F	G	H	Weight*
(mm)								(kg)
225	100	325	400	475	150	1460	130	1215
	150	375	450	525				1395
	225	450	525	600				1635
	300	525	600	675				1875
275	100	375	450	525				1280
	150	425	500	575				1460
	225	500	575	650				1700
	300	575	650	725				1920
325	100	425	500	575				1345
	150	475	550	625				1525
	225	550	625	700				1765
	300	625	700	775				1985
375	100	475	550	625				1410
	150	525	600	675				1590
	225	600	675	750				1830
	300	675	750	825				2050
425	100	525	600	675				1475
	150	575	650	725				1655
	225	650	725	800				1895
	300	725	800	875				2115

*The weight is the maximum weight of a base. Refer to the clockface design for the weight of the designed base.



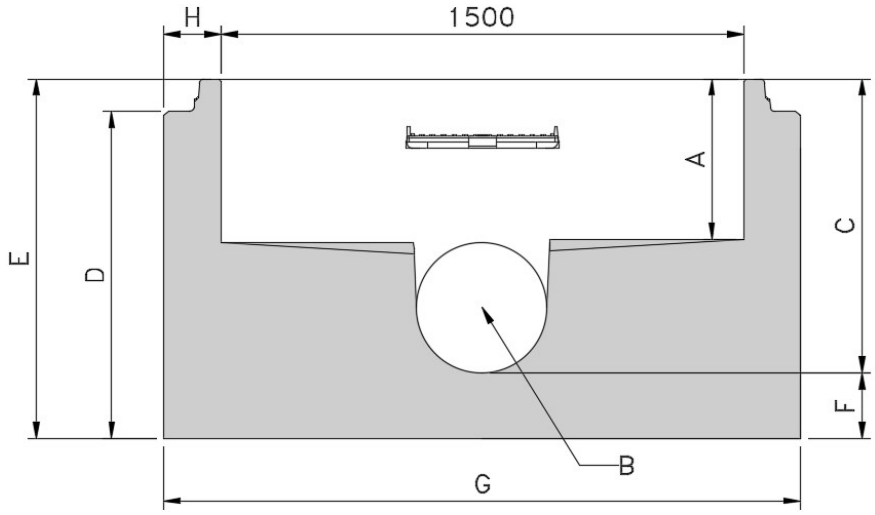
1500mm Base Unit up to 450mm Pipes (Non-Concrete Pipes)								
A	B	C	D	E	F	G	H	Weight*
(mm)								(kg)
275	100	375	440	525	150	1820	160	1970
	150	425	490	575				2255
	225	500	565	650				2650
	300	575	640	725				3020
	375	650	715	800				3355
	450	725	815	900	175			3820
325	100	425	490	575	150			2070
	150	475	540	625				2355
	225	550	615	700				2750
	300	625	690	605				3120
	375	700	765	850				3455
	450	775	865	950	175			3920
375	100	475	540	625	150			2170
	150	525	590	675				2455
	225	600	665	750				2850
	300	675	740	825				3220
	375	750	815	900				3555
	450	825	915	1000	175			4020
425	100	525	590	675	150			2270
	150	575	640	725				2555
	225	650	715	800				2950
	300	725	790	875				3320
	375	800	865	950				3656
	450	875	965	1050	175			4120
475	100	575	640	725	150			2370
	150	625	690	775				2655
	225	700	765	850				3050
	300	775	840	925				3420
	375	850	915	1000				3756
	450	925	1015	1100	175			4220

*The weight is the maximum weight of a base. Refer to the clockface design for the weight of the designed base.



1500mm Base Unit up to 450mm Pipes (Concrete Pipes)								
A	B	C	D	E	F	G	H	Weight*
(mm)								(kg)
275	300	575	690	775	200	1820	160	3330
	375	650	765	850				3670
	450	725	865	950	225			4130
325	300	625	740	825	200			3430
	375	700	815	900				3770
	450	775	915	1000	225			4230
375	300	675	790	875	200			3530
	375	750	865	950				3870
	450	825	965	1050	225			4330
425	300	725	840	925	200			3630
	375	800	915	1000				3970
	450	875	1015	1100	225			4430
475	300	775	890	975	200			3730
	375	965	965	1165				4070
	450	925	1065	1150	225			4530

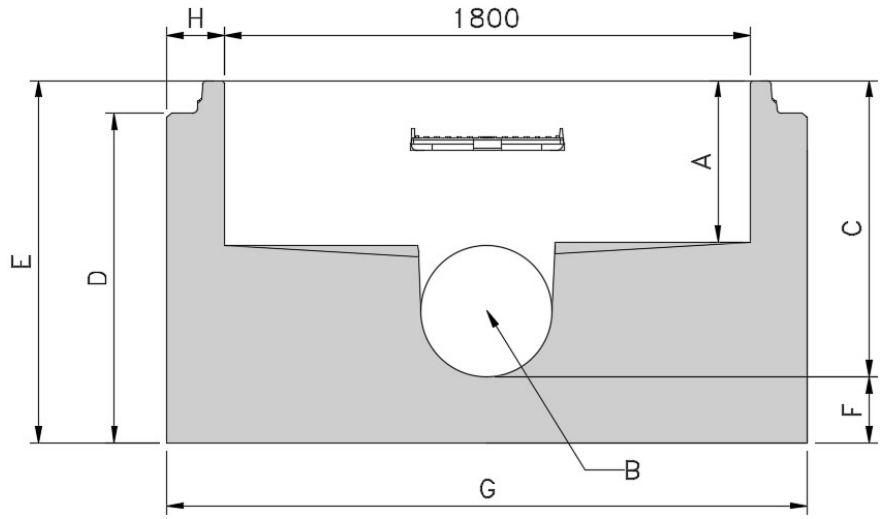
*The weight is the maximum weight of a base. Refer to the clockface design for the weight of the designed base.



