BORELINE

FLEXIBLE RISING MAIN

INSTRUCTIONS FOR USE
&
TECHNICAL INFORMATION

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hose.manufacturers

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Manufactured By
Hose Manufacturers
Micro Street, Triangle Estate, 7530
Telephone: +2721 948 3971 Facsimile: +2721 946 2379
Website: www.hoses.co.za
Email: sales@hoses.co.za

ISO 9001:2000 REGISTERED

Boreline Instruction & Technical Manual

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Introduction to BORELINE

Boreline is manufactured in South Africa by Hose Manufacturers, a Company established in early 1960 and specialising in the manufacturer of fire, industrial, mining, and agricultural hoses.

Introduced in 1993, Boreline synthetic flexible riser has proved itself throughout Africa, Australia, North and South America, Europe and in parts of the Middle East for smooth and cost-effective borehole pump installation.

Easy to install and retrieve, Boreline is designed as a long lasting replacement for steel riser pipes, which in aggressive water conditions are prone to rust and encrustations. Fully approved by the WRAS (Water Research Advisory Council). Boreline also benefits from BS 6920:1996 accreditation - suitable for use in potable water applications. Boreline has NSF / ANSI Std 61 AWWA approval for drinking water system components.

Totally resistant to corrosion, this riser also benefits from an unrivalled choice in couplings - available in a wide range of sizes and materials. (Including a new High Tensile Polymer version for the smaller sizes.)

Extremely cost-effective and with very little downtime or maintenance required, Boreline is made from exceptionally strong, high tenacity yarns and thermoplastic materials which provide superior durability.

Rising Mains

Steel Risers have historically been used for borehole rising mains. They are generally available in 3m or 6m lengths (10 / 20 ft) with sizes 1½" to 3" being screwed together, while 4" and above are usually flanged & bolted.

As a protection against corrosion these pipes are galvanized or epoxy-coated but such coatings have proven not to be 100% effective in protecting the steel. The slightest damage to the coating can be a source of localised corrosion, while screwed and flanged joints are always susceptible to corrosion.

Due to their weight and size, steel pipes require large vehicles for transportation and handling can be awkward in confined spaces.

Boreline is a Flexible Rising Main that has been designed to benefit the user in the long term. It simplifies the work involved in installing and removing submersible pumps. Constructed of high tenacity polyester yarns with an inner and outer coating of polyurethane, the product provides excellent resistance to abrasion resulting in a durable product that has already proved itself worldwide.

Boreline is lightweight, flexible and flat and is supplied in compact rolls. It is easily stored and handled in comparison to steel and conducive to safe working conditions.

Boreline is available in any continuous lengths of up to 200m (650 ft). At the pump end the patented double-ring coupling is screwed into the non-return valve and attached to the hose. On the upper end the coupling screws into the base plate or head works. This simple operation greatly reduces the installation or retrieval time of the system. Less labour is also required.

Corrosion and Scaling

Boreline is totally resistant to corrosion, scaling and biological growth.

Corrosion affects steel risers and therefore their strength, while internal scaling or encrustation affects the efficiency of the system. Corrosion takes place on the surface of the pipe and can lead to holes. Apart from causing a loss of efficiency through leakage, the water emanating from these holes can damage the casing of the borehole.

Corrosion also occurs on the threaded joints of screwed pipe. The threads can corrode to such a degree that the rising main can break off at these points and the rising main, complete with pump and cable, can be lost down the borehole. Not only is this a loss of the pumping equipment but if the riser and pump cannot be recovered, the borehole can be rendered unusable.

Corroded threads and bolts on flanges are extremely difficult to remove and can require flame cutting for removal from the borehole. It is this time consuming exercise that causes borehole system users to be reluctant to carry out preventative maintenance on the borehole. If the correct equipment is not available this can be a very costly exercise especially in remote areas.

Scale or encrustation often forms on the inside of the steel pipes and reduces the effective bore of the pipe. Additionally, the scaling has a higher coefficient of friction to that of new steel and both of these factors cause a substantial increase in the friction through the pipeline.

