NAYLOR
DENLOK
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Excellent Construction Products

DENLOK®

Vitrified Clay Jacking Pipes

Product Manual
and
Specification Data

email: sales@naylor.co.uk web: www.naylor.co.uk

BENOR
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Water for All: Conserve, Value, Enjoy
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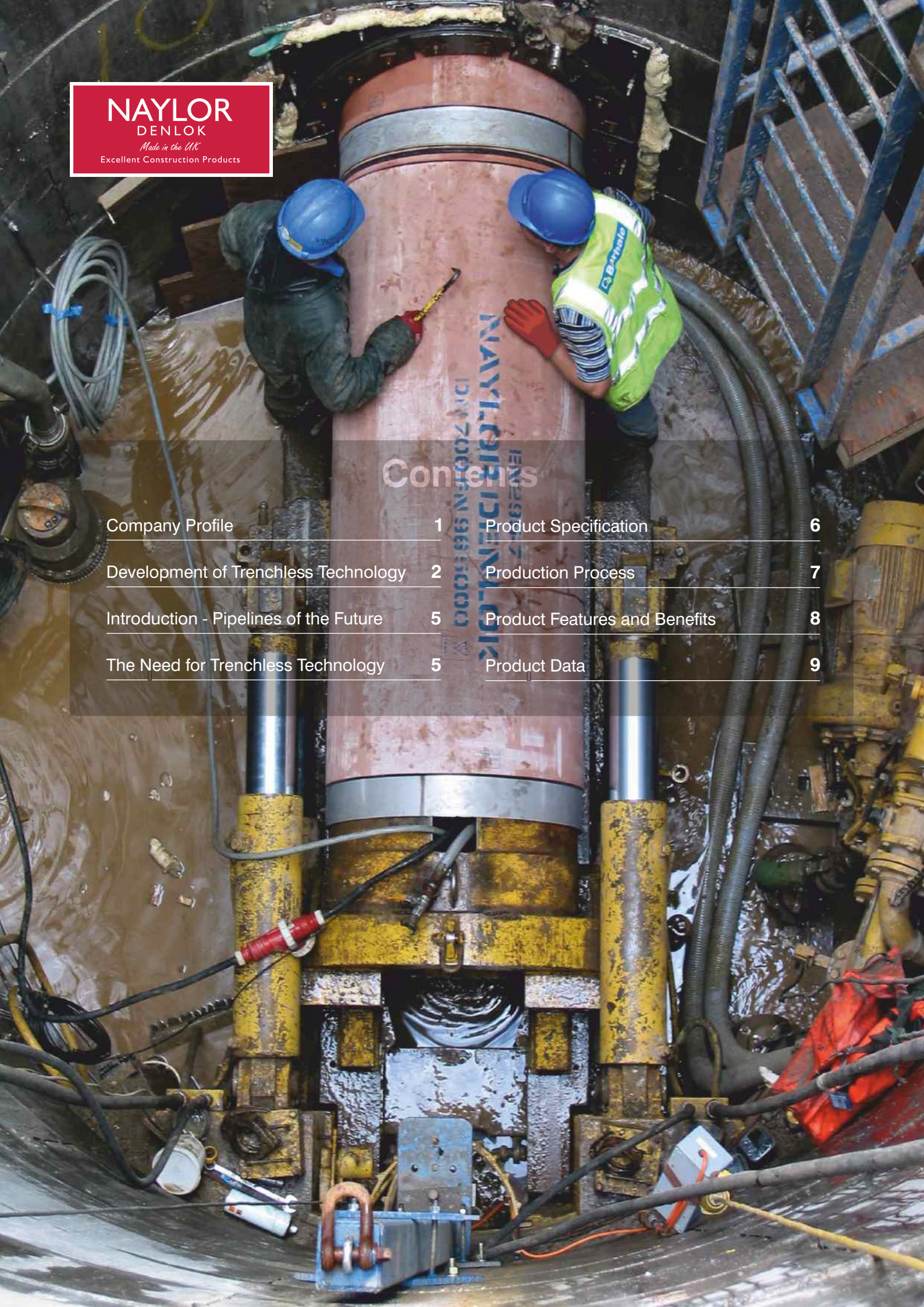

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Company Profile

Naylor Industries PLC is a 4th generation family business. With its head office in Barnsley UK and factories in South and West Yorkshire, West Midlands and Fife the group employs some 300 people and sell a wide range of products across Britain, Europe, the Middle East, South East Asia, Australasia and North America generating a 55 million pound annual turnover.

