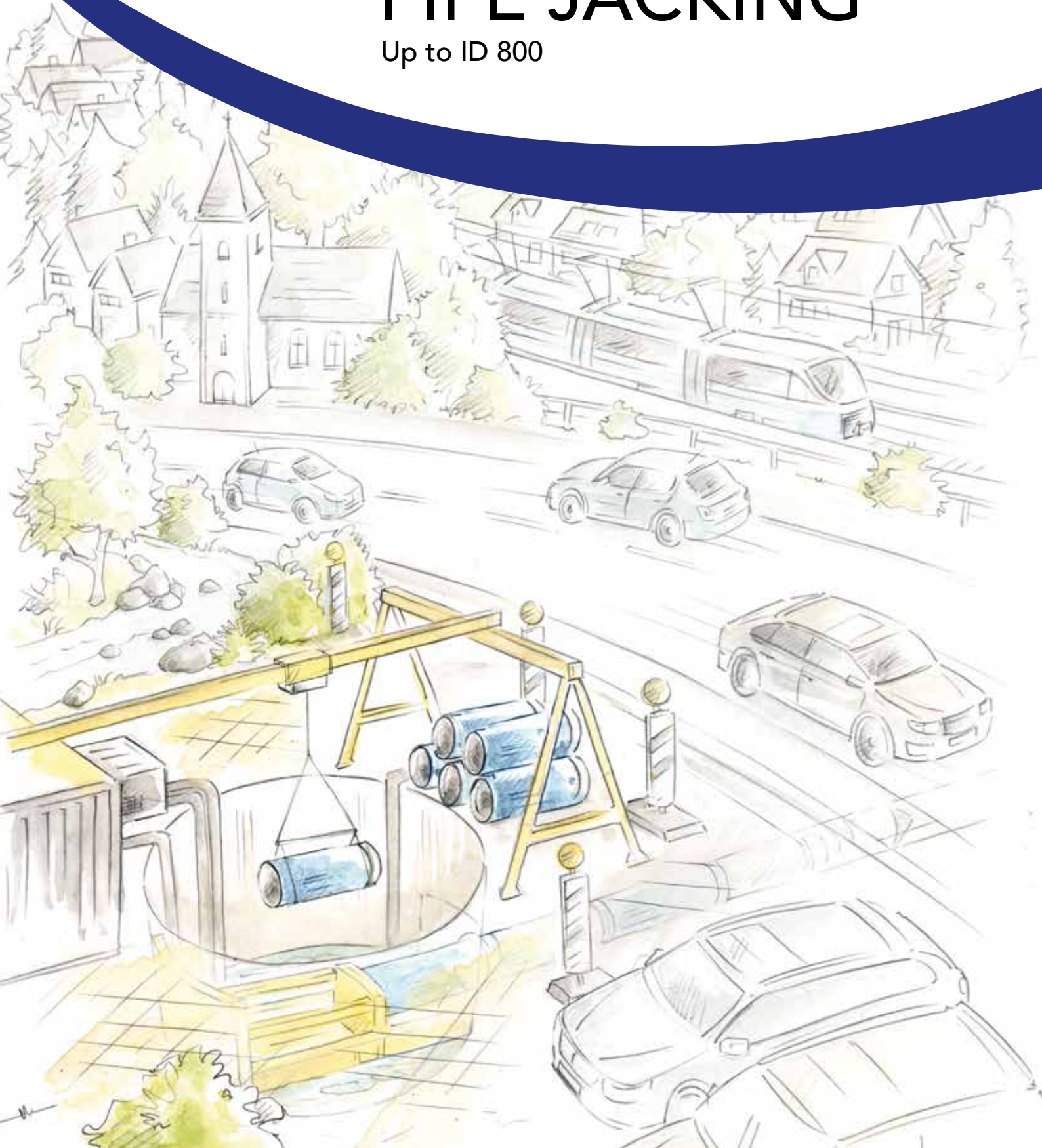


Without open trench

PIPE JACKING

Up to ID 800





GOOD TO KNOW

Guide part 1 for clients and engineers for planning, tendering and implementation of pipe jackings up to ID 800.