1500mm Base Unit 475-600mm Pipes (Non-Concrete Pipes)								
A	B	C	D	E	F	G	H	Weight*
(mm)								(kg)
325	475		915		200	1960	230	5030
	500		940					5170
	600		1040					5595
375	475		965					5180
	500		990					5320
	600		1090					5745
425	475		1015					5330
	500		1040					5470
	600		1140					5895
475	475		1065					5480
	500		1090					5620
	600		1190					6045
525	475		1115					5630
	500		1140					5770
	600		1240					6195

1500mm Base Unit 525-675mm Pipes (Concrete Pipes)								
A	B	C	D	E	F	G	H	Weight*
(mm)								(kg)
325	525		1015		250	1960	230	5565
	600		1090					5960
	675		1165					6330
375	525		1065					5715
	600		1140					6110
	675		1215					6480
425	525		1115					5865
	600		1190					6260
	675		1265					6630
475	525		1165					6015
	600		1240					6410
	675		1315					6780
525	525		1215					6165
	600		1290					6560
	675		1365					6930

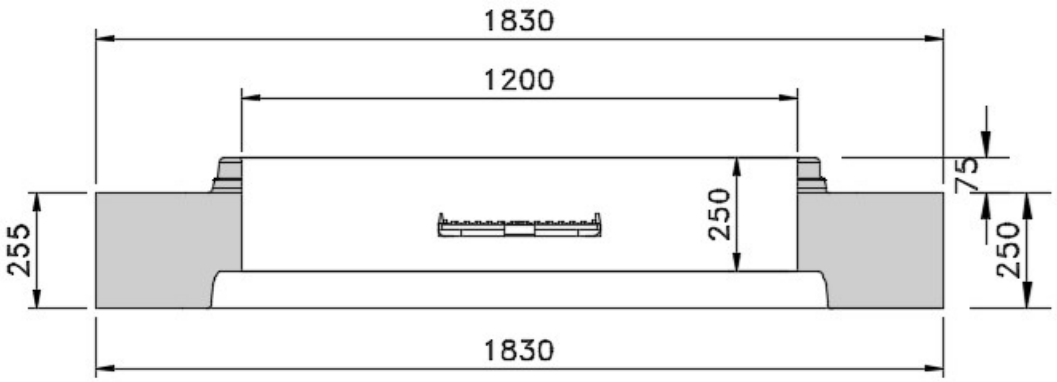
*The weight is the maximum weight of a base prior to the addition of mould weight reducers. Refer to the clockface design for the weight of the designed base.



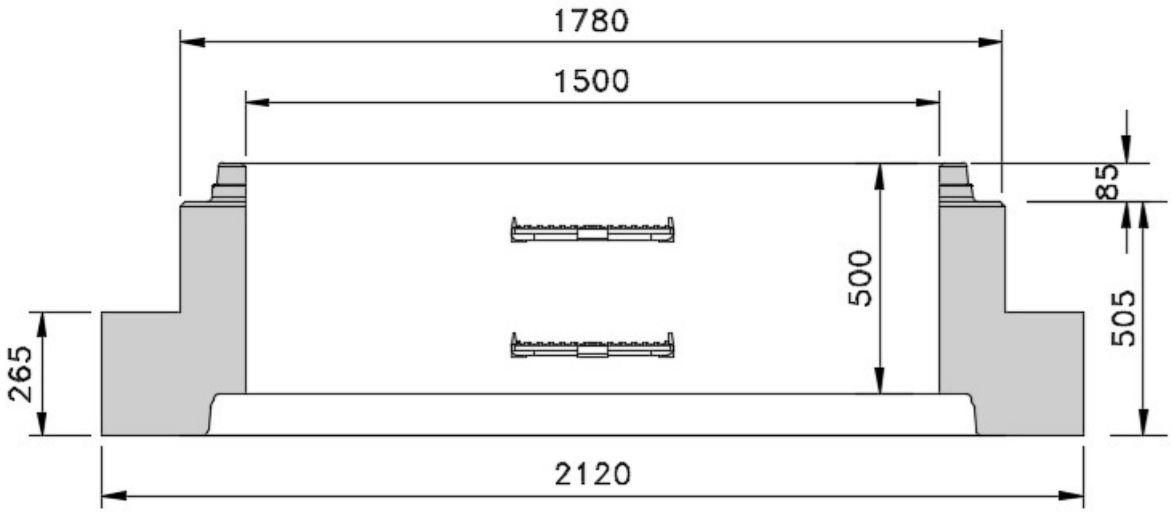
1800mm Base Unit (Concrete & Non-Concrete Pipes)								
A	B	C	D	E	F	G	H	Weight*
(mm)								(kg)
385	450		1025		275	2440	320	8675
	525		1100					9110
	600		1175					9700
	675		1250					10,000
	750		1325					10,000
	825		1400					10,000
	900		1475					10,000
435	450		1075					8915
	525		1150					9355
	600		1225					9940
	675		1300					10,000
	750		1375					10,000
	825		1450					10,000
	900		1525					10,000
485	450		1125					9160
	525		1200					9600
	600		1275					10,000
	675		1350					10,000
	750		1425					10,000
	825		1500					10,000
	900		1575					10,000
535	450		1175					9400
	525		1250					9840
	600		1325					10,000
	675		1400					10,000
	750		1475					10,000
	825		1550					10,000
	900		1625					10,000
585	450		1225					9645
	525		1300					10,000
	600		1375					10,000
	675		1450					10,000
	750		1525					10,000
	825		1600					10,000
	900		1675					10,000

