Denlok®

NAYLOR
DENLOK

EMAIL: INFO@NAYLOR.CO.UK
WEB: WWW.NAYLOR.CO.UK

DENLOK®

Vitrified Clay Jacking Pipes

Product Manual and Specification Data

December 2007

INVESTOR IN PEOPLE

Index of **Contents**

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 100 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.

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.

CAIRO, EGYPT

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.

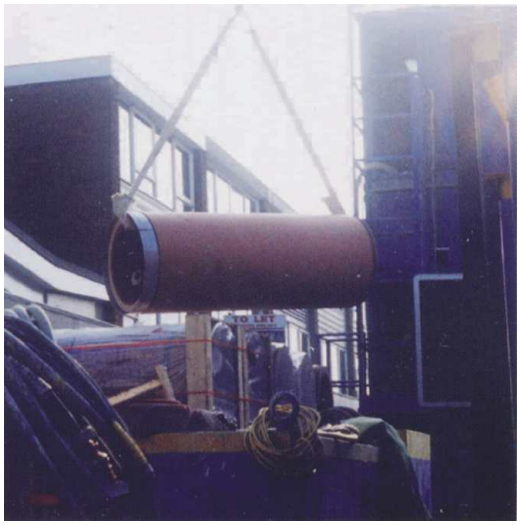
For trenchless projects, experience has shown that there is little relationship between cost and depth. For work on existing services, the access points already provided could be used and work can be planned to reduce disruption.

CLAY TUNNEL PIPE

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.

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.


DUNSTABLE, UK

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.

Trenchless Technology -
Applications for new installations

PIPES BEING LOADED FOR DESPATCH

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.

DN700 SLIPLINING, CARDIFF

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.

Production Process

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

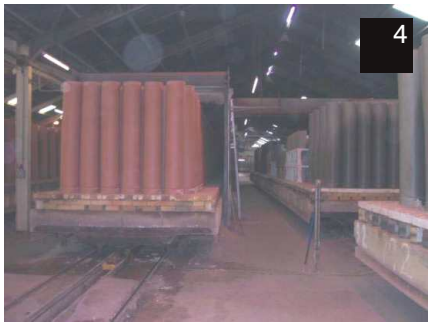
Clay raw material is mixed with water to give plasticity for extrusion.

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.

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

Smaller diameters fired in continuous production tunnel kilns.



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

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.

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.

Certification

UKSTT

UNITED KINGDOM SOCIETY FOR TRENCHLESS TECHNOLOGY (UKSTT)

2004 AWARD
for

INNOVATION

is presented to

NAYLOR DRAINAGE LTD

For

'Naylor DenChem'

WINNER

Award sponsored by

South West Water Ltd & Barhale Ltd

UKSTT AWARDS – designed to recognise outstanding quality and excellence within the construction industry

Chairman

for and on behalf of
United Kingdom Society of Trenchless Technology

38 Holly Walk
Leamington Spa
Warwickshire
CV32 4LY

April 2005

CERTIFICATE OF REGISTRATION

Quality Management System

This is to certify that:

Naylor Drainage Limited
Clough Green
Cawthorne
Barnsley
South Yorkshire
S75 4AD
United Kingdom

Hold Certificate No: **FM 01420**

and operate a Quality Management System which complies with the requirements of **BS EN ISO 9001:2000** *for the following scope:*

The manufacture of vitrified clay pipes and fittings, and flexible mechanical joints.