Publisher: GSTT - GERMAN SOCIETY FOR TRENCHLESS TECHNOLOGY E.V. | Messedamm 22 | 14055 Berlin
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„Why dig trenches if small shafts will do the job?“

„Why put up with detours and traffic jams, if you can avoid them?“

„Why interfere with nature if flora and fauna can remain undisturbed?“

„Why expose businesses and restaurants to a financial burden, if you can do it without dirt, blocked pavements and roads?“

Shafts instead of trenches

The superior solution

There is a different way - better and more efficient. Pipe jacking is available as an alternative for new construction and renewal of underground infrastructure – and it offers many convincing benefits for use in virtually any case. The appropriate technologies have been so consistently and continuously developed over the past 35 years that they lack nothing compared with open trench technologies today – on the contrary – they offer clear technical, ecological and economic benefits.

1 DESIGN

OF PIPE-JACKING PROJECTS

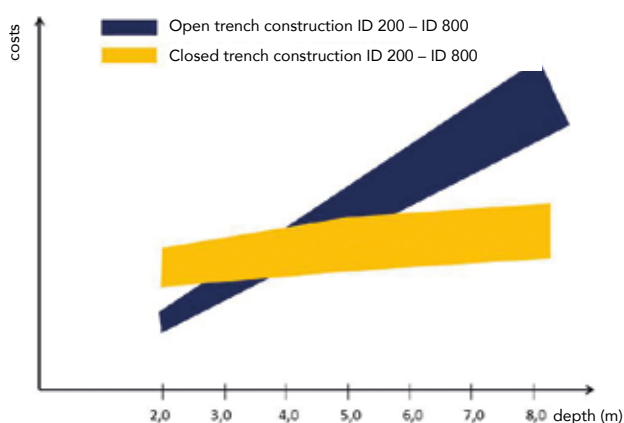
Today, pipe jacking offers many solutions for a variety of uses; it is universally deployable and provides substantial benefits.

4

FIELDS OF APPLICATION

- > Versatile options for use in technical infrastructure (wastewater, water, gas, district heating, electricity, etc.)
- > Construction in existing development (new construction/renewal)
- > New development
- > Constructing house connections
- > Crossings under roads and motorways, rail tracks, rivers, lakes
- > Crossings under historic buildings and building facilities
- > Installation in water collection areas

COSTS AT A GLANCE



The figure shows the qualitative development of construction costs for open trench and trenchless construction methods as a function of depth. Depending on the existing road surface, the nominal diameter of the pipe, and the groundwater level, a trenchless construction method can be more favorable than an open trench construction method starting at a depth of 3.00 m. In some cases, pipe jacking is more economical, even at lower depths.

SUCCESS PARAMETERS

basics and requirements:

- > Design and tendering on the basis of the applicable regulations for pipe jacking
- > Knowledge of the soils
- > Use of suitable machine technology
- > Performance of the work by experienced contractors

While the jacking pipes are being installed underground, life goes on above. Construction work on the surface is only required at single points.



2

BENEFITS

„With all of its possible applications and benefits in economic, environmental and social terms, pipe jacking is the best alternative to open trench construction.“



ECONOMIC CONSTRUCTION METHOD

- + Multiple use of launch and target shafts for creating sewers and house connections
- + Use of the launch and target shafts as maintenance shafts
- + Easy checking and inspection through directly connected house connections

ENERGY EFFICIENCY

- + 90% less soil needs to be transported
- + Less or no traffic jams, no detours
- + 90% less CO₂ emissions/fine dust

SOCIAL / ECONOMIC LIFE

- + Low noise levels, minimal vibrations
- + Minimal disruption of the technical infrastructure
- + Marginal interference with life on the surface thanks to short construction periods

SURFACES

- + Road interference only in the area of the start/target shafts
- + Minimal impact on nature
- + Gentle handling of lateral buildings

GROUNDWATER

- + Construction without groundwater lowering

SOIL

- + Less soil excavation and landfilling
- + No need to replace the soil near the pipeline
- + No intermediate storage