*The weight is the maximum weight of a base prior to the addition of mould weight reducers. Refer to the clockface design for the weight of the designed base.

Anti-Flotation Rings



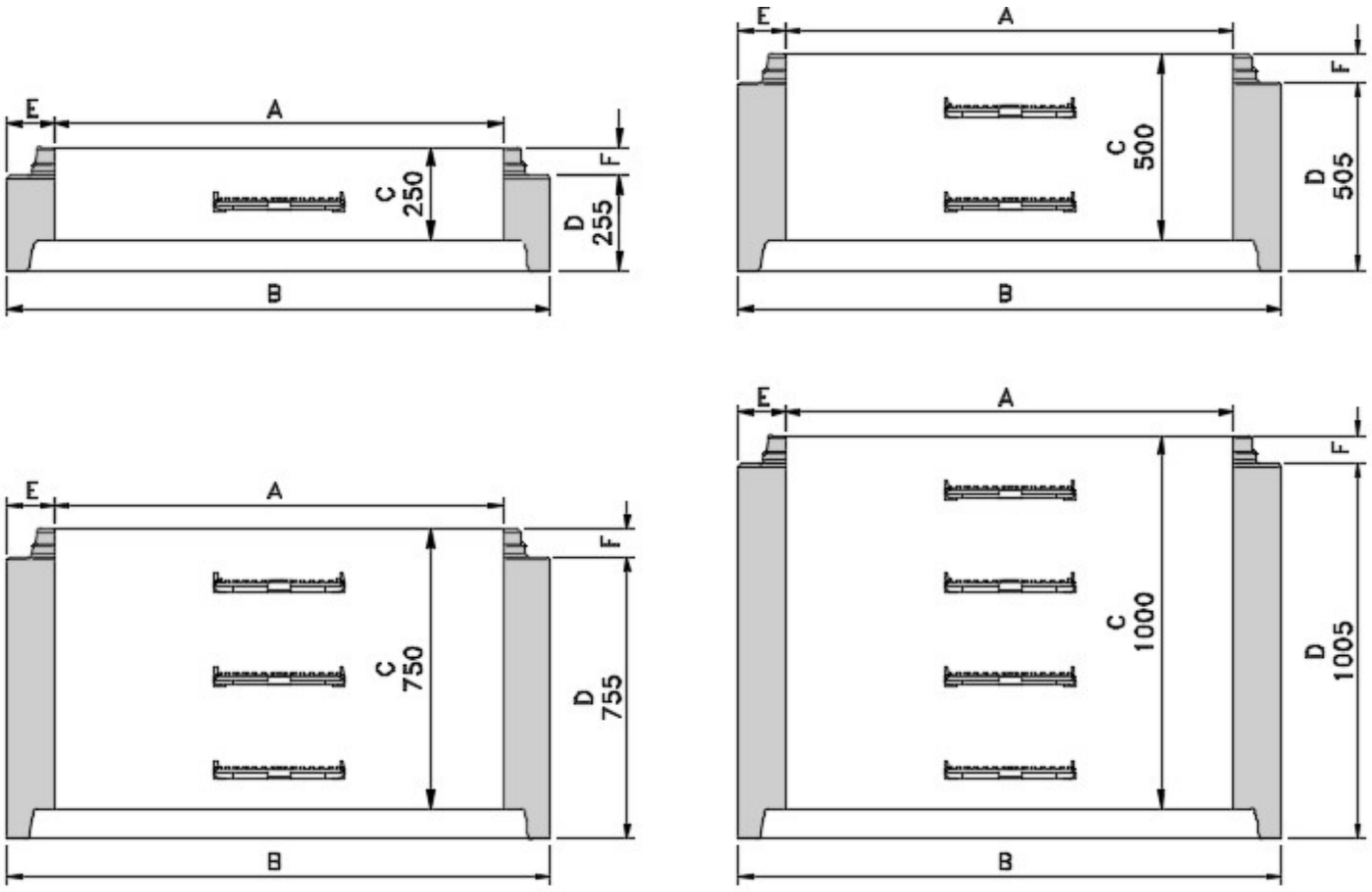
1000kg



2000kg

Required on installations where standing water table > 2.5m from underside of the base, see the technical advice note for further information regarding installations in high water tables. Each ring has 3No. lifting pins spaced at 120°. Available with no steps, steps, 150mm ladder or 200mm ladder.