This increase in friction causes various problems:

1. Reduces flow
2. Prevents the pump from operating at its best efficiency
3. If severe, can cause over heating of the pump motor because of reduced cooling.
4. Reduces the efficiency of the system increasing lifetime costs
5. Substantially increases pump running costs

Preventative maintenance is seldom carried out on rising mains and their borehole pumps due to the costs of removal. All too often borehole pumps are run to destruction before replacing but little consideration is given to the rising main on which the pump is suspended. Borehole pumps can outlast the life of a steel rising main.

As systems deteriorate they cost more to run, in addition to this, complete operational failure can result in long down time and possible borehole loss.

Due to the flexible nature of the Boreline scaling does not build up internally and its efficiency is maintained throughout its life. Boreline is quick and easy to install thus reducing installation costs and allowing more frequent pump maintenance. The efficiency of the entire system is, thereby, retained and downtime kept to a minimum.

System Efficiency

In recent years the “life costs” of pumping systems have become of prime concern to design engineers and end users.

A borehole must be designed to achieve maximum efficiency in both the short and long term – costs to be considered include:

1. Initial capital costs
2. Amortisation of investment
3. Power consumption
4. Supervision and maintenance
5. Cost of down time and standby equipment.

A poorly designed borehole or pumping system can result in unacceptably high operational costs. Great care must to be taken when considering the design of the borehole and when selecting a rising main and pump.

A pump should always run close to its best efficiency point but if a steel rising main is used and is not regularly maintained, increased friction due to scale will cause the pump to operate out of its design parameters causing numerous problems. Investment in an efficient system will reduce operational and maintenance costs.

As an example, a 4” Boreline rising main set at one hundred metres depth, with a flow of 54 m^3/hr, has a friction loss of approximately 1.5 metres while an encrusted steel pipe can have a friction loss of 9 metres. This can have severe consequences on the system, due to reduced supply rates, and equates to an additional cost of approximately R 4 600 per year in energy costs alone. These costs cannot be ignored.

An added benefit of Boreline is that it expands slightly under pressure providing excellent flow characteristics throughout its life.

Description

Boreline has been specifically designed to replace rigid risers. Because of its design the use of Boreline results in major savings in time and labour. A pump and column can be installed and retrieved in a fraction of the time required for the rigid riser. In the long term, Boreline is immune from corrosion or internal scaling resulting in further savings.

Boreline is a flexible rising main constructed using a combination of the latest high tenacity yarns and thermoplastic materials available in diameters ranging from 1" to 8". Quality assurance and control are integral to all design and manufacturing procedures through the applications of the International Standards Organisation ISO 9001:2000.

Boreline incorporates a cable support rib running the entire length of the hose which allows the electrical cable to be attached to the hose with re-useable cable straps. This cable support rib, which is applied during manufacture, forms an integral part of the hose and has connection points at 1m (3 ft) intervals. Boreline is suitable for operation to depths of 200m (650 ft).
Boreline couplings are available in 316 Stainless Steel or Aluminium Bronze (Additionally in High Tensile polymer for 1" - 2" sizes). The coupling is made up of a body and two sets of fastening clamps.

Product Approval

(Water Research Advisory Council) WRAS Approval Ref 512 505 Dated January 2006. This is the new Standard which supersedes WRC.

Boreline has been approved by the UKAS accredited ITS Laboratories. (Date approved 30 June 2000). Boreline meets with the requirements of the WRAS. Tests of Effects on Water Quality/BS6920:1996/Cold Water Use.

Boreline also has NSF / ANSI 61 Drinking Water approval and is approved for use in potable water applications by The Australian Water Quality Centre (Date tested 13.03.98).

Hose Manufacturers satisfies the requirements of ISO 9001: 2000 Quality System assessed by the South African Bureau of Standards (SABS).

Specifications

The Riser

A special rib is incorporated in the cover to facilitate the attachment of securing cable straps for the electric cable. The Flexible Riser is constructed from high tenacity polyester yarns, which are circular woven and then totally encapsulated to form an integrated cover and lining of a high performance polyurethane elastomer, which is approved for use with potable water.

Riser Specifications

The riser has a minimum theoretical short length burst pressure and tensile strength as stated on the table below. The average extension is no more than 3% and the maximum diametric swell 15%. The material is capable of operating in water with a pH from pH 4 to pH 9. The manufacturer provides a warranty of 5 years against materials and manufacturing defects.