MAINTAINING VALUE/LIFETIME

- + Up to 50 % longer lifetime thanks to premium building and material quality
- + Lower charges thanks to longer amortization period
- + Excellent installation precision and ideal bedding of the pipes
- + High level of stability thanks to greater wall thickness
- + Prevention of settlements

ROADS/TRAFFIC ROUTES

- + No reduction in value
- + Existing pipes/connections can be underpassed

SAFETY ASPECTS

- + High level of safety for construction workers
- + Less accidents than in open trench
- + Less open trenches – more traffic safety

3

TUNNELLING TECHNOLOGIES

Trenchless technology for sewer construction has seen major advances in the past 35 years; its fields of application have been continuously expanded. Today, there is a solution for almost any application.

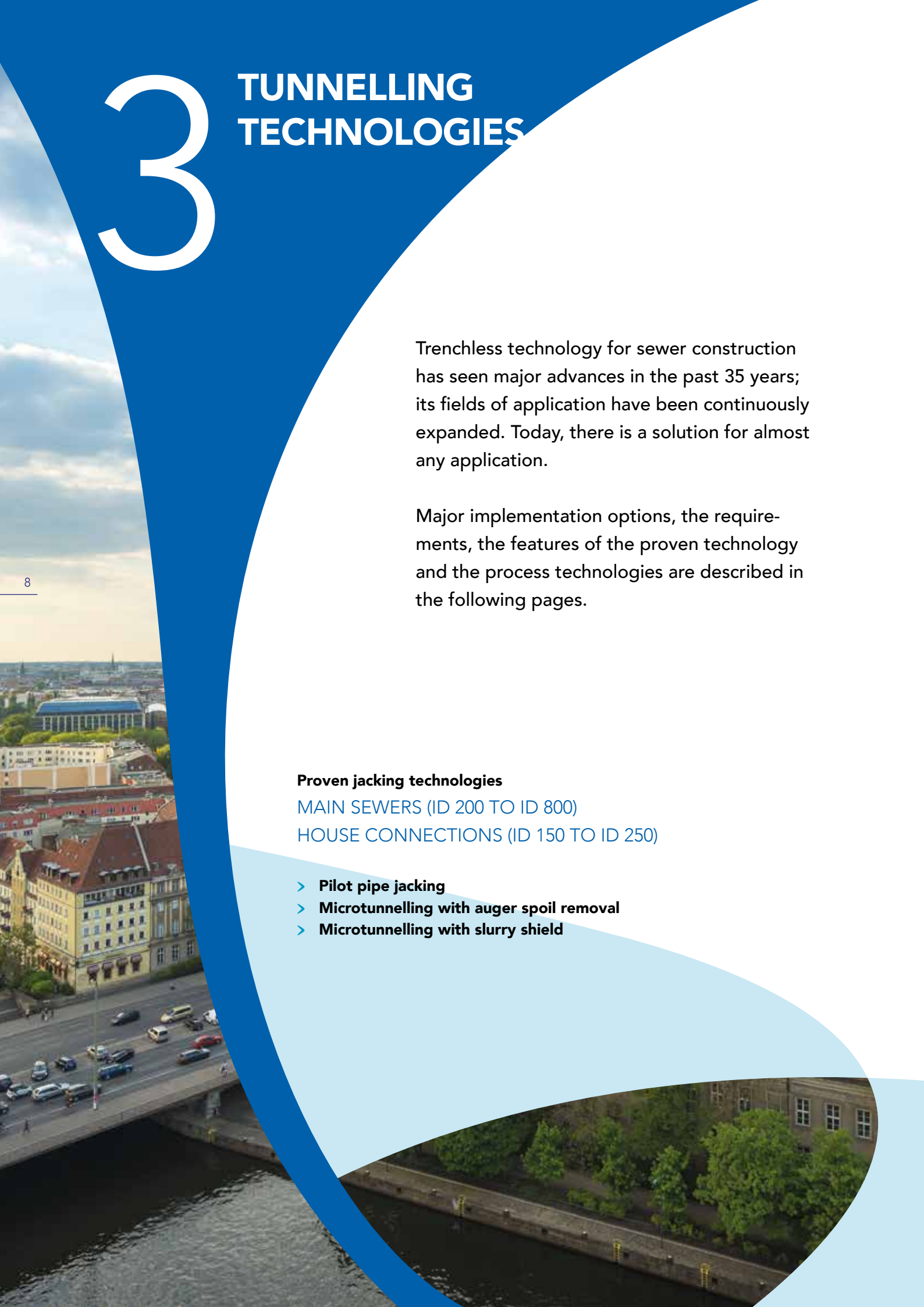
Major implementation options, the requirements, the features of the proven technology and the process technologies are described in the following pages.