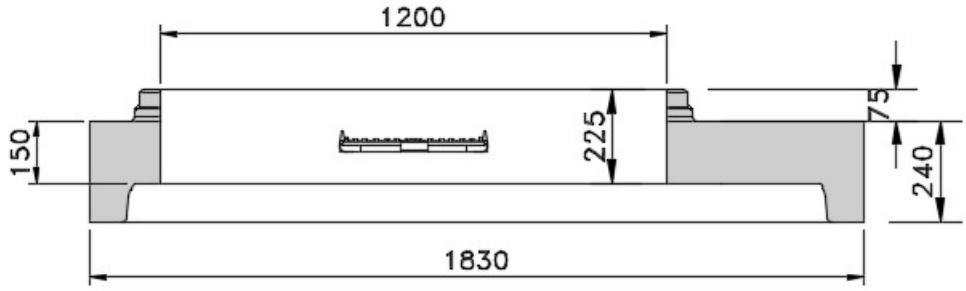
Chamber Rings



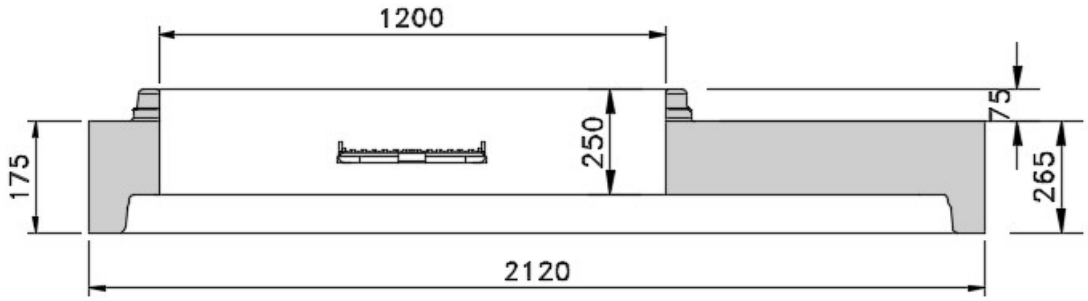
A	B	C	D	E	F	F
(mm)						(kg)
1200	1455	1000	1005	128	75	1300
		750	755			975
		500	505			650
		250	255			330
1500	1780	1000	1005	140	85	1730
		750	755			1330
		500	505			860
		250	255			430
1800	2080	1000	1005	140	85	2060
		750	755			1545
		500	505			1030

Each chamber ring has 3No. lifting pins spaced at 120°. Available with no steps, steps, 150mm ladder or 200mm ladder.

Reducing Slabs



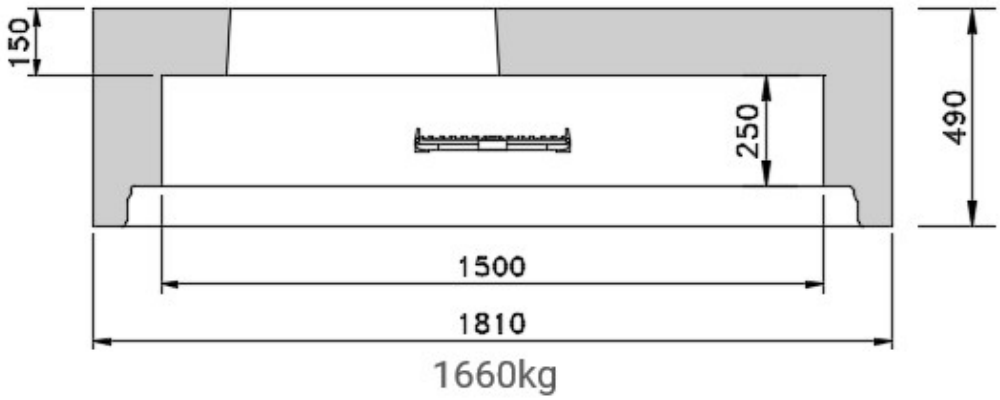
700kg

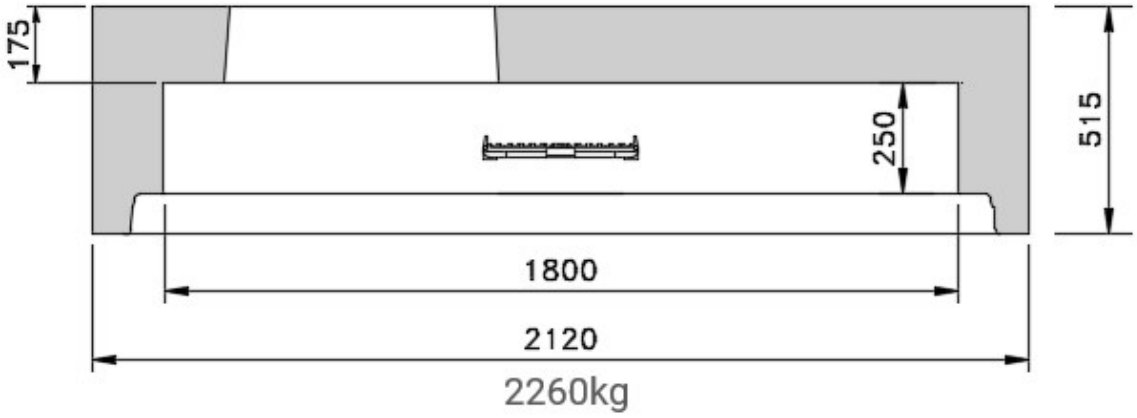


1100kg

Available for installations with a depth to soffit >3.0m and a minimum head clearance of 2.0m. Each chamber ring has 3No. lifting pins spaced at 120°. Available with no steps, steps, 150mm ladder or 200mm ladder.