The last decade has seen the company change dramatically, a capital investment programme has enabled Naylor both to diversify as well as to improve the productivity and efficiency of its existing and emerging business.

Naylor's has a unique business approach that builds on long-term relationships with our customers. This is primarily based on open collaboration with customers, mutual dependency, professional delivery, sustainable profitable growth and innovation.

The world of construction and service provision is changing, public and private sector organisations are working more closely together, joint ventures are expected to deliver end-to-end solutions, new forms of contract enable collaborative supply chains.

From sustainability and community engagement to technical innovation and safety we are proud of the many awards that recognise Naylor's commitment to setting the highest standards.

Naylor's have established strong relationships with supply chain partners in order to minimise risk and to deliver projects fault-free, on time and to budget.

The Development of Trenchless Technology Systems

Until recently, city administrators and planners believed that the use of construction techniques involving surface trenching was the only option for the construction and repair of utility services. It was assumed that existing services were in good condition unless there was evidence to the contrary. In reality, gradual deterioration went unnoticed and failures occurred without warning, in many cases requiring an urgent response.

Over the last 25 years, it became apparent that little was known about existing utility services. Installation drawings, where they existed, gave little information on pipe capacity or materials used. Furthermore, the condition of the pipe linings was unknown, leakage and infiltration were unmeasured and related health issues were often not addressed.

Installation Options

The two installation options currently available for access to underground utility services are Open Cut and Trenchless.

For access by open cut there are four stages:-

- Excavation of the trench, removal of spoil and temporary support of other services.
- Laying and jointing the product pipe.
- Refilling the trench and compacting the selected spoil or filling material.
- Restoring above ground infrastructure.

All four stages are characterised by the amount of physical work to be undertaken. Typically, 50 times the amount of spoil to be occupied by the product pipe has to be moved once during excavation and again in refilling. Much of the work in all four stages is labour intensive, involving different skills that require co-ordination between several companies and authorities. A large project can extend over a long period and be very disruptive in social, economic and environmental terms. Access using trenchless techniques also requires surface work, but not on the scale needed for an open cut approach.

Trenchless technology projects require careful consideration of the existing condition of the underground pipes and ground conditions in order to select the most appropriate technique. The technology and approach must be determined and the surface work must be conducted using an existing access or by digging access pits.

The determination of the technique, location of the access pits and the route for a new pipe requires an initial survey. This is often viewed as an additional expense in comparison to open cut techniques. However, the cost of the initial survey stage of a trenchless project is usually offset by a shorter time on site.

Trenchless technologies present a number of unique advantages. With new installations, engineers can install pipe in the most favourable stratum, irrespective of depth. For gravity sewers, significant savings can be realised by retaining gravity flow and avoiding pumping stations.

Site Assessment

Whichever construction technique is used to install underground service utilities, the project is greatly improved by an understanding of the existing services and the ground in which they are to be installed before work commences. This is particularly important for trenchless projects, where the project design is based on a site investigation report. In open cut projects, the trench itself is often ''the investigation'' and the plan usually involves solving problems as they occur. Advances in the design and use of CCTV have considerably reduced the cost of surveying water and sewage networks, and information on conditions below the water level can be obtained by the use of ground penetrating radar. A traditional rule for most underground projects is that cost usually rises in direct relationship to the depth of work below the surface. As a result, the first consideration has been to make any new installation as shallow as practical, and any access to an existing service as short and direct as possible.

For trenchless projects, experience has shown that there is little relationship between cost and depth. For work on existing services, the access points already provided could be used and work can be planned to reduce disruption.

For new projects, the nature of the ground and depth of the water table can influence the chosen technology and process to be used. By using trenchless technologies, project designers can take advantage of the most favourable ground conditions, irrespective of depth, allowing for the installation of new services in areas where open cut methods were previously impossible. The ability to install pipe at great depths can help to simplify designs by allowing longer pipe runs with shallow gradients, thus avoiding the need for pumping stations and sumps. This facilitates pipe installation below already congested underground areas close to the surface in towns and cities.