Proven jacking technologies

MAIN SEWERS (ID 200 TO ID 800)

HOUSE CONNECTIONS (ID 150 TO ID 250)

- > **Pilot pipe jacking**
- > **Microtunnelling with auger spoil removal**
- > **Microtunnelling with slurry shield**



MAIN SEWERS

PILOT PIPE JACKING ID 200 TO ID 800

IMPLEMENTATION OPTIONS

- > Main sewers
- > House connections
- > Displaceable soil, stones ≤ 80 mm
- > Usable in groundwater with restrictions depending on the ground conditions
- > Drive lengths up to approx. 80 m

Phase 1

- > Controlled soil displacing pilot pipe drilling with permanent visual monitoring of direction and slope using camera and LED target

Phase 2

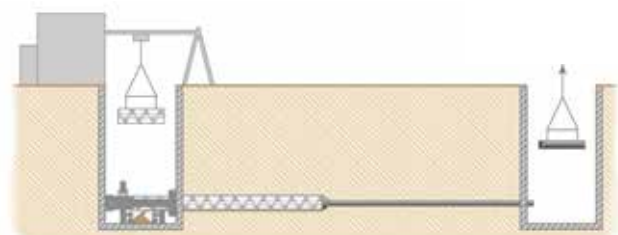
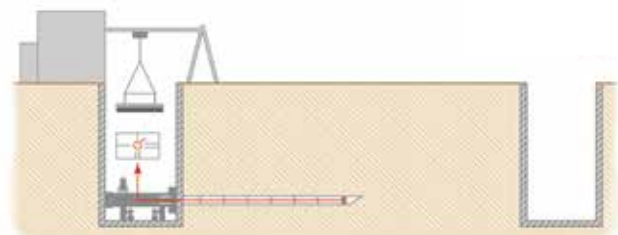
- > Extension step with retrievable steel casings and internal auger transportation
- > Soil transportation into the start shaft and removal by means of soil buckets
- > Removal of the pilot pipe in the target shaft

Phase 3

- > Jacking of the jacking pipes
- > Removal of the steel casings in the target shaft

FEATURES

- > Low space requirements for construction site facilities
- > Small start and target shafts
- > Fast jobsite setup and clearing
- > Mechanical auger spoil removal and cheap disposal
- > Lower machine and staff costs compared to microtunnelling
- > Easy to operate



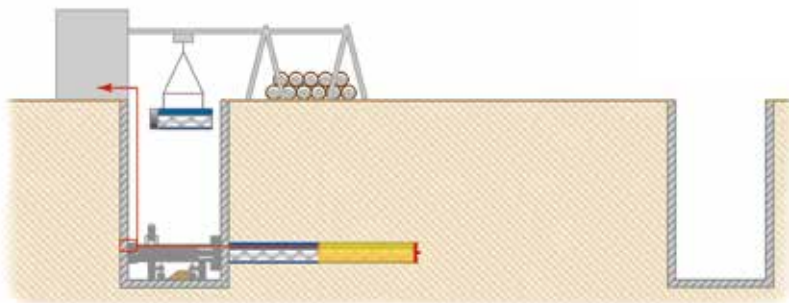
MICROTUNNELLING FROM ID 250 TO ID 800 WITH AUGER SOIL REMOVAL

IMPLEMENTATION OPTIONS

- > Main sewers
- > Soil with stones of max. 40 to 80mm depending on the nominal width
- > Usable in groundwater with restrictions depending on the ground conditions
- > Drive lengths of 80 to 100m depending on the diameter