Couplings

The flexible riser is fitted with fully re-usable couplings each comprising a body and two outer fastening clamps. The body of the coupling contains two ribs over which the hose fits and the clamps are tightened – the two fastening clamps being split into three equal parts. Couplings are made in 316 Stainless Steel for use with drinking water or where water is of an aggressive nature in Aluminium Bronze. For extreme conditions the Couplings are also available in 904L. (Additionally in High Tensile Polymer for 1½" & 2" sizes). The couplings are supplied with BSP or NPT male threads for attachment to the pump at one end and to the surface head works at the other.

Nominal Size	1"	1½"	2"	3"	4"	5"	6"	8"
Inside diameter	24mm	40 mm	50 mm	76 mm	102 mm	127 mm	152 mm	200 mm
Burst pressure	85 bar	65 bar	65 bar	60 bar	58 bar	58 bar	58 bar	45 bar
Operating pressure	40 bar 580 psi	30 bar 425 psi	30 bar 425 psi	25 bar 350 psi	25 bar 350psi	22 bar 310 psi	22 bar 310 psi	12 bar 175 psi
Tensile strength	1.4t	3,000 kg	4,000 kg	7,000 kg	12,000 kg	16,000 kg	20,000 kg	22,000 kg
Weight of Boreline	0.2 kg/m 0.13 lb/ft	0.50 kg/m 0.34 lb/ft	0.55 kg/m 0.37 lb/ft	0.95 kg/m 0.64 lb/ft	1.40 kg/m 0.94 lb/ft	1.70 kg/m 1.14 lb/ft	2.50 kg/m 1.68 lb/ft	3.7 kg/m 2.49 lb/ft
Minimum well diameter	76mm 3 in	102 mm 4 in	102 mm 4 in	152 mm 6 in	203 mm 8 in	255 mm 10 in	305 mm 12 in	406 mm 16 in
Coupling clamp torque setting	10Nm 7.3 ft.lb	10 Nm 7.3 ft.lb	12 Nm 8.8 ft.lb	30 Nm 22 ft.lb	30 Nm 22 ft.lb	40 Nm 29 ft.lb	45 Nm 33 ft.lb	45 Nm 29 ft.lb
Outer diameter of coupling	60mm 2.35 in	80 mm 3.25 in	95 mm 3.75 in	140 mm 5.55 in	165 mm 6.50 in	200 mm 7.90 in	230 mm 9.10 in	350 mm 13.80 in
Weight of coupling each	1.20 kg 2.6 lb	3.10 kg 6.8 lb	3.50 kg 7.7 lb	7.50 kg 16.6 lb	10.00 kg 22.1 lb	14.50 kg 32.0 lb	18.10 kg 40.0 lb	41 kg 61.6 lb
Weight of water	0.60 kg/m 0.40 lb/ft	1.94 kg/m 1.30 lb/ft	2.25 kg/m 1.52 lb/ft	5.10 kg/m 3.42 lb/ft	9.05 kg/m 6.10 lb/ft	14.15 kg/m 9.50 lb/ft	20.35 kg/m 13.7 lb/ft	31 kg/m 20.9 lb/ft

Due to continual Research & Development the above specifications are subject to change without notification

Benefits of BORELINE

- Available in continuous lengths of up to 200m (650 ft) (8" Boreline limited to 100m)
- Water Research Advisory Council approved
- NSF / ANSI 61 Drinking Water approved
- Advantageous in restricted working area
- Quick and easy to install and retrieve
- Not subject to microbiological attack
- Easy to store, handle and transport
- Corrosion free and does not scale
- Superior flow rates
- BS6920 accredited
- Long life expectancy
- Potable water approved
- Light weight and rolls flat
- Less manpower required
- Tremendous Tensile Strength
- Superb hydraulic performance

Applications

Boreline has been used in a variety of new and replacement applications. These include the pumping of potable or mineral enriched ground water, regular and emergency dewatering of mines and quarries, ground water control on landfill and building sites and to create salt water barriers for the prevention of saline intrusion into potable ground water.

Storage and Handling

Boreline is available in continuous lengths of up to 200m (650 ft) – it is normally supplied crated but any odd or unused lengths should be coiled loosely and covered for protection. It is recommended to keep Boreline out of direct sunlight if it's to be stored for a prolonged period.

