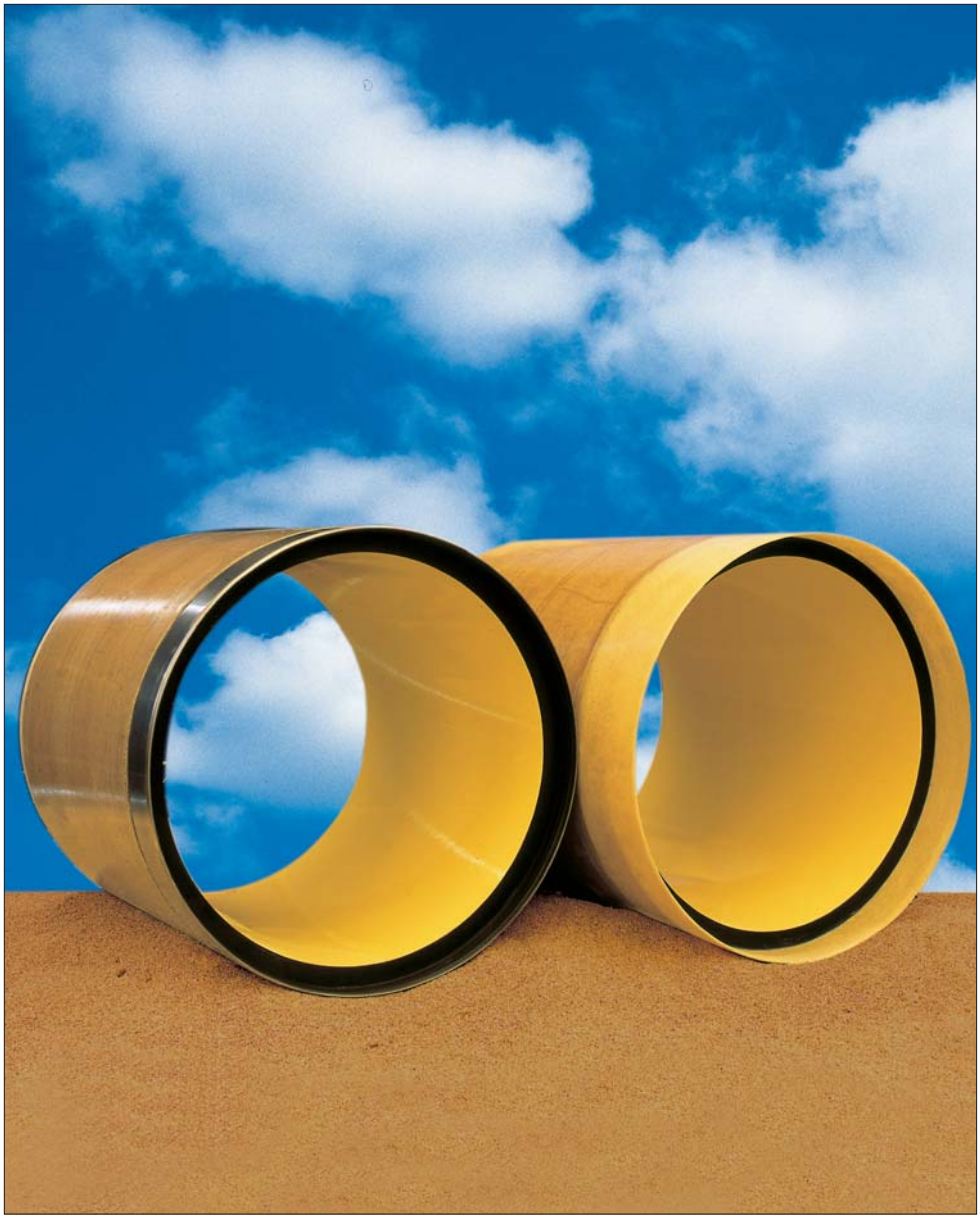
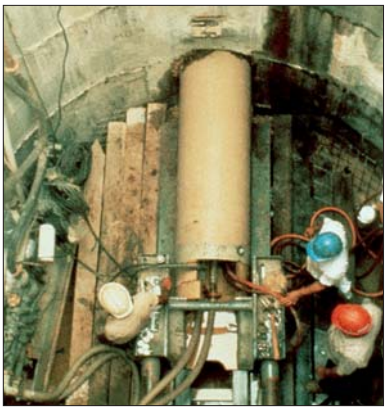
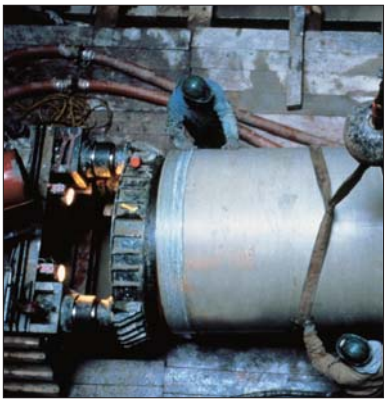
Quality going into depth. HOBAS

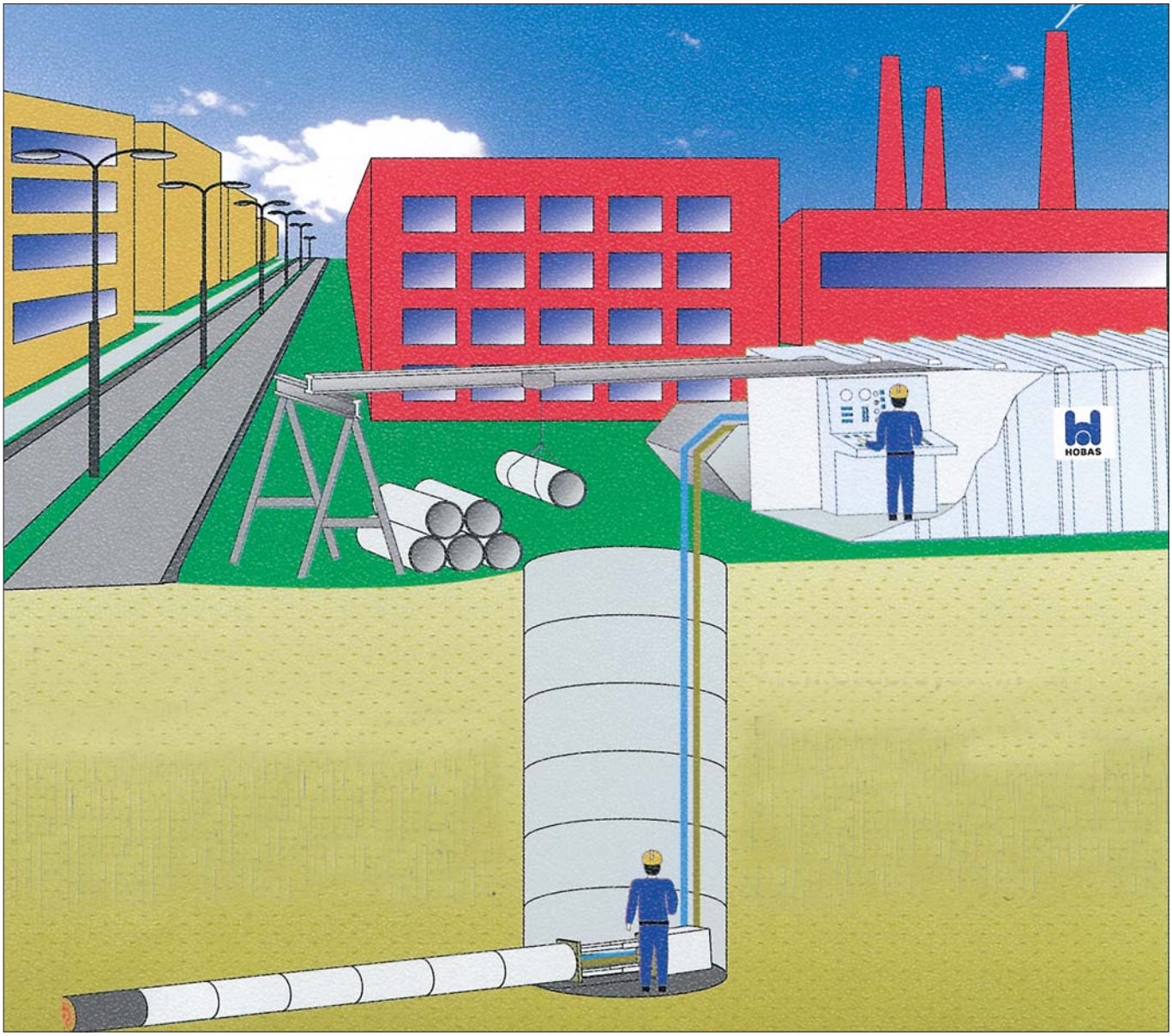
HOBAS Jacking Pipes







Closed design - Future technology



Advantages of driving technique

- The pipe laying takes place without digging up the line routing.
- Traffic is hardly obstructed.
- Environment and residents are protected against noise, pollution, and vibrations.
- Neither landscape nor townscape suffer from the construction activities.
- A vegetation-disturbing lowering of the ground water can be avoided most of the times.
- Relatively little soil masses are dug and taken away.
- No demand of special storage areas for sheeting equipment and bulk materials.
- Short and weather-independent construction times.
- Less damage influence compared with the open design.

HOBAS Jacking Pipes

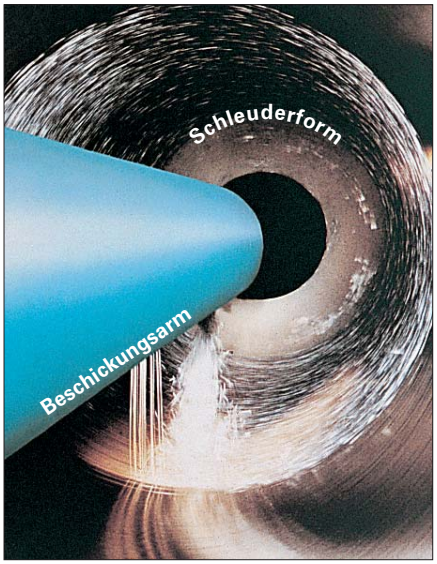
Requirements on pipes for jacking

Pipes for jacking are subject to high load during installation. The quality of the surface, the jointing system as well as the physical property are important for the successful use of the pipe material for the buried pipe installation. Following the installation, the pipes must meet the hard requirements of day-to-day canal operations, i.e. the pipes must be leak-free, corrosion- resistant, hydraulic smooth interior surface and flush-safe.

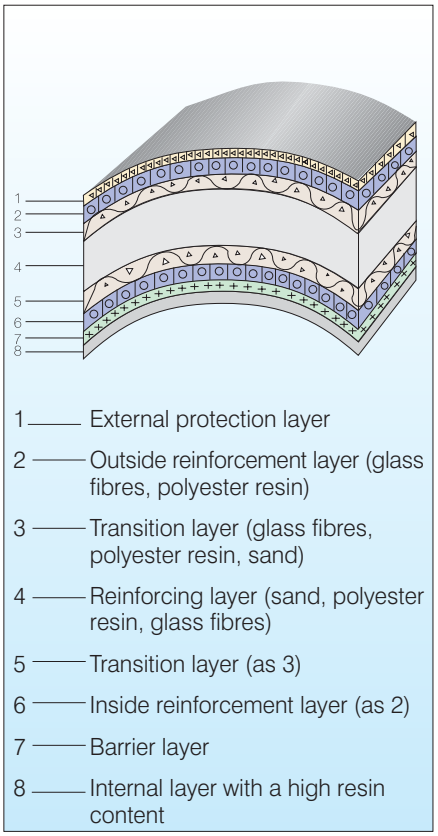
Production

The HOBAS pipe consists of a thermosetting composite material which is leak-free, durable, corrosion-resistant and light.

During the specially developed automated centrifugal casting process, several component of the compound material – polyester resin as binding agent, textile glass fibres as reinforcement, and aggregates – are fed into a rotating mould, degasified by rotation with a pressure of 30 to 50 bar, compacted, and tempered. The composite material technology offers the benefit that the physical properties are purposefully assigned to the load directions.



At the end of 1980, the first pipe for the remotely controlled pipe driving – which was a new technology at that time – was jacked on a trial basis at a company's premises in Schwaig (Bavaria). Since then, the physical properties are fundamentally improved and the jointing system is perfected.



1 — External protection layer
2 — Outside reinforcement layer (glass fibres, polyester resin)
3 — Transition layer (glass fibres, polyester resin, sand)
4 — Reinforcing layer (sand, polyester resin, glass fibres)
5 — Transition layer (as 3)
6 — Inside reinforcement layer (as 2)
7 — Barrier layer
8 — Internal layer with a high resin content

Quality

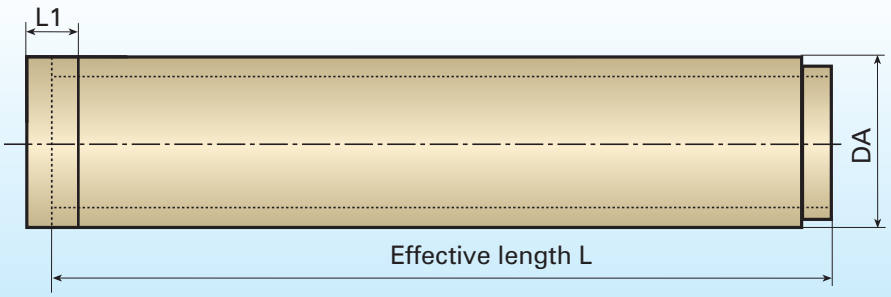
Production, wall structure as well as the important material characteristics base on DIN 16869, part 1 and part 2, respectively DIN 19565, part 1. The modification to the geometry necessary for jacking is important, i.e. higher wall thickness and coupling integrated in the pipe wall. Couplings either have a stainless steel sleeve or a glass fibre reinforced plastic sleeve depending on the nominal diameter. In addition to the necessary quality criteria, special tests regarding relevant characteristics are carried out that correspond to the special feature of the pipe for jacking. We are providing a manufacturer's description in accordance with EN 10204/2.1 on request.

Experiences

To this day, several hundreds of kilometres of glass fibre reinforced plastic pipes for jacking were jacked worldwide with jacking devices at dry or hydraulic conveyance. Depending on the jacking forces to be expected, the pipes for jacking had a wall thickness between 17 and 80 mm, and the effective length of the pipes was 1 to 6 m depending on the size of the starting manhole.

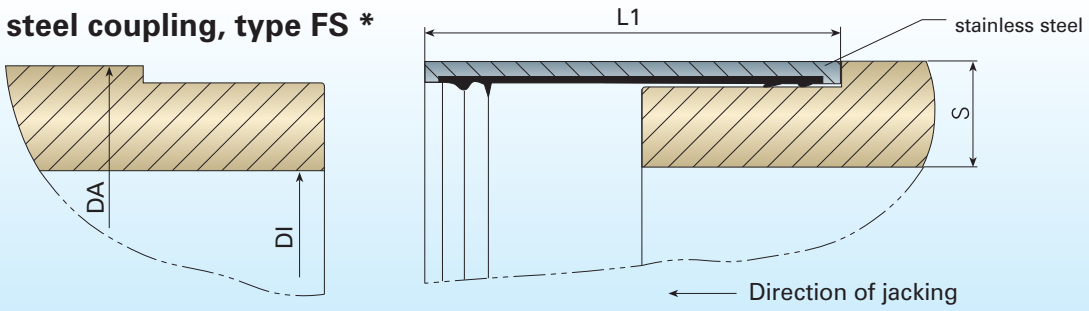

Compression strength test

Pipe coupling



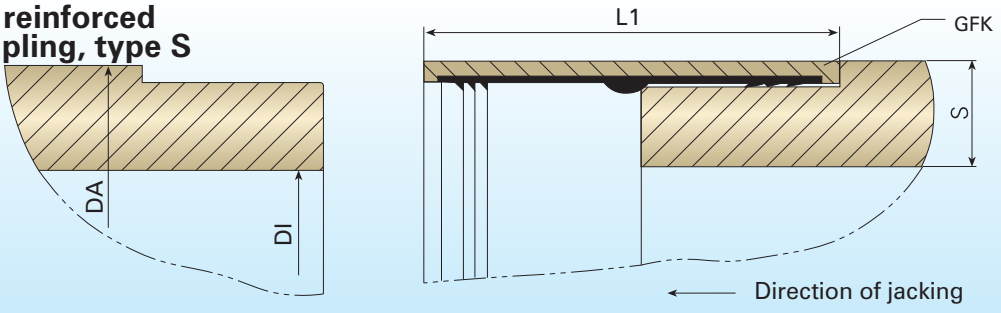
Effective length L
1 m 2 m 3 m 6 m
Additional effective lengths on request, Tolerances in accordance with company standard

Stainless steel coupling, type FS *

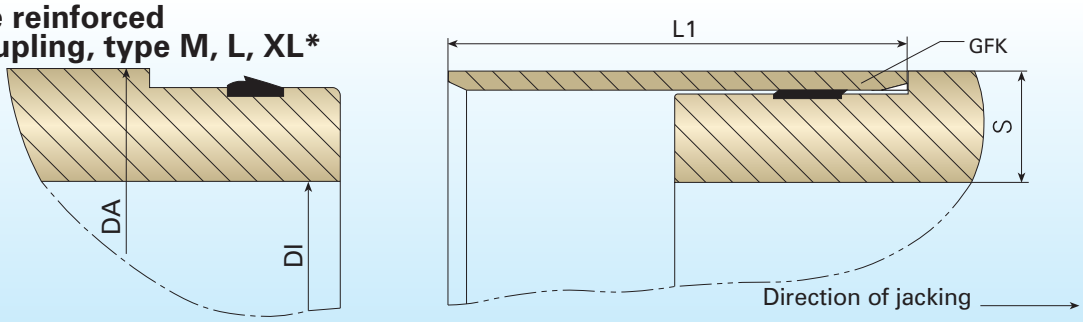


.* The execution of the stainless steel coupling with regard to width and sheet-metal thickness is adjusted to the nominal diameters.

glass fibre reinforced plastic coupling, type S



glass fibre reinforced plastic coupling, type M, L, XL*



* The letters M, L and XL are an abbreviation for the size of the sealing profile. Therefore, XL is used for large pipes.

Material parameters	Short-term	Long-term
Density	20 kN/m³	20 kN/m³
Bending E module, circumferential	10000 N/mm²	4800 N/mm²
Bending breaking elongation, circumferential	1.0 %	0.8 %
Compression strength, axial	90 N/mm²	-
Security factor for jacking force	3.5	

Jacking Pipes

Auswahl aus dem Wanddickenprogramm, weitere Wanddicken auf Anfrage.

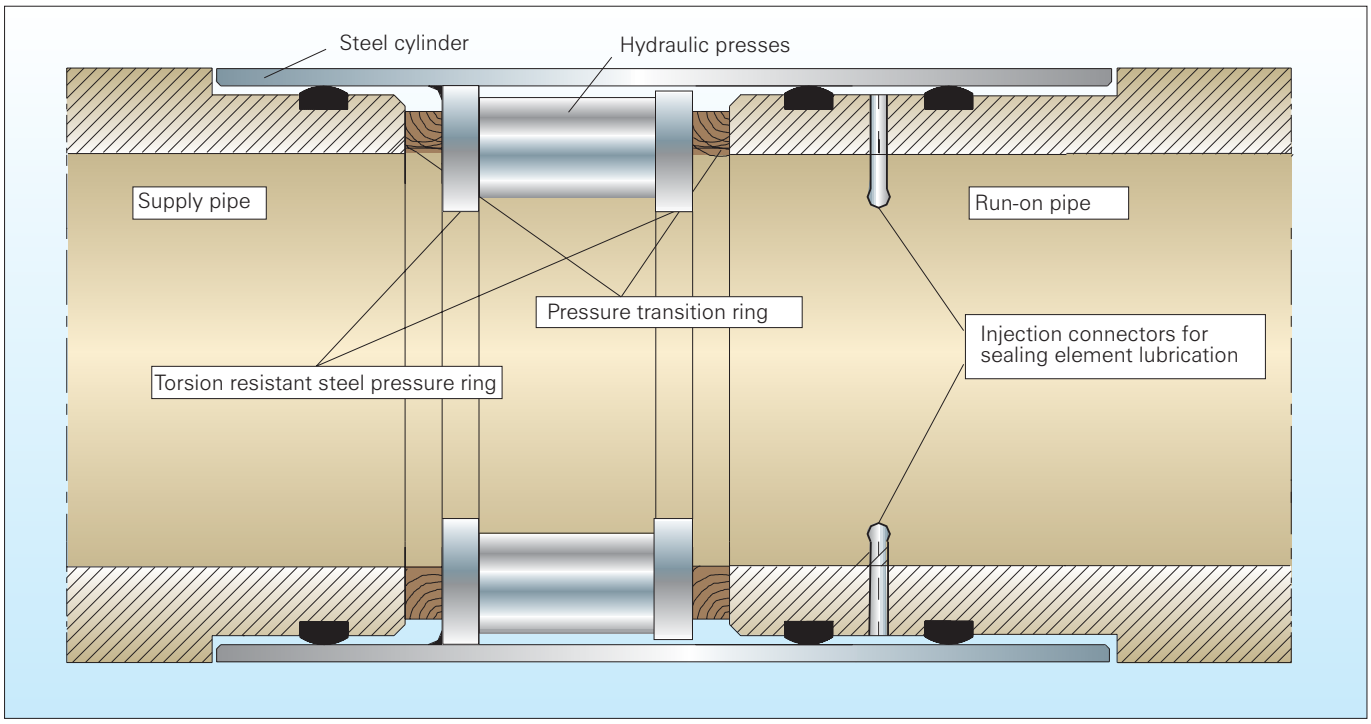
Nominal diameter	External diameter	Wall thickness	Jacking force $F_{max.}$ (kN)*		Nominal diameter	External diameter	Wall thickness	Jacking force $F_{max.}$ (kN)*	
DN	DA (mm)	s (mm)	Stainless steel sleeve	Glass fibre reinforced plastic sleeve	DN	DA (mm)	s (mm)	Stainless steel sleeve	Glass fibre reinforced plastic sleeve
200	272	16	110	150	800	924	34	1640	1440
-	-	24	260	300	-	-	46	2460	2260
250	324	17	140	200	-	-	77	4460	4260
-		28	390	450	850	960	31	1490	-
300	376	17	170	240	-	-	42	2280	2040
-		32	560	630	-	-	48	2700	2460
350	401	18	280	280	-	-	64	3800	3560
-	-	21	370	370	900	1026	34	1820	1580
-	-	39	860	870	-	-	48	2890	2650
350	427	18	310	310	-	-	68	4360	4110
-	-	24	490	490	1000	1099	35	2030	1710
-	-	39	930	930	-	-	51	3340	3020
400	501	18	350	-	-	-	73	5070	4750
-	-	30	790	-	1100	1229	40	2740	2280
-	-	48	1410	1300	-	-	53	3940	3470
400	530	18	380	-	-	-	81	6410	5950
-	-	31	880	-	1200	1348	44	3460	2820
-	-	51	1600	1500	-	-	54	4470	3830
450	550	20	480	-	-	-	72	6250	5600
-	-	26	720	-	1300	1434	46	3890	3140
-	-	38	1190	1080	-	-	57	5070	4330
-	-	53	1750	1640	-	-	76	7060	6320
500	616	21	580	-	1400	1499	48	4230	3470
-	-	43	1560	1470	-	-	60	5580	4820
-	-	58	2180	2090	-	-	79	7660	6900
550	650	21	610	-	1500	1638	52	-	4210
-	-	26	850	-	-	-	65	-	5810
-	-	44	1700	1600	-	-	81	-	7730
-	-	62	2490	2390	1600	1720	55	-	4380
600	718	23	730	-	-	-	64	-	5540
-	-	43	1780	1740	-	-	78	-	7320
-	-	59	2580	2530	1700	1842	59	-	5220
650	752	26	910	-	-	-	73	-	7150
-	-	42	1790	1770	-	-	83	-	8510
-	-	51	2270	2250	1900	2047	65	-	6540
-	-	62	2840	2810	-	-	75	-	8080
700	820	25	960	-	-	-	81	-	9000
-	-	45	2170	1940	2100	2252	71	-	7980
-	-	67	3430	3200	-	-	82	-	9840
750	860	27	1130	-	2300	2400	76	-	9250
-	-	43	2160	1910	-	-	81	-	10150
-	-	58	3070	2820	2400	2530	80	-	10340
-	-	72	3900	3650	2600	2740	86	-	12270

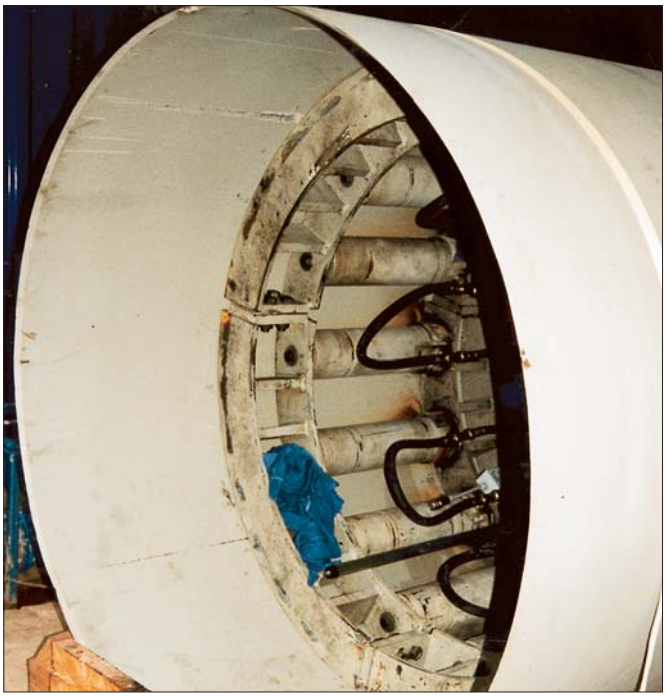
* The admissible jacking force Fmax. corresponds to a safety 3.5 times higher compared with the arithmetical rupture load.

Intermediate jacking stations

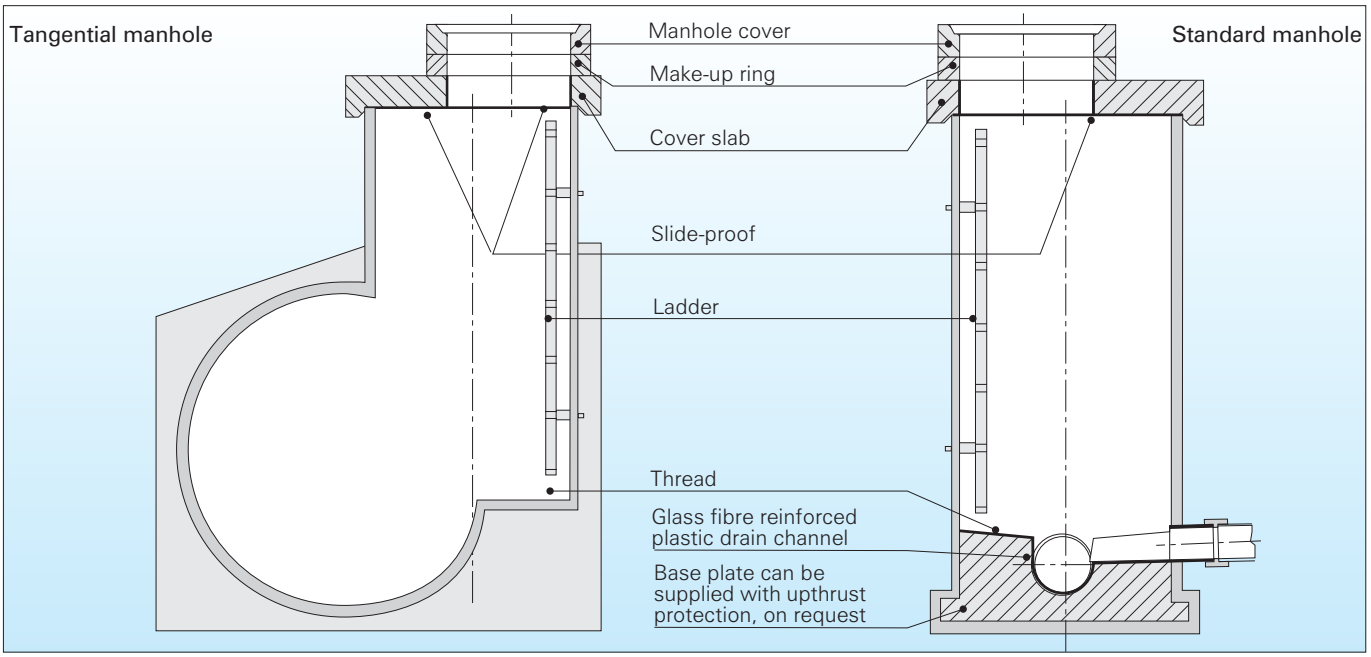
An intermediate jacking station normally will be used if special conditions are expected because of the jacking conditions and/or lengths of jacking. Such equipment enables the subdivision of the total pipe run into individual runs that can be easily jacked. The intermediate jacking station is built back after completion of the position. The installation of the driving and run-on pipes take place in coordination with the building contractor in order to meet the respective equipment requirements.

The steel cylinder (jacket) of the intermediate jacking station must consist of a smooth interior surface without groove and burr. It must have such a stiff development that there will be insignificant deformation by soil load only



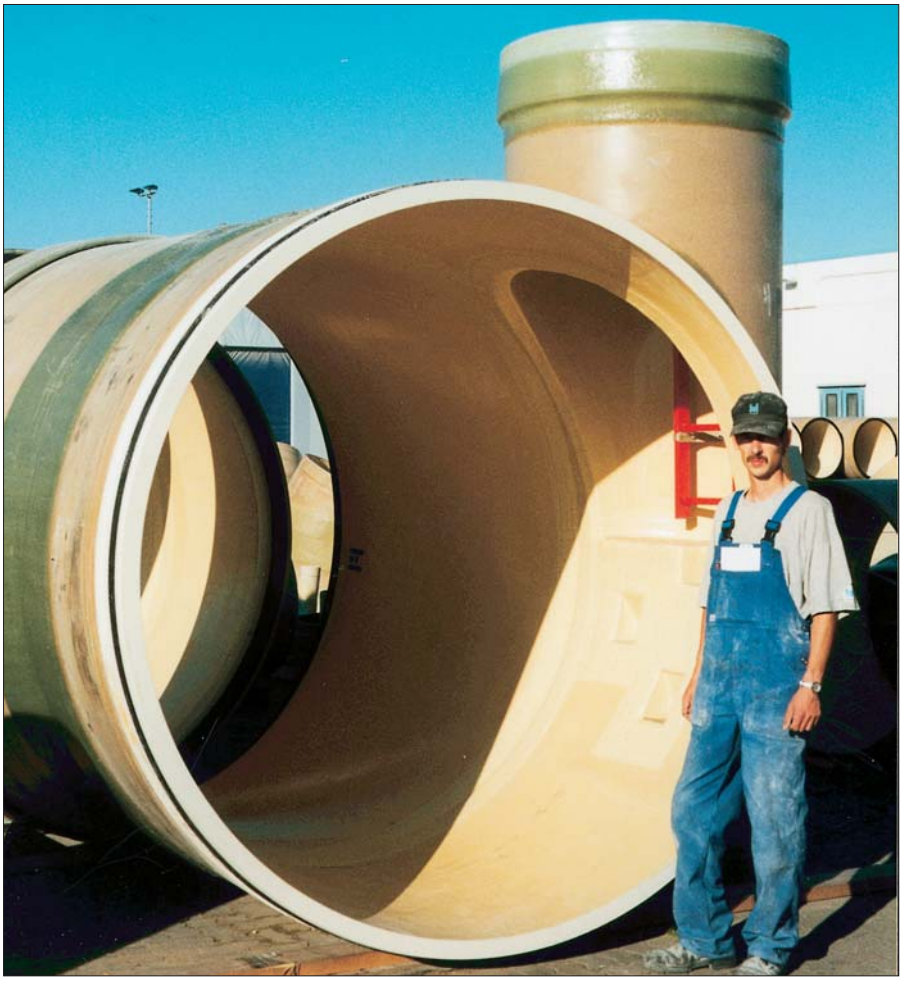


Manholes and structures for jacking building site



Advantages

- High economic efficiency
- Lightweight
- Uncomplicated and fast installation
- Good hydraulics
- Couplings of different materials is possible without any problems
- Supply as complete component
- Limitation of the building site risk
- Manufacturer's quality
- Protective coats or sealing works are not necessary
- Production with quality monitoring and licensing in accordance with GKR R 7.8.33
- Smooth



Advantages of HOBAS pipes

- High accuracy
- Variable effective lengths
- Mar-resistant external surface
- Relatively low weight and comfortable pipe couplings
- High abrasion resistance
- Very smooth external and interior surfaces of the pipe – pipe wall roughness: (ki - 0,01 mm)
- High chemical resistance
- Variable wall thickness and jacking forces
- External surface with low-grade absorption
- Highly resistant against UV light
- Pipes can be bent at the coupling joint
- High durability provides long service life
- More than 40 years of experience
- Pipe laying can be carried out in any weather conditions
- Complete range of fittings, incl. manholes and mouldings
- Pipes provide easy machining on site

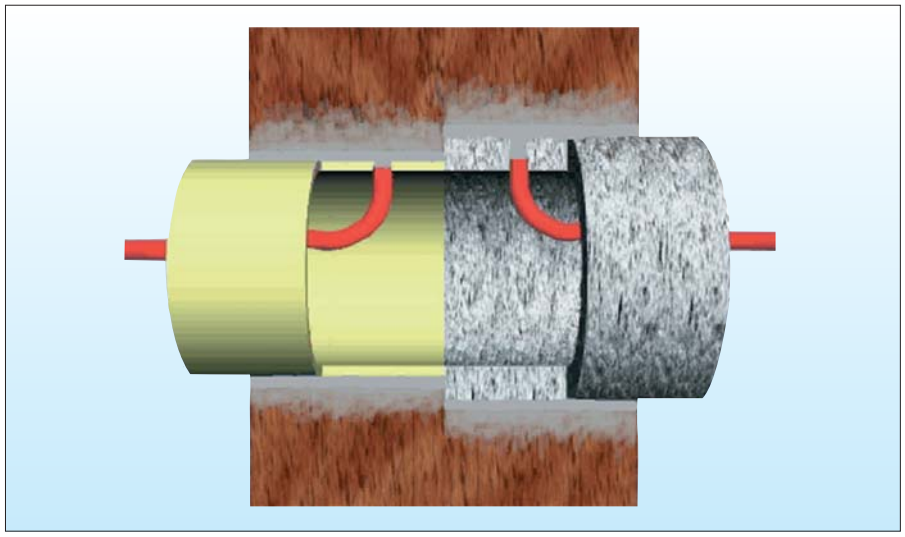
Advantageous jacking

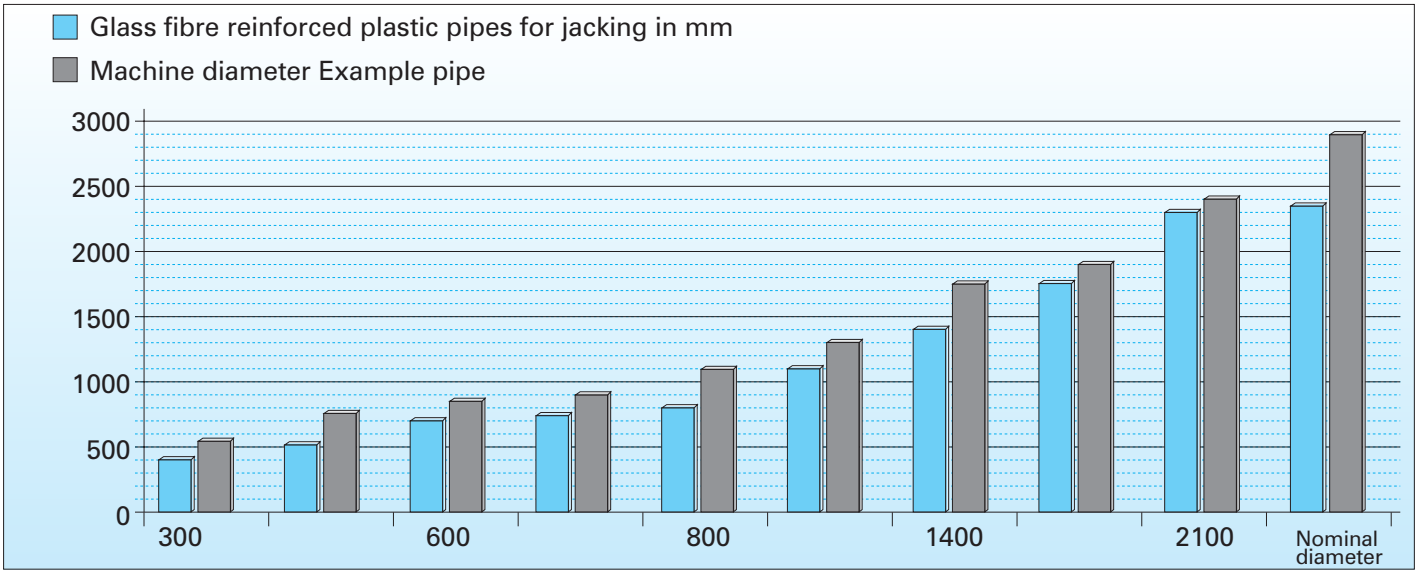
High compression strength

Nominal diameter of HOBAS pipes for jacking have a compression strength of 90 N/mm² and greater. Therefore, a smaller wall thickness with comparable jacking forces results as a rule. The consequences are weight benefits and smaller external diameters. On the other way round, a larger internal diameter is available with comparable external diameter. The hydraulic advantages might become considerable, especially under the consideration of smooth interior surfaces.

Smaller external diameters - Less machine costs

Smaller external diameters with comparable internal diameter have many advantages. In many cases, a smaller machine class can be used instead of a conventional pipe for jacking.
This results in a reduction of the equipment and/or leasing costs. Such costs may considerably increase in the event of larger nominal diameters, in particular if the equipment class changes. The savings possibilities also apply to the building site and/or jacking hole equipment.

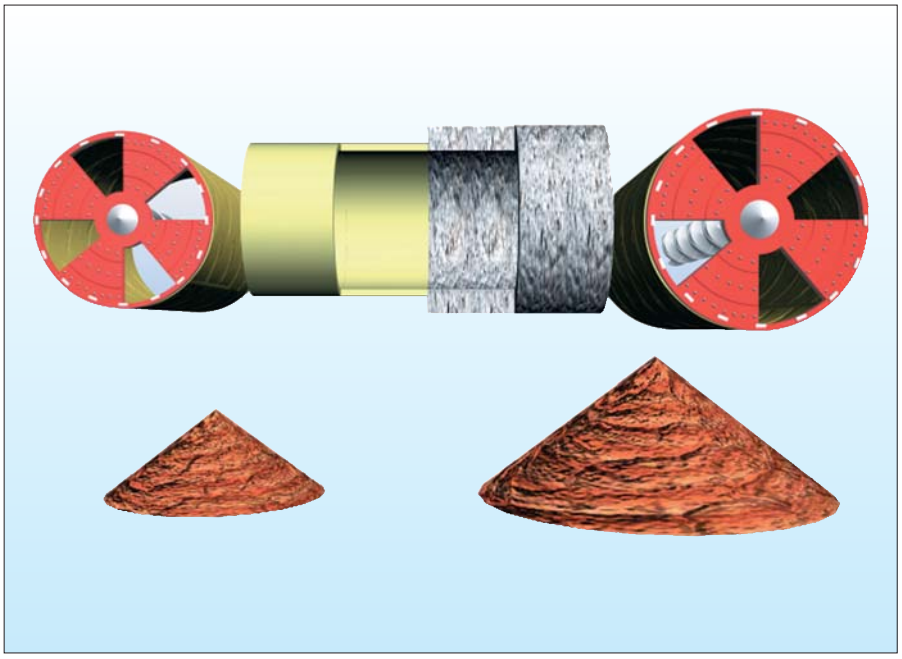




Advantageous jacking

Smaller external diameter - Less excavation work

A smaller drill hole automatically means that less ground material has to be removed, transported, and disposed.
The result is considerably savings regarding excavation work that can amount to 14 to 53 % depending on the nominal diameter.
The consequence is that less bentonite has to be jacked and additional costs can be saved therefore.

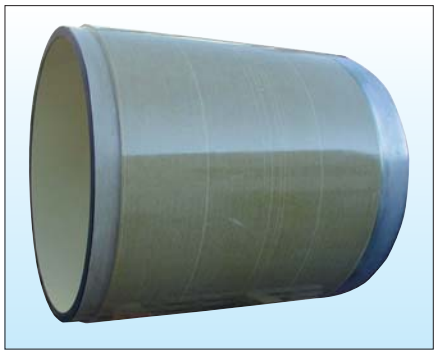


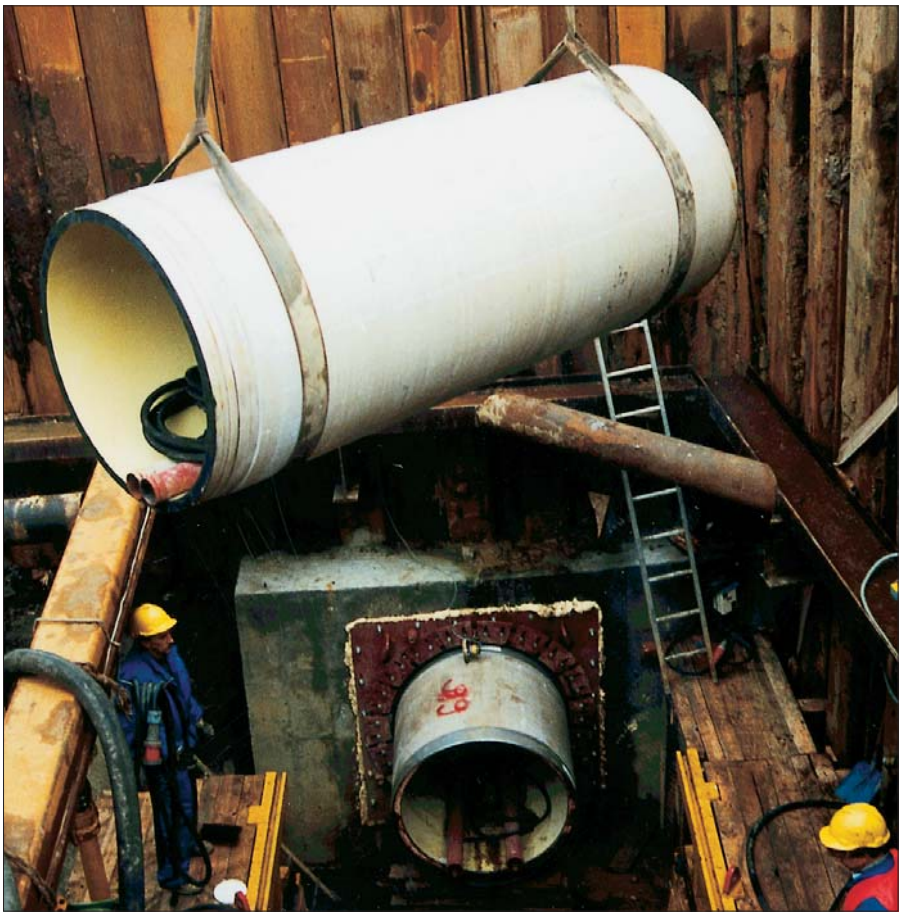
effective length	HOBAS pipe		Example pipe		excavation work reduction	
DN	DA mm	excavation work m^3/m	DA mm	excavation work m^3/m	m^3/m	%
300	376	0,11	552	0,24	0,13	53,60
400	501	0,20	658	0,34	1,14	42,03
500	550	0,24	752	0,44	0,20	46,51
600	650	0,33	862	0,58	0,25	43,14
700	752	0,44	960	0,72	0,28	38,64
800	860	0,58	1100	0,95	0,37	38,88
1000	1099	0,95	1280	1,29	0,34	26,28
1400	1499	1,76	1720	2,32	0,56	24,05
1600	1720	2,32	1998	3,13	0,81	25,89
2200	2400	4,52	2910	6,65	2,13	31,98

Advantageous jacking

Favourable jacking force development

The diffusion tightness of polyester resins only allows a very low water absorption at the external plating of the glass fibre reinforced plastic pipe for jacking.
Therefore, suction to moist ground material is not possible.
By this means, there are comparable low starting resistances when starting jacking also in the event of longer stop. The friction forces are also low during jacking because of the smooth external surface. This allows larger jacking lengths.

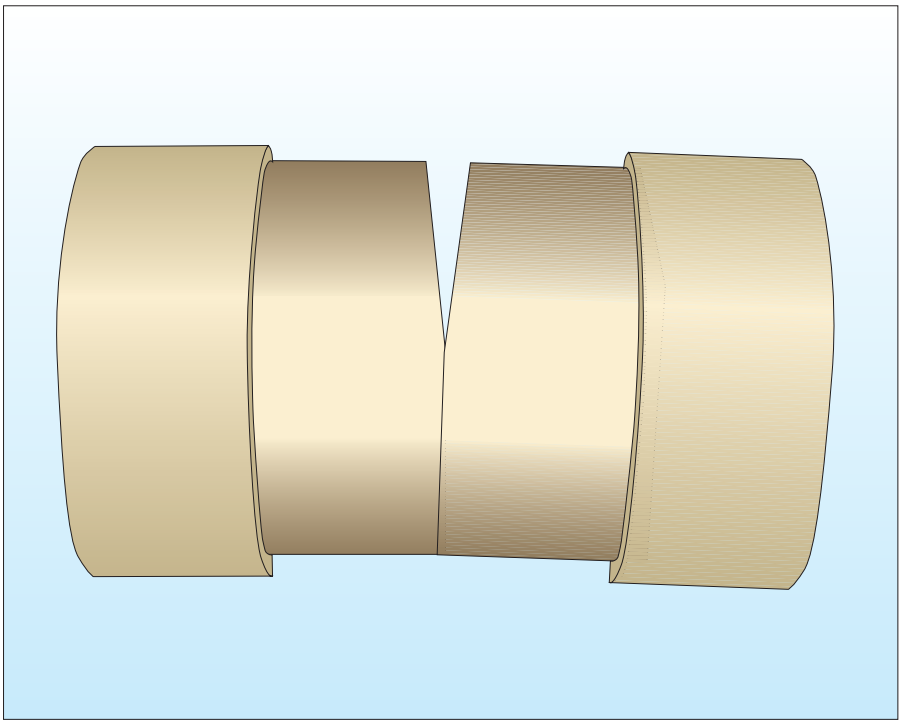




Elasticity = Optimum contact surface

Necessary control movement results in a bending in the pipe couplings. Therefore, wood rings are inserted into the coupling joints for conventional materials per default. Elasticity of such wood rings compensates irregularities, tolerances of the pipe cutting surfaces, and minor bending.

The HOBAS pipe for jacking is able - because of the elasticity of the material - to react on off-centre load application by means of deformation.
Therefore, there is no need of a wood spacer in the joints. In addition, the pipe is able to compensate minor irregularities of the face and deviations from the squareness by means of elastic deformation.

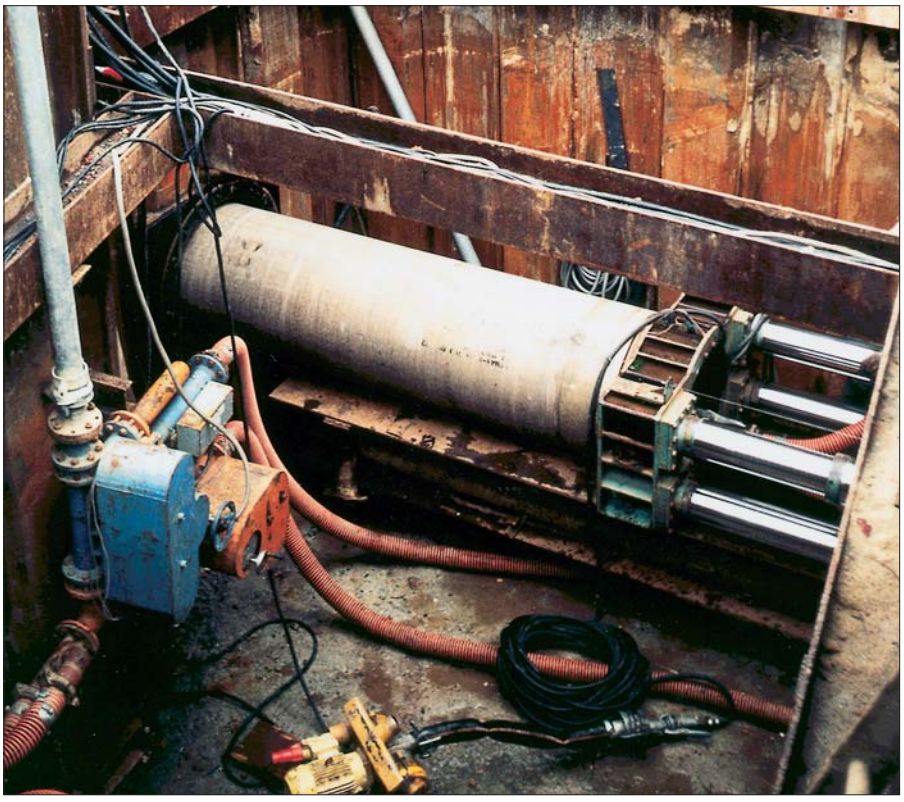


Hamburg – Practical suitability verified

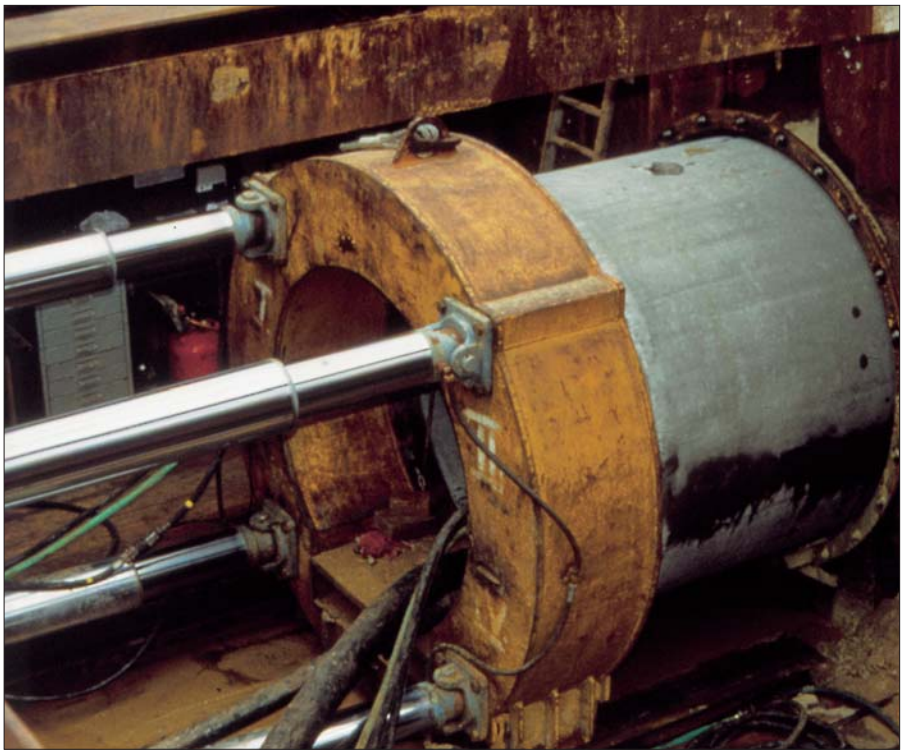
Hamburg is forerunner regarding the use of the glass fibre reinforced plastic pipe for jacking. Early the eighties, a channel with a clear width of 600 mm underneath a busy part of the customs house had to be installed for the project "Hamburger Zollhafen". The decision regarding a closed design was taken because an obstruction of a fire department exit, a docks railway and Federal Railways line was not allowed on the one hand and settling must be avoided on the complete effective length on the other hand.
HOBAS pipes for jacking with an external diameter of 752 mm and a wall thickness of 50 mm were used because of the resistance against aggressive sewage, the smooth external surface as well as the easy handling. The pipe was jacked through mudflat and clay soil with enormous precision under the ground-water level. The actual deviation from the planned line was – with a position length of more than 100 m that was unprecedented for plastic pipes – just 15 mm and was considerably below the predefined tolerance of +/- 30 mm therefore.

Project Hamburg, Wulksfelder Weg

In those days, a world record was set up for pipes for jacking made of glass fibre reinforced synthetic material with the project "Wulksfelder Weg".
The pipes (752 x 50 mm) were successfully jacked in sandy ground with a position length of 180 m underneath the ground water level. Intermediate jacking stations were not necessary. The pipe run was lubricated with bentonite every 30 m for the reduction of jacket friction. The largest necessary jacking force was 1800 kN and was therefore far below the force permitted for the pipes. A limitation of the jacking length was not produced by the pipe but by the laser control. Atmospheric humidity and different air temperatures in the pipe run caused a blooming up and movement of the laser beam on the target panel. Therefore, a jacking of more than 180 m within the scheduled tolerances (deviation from height 30 mm) was not possible any longer.



New York, Staten Island



The largest pipeline project in North America with centrifuged glass fibre reinforced plastic pipes for jacking in closed design was carried out between 1989 and 1991 in New York. A total of 2400 m of glass fibre reinforced plastic pipes for jacking, DN 1500, with a maximum covering of 20 m up to 29 m below the ground water level were jacked. The used glass fibre reinforced plastic pipes for jacking had an external diameter of 1600 mm and a wall thickness of 68.6 mm, designed with a safety factor 2.5 for a admissible jacking force of 9000 kN in accordance with US safety regulations, and a construction length of 3 m and a weight of 1800 kg. The complete pipe route ran in heavily binding sand. After several routes with position lengths of almost 200 m each were successfully started, the building constructor obtained a jacking width of 468 m with the installation of intermediate jacking stations never obtained before. The maximum measured jacking force was 6000 kN that was clearly below the permitted value of 9000 kN. Encouraged by such favourable result regarding the jacking force, the building constructor went for the jacking of the next position at a jacking width of 366 m without the use of intermediate jacking stations. Reasons for the renunciation of intermediate jacking stations were cost reduction on the one hand - because jacking had to be interrupted for one day at least when installing an intermediate jacking station – as well as the latent leak risk especially below high ground water pressure on such route of 2 bar. Until right before reaching the target manhole, the jacking was without any problems. Jacking be stopped 20 m in front of the target because of a ground water intrusion into the target manhole in a depth of 30 m. Because of the depth and the high ground water pressure, it took 16 days until the problem was solved and the target manhole was drained. Fears that the long stop would cause a clear increase of the necessary jacking force could not be confirmed to the building constructor's great surprise. The jacking force of 5500 kN measured right before the jacking stop had increased to 6800 kN only.

Therefore, jacking of 366 m could be successfully completed to the client's satisfaction by means of the precision performance of the building site staff and the excellent characteristics of the centrifuged glass fibre reinforced plastic pipes for jacking despite of the unpredictable adverse circumstances.

Market leader in the United States

In the middle of the eighties, a delegation of the city Houston travelled to Hamburg to get information regarding the new installation technique of the microtunnel construction and was very impressed regarding the use of such installation technique with centrifuged glass fibre reinforced plastic pipes for jacking. Starting with Houston, centrifuged glass fibre reinforced plastic pipes for jacking were successfully jacked in almost all American cities with nominal diameters from DN 400 to DN 2200 on a total length of more than 200 km until today. Since 1989, centrifuged glass fibre reinforced plastic pipes for jacking are market leader with an average market share of 38% of the jacking market during the past years according to the statistics of the "Trenchless Technology Centre (TTC)" in the United States of America.

Pressure sewer in Orlando, Florida

At the beginning of 1997, the city Orlando, Florida, planned the construction of a pressure sewer DN 800 with a length of 1.4 km and an operating pressure of 2 bar. After thorough comparison of variants, the city took the decision with regard to the use of HOBAS pipes for jacking with special glass fibre reinforced couplings for the leakage protection against internal pressure.

For the construction, the length was divided into 8 sections from 58 m to 305 m by means of position lengths. In order to jack such 8 positions by 4 excavations, special glass fibre reinforced plastic pressure pipes for jacking with an external diameter of 975 mm were used. PN7 was used as nominated pressure level. The admissible jacking force was 1760 kN at a wall thickness of 62 mm. Intermediate jacking stations were not used.

No problems occurred during the jacking process of the pressure pipelines. The feared crushes of ground material underneath the couplings in direction of jacking were not noticed. Each position passed the pressure test with a test pressure or 7 bar. A remarkable installation speed of 6 m per working hour could be managed.

The total time of construction was 3 months only, and HOBAS pipes for jacking have impressively demonstrated the suitability as pressure pipeline.esen.

Warsaw, Prymasa

In autumn 1999, tenders were invited for the – until today – largest driving project in Poland: the construction of a main sewer with a length of 1.9 km and an internal diameter of 2200 mm. The client required a corrosion-resistant pipe material because of the low gradient and gas formation connected with it. Therefore, the tender text specified the alternative of pipes for jacking of centrifuged glass fibre reinforced synthetic material and concrete pipes with a complete plastic lining.

HOBAS pipes for jacking with an external diameter of 2400 mm and a wall thickness of 76 mm received the award. The complete route was divided into jacking sections with lengths of 420 m, 470 m, 286 m, 404 m, and 200 m. The installation was carried out in sandy mixed grounds with organic inclusions between 7.5 and 10 m underneath the ground water level that was up to 3.5 m above the pipe crown. All pipes were equipped with injection connectors for lubrication.
3 intermediate jacking stations were installed into the pipe run in such a way that they had the exact position of the revision manholes after completion of jacking.
Therefore it was possible to recover and reuse them at the later installation of the manholes.

After first problems with the separation of the hydraulically extracted ground were solved, the works could be successfully completed after a total time of construction of 8 months, including the installation of the glass fibre reinforced plastic manholes. The maximum jacking force for the longest section of 470 m was 7500 kN on restart after a longer stop.

During the jacking process, the average jacking force was 4000 kN and an average of 15 m per day were installed.

Krefeld, Rundweg

In summer 2000, a retaining channel with overflow construction for the extension of the retaining volume had to be built in front of the mixed water raising plant at the area “Linn” in Krefeld. The client required glass fibre reinforced plastic pipes with an external diameter of 2400 mm and a wall thickness of 76 mm in order to guarantee the highest possible corrosion prevention for the new channel. The first jacking line with a length of 282 m ran in an installation depth of 6.5 to 7.5 m, partly parallel to a private railway line underneath a city-interior minor road. The second jacking line with a length of 36 m had to underrun the busy federal road B 288 with a covering of 5 to 7 m.

Following the first two working pipes, the first intermediate jacking station was installed. After the installation of additional 120 m, the second intermediate jacking station was used although the maximum jacking force was clearly less than 45 % of the permitted force at that time. Then, jacking was made with a curve radius of 1500 m until the target hole was reached after additional 160 m and a total jacking time of 32 working days. The jacking forces were between 5000 to 6000 kN during the total pipe jacking. Only in exceptional cases, e.g. when starting the line after a weekend, jacking forces of almost 7000 kN had to be used in order to start the pipe run.

Since the used jacking forces were just 70 % of the permitted jacking force of the glass fibre reinforced plastic pipes for jacking, the second intermediate jacking station was not put into operation during the complete jacking.

The installation of HOBAS glass fibre reinforced plastic manholes turned out as a special advantage - compared with the originally planned concrete buildings with recess:

- shorter construction time,
- easy assembly
- manhole assembly as smooth building in one piece
- reduced building site risk
- excellent hydraulics, no change of material
- high quality standard
- reduced settling risk, low weight

Information regarding static calculation in accordance with ATV A 161

The static calculation is carried out free of charge and as a favour on the basis of your information in accordance with ATV A 161. We are not incumbent to check if your given information agree with the actual conditions. The guideline ATV A 161 shall apply to a professional conduct as a rule. It neither shall consider extreme conditions justifying deviations from such guideline nor special cases that may demand additional or restricted actions. The calculation shall apply to the straight driving. We shall not carry out a check for a purpose requiring special characteristics of our products. The static calculation shall not excuse you to check yourself it our products are suitable for your intended purpose.

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Building project:

glass fibre reinforced plastic pipes for jacking

DA mm | wall thickness: mm | jacking length: m

Phase of processing: planning | Offer no.: | ordner no.:

Loads:

Overlapping height above pipe crown $h_{ü\ min}$= m | $h_{ü\ max}$= m

ground water above pipe crown

Ground water level at minimum covering depth h_w=

Ground water level at maximum covering depth h_w=

traffic load	SLW 60	SLW 30	LKW 12	**Aircraft load**	BFZ

BFZ load at parapet shield		kN	
Parapet shield diameter		mm	
Grouting of the intersection	☐ yes	☐ no	
Lubrication in building condition	☐ yes	☐ no	
Lubricant and supporting material pressure		bar	
Jacking under compressed air	☐ yes	☐ no	
Overpressure of compressed air		bar	
Additional loads			

Ground conditions: (cropped-out soil) compression degree d D_{Pr} | Ground group in accordance with ATV A 217: G1 | G2 | G3 | G4

Unusual features/ Remarks:

Information given by:

Company:

Name:

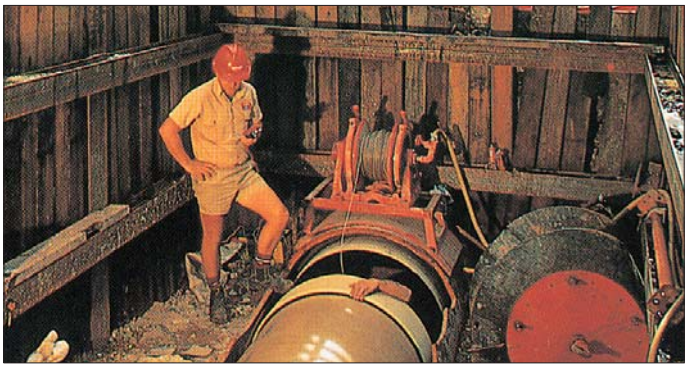
Street:

Zip code / City:

Telephone number: Facsimile number:

Date: Signature:

Notes

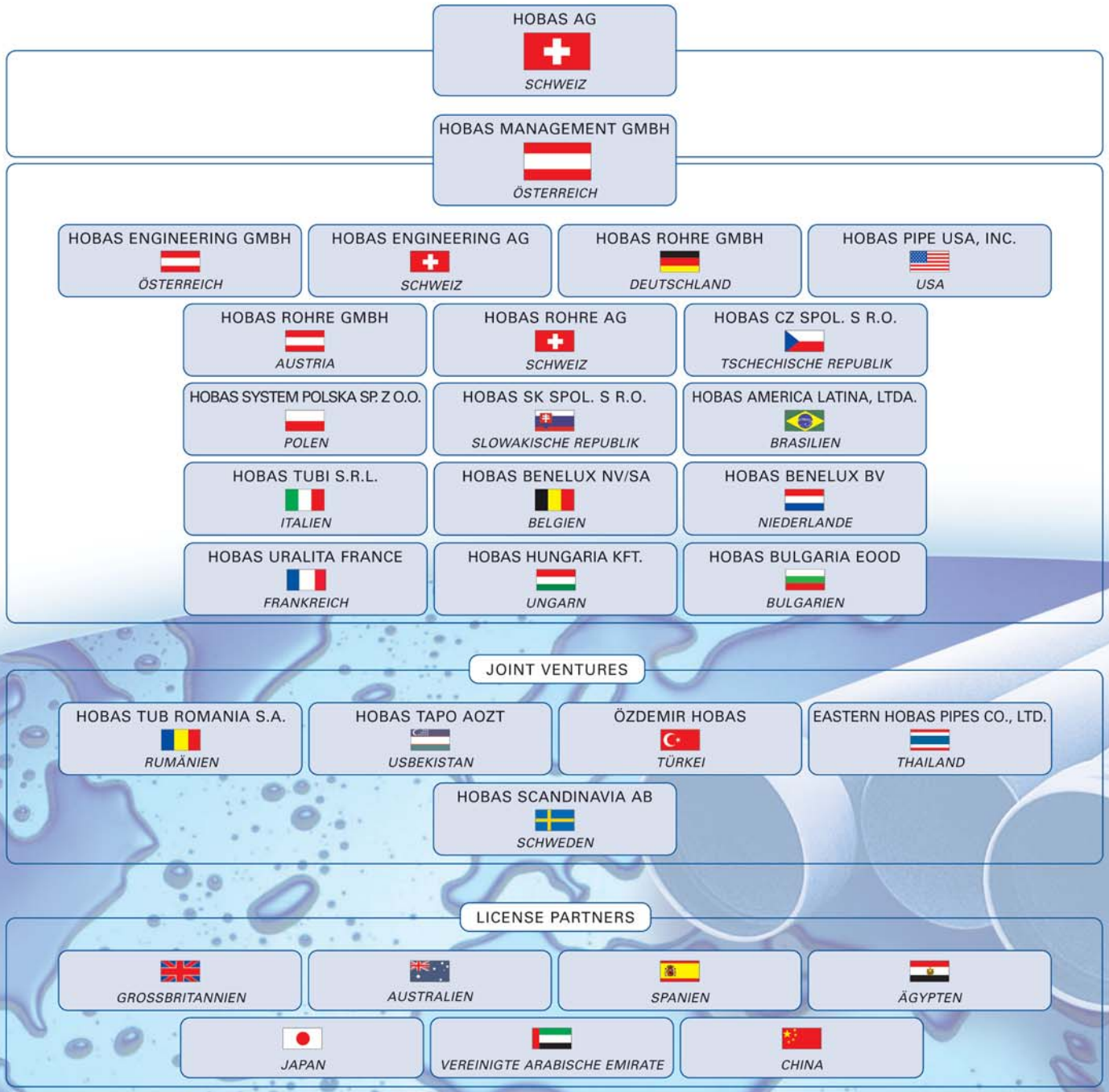


HOBAS pipes are used for the following applications:

- Sewerage interceptors
- Pressure pipelines
- Tunnelling and above-ground installations on slopes
- Inverted siphons and sea pipelines
- Industrial pipelines
- Pipelines along bridges
- Drinking water pipelines
- Relining
- Jacking and microtunneling

HOBAS

HOBAS Weltweit



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