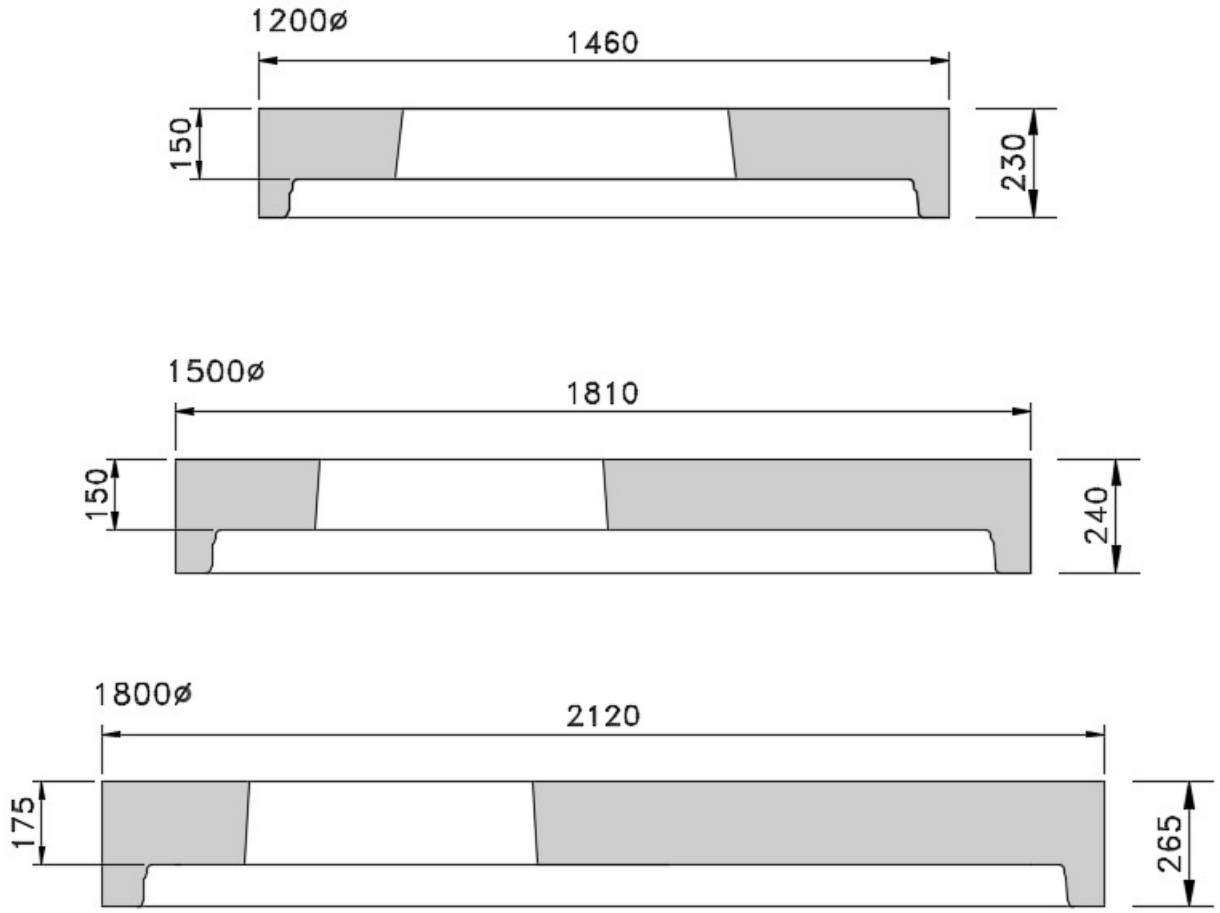
Raiser Slabs





Available as an alternative to separate cover slab and 250mm ring or when a 250mm ring is not available. Each chamber ring has 3No. lifting points spaced at 120°. Available with no steps, steps, 150mm ladder or 200mm ladder.