Because Boreline is lightweight and can be rolled up flat, an ordinary van or pick-up truck can be used to transport it to site, instead of the cumbersome vehicle necessary for rigid pipes.

Disposal

Boreline will normally be supplied cut to exact length to suit the borehole but occasionally an adjustment may be necessary on site and a length of hose found surplus to requirements. This should be disposed of properly in accordance with local / national industrial waste disposal regulations.

Safety

Boreline is light in comparison to steel rising main and therefore presents a lesser hazard to personnel when handling.

Because Boreline is supplied in continuous lengths care must be taken to ensure that it is either laid out neatly on site or coiled on a drum (if space is limited) whenever it is being installed or retrieved. An untidy workplace is a dangerous workplace.

Installation instructions must be followed. Boreline must be installed by competent personnel. Care must be taken to ensure that the correct tools are available for the installation.

Hazards

Boreline presents no chemical or biological hazards in normal usage, nor during installation or retrieval.

If Boreline is involved in a **fire**, during storage or transportation, toxic & irritating gasses may be produced – **if inhaled, medical advice should be obtained immediately**. Molten material can cause severe burns – no attempt should be made to remove any such contamination from the skin but **should be flushed with copious amounts of cold water and medical assistance sought without delay.**

BORELINE Installation / Retrieval Procedure

Installation : Before you Start

Ensure you have the following on site :

- Submersible Pump
- Base plate and wellhead assembly
- The required length of Boreline
- Electrical cable – equal to the length of Boreline – plus 5% minimum.
- Two Boreline Couplings. For 1" to 8" hose each coupling consists of a coupling body and two outer rings. The outer rings each comprise three equal segments - three Allen screws are supplied to connect each segment with its neighbour.
- Sufficient Boreline Cable Straps to attach the power cable to the Boreline along the entire length of the riser. (1 cable strap is needed for each metre (3 ft) of riser.
- Short lengths of Polyethylene or PVC hose to act as a cable guard where cable passes over the coupling – and PVC tape to secure it to the cable.
- 2 sets Boreline Installation Clamps*
- Tripod or Crane and / or the Rolling Wheel assembly*

* These items are also required for pump retrieval.

The following table sets minimum requirements for the use of Boreline with regards to wellcasing diameters:

Boreline Diameter		**Aprox Flat Width**		**Minimum Casing Diameter**	
Inches	mm	inches	mm	inches	mm
1	25	1.7	43	3	76
1,5	40	2.6	65	4	102
2	50	3.1	78	4	102
3	76	4.9	125	6	152
4	102	6.7	170	8	203
5	127	7.9	200	10	255
6	152	9.7	248	12	305
8	204	12.6	320	*	*

* Dependant on pump and couplings being used

Fitting the BORELINE coupling and Riser to the Pump

1. Ensure that the ends of the riser are square. Trim with a sharp knife or hacksaw if necessary.

2. Screw the Boreline coupling into the check-valve (non-return valve) located at the top of the pump. **A 6mm (¼") hole should first be drilled in the non-return valve to allow draining upon system removal if no break-out plug is being fitted. Please note that you need to check with the pump manufacturer on this as some do not condone this method.**

3. Push the Boreline riser over the coupling body making sure the riser end is flush with the shoulder at the threaded end of the coupling. **Do not use any kind of lubricant.**

4. Fit the first ring with the three segments, over the rib closest to the threaded end of the coupling body. Tighten all three screws evenly, ensuring the gaps between the segments are even. When fully tightened the gaps between these segments should be 1-2mm. If a Torque wrench is not available we recommend hand tightening with long series allan keys. Do not overtighten or use extension bars.

   Coupling Torque Settings

Size	Nm
25mm	10
40mm	10
50mm	12
76mm	30
102mm	30
125mm	35
154mm	40
204mm	40

5. Fit the second ring over the second rib positioning the gaps half way between the gaps of the first ring and tighten as above.