FEATURES

- > Low space requirements for construction site facilities
- > Small start and target shafts
- > Fast jobsite setup and clearing
- > Mechanical soil conveyance and cheap disposal



PROCESS

- > Installation of the jacking pipes directly behind the tunnelling machine
- > Steering with cylinders in the machine
- > Laser measurement with laser target
- > Removal of the soil at the tunnel face using a cutting head
- > Soil conveyance via auger inside steel casings with a smaller diameter
- > Soil removal via soil bucket in the start shaft
- > Recovery of the tunnelling machine in the target shaft
- > Pulling of all steel casings, augers, cables and hoses

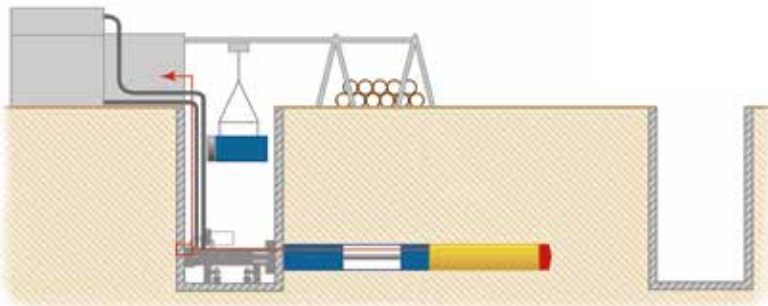
MICROTUNNELLING FROM ID 250 TO ID 800 WITH SLURRY SYSTEM

IMPLEMENTATION OPTIONS

- > Main sewers
- > Soil with stones up to max. 1/5 outside diameter of the tunnelling machine
- > Rock up to 80 MPa depending on the internal diameter
- > Can be used for any groundwater level
- > Pipe jacking lengths up to 150m depending on the diameter

FEATURES

- > Small start and target shafts
- > Separation of the excavated soil from the drilling fluid



PROCESS

- > Installation of the jacking pipes directly behind the tunnelling machine
- > Steering with cylinders in the machine
- > Laser measurement with laser target
- > Removal of the soil at the tunnel face using the cutting wheel
- > Soil conveyance via slurry line with separation
- > Recovery of the tunnelling machine in the target shaft
- > Removal of all slurry pipes/hoses and cables

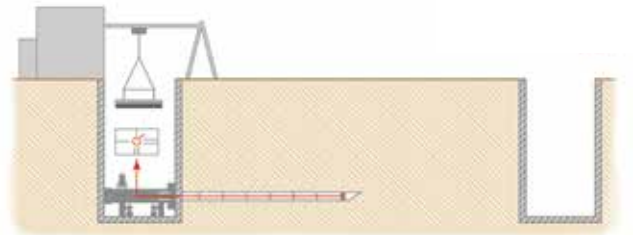
HOUSE CONNECTIONS



AUGER BORING METHOD

ID 150 TO ID 250

- > Uncontrolled method for max. 10m length
- > Screwed steel casings with augers
- > After reaching the target shaft, a jacking pipe of the same outer diameter is retroactively jacked

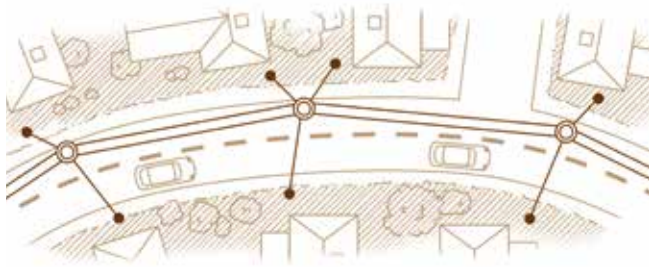


PILOT PIPE JACKING

ID 150 TO ID 250

- > Pilot pipe jacking by means of controlled tunnelling method from the start to target shaft
(See also „Pilot pipe jacking ID 200 to ID 800“; page 9)