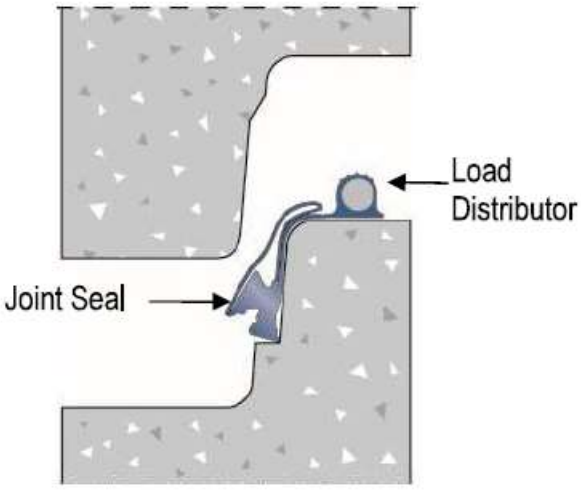
Cover Slabs

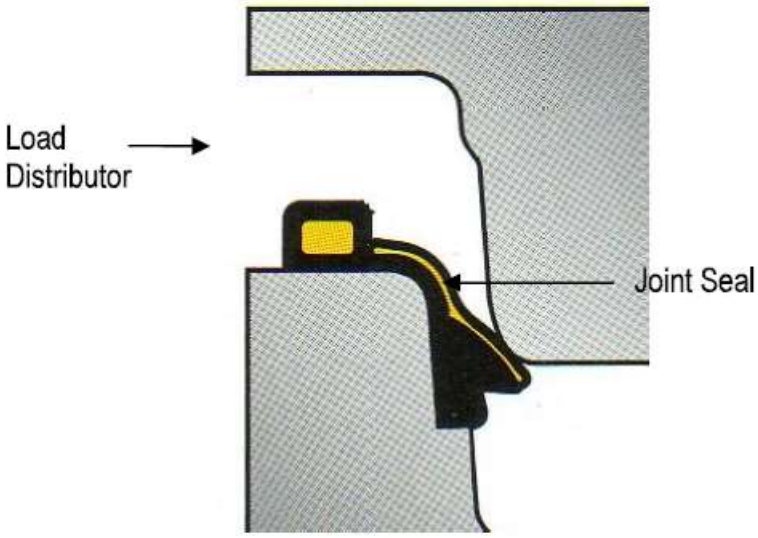


Diameter (mm)	Opening (mm)	Weight (mm)	Effective Depth (mm)
1200	600x600	615	150
	675x675	600	
	750x600	600	
1500	600x600	1170	150
	675x675	1120	
	750x600	1120	
	1200x675	960	
1800	600x600	1590	175
	675x675	1590	
	750x600	1590	
	1200x675	1440	

The products in the table above are standard eccentric openings apart from the 1500mm dia with 1200x675mm opening is a dual purpose eccentric/central opening. Special cover slabs with alternative opening sizes or central access are available subject to a manufacturing lead time. Each chamber ring has 3No. lifting points spaced at 120°.

Elastomeric Seals (2 types available – either type may be supplied)





Seal references are Forsheda F-171 or DS SDVSEAL, both manufactured to BS EN 681-1 type WC. Actual size is dependent on the manhole diameter.

Offloading and Lifting

Marshalls can offer advice and recommendations for offloading products on site and assist in the preparation of a safe delivery plan in accordance with the HSE document 'Delivering safety: co-operation to prevent workplace vehicle accidents'. Also see Marshalls advisory note on Customer offloading.

Marshalls recommend that ALL lifting operations should comply with the Lifting Operations and Lifting Equipment Regulations (LOLER) 1998, and the Provision and Use of Work Equipment Regulations 1998 (PUWER).

The lifting system used is of a 'Deha' style incorporating a cast in lift pin onto which a lifting clutch is attached for lifting. Marshalls can provide a set of 3 way lifting straps onto which the lifting clutches are fixed. The lifting straps are supplied for sale or hire and are fully certified.

The lift clutches are attached to the lift pins by lowering the clutch slot over the lift pin and rotating the tab until it rests on the concrete surface, with the tab facing the direction of the lift.

Correctly attach the lift clutch;-

Note:
DN1200 units – 3 No. 2.5 tonne capacity
DN1500 units – 3 No. 5.0 tonne capacity
DN1800 units – 3 No. 10.0 tonne capacity

3 way lifting straps with protective sleeve

Assembly

Excavation and Formation

Normal considerations should be taken into account when assessing the suitability of the formation. The manhole can be constructed on either; -

- Minimum 150mm pipe granular bedding material being 5-20mm graded, 14mm, 20mm or 40mm single size suitably compacted to provide a level base.
- 150mm Gen 1 (C8/10) concrete. The base unit should be placed whilst the concrete is wet so the base can be set level. Alternatively, the concrete can be left to set and a levelling screed of 15-20mm sand/cement will be required to prevent point loading on the base unit.

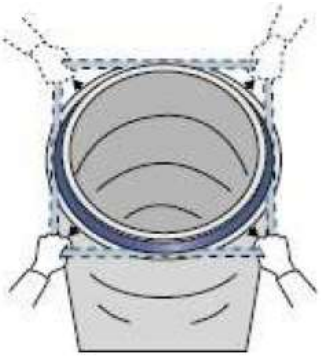
Note: In poor or wet ground conditions, a concrete pad is advised. Normally a granular bedding is recommended where the safe ground bearing pressure is >200kN/m². Marshalls Technical Department can advise if required.

Seal Installation

The seal is ideally positioned on the unit before the unit is installed as per the following; -

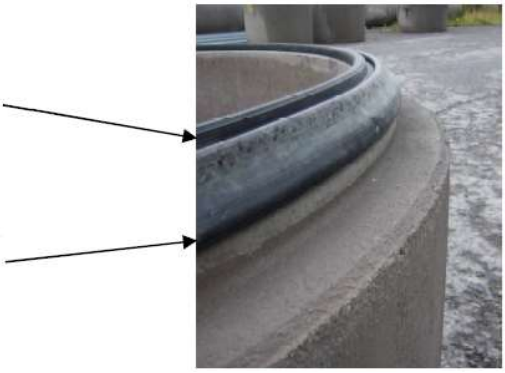
Stretch the seal onto the spigot of the manhole and position it against the rest shoulder.