Fitting the Power Cable

1. The Boreline riser should be laid on the ground with the rib facing up.

2. Push a Boreline cable strap through the cable rib openings every metre (3 ft) along the entire length of the riser. Turn the riser over as you proceed to the next opening so that by the time all the cable straps have been inserted the rib of the riser is facing down. **(A number of red cable straps are supplied – these should be used closest to the pump to serve as an indicator when the pump is being removed from the borehole.)**

3. Roll the power cable out next to the riser – allowing a little slack (5%).

4. **Fit a protective sleeve to act as a guard over the cable where it will pass over the coupling and secure with PVC tape. PVC reinforced hose or Polyethylene tube can be used.**

5. Connect the power cable to the pump motor. (This work should be carried out by a qualified electrician only.)

6. Starting from the end nearest the pump lift the power cable onto the centre of the riser. Bring the cable strap **around** the power cable, and secure using a **Clove Hitch Knot (See page 19).**

7. Pull tight ensuring the power cable is hard against the Boreline riser. Buckle the strap. The power cable will be on the opposite side of the Boreline to the support rib.

8. Move to the next cable strap. **Before tightening the strap snakes the power cable along the riser to allow the latter to stretch slightly under load.**

9. Repeat the procedure for fastening the cable strap and then move to the next cable strap. **(Remember to snake the power cable along the entire length of the riser allowing approximately 5% slack.)**

10. Any additional high / low level probes etc. can be attached directly **to the power cable** using standard cable ties, alternatively the provided Boreline Cable straps can be used tying every 4^{th} or 5^{th} meter.

BORELINE Installation Procedure using a VEHICLE

A tripod or crane will be required to lift the pump into the borehole. If a tripod is used it should be positioned directly above the borehole high enough to allow the pump and clamp to be lifted over the borehole.

Connect the Boreline coupling to the pump discharge or check-valve / non-return valve and then the Boreline riser to the coupling.

Unroll the Boreline riser along the ground. Lay the power cable next to the riser along the length.

Connect the power cable to the pump motor. (This should only be carried out by a qualified electrician.) Use the Boreline cable straps to tie the power cable to the riser at the recommended intervals. (Remember to snake the power cable along the length allowing approximately 5% slack.) See 'Fitting the Power Cable' above.

Clamp the Boreline riser only **(not the power cable)** using one set of Boreline clamps approximately 500mm (18") above the pump.

Lift the pump using the clamp and lower it into the borehole until the clamp rests on the well head. Move the rolling wheel over the borehole ensuring that it is centrally positioned and secured**. (An unsecured roller can move and cause damage to the hose - or injury to the operator.)**

Lift the Boreline riser over the rolling wheel with the power cable fastened and positioned.

Attach the second Boreline clamp to the other end of the riser and secure it to the front of the installation vehicle. Reverse the vehicle so that the vehicle now takes the weight of the pump. Remove the first clamp. (The full load will now be taken by the vehicle and rolling wheel.)

Drive the vehicle slowly forward allowing the pump and riser to be lowered into the borehole. Joiners, couplings and clamps must **not** pass over the rolling wheel.

When the vehicle is close to the rolling wheel, clamp the riser above the wellhead. Lower the riser slightly so that this clamp now rests on the wellhead and remove the other clamp from the vehicle.

Attach the second Boreline coupling and head works to the end of the riser.

Raise the head works using the tripod or crane until the weight of the whole assembly is taken, remove the clamp and lower the assembly onto the borehole.

BORELINE Retrieval Procedure using a VEHICLE

Stop the pump. If a 6mm (¼") hole has been drilled into the check valve allow the water to drain down to the static water level – allow 30 seconds per metre (10 seconds per foot).

Disconnect the electrical supply and discharge pipe-work.

Using the tripod or crane lift the Boreline out of the borehole and clamp the riser with the Boreline clamps. **Do not clamp the cable. Lower the Boreline so that the clamp rests on the casing and takes the complete weight.**

Place the rolling wheel against the borehole ensuring that it is centrally positioned and secured**. (An unsecured roller can move and cause damage to the hose - or injury to the operator.)** Lift the Boreline and fold the Boreline over the rolling wheel and attach it to the vehicle using the second set of clamps. Ease the vehicle away from the borehole so that it takes the weight of the assembly and remove the first clamp.

Drive the vehicle slowly away from the borehole lifting the Boreline and pump.

As the pump approaches the top of the borehole, clamp the riser and allow the clamp to rest on the borehole. (The arrival of the pump will be indicated by the red cable ties.)

Use the tripod or crane to lift the pump out of the borehole.