Trenchless Technology

Applications for new installations

The trenchless sector is continually being refined and developed. Improvements cover both large and small diameters, longer drives, greater accuracy, faster and curve driving, different soil conditions and the ability to work deeper into water tables.

There are many variants of Pipe jacking, during which the product pipe is forced into the ground by hydraulic cylinders mounted horizontal in a launch shaft. The run is completed when the pipe string reaches an exit shaft. Both shafts are used later as service access points.

The various systems for new installations can be broadly categorised into:-

- Pipe Jacking in which the spoil and water is removed by pumping as slurry.
- Guided Auger Boring where the spoil is removed by an auger through a steel casing. Specially designed pipes are then hydraulically jacked in by the machine.
- Pipe Bursting where the existing pipeline is forced into the pipeline bedding by the means of an expanding hydraulic cone controlled from the surface. The new pipe pushes the expanding head through the pipeline which is being replaced.
- Pipe Eating where the existing pipe line is ground using a cutting head and the fragments of the pipeline are removed by augers through the new incoming pipe.
- Slip Lining where pipes are winched through an existing pipe system and the voids between new system and old system are filled with grout.

Above: Open cut installation

Opposite: Sorry for the inconvenience

Financial Considerations

In addition to environmental and social factors, financial comparisons can be made between trenchless technologies and traditional open cut methods. However, these comparisons are often difficult because there are no universal cost comparison methods. While technically the best solution depends upon the ground conditions and the location of the water table, in practice the financial boundaries of a project and the degree of acceptable financial risk generally play a more significant role in the decision-making process.

The question also arises, ''cost to whom?'' The client is responsible for the direct costs of the contract and possibly for any compensation for the loss of amenity or trade by local residents and businesses. This often means that the costs are borne by local citizens and future generations. Furthermore, certain government financial policies can distort the real costs of installing, maintaining and repairing utility services. This can lead to the misconception that open cut is cheaper, when in fact a full accounting of the environmental and social costs may indicate otherwise.

The direct costs of both the trenchless and open cut methods in the terms of materials, time and equipment can be established relatively easily. Indirect costs such as reinstatement of the surface, long-term repairs to roads and buildings due to delayed settlement, useful life of the service after work and a degree of risk for unplanned or additional emergency work that may arise during the project can often exceed direct costs. An advantage of trenchless methods is that there are generally less indirect costs because surface access is less disruptive, projects are shorter and hence the social and environmental costs are considerably reduced.

Strategic Considerations

Open cut construction work disrupts roads, buildings and other infrastructure. The duration of these disruptions is a major source of frustration for local residents, business and the general public. This has resulted in growing opposition to construction work in general, including concern for the natural environment, as well as an increase in claims for compensation.

Health and safety of workers, equipment operators and the public is well recognised and has led to the introduction of legislation requiring the use of safe working practices. In the case of underground utilities, the closer workers and operators are to mechanical and electrical equipment, to moving traffic, or the more they have to work in confined spaces the greater the risk of accidents. With trenchless projects, surface excavation is confined to relatively small entry and exit pits or shafts, and it is often possible to locate these away from hazardous areas and road traffic.

In comparison to the use of open cut methods, trenchless projects are characterised by minimal surface disruption over a much shorter period of time. For a well-managed trenchless project, the public may not be aware that major construction work is actually going on below them.

Opposite: Narrow roads

Carbon CO_2 Emissions

Minimising CO_2 emissions arising from construction activities represent a key area for the industry and a major contributor in meeting targets.

To manage you must measure practical and systematic pproach to measuring project carbon emissions that enables Project Teams to re-engineer their design, procurement, logistics and construction processes to minimise their footprint.

Clients, contractors whose actions that reduce carbon, and generate potential savings through travel arrangements and material/supplier procurement, both on the project in question and on future projects.

To enable a proactive measure and understand your CO_2 footprint to enable improvement and reduction of additional cost please visit the www.pipejackingco2calculator.com to operate a free to use carbon calculator which has been developed by TRL, verified by WRc and sponsored by the Pipe Jacking Association.

Pipelines of the Future

For a company with its origins in clay pipes it is natural that Naylor Drainage Limited is in the forefront of product development and innovation.