Equalize the stress in the seal by lifting and releasing at a few points.



Load Distributor

Check that the internally lubricated skin is correctly positioned and sitting against the rest shoulder all around the manhole.



Note: External lubrication is not required!

Shaft Construction

Once the bedding has been prepared, the base unit can be positioned.

It is advisable to lay the pipeline up to and including the rocker pipe on the downstream side.

A butt pipe should then be inserted into the outlet pipe seal on the base unit.

The unit can then be jointed with the rocker pipe as it is finally positioned in the excavation. A final level check should be carried out.

The base unit can then be backfilled with granular pipe bedding around the pipes and suitable material around the shaft.

The remainder of the shaft can then be constructed by centering the upper manhole section, and lowering into place. The design of the joint encourages 'self centering'.

For ease of installation, it is advisable to backfill the shaft as it is built. This provides ease of access to unhook the lift clutches and to guide the units into position.

A joint gap of between 10-20mm should be obtained after jointing. The gap may reduce as the shaft is constructed dependent on the depth to the minimum 5mm. 250mm deep rings may require slight downward pressure to the joint.

The cover slab can also be installed using the same lifting system. The slab may need slight vertical downward pressure to seal the unit, as the self weight may not always be sufficient.

Ensure the seal is brushed clean (and dried when necessary) to aid in achieving a satisfactory joint.

The shaft can then be completed using adjusting units and an access cover and frame.

Pipe Jointing to Perfect Bases

Perfect Manhole bases are usually supplied with inlet/outlet seals specifically for the 100-675mm pipework being used. When the seals are supplied the bases will be delivered with the seals set in the base wall. When a seal is not available and for pipe sizes ≥750mm where a seal is not provided, the base will be provided with a hole only. For bases without a seal the use of a class 1 mortar or an epoxy resin (preferred) to set the pipe into the base rebate is acceptable. The connection is dependent on the pipe type as below.

'Sewerage Sector Guidance Appendix C' requires a flexible joint as close as possible to the manhole face for movement. The base joint can be considered as this joint; however, it is still advisable to provide short length pipe connections acting as rocker pipes and of the same length as would normally be required. For concrete pipes the hole and seal are designed to accommodate spigot and socket butts. The arrangement then provides two flexible joints for all connecting pipes as required by 'Sewerage Sector Guidance Appendix C'.

General; -

- All pipes to be jointed into the Perfect Manhole base should be cut square with all sharp edges removed and where necessary chamfered.
- All pipes and F-910 seals fitted to the Perfect Manhole base should be lubricated with Marshalls pipe jointing lubricant.
- All pipes should be centred and pushed squarely into the F-910 seal unit an even joint gap is achieved.
- It may be necessary to utilize mechanical means such as an excavator bucket. In which case a timber should be placed against the pipe to prevent damage to the pipe.
- If the F-910 seal has to be removed, when it is put back, locate the seal back into the hole without any lubricant.
- Care should always be taken to prevent soil and stones from entering the joint.
- A joint gap of between 5-20mm should be obtained between the end of the pipe and the concrete channel. An even joint gap should be achieved.
- The permitted deflection on the pipe / base joint is 2 degrees.
- The provision of a short length 'butt' pipe is advised particularly with flexible pipelines.

DN1200 base units – generally suitable for connecting pipework up to and including DN300.
DN1500 base units – generally suitable for connecting pipework up to and including DN675.
DN1800 base units – generally suitable for connecting pipework up to and including DN900.

Concrete Pipe Connections; -

- A socket butt at the upstream and spigot butt at the downstream end are required.
- Using Marshalls pipe lubricant, thoroughly grease the seal and butt or spigot end of the pipe.
- The pipe can now be jointed into the base.

Clay / Solid Wall PVC Pipe Connections; -

- Cut and chamfer the pipe prior to jointing.
- Clean and lubricate the pipe end to be jointed.
- Care should be taken to ensure the pipe is not damaged during mechanical jointing.
- The pipe can then be jointed directly into the F-910 seal.

Twinwall Pipe Connections up to and including 600mm diameter; -

- Cut and remove all sharp edges to jointing.
- Ensure the pipe is clean.
- Locate the twinwall seal into the pipe groove as per the manufacturer's instructions (this may vary between manufacturers)
- Lubricate the F-910 seal, the twinwall seal and the rib of the twinwall pipe prior to jointing.
- Care should be taken to ensure the pipe is not damaged during mechanical jointing.
- For twinwall pipes greater than 600mm a F-910 seal is not provided, the use of a class 1 mortar or an epoxy resin (preferred) to set the pipe into the base rebate is acceptable.

Ultrarib Pipe Connections up to and including 600mm diameter; -

- Cut the Ultrarib pipe according to the manufacturer's instructions.
- Stretch the adaptor sleeve on to the end of the pipe.
- Ensure the adaptor sleeve is evenly distributed over the end of the pipe.
- Ensure both the manhole base F-910 seal and adaptor sleeve are clean and dry.
- Evenly apply lubricant to both the F-910 seal and the adaptor sleeve.
- Centre the pipe and push it into the seal until the pipe end is flush with the inner wall.
- When fitting Ø225 and Ø300 pipes, mechanical assistance may be required.
- Care should be taken to ensure the pipe is not damaged during mechanical jointing.
- When the pipe and adaptor sleeve are pushed into the manhole base F-910 seal, both sealing elements are designed to deform. This creates sealing pressure on both the spigot and the socket, ensuring a watertight seal.