For and on behalf of BSI:

Certification Manager, Systems Assessment

Originally registered: **16 Aug 1989** *Latest issue:* **29 Jun 2004** *Page:* 1 of 1

UKAS QUALITY MANAGEMENT 003

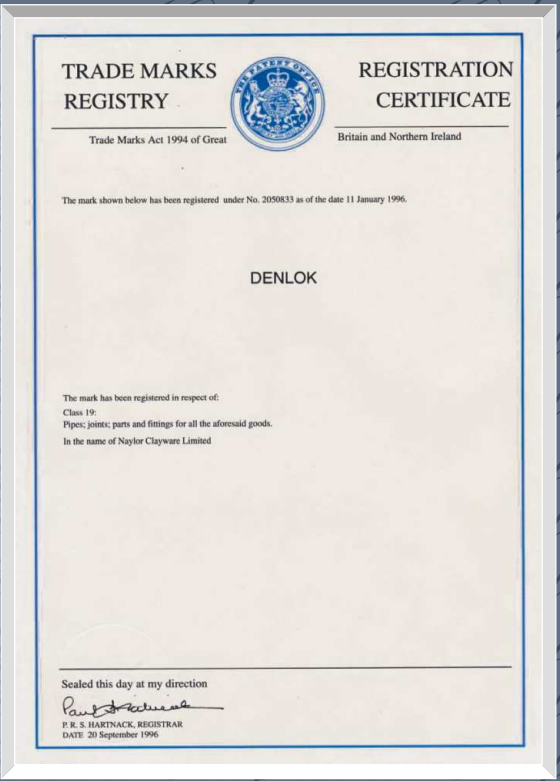
MGMT. SYS. RvA C 030

This certificate remains the property of BSI and shall be returned immediately upon request. This certificate does not expire. To check its validity telephone: +44 (0)20 8996 9001 or visit www.bsi-global.com/ClientDirectory. Further clarifications regarding the scope of this certificate and the applicability of ISO 9001:2000 requirements may be obtained by consulting the organization.

The British Standards Institution is incorporated by Royal Charter.
Group Headquarters: 389 Chiswick High Road, London W4 4AL, UK.

BSI Management Systems

MC 48339/SSUE 15/A/0201/UK/EP



TRADE MARKS REGISTRY

Trade Marks Act 1994 of Great Britain and Northern Ireland

REGISTRATION CERTIFICATE

The mark shown below has been registered under No. 2050833 as of the date 11 January 1996.

DENLOK

The mark has been registered in respect of:
Class 19:
Pipes; joints; parts and fittings for all the aforesaid goods.
In the name of Naylor Clayware Limited

Sealed this day at my direction

P R S. HARTNACK, REGISTRAR
DATE 20 September 1996

This is to certify that

NAYLOR CLAYWARE LIMITED

is the holder of

Kitemark Licence

No. KM 20173

to BS EN 295 : Part 1, 4, 5 & 7
Vitrified clay pipes and fittings and pipe joints for drains and sewers

and is entitled to affix the Kitemark to the Products detailed in the Licence Schedule.

Director

Signed for and on behalf of BSI Product Certification

Licence Issued 20 March 1992

Note: this is not a legal document and should not be used as such

BSI

BSI Product Certification
PO Box 375 Milton Keynes
United Kingdom MK14 6LL

PCM 081 Issue 1

Product Specification

Component Specification

All Denlok® pipes and assemblies are manufactured in accordance with

BS EN295-7 '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'.

Joint components fully comply with the requirements set out in the BS EN295-7 together with the following joint material components standards: BS EN295-10 'Performance Requirements'.

Joint Component Standards

Sleeve - manufactured from stainless steel complying with:

BS EN10088-1 Stainless steel - Part 1:
Technical delivery conditions for bars, wire rod and forgings.

BS EN10088-2 Stainless steel - Part 2:
Technical delivery conditions for sheet, plate and strip for general purposes.

EN1008.2 Ti 1.457 stainless steel is used as standard or customers own specification.

Sealing components - manufactured from elastomers complying with:

BS EN681-1:1966 Elastomeric seal material requirements for pipe joint seals used in water and drainage applications.

ISO 3302: 1990 Rubber - Dimensional tolerances for use with products. EPDM rubber is used as standard or customers own specification.

Joint packing rings - manufactured from either EPDM for use with the NC type joint or wooden particle boards for use with the NS type joint all complying with:

Pr EN312: Part 1: Particle boards - Requirements.