With over 125 years of constant production of pipes and fittings throughout the development of water-borne sewerage systems with their associated improvements, the Naylor company has developed a product that is a core requirement for the trenchless construction industry.

With worldwide operational activities, Naylor Drainage has become the world's leading international supplier of specialist pipes for trenchless technology and many prestigious projects have been supplied throughout the company's UK home base as well as many continents overseas.

Reputation for product reliability and customer service is part of the Naylor tradition.

The company's trenchless technology product - Denlok® - is a specially-developed vitrified clay pipe system to meet the requirements of pipe installation by trenchless construction methods which include:-

- Microtunnelling
- Guided Auger Boring
- Pipe Bursting
- Pipe Eating
- Slip Lining

The Naylor approach to its development of products for the trenchless construction industry has resulted in new manufacturing equipment and production techniques. These progressive steps have led to reductions in specialist product costs and these savings have been passed onto the customer to enable the use of a first-class product at affordable prices.

Characteristics of Clay

- **Chemically resistant to corrosion, eg. hydrogen sulphide attack**
- **Resistant to abrasion - jetting etc. No linings to fail**
- **High mechanical strength**
- **High resistance to imposed loads**
- **No deformation**
- **Impermeability**

Vitrified Clay Pipes ideally suited to trenchless installation

The Need for Trenchless Technology

Water and sewerage infrastructures have represented a significant asset investment on the part of most municipal organisations and water authorities for well over 100 years. The distribution networks for utility services have been located underground in pipes that are laid, repaired or replaced by trenching from the surface. In cities and urban areas, these distribution networks are located underneath roads. This often makes access difficult, particularly in areas congested with traffic and buildings.

When pipeline infrastructures are not well maintained then inefficiencies arise. For example, in water distribution systems, leakages occur and water shortages are possible. However, in sewerage systems, cracked and damaged pipes can cause wastewater seepage, leading to contamination of groundwater. These problems often give rise to related health and environmental impacts.

The oldest underground utility services are usually found close to the surface. Services installed later are most often found below or interwoven with the initial installations. Construction and repair carried out from the surface inevitably disrupts traffic, business and other services. This disruption has a negative impact on the local environment in terms of air quality, noise and other pollution, as well as on local vegetation and buildings. This in turn diminishes the quality of life for local residents.

Trenchless technologies, which minimise the requirements for surface excavation, can significantly reduce the environmental impacts of underground utility service installation, maintenance and repair. By minimising surface disruption, traffic congestion is significantly reduced.

Product Specification

Quality Assurance

Naylor Drainage manufactures its products under the control of an approved Quality Assurance System complying with the requirements of BS EN9002: 2008. Naylor Drainage Ltd is a Registered Firm of Assessed Capability (BSI Certificate No. FM1420).

Third Party Assurance

Denlok® is Third Party Certified by:

BSI UK Kitemark Licence No 20173.

CE07 in accordance with Directive 93/68/EC.

MPA NRW Germany - Licence No 210001169-01-01

PSB Singapore - Licence No 02235

CPRU Brunei - Licence No STD3/003

Ashgal - Qatar

Manilla Water - Philippines

BENOR Belgium - Licence No 023

CE Conformity

Naylor Drainage Vitrified Clay Pipe conforms to European Standard: EN 295-10.

Seal Design and Function

The seals are designed as a sliding seal that is located in the pipe end rebate. No lubricant is required on either the seal or stainless steel sleeve as lubricant is enclosed within the sliding mantel. As the male spigot is inserted into the female sleeve the seal is compressed creating a positive 5 bar internal and external pressure.

The mantel rolls over the seal during jointing reducing friction to a minimum and acts as a cushion between the spigot and sleeve limiting differential movement under transverse shear loads once the joint is completed. The design optimises joint performance and provides an exceptionally high level of operational reliability.

Seals are available in either EPDM or Nitrile certified to EN681- 1

Component Specification

All Denlok® pipes and assemblies are manufactured in accordance with

BS EN295-7 2013

'Requirements for vitrified clay pipes and joints for pipe jacking'.

Denlok® pipes and joint assemblies are manufactured in accordance with

BS EN12889: 2000

'Trenchless construction and testing of drains and sewers'.