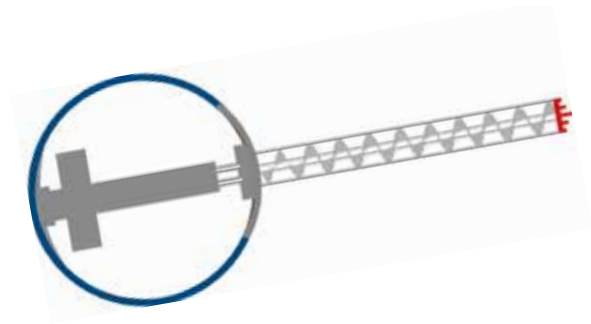




STAR-SHAPED CONSTRUCTION METHOD

FROM THE SHAFT

Installation of house connection pipes with a star-shaped construction method has proven to be extremely efficient. The house connections are drilled from the existing round start, target or intermediate shafts, and connected directly to the final shaft constructions.



PIPE JACKING OUT OF THE PIPE \geq ID 1200

ID 150 AND ID 200

- > Non-steered pipe jacking out of sewers \geq ID 1200 with screwed steel casings with augers (see also auger boring method; page 12)
- > Jacking or pulling of the product pipes with the same outside diameter



4 SHAFTS

Construction of start and target shafts with suitable shoring makes a major contribution toward trouble-free progress of the tunnelling work.

The construction possibilities are:

- > Reinforced steel concrete sinking shafts
- > Sheet pile walls, trench sheeting
- > Shotcrete
- > Trench shoring equipment
- > Timber lining

The method selected depends on:

- > The ground and groundwater conditions
- > The tunnelling method used
- > The tunnelling depth



Reinforced concrete sinking shaft



Sheet pile lining

Both pilot pipe jacking and microtunnelling are possible with a small start shaft. With both methods, the start and target shafts can be implemented as final shaft constructions. In particular for the star-shaped construction method (*Berliner Bauweise*) in groundwater, round system shafts made of reinforced concrete are used as jacking shafts and later converted to the final shaft constructions.

Dimensions	Start shaft internal diameter or length x width	Target shaft internal diameter or length x width
ID 150 Pipe with 1.00 max. length	ID 2000/1500 2,00 m x 1,50 m	ID 1500 1,50 m x 1,00 m
ID 200 to ID 400 Pipe with 1.00 max. length	ID 2000 2,50 m x 2,00 m	ID 2000 1,50 m x 1,50 m
ID 250 to ID 800 Pipe with 2.00 max. length	ID 3200 4,00 m x 3,00m	ID 2600 3,00 m x 2,50 m

5

WHAT WORKS AND WHAT DOESN'T

The benefits and potential applications of pipe jacking have been described in section 1 „Design“ (page 4).

The following table as per GERMAN DWA* RULES AND STANDARDS DWA-A 125E PIPE JACKING AND RELATED TECHNIQUES December 2008 (* German Association for Water, Wastewater and Waste; 53773 Bad Hennef, Germany); provides an overview showing the most important parameters that decide whether pipe jacking technology works or not.

internal diameter	pipe jacking length	tunnelling in soil	tunnelling in rock	tunnelling in groundwater
ID 150	25m	✓	∅	∅
ID 200	80m	✓	∅	✓
ID 250	90m	✓	∅	✓
ID 300	90m	✓	∅	✓
ID 400	100m	✓	∅	✓
ID 500	120m	✓	✓	✓
ID 600	120m	✓	✓	✓
ID 700	120m	✓	✓	✓
ID 800	150m	✓	✓	✓

In internal diameter range up to ID 800 only straight tunnelling is possible.

Removal of obstacles from within the pipe is neither possible nor permissible.

- ✓ works
- ✓ following verification on a case-by-case basis
- ∅ doesn't work



PREFACE BY AUTHOR

(notes for constructors and planners)

16

This specification template is designed to provide the author of the draft with instructions on the possible tendering of controlled pipe jacking ID 150 – ID 800. It contains only those RFQ items that are necessary for the actual pipe jacking tendering in view of the author of this guideline.

The most important standards, rulesets, accident prevention regulations, recommendations and contractual provisions to be observed and/or applied are listed under item 3.