Please note. If the Boreline and pump have to be removed while full of water the column will be considerably heavier than normal. In this case make sure to allow for the extra weight when using lifting devices and vehicles.

See full specification table, above, for nominal weights of the Boreline and water column per metre / foot. The addition of pump, cable and accessories weights will give the total weight of the column to be lifted.

BORELINE Installation Procedure using a CRANE

Connect the Boreline coupling to the pump discharge or check-valve / non-return valve and then the Boreline riser to the coupling.

Unroll the Boreline riser along the ground. Lay the power cable next to the riser along the length.

Connect the power cable to the pump motor. (This should only be carried out by a qualified electrician.) Use the Boreline cable straps to tie the power cable to the riser at the recommended intervals. (Remember to snake the power cable along the length allowing approximately 5% slack.) See 'Fitting the Power Cable' above.

Calculate the maximum height that the eye of the crane can achieve above the wellhead. Clamp the Boreline riser only **(not the power cable)** using one set of Boreline clamps approximately 1000mm (3 ft) less than the crane maximum height from the base of the pump.

Connect the clamp to the crane hook and lift the Boreline to the maximum height of the crane, guiding the pump as it is moved into the vertical position over the borehole.

Lower the pump down the borehole until the clamp rests on the wellhead.

Secure the second clamp at the maximum lifting height to the Boreline riser less 1000mm (3 ft), raise this clamp to take up the slack and release the first clamp off the well head. Once the top clamp has taken all the weight remove the lower clamp. Repeat this operation to continue lowering the pump down the borehole.

On the last lift raise the head works until the weight of the whole assembly is taken, remove the clamp and lower the assembly onto the borehole. The Boreline **must not** be dragged over the edge of the casing as this will cause damage.

BORELINE Retrieval Procedure using a CRANE

Stop the pump. If a 6mm (¼") hole has been drilled into the check valve allow the water to drain down to the static water level – allow 30 seconds per metre (10 seconds per foot).

Disconnect the electrical supply and discharge pipe-work.

Lift the headplate off the borehole using the crane and slings to approximately 3m (10 ft) above the well head. Clamp the riser using a set of Boreline clamps at the wellhead level. Lower the riser to allow the clamp to take the full load. Lower the headplate to the ground and remove it from the riser. **Do not clamp the cable.**

Once the headplate has been removed the Boreline can be drawn from the borehole to the maximum height allowed by the crane and clamped, again, using the other set of clamps at the well head.

This procedure is repeated until the pump is lifted clear of the borehole.

Please note. If the Boreline and pump have to be removed while full of water the column will be heavier than normal. In this case make sure to allow for the extra weight when using lifting devices and vehicles.

See full specification table, above, for nominal weights of the Boreline and water column per metre / foot. The addition of pump, cable and accessories weights will give the total weight of the column to be lifted.

Boreline Questions & Answers

1. Will the riser withstand the forces and stresses involved in pumping?
It can operate continuously at pressures up to 25 bars with a good safety factor over its life while also maintaining its design tensile load. In practice most wells operate far below the design pressure and tensile loadings of Boreline thus giving safety factors way in excess of the requirement.

2. Abrasion resistance. Will Boreline cope with sand in the pumped water?
The materials used in Boreline are particularly resistant to abrasion and have been shown to resist particulate matter such as sand extremely well.

3. Can Boreline tolerate dragging across the ground?
Normal dragging and abrasion encountered during riser installation causes no visible damage. Care should, though, be taken to avoid any snagging of the hose on the well head or any sharp objects in the vicinity.

4. Temperature of Operation. What water temperatures can be tolerated?
Boreline will safely handle water up to 60°C - this includes the vast majority of likely applications. (Use of Boreline in water temperatures above 60°C will reduce its working life.) For advice refer to your Boreline distributor.

5. Water Quality. Is Boreline restricted with respect to Water Quality?
A pH range of 4-9 can be safely tolerated for pumped water temperatures below 30°C. At temperatures in the 30°C to 55°C the recommended pH range is from pH5 to pH9. Boreline is resistant to a wide variety of chemicals, details of which are available on request.

6. Failure of the Riser. How can I retrieve the pump if the riser fails?
In the event of very severe riser misuse, Boreline is designed to fail safe. I.e. if the riser bursts it retains its longitudinal strength and the pump can be withdrawn attached to the riser.