Pr EN312: Part 4: Particle boards - Requirements for load bearing boards for use in dry conditions.

Pr EN312: Part 5: Particle boards - Requirements for load bearing boards for use in wet conditions.

ISO 3302: 1990 Rubber - Dimensional tolerances for use with products.

Quality Assurance

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

Third Party Assurance

Denlok® is Third Party Certified by BSI Quality Assurance under Licence No 20173.

CE07 in accordance with Directive 93/68/EC.

CE Conformity

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

Product Data

DN150 NC

Naylor Denlok® NC Range DN150

Comprising of a vitrified clay jacking pipe with EPDM seals and an injection moulded polypropylene sleeve and integral thrust ring.

Naylor Denlok® NC range from DN200 to DN300

Vitrified clay jacking pipes with 316 Ti stainless steel coupling fitted with integral EPDM seal and thrust ring component.

(This joint system is especially beneficial for smaller diameter jacking pipes as the joint system can accommodate better storage extremes).

Naylor Denlok® NS range from DN400 to DN1200

Vitrified clay jacking pipes with 316 Ti stainless steel sleeves, EPDM seals to achieve min. 2 bar internal/external pressure with factory fitted particle board thrust ring.

Naylor Micro-Duct Range from DN150 to DN300

Microtunnelling pipes developed for No-Dig installation of ducting for high voltage electrical cables and fibre optics.

Naylor DenChem range from DN150 to DN300

For pipelines needing to operate at high temperatures - up to 150°C - the Denlok® DenChem range is ideally suitable. Special ceramic pipes capable of withstanding higher temperatures 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.

Naylor Revit range from DN400 to DN600

Vitrified clay jacking pipes designed for installation by either the '3' pass guided auger boring or pipe bursting.

Delivery and Site Handling

Pipes are despatched in unit packs that are made up using timber spacer boards and frameworks to ensure that there is no pipe-to-pipe contact.

Unit packs can be handled by forklift to facilitate offloading and site storage. If packs are to be offloaded using lifting slings then advice of this method of handling must be notified to us for loading purposes.

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

Major advantages of Denlok® Vitrified Clay Jacking Pipes are:

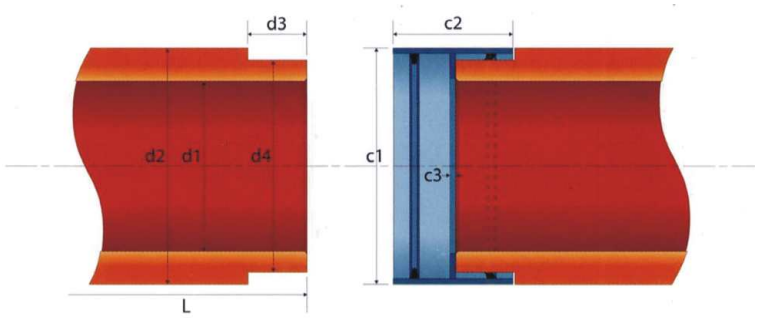
- Denlok® is covered by and fully certified to EN295, the international standard for clay jacking pipes.
- High-axial strength for jacking force assurance.
- High crushing strength for load bearing capabilities.
- Smooth wall surface with very minimal frictional resistance.
- Excellent chemical resistance,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

Naylor Denlok®
NC range of jacking pipes

Jacking Strengths
1. F1 = permissible jacking force for manual recorded safety factors 2/2 (for standard dimensioning)
2. F2 = permissible jacking force for automatic and control, recorded safety factors 2/1.6)