Notes

The Installer is to ensure that the connecting pipe is within the manufacturers specifications.

The Perfect Manhole base F-910 seals have been specifically designed to ensure a watertight seal and operate within an acceptable tolerance range of connecting pipe types.

Should the outside diameter of the pipe be out of the specification tolerances, Marshalls cannot accept responsibility for the performance of the joint.

Marshalls is committed that its products are designed and manufactured to ensure the safety of users. Installation of products involves breaking ground and is thus considered as construction work under the Construction (Design and Management) Regulations 2015.

Marshalls puts a great deal of effort into ensuring that its designs are safe and will provide structural details to the Principal Designer nominated by the Construction Site Client (please contact Marshalls Technical Office).

Backdrop Manholes

Provide B12 dowels at 150mm centres vertically either side of the vertical pipe, set into the chamber wall with epoxy resin. The dowels are to be set into the wall a maximum of 75mm to ensure sufficient cover to the dowl on the internal face.

The vertical pipe can then have a concrete surround as detailed in SSD DCG and a monolithic structure will be achieved.

Jointing in Extreme Cold Weather

When jointing connections into the Perfect Manhole base in extreme cold conditions follow the below procedures; -

- Ensure the seals are clean and free from dirt, water and frost prior to installation.
- If the seals have been stored below freezing, then
    - Remove frost
    - Warm the seals by storing them at room temperature (in a canteen/truck cab) for a few minutes prior to installation to aid the lateral pipe assembly.
    - Alternatively, the seals can be ‘banged’ with a rubber mallet or against the manhole base to energise the rubber.
- Seals should be replaced back into the manhole base, without lubrication.
- Cut and chamfer the pipe.
- Lubricate the connecting pipe and the sealing lips of the F-910 seal with Marshalls lubricant.
- Centre the end of the pipe and push it into the seal until fully home.

Perfect Sealed Manhole System in High Water Tables

The units are designed, manufactured and tested in accordance with BS 5911-3 and BE EN 1917 'Concrete Manholes and Inspection Chambers'.

The requirements in BS EN 1917 for watertightness is for the units to withstand a 5m head for **15 minutes only**. This is primarily to simulate **temporary** surcharge conditions and not a permanent head of water.

Manholes subject to a high water table i.e. a permanent head of water, will be subject to the following.

Potential Flotation

This can occur when the weight of water displaced by the shaft exceeds the weight of the shaft itself.

Watertightness

Whilst a sealed manhole system offers substantial enhanced watertightness over traditional construction, it has not been designed for a permanent head of water and the performance cannot be guaranteed under such circumstances. It will however comply with Class 1 Watertightness in accordance with BS En 1992-2 Design of Concrete Structures Part 3 – Liquid retaining and containment structures.

To overcome the above, a 150mm concrete surround should be installed to provide additional buoyancy and aid watertightness. The concrete surround should be provided to the height of the water table.

The matrix below provides information of permitted depths in a high water table to prevent potential flotation. The depths given have a factor of safety against flotation of 1.2, which is consistent with the partial safety factor for liquid loads in BS EN 1991-4:2006 Eurocode 1 'Actions on structures'.

Individual assessments can be provided if required.

Manhole Depth (m)	Water Table from Ground Level (m)							
	0.5	1.0	1.25	1.5	1.75	2.0	2.5	2.75
3.0	Buoyant							
3.5	Buoyant	Buoyant						
4.0	Buoyant	Buoyant	Buoyant					
4.5	Buoyant	Buoyant	Buoyant					
5.0	Buoyant	Buoyant	Buoyant	Buoyant				
5.5	Buoyant	Buoyant	Buoyant	Buoyant	Buoyant			
6.0	Buoyant	Buoyant	Buoyant	Buoyant	Buoyant	Buoyant		

Notes:

Frictional resistance from backfill has not been considered, as this cannot be relied upon in a temporary works condition. Additionally, the value used would vary dependent on the backfill used.

Technical Advice Note

Steep Pipe Gradients Connecting to Perfect Sealed Manhole System.

F-910 seals fitted to the Perfect Manhole base will provide a watertight seal for connecting pipes with a gradient shallower than 1:39. When the gradient is 1:39 or steeper the base will require a pan slope to ensure a watertight seal and to avoid the use of a bend. Marshalls Design Team will design the required pan slopes when the gradient is annotated on the layout drawing, when it is not annotated (private connections, gully connections etc), it is the Contractors responsibility to inform Marshalls of the pan slope requirements. Alternatively, a bend will need to be installed on the manhole.

Gradient	Pan Slope	Gradient	Pan Slope
1:1	6	1:21	3
1:2	6	1:22	3
1:3	6	1:23	3
1:4	6	1:24	2
1:5	6	1:25	2
1:6	6	1:26	2
1:7	6	1:27	2
1:8	6	1:28	2
1:9	6	1:29	2
1:10	6	1:30	2
1:11	5	1:31	2
1:12	5	1:32	2
1:13	4	1:33	2
1:14	4	1:34	2
1:15	4	1:35	2
1:16	4	1:36	2
1:17	3	1:37	2
1:18	3	1:38	2
1:19	3	1:39	1
1:20	3		