7. Can I use the riser for applications other than rising mains?
Boreline can be used for most submersible pump operations and may also be used as a delivery hose for a wide range of fluids. However, Boreline is designed to a higher specification than most other delivery requirements and for more general application you should contact your local Flexible Pipeline distributor or the manufacturer for advice on the most economic systems.

8. What couplings are available?
A range of reusable couplings is available specifically designed for on-site attachment. The stainless steel or aluminium bronze couplings (& High Tensile Polymer in 1½"& 2" sizes) complement the riser, having a good resistance to aggressive water and the benefits of long life and low maintenance.

9. How do the couplings work?
1½" to 8" couplings are double ribbed with clamps ensure no movement in any direction.

10. How strong are the couplings? Can the riser pullout?
Provided the manufacturer's instructions are followed, the couplings are stronger than the riser. The riser will tear or burst before the couplings lose their grip.

11. How's the power cable attached?
Normally cables supplying submersible pumps are attached diametrically opposite to the ridge specifically provided along the outside of the riser. The cable is attached using straps tied in a clove hitch as shown on page 14. When the pump and riser assembly are a tight fit within the casing or in dog-leg wells. the power cable should be protected particularly as it passes over the top of the pump. For absolute stability the use of a spider or centralising device is recommended.

Boreline Questions & Answers

12. What if the cable is heavy or I have several items to attach?
If a safety cable/dosing tube/dip tubes, etc. are included in any installation these may be secured to the riser in the same way as the power cable or, if preferred, attached to the power cable. On lowering into the borehole care must be taken to ensure Boreline takes the entire load.

13. Can I retain the pump's non-return valve?
It is important to assist lifting of the pump and riser that the water is allowed to drain from the riser. Removing of the pump's non-return valve allows the riser to drain, thus making removal of the pump from the well easier and a non-return valve fitted at the wellhead will stop the surface system draining back through the pump. Otherwise, providing you do not contravene the pump warranty, we recommend that a 6 mm (¼") hole is drilled in the non-return valve retained in the pump. If further advice is required consult your distributor.

14. What if I forget to drill or remove the non-return valve and the riser remains full of water?
This is not detrimental to performance but care must be taken on lifting the riser full as the standard lifting clamps may not be sufficiently rated for the loading. Details of pump weight, riser size and depth should be passed to your distributor who will advise on lifting methods.

15. How can I earth my pump with your riser?
Pump manufacturer's recommendations should be followed with regard to the equipment and its electrical safety. If no other guidance is given, we would recommend using a separate earth cable from the pump to a suitable surface earthing point.

16. Does the pump torque twist the riser?
At pump start-up there is a partial rotation of the riser in the area of the pump which ceases immediately the pump speed increases and the riser fills to become a rigid system. This is not detrimental to the performance of the system, merely a consequence of the elastic nature of the riser. This property has major benefits in the resistance of shock loadings.

17. Steel risers sometimes suffer from solid deposits building up-how does Boreline perform? In operation the riser will flex continually – though imperceptibly. On stopping the pump the riser will drain and collapse to its original lay-flat state provided the non-return valve has been removed or drilled out. Because of these features solid encrustation cannot gain a grip on the Boreline.

18. Does slime and other algae-based deposit build-up inside Boreline?
One feature of the Boreline material is that it does not support algae growth. Tests performed by the manufacturer and repeated by the Water Research Centre (U.K.) have shown that algae will not grow on the riser material.

19. What pressure losses can be expected with Boreline?
Pressure losses through Boreline are lower than with any other type of riser. This Super hydraulic performance is achieved by the avoidance of internal deposit build-up. (i.e. Friction factors claimed for rigid pipe are valid only in new systems and corrosion / sedimentation in use will soon have a detrimental effect.) Being of flexible construction Boreline is designed to swell under pressure. This flexibility allows increases in the diameter, thus further reducing head loss as compared to rigid risers.

20. Will Boreline and its couplings stand up to long term use?
Extensive laboratory trials and several years practical experience in hundreds of wells world-wide has shown that Boreline and its couplings are capable of long life in conditions where steel riser would quickly fail. The recommendations made in this literature generally assume that the most extreme conditions will apply simultaneously and continuously. In practice this is generally not the case. Safety margins are therefore very high.