Root Infestation

Due to the high contact pressure a 5 bar seal reduces the risk of root infestation through the joint allowing for pipe installation under mature trees

Production Process

1. Locally-quarried raw materials are accurately blended before being ground to a fine form to enable subsequent extrusion.

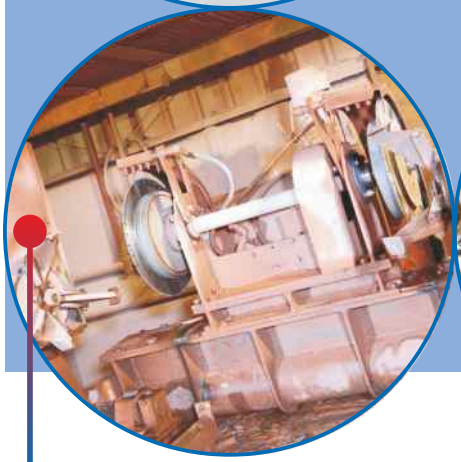
2. Clay raw material is mixed with water to give plasticity for extrusion.

High-pressure extrusion ensures that a strong dense pipe body is produced.

Close attention to drying to remove moisture is undertaken prior to firing under accurate temperature control.

3. Use of special highly-insulated kilns is employed for attaining accurate firing.

The special qualities of vitrification of the pipe body are attained at a firing temperature in excess of 1050°C.



4. After the firing and subsequent grading processes the pipe ends are accurately machined with computer-controlled diamond profile cutters. Accurate production of parallel ends is also achieved.

5. Intermediate inspection takes place as well as pipe ends being pressure tested to ensure integrity of pipe material. The joint components are then applied and materials are packed for shipment.

6. Naylor Denlok Pipes ready for despatch.

Delivery and Site Handling

Delivery of pipes is to the customer's request, consignee to be responsible for offloading all packs, which are designed to be offloaded by forklifts.

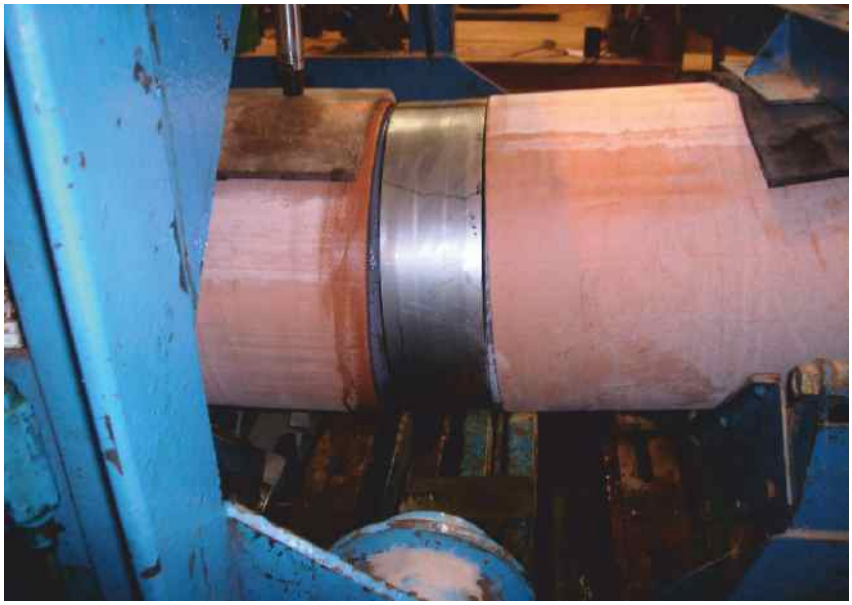
If there is no forklift available on site a moffat off-load vehicle can be arranged at the time of order placement.

Close attention to packing for transportation and overseas shipment is part of the Naylor delivery service.

It is a major recommendation that all unit packs must be kept assembled with all protection intact until the pipe is ready for use.

All Denlok® pipes and elastomer components are resistant to heat, ozone and ultra violet light.

Product Features and Benefits



Above:
Angular joint deflection testing

Opposite:
Installed pipeline

Opposite:
Pipe under research at a UK material laboratory

Opposite:
Pipe being type tested in accordance with EN295-7 Clause 4.8 Strength

Major advantages of Denlok® Vitrified Clay Jacking Pipes are:

- Denlok® is covered by and fully certified to EN295, the international standard for clay jacking pipes.
- High-axial strength for jacking force assurance.
- High crushing strength for load bearing capabilities.
- Smooth wall surface with very minimal frictional resistance.
- Excellent chemical resistance, Denlok® handles domestic, industrial and chemical effluents.
- Accurately machined pipe ends for easy load transference of jacking force.
- Wide range of diameters available.
- Worldwide international project-supply references.
- International Technical and Commercial support.

Product Data

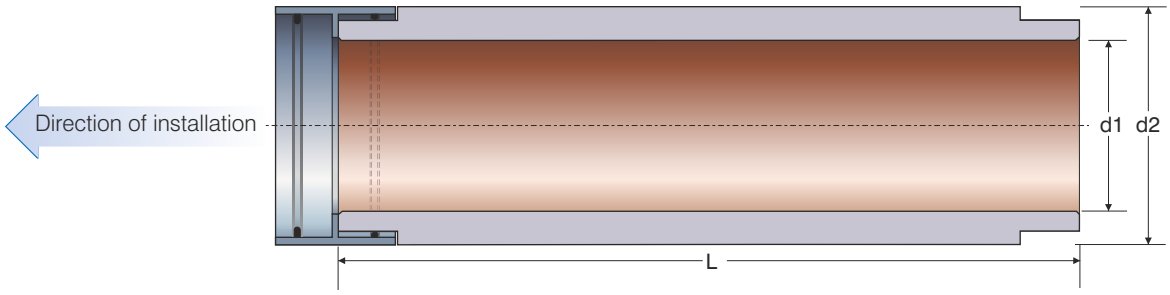
Naylor Denlok®
NC Range

DN150

DN150 jacking pipe with EPDM seals and an injection moulded polypropylene sleeve and integral thrust ring, all elastomer conforms to the requirements of EN681 1.

A vitrified clay jacking pipe which is suitable for the construction of house connection installed by trenchless technology.

Naylor DN150 Denlok can be connected directly to Naylor DN150 Densleeve using the factory fitted Denlok coupling removing the need for any special connections.



	Pipe Dimensions			Strength					
Nominal Size DN mm	ID d1 mm	OD d2 mm	L +/– 0.5 mm	Crushing Strength kN/m FN	Class Number	Jacking Strength FJ kN	Jacking Strength FJ MN	Seal Rating Bar	Weight kg/m
150	149+/–3.0	208+/–3.0	996	64	400	900	0.9	0.5	45

Naylor Denlok®

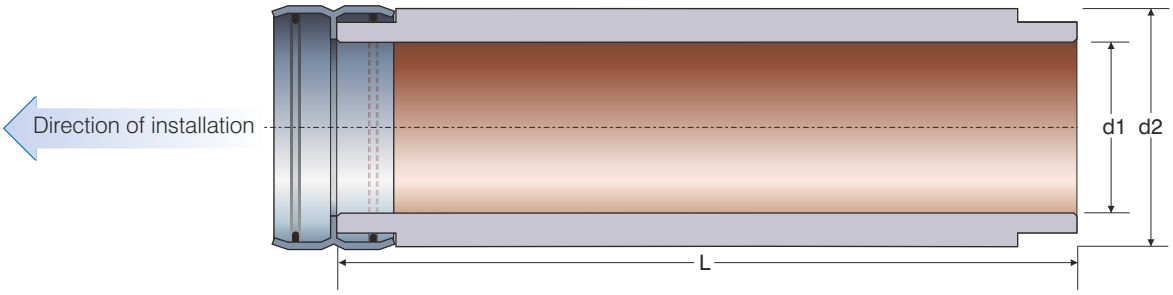
NC Range

DN200 to DN300

Naylor Denlok NC range of jacking pipes consists of a vitrified clay pipe with parallel end faces and a square accurate machined seal interface.

All pipes have a factory fitted stainless steel coupling which incorporates a moulded EPDM elastomer seal, each seal has an integral EPDM thrust ring, which transmits the jacking forces during pipe installation, all elastomer conforms to the requirements of EN681 1.

By precision machining of the seal interface the coupling will withstand a 5 bar internal and external pressure allowing installation below the water table and protection from lubrication systems during pipe installation.



	Pipe Dimensions			Strength					
Nominal Size DN mm	ID d1 mm	OD d2 mm	L +/– 0.5 mm	Crushing Strength kN/m FN	Class Number	Jacking Strength FJ kN	Jacking Strength FJ MN	Seal Rating Bar	Weight kg/m
200	200+/–3	271+/–3	996/1996	80	400	1400	1.4	5	60
225	225+/–4	293+/–4	996/1996	80	360	1700	1.7	5	80
250	253+/–4	357+/–4	996/1996	100	400	3400	3.4	5	100
300	305+/–5	412+/–5	996/1996	120	400	4245	4.2	5	120

Naylor Denlok®

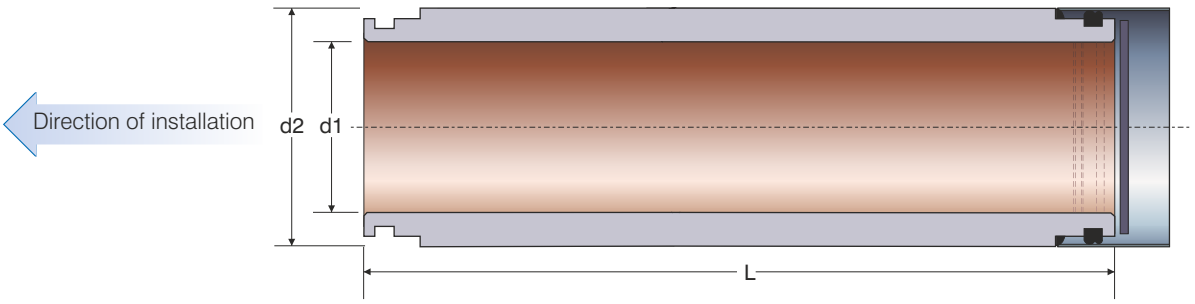
NS Range

DN400 to DN1000

Naylor Denlok NS range of jacking pipes consists a vitrified clay jacking pipe with parallel ends and a rebated accurate joint interface.

All NS range of pipes consists of a coupling manufactured from stainless steel, a 5 bar EPDM seal and MDF load transferee ring.

Each pipe supplied will have all seals and a stainless steel sleeve factory fitted with the thrust ring supplied separate in a cover to protect the material from the weather elements.



	Pipe Dimensions			Strength					
Nominal Size DN mm	ID d1 mm	OD d2 mm	L +/– 0.5 mm	Crushing Strength kN/m FN	Class Number	Jacking Strength FJ kN	Jacking Strength FJ MN	Seal Rating Bar	Weight kg/m
400	406+/–5	552+/–5	984/1984	160	400	8135	8.1	5	240
450	450+/–5	585+/–5	984/1984	144	320	8370	8.3	5	250
500	504+/–5	639+/–5	984/1984	120	240	8735	8.7	5	260
600	620+/–7	758+/–7	984/1984	144	240	10580	10.6	5	340
700	715+/–9	855+/–9	984/1984	112	160	10681	10.7	5	430
800	792+/–12	976+/–12	984/1984	96	160	17160	17.1	5	610
900	893+/–15	1084+/–15	984/1984	96	160	19545	19.5	5	680
1000	1009+/–15	1121+/–15	984/1984	96	160	23515	23.5	5	800

Naylor Denlok®

Revit Range

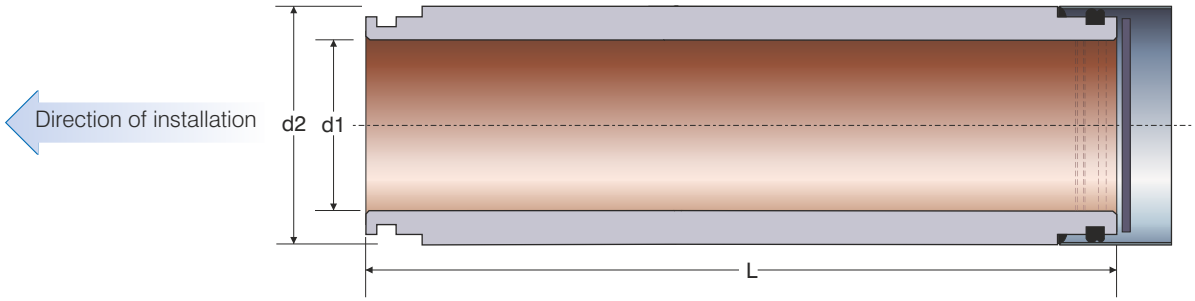
DN225 to DN500

Naylor Revit the special designed pipe for use by the '3' Pass Guided Auger Boring Installation Technique.

Naylor Revit NS range of jacking pipes consists a vitrified clay jacking pipe with parallel ends and a rebated accurate joint interface.

All Revit NS range of pipes consists of a coupling manufactured from stainless steel a 5 bar EPDM seal and MDF load transferee ring.

Each pipe supplied will have all seals and a stainless steel sleeve factory fitted with the thrust ring supplied separate in a cover to protect the material from the weather elements.



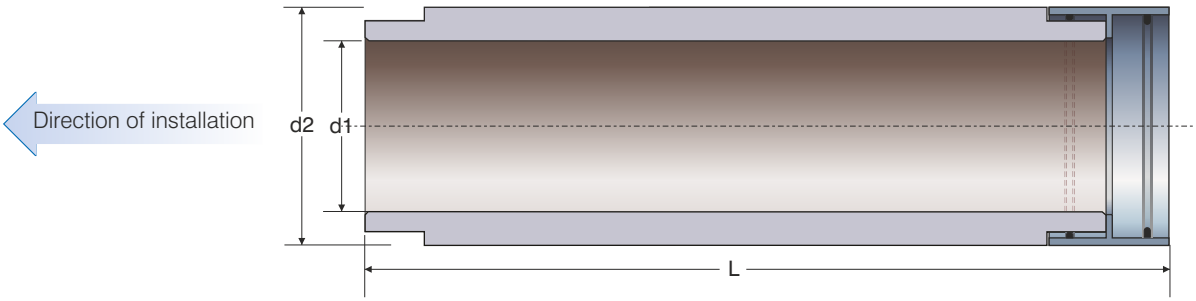
	Pipe Dimensions			Strength					
Nominal Size DN mm	ID d1 mm	OD d2 mm	L +/– 0.5 mm	Crushing Strength kN/m FN	Class Number	Jacking Strength FJ kN	Jacking Strength FJ MN	Seal Rating Bar	Weight kg/m
300	300+/–5	380+/–5	1000/2000	72	240	2275	2.27	5	75
375	375+/–5	455+/–5	1000/2000	48	128	2680	2.68	5	125
400	400+/–5	482+/–5	1000/2000	64	160	2990	2.99	5	150
450	450+/–5	585+/–5	1000/2000	72	160	5020	5.2	5	200
500	500+/–5	610+/–5	1000/2000	80	160	6165	6.16	5	235
600	620+/–7	710+/–7	1000/2000	96	160	7300	7.3	5	250

Naylor Denlok®

DenChem Range

DN150 to DN500

For pipelines needing to operate at high temperatures - up to 120°C - the DenChem range is ideally suitable. Special ceramic pipes capable of withstanding higher temperatures and full resistance to Alkaline and Acid attack can now be offered for microtunnelling. Applications within the chemical, pharmaceutical, food and dairy processing as well as brewing industries can be accommodated. High temperature chemical effluents resulting from process or cleaning operations can be handled with confidence.



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300	300+/–5	380+/–5	1000	72	240	2275	2.27	5	85
375	375+/–5	455+/–5	1000	48	128	2680	2.6	5	140
400	400+/–5	482+/–5	1000	64	160	2990	2.9	5	160
450	450+/–5	585+/–5	1000	72	160	5020	5.02	5	200
500	500+/–5	610+/–5	1000	80	160	6165	6.16	5	235

Naylor Industries plc - more than 100 years of production and supply to the Construction Industry

- Vitrified clay pipe systems for trench and trenchless installation
- Thermachem - Chemical Drainage and Industrial Ceramics
- Band-Seal couplings for the repair of and connections into existing pipelines
- Plastic Land Drainage, Twinwall Ducting Systems and Access Boxes
- Lintels - Prestressed Concrete Lintels
- Yorkshire Flowerpots, a range of frostproof plant pots

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Excellent Construction Products

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