Denlok® NC Jacking Pipe DN150

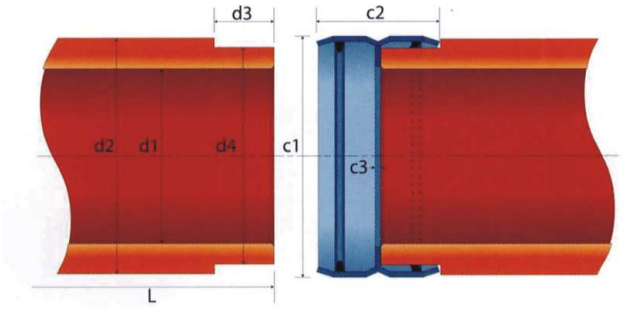
Vitrified clay jacking pipe with polypropylene sleeve coupling and moulded-in EPDM rubber seals



	Pipe Dimensions					Sleeve Dimensions			Jacking Strength		
Nominal Size	Internal Diameter	External Diameter	Pipe End Width	Pipe End Diameter	Effective Length	External Diameter	Width	Pressure Transfer Ring Width	Manual Steering	Automatic Steering	Approx Weight
DN	d1	d2	d3	d4	L	c1	c2	c3	F1 (2) sf=2.0	F2 (3) sf=1.6	
mm	mm	mm	mm	±0.5 mm	±0.5 mm	±1.0 mm	±1.0 mm	mm	kN	kN	kg/m
150	149±3.0	208±3.0	52±1.0	186	996	200	100	5	183	228	45

Denlok® NC Jacking Pipe DN200 - DN300

Vitrified clay jacking pipe with stainless steel sleeve coupling and integral EPDM elastomer sleeve moulding



	Pipe Dimensions					Sleeve Dimensions			Jacking Strength		
Nominal Size	Internal Diameter	External Diameter	Pipe End Width	Pipe End Diameter	Effective Length	External Diameter	Width	Pressure Transfer Ring Width	Manual Steering	Automatic Steering	Approx Weight
DN	d1	d2	d3	d4	L	c1	c2	c3	F1 (2) sf=2.0	F2 (3) sf=1.6	
mm	mm	mm	mm	±0.5 mm	±0.5 mm	±1.0 mm	±1.0 mm	mm	kN	kN	kg/m
200	200±3.0	271±3.0	53	246	996	266.5	107	6	350	438	60
225	225±4.0	293±4.0	53	272	996	291.7	107	6	358	447	80
250	253±4.0	357±4.0	53	332	996	351.4	107	6	815	1019	100
300	305±5.0	412±5.0	53	388	996	409.5	107	6	938	1172	120

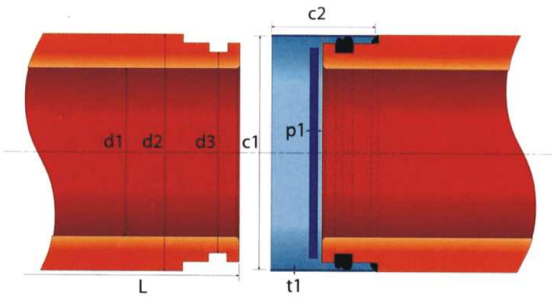
Pipes up to and including DN300 are generally supplied in 1.0m lengths
DN300 are available in 2.0m lengths
Other lengths available as special requirements

Naylor Denlok®
NS range of jacking pipes

Jacking Strengths
1. F1 = permissible jacking force for manual recorded safety factors 2/2 (for standard dimensioning)
2. F2 = permissible jacking force for automatic and control, recorded safety factors 2/1.6)

Denlok® NS Jacking Pipe DN400 - DN1200

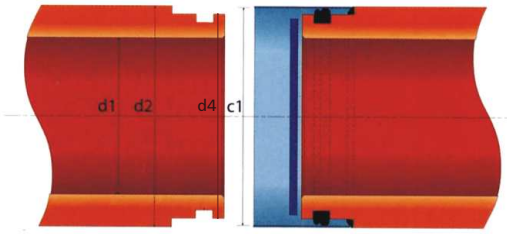
Vitrified clay jacking pipe with stainless steel sleeve, EPDM elastomer seals and factory fitted packing ring