Boreline Questions & Answers

21. How can you be sure of the precise pump setting?
By careful design of the Boreline reinforcement, the extension of the riser has been minimised by balancing the extension effect of axial loads against the reverse effect of internal pressure. The precise extension of the Boreline riser can be predicted with reasonable accuracy, but as a rule, this will not exceed 2%. The riser swell can be up to 15% at the maximum operating pressures which benefits hydraulic efficiency.

22. Can the Boreline withstand the surge pressure due to sudden valve operation?
The ability of Boreline to safely expand under pressure minimises the effect of surge pressure. This is a major advantage over rigid risers.

23. Who has approved the riser?
The potable water qualities of the riser have a number of national approvals including United Kingdom, Germany, South Africa, America and Australia. Boreline has been installed in many countries and in a wide range of operating conditions over the last few years. It has proved to be a revolutionary solution to aggressive water problems and when the additional installation and handling costs of steel pipe are considered, it is a cost effective solution in most water well applications.

24. Boreline - Does Chlorine affect its properties?
Under known conditions of application to the well water. chlorine has no detrimental effect on the mechanical performance of the riser. Use of high concentrations should be discussed with your local distributor.

25. What guarantees do we have with Boreline?
Boreline and its accessories are covered by our normal product warranty thus: If within six months of ex-works delivery and provided that the customer notifies the company immediately of any defect arising from faulty workmanship or material will result in free of charge replacement of the goods. Departure from recommended operational usage and use of materials not supplied by the company will invalidate this. The warranty does not cover incidental costs incurred in removal and installation of the riser.

26. How must Boreline be stored?
Boreline should be stored out of direct sunlight between -20°C and +40°C to ensure maximum working life. Exposure to humid or damp conditions is not detrimental.

Appendix 1

Cable Strap Clove Hitch

Pass the running end of the strap in front of the power cable and around it.

Then bring the running end forward over its own standing part. Pass the running end once more around the power cable and bring the running end in between the strap and the power cable.

Tighten the Clove hitch by pulling on the running end.

Push the loops closer together.

Appendix 2
Polyurethane Resistance Table

Medium	Temperature ℃	Result	Max Vol Inc %
Acetone	RT	-	40
AL-chloride, aqueous, 5 %	RT	++	1
Ammonia, 10 %	RT	++	1
Aniline	RT	--	
ASTM Fuel A	RT	++	4
ASTM Fuel B	RT	++	10
ASTM Fuel C	20 ℃	+	18
ASTM oil 1	80℃	++	
ASTM oil 2	80℃	++	3
ASTM oil 3	80℃	++	6
Ethanol 96 %	RT	+	11
Petrol, standard grade	RT	++	10
Petrol, premium grade	RT	-	17
Benzene	RT	-	
Butanol	RT	-	
Butylacetate	RT	-	40
Cyclohexanol	RT	+	5
Dibutylphthalate	RT	+	40
Diesel oil	RT	++	5
Dimethylformamide	RT	o	
Acetic acid 3 n	RT	-	2
Acetic acid, 20 %	RT	+	
Ethylacetate	RT	-	40
Ethylether	RT	+	
Fe chloride, aqueous, 5 %	40℃	+	
Glycol	RT	++	2
Glysantin / water 1:1	20℃	+	
Glysantin / water 1:1	80℃	+	
Isopropanol	RT	+	12
Kerosine	RT	++	3
Sodium chloride solution, conc.	RT	++	
Methanol	RT	+	10
Methylen chloride	RT	--	
Methylethylketone	RT	-	45
Mineral oil	80℃	++	
Soda soap fat	RT	++	
Sodium hydroxide solution 1N	RT	+	
Nitric acid, 20 %	RT	--	
Hydrochloric acid, 20 %	RT	+	
Sulphuric acid, 20 %	RT	+	
Sea water	RT	++	
Carbon tetrachloride	RT	-	
Toluene	RT	-	35
Trichloro ethylene	RT	-	
Water	100℃	-	
Water	RT	++	1

++	resistant over a prolonged period
+	conditionally resistant, after a certain time appreciable differences are possible
-	not resistant, short-term contact possible under certain conditions
--	not resistant, pronounced attack
o	soluble
RT	room temperature 23℃