This specifications template must be individually checked and customized for each case. The author of the draft must edit all points in section 0 „Notes on creating the RFQ specification of the general technical contractual provisions for building services DIN 18299 ff“ as per section 7 para. 1 no. 7 VOB/A (General Local Authorities Code for the Delegation of Building Services) For unmanned, controlled pipe jacking ID 150 – ID 800, this specifically means ATV DIN 18299 and ATV DIN 18319.

Various pipe jacking methods can be suitable for controlled pipe jacking ID 150 – ID 800. The applicability of a specific method is determined by the ground conditions. Notes on this are provided in this guide and in Annex B of worksheet DWA-A 125E. DIN 18319 assigns responsibility for selecting the pipe jacking method and construction sequence, as well as for providing the construction equipment to the contractor (section 3.1.2.). This approach means that the purchaser can benefit from the special civil engineering company's specific experience in this sector without unnecessarily restricting competition. For this reason, the following RFQ specification template does not use any method designations. However, in individual cases, it may be necessary for the purchaser to define the pipe jacking method. This approach is permissible as per section 0.3.2 DIN 18319. In such a case, the authors recommend calling an recognized expert in this sector to determine the pipe jacking method, or to call in such experts for support.

Surveying and describing the ground in the course of the planning process is a mandatory precondition for selecting a suitable pipe jacking method. The basic approach is regulated in sections 2.2 – 2.4 of DIN 18319. The notes in sections 0.2.2 – 0.2.6 and 0.2.8 of DIN 18319 must be observed in addition.

On publication of the supplementary volume 2015 for VOB 2012, the system of describing the ground in the RFQ documents was changed. The surveyed ground must now be broken down into homogeneous areas as per the respective maintenance group regulations. The properties and characteristics as well as the determined bandwidth must be specified for each ground condition area (homogeneous area). This can be done in the respective RFQ items. For a better overview, the recommendation is to only state the various homogeneous areas, possibly the depth graduations (as per DIN 18300 and 18303 for start, intermediate and target shafts) or length graduations (as per DIN 18319 for pipe jacking work) for each RFQ item, and to list the matching properties and characteristic values in a separate document, which must be marked as a part of the request for quotation.

In addition to performance and reliability, the professional suitability of the bidders for implementation of the pipe jacking work must be verified. RAL GZ 961 paragraph 3.5 or 3.6 can be referenced as criteria for this, depending on the quoted pipejacking method.

The items listed in the following relates directly to pipe jacking-specific work. Planners must formulate additional items, such as acceptance criteria, visual inspection, leakage testing of the components, etc.



TENDER FOR UNMANNED, CONTROLLED PIPE JACKING ID 150 TO ID 800

1. Service description

Preliminary remarks on the specifications

DWA-A 161, DWA-A 125 and DIN EN 14457, as well as the respective product standards must be observed for the design of the jacking pipes.

Design of the supporting structure for jacking pipes must be implemented in line with DWA-A 161E.

The planning of the supporting structure and evidence of suitability for purpose must be verified by a qualified test engineer where appropriate. The test report must be submitted to the purchaser two weeks before the scheduled start of the section of the building works in question at the latest. The test engineer's fees will be reimbursed on request.

DIN 18319, DIN EN 12889 and DWA-A 125E must be observed in the implementation of the pipe jacking work.

The contractor must have a quality assurance system (in-house and external auditing) in place for the pipe jacking work. Quality assurance in sewer construction RAL-GZ 961 contains a system of this type for implementation section V. The bidder must include the costs of this in the unit costs for controllable pipe jacking.

With respect to occupational and health protection of the staff employed, reference is made to DGUV Information Sheet 201-020.

Note for the planner: You may need to add further preliminary remarks here!



2. Applied German standards and directives

The current versions of the following standards and directives must be applied. The list does not claim to be complete.

DIN EN 1610: Construction and testing of drains and sewers

DIN EN 12889: Trenchless construction and testing of drains and sewers

DIN EN 14457: General requirements for components specifically designed for use in trenchless construction of drains and sewers

DIN 18299