	Pipe Dimensions				Sleeve Dimensions				Jacking Strength		
Nominal Size	Internal Diameter	External Diameter	Pipe End	Effective Length	Internal Diameter	Width	Thickness	Pressure Transfer Ring Width	Manual Steering	Automatic Steering	Approx Weight
DN	d1	d2	d3	L	c1	c2	t	p	F1 (2) sf=2.0	F2 (3) sf=1.6	
mm	mm	mm	±0.5 mm	±0.5 mm	±1.0 mm	±0.5 mm	mm	±0.5 mm	kN	kN	kg/m
400	406±5.0	552±5.0	526.5	984 1984	541.0	115	2	18	1575	1969	240
450	450±5.0	585±5.0	564.0	984 1984	578.0	115	2	18	1625	2031	250
500	504±5.0	639±5.0	612.5	984 1984	626.0	115	2	18	1700	2125	260
525	524±5.0	660±5.0	633.0	984 1984	646.5	115	2	18	1780	2225	280
600	609±7.0	758±7.0	730.5	984 1984	744.0	115	2	18	2260	2825	338
700	720±9.0	855±9.0	824.0	984 1984	837.0	125	3	18	2500	3126	430
800	790±9.0	950±9.0	921.0	984 1984	935.5	125	3	18	3077	3846	508
900	890±9.0	1080±9.0	1051.0	984 1984	1065.5	125	3	18	4350	5437	680
1000	991±9.0	1193±9.0	1164.0	984 1984	1178.5	125	3	18	5210	6512	800
1100	1085±12.0	1307±12.0	1276.0	984 1984	1209.5	125	3	18	6237	7797	967
1200	1183±12.0	1430±12.0	1393.0	984 1984	1407.5	125	3	18	7527	9408	1170

Revit NS Pipe DN400 - DN500

Vitrified clay jacking pipe with stainless steel sleeve, EPDM elastomer seals and factory fitted packing ring



	Pipe Dimensions			Sleeve Dimensions	Jacking Strength	
Nominal Size	Internal Diameter	External Diameter	Pipe End Diameter	Internal Diameter	Maximum Working Jacking Load	Approx Weight
DN	d1	d2	d4	c1		
mm	mm	mm	mm	mm	kN	kg/m
400	400±5.0	482±5.0	468.5	475	650	149
450	450±5.0	548±5.0	534.5	541	745	202
500	500±5.0	610±5.0	586.5	593	815	232

All information correct at time of print.

Further Information

Information on other Naylor Group Products may be obtained by **faxing this form** back to Liz Hudston on 01226 794415

Please ✓ tick

- ☐ **Densleeve** - Building Drainage
- ☐ **Denseal** - Sewers and Surface Water Drainage
- ☐ **Hathernware Pipes** - For Aggressive Environments
- ☐ **Tiles** - For Sewage Treatment
- ☐ **Drainage Design Handbook**
- ☐ **Band-Seal** - Flexible Couplings
- ☐ **Twinwall Ducting**
- ☐ **Land Drainage**
- ☐ **Aqua-Lite** - Linear Drainage
- ☐ **Environmental Products** - For Attenuation and Infiltration
- ☐ **Lintels**

Name: _____

Company: _____

Address: _____

_____ Post Code: _____

Tel: _____ Fax: _____

E-mail: _____

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

- Vitrified clay pipe systems for trench and trenchless installation
- Hathernware - 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
- Yorkshire Flowerpots, a range of frostproof plant pots

NAYLOR DENLOK

NAYLOR DRAINAGE LIMITED

CLOUGH GREEN
CAWTHORNE
BARNSLEY, SOUTH YORKSHIRE
S75 4AD

TELEPHONE: 01226 790591
FACSIMILE: 01226 790531
EMAIL: INFO@NAYLOR.CO.UK
WEB: WWW.NAYLOR.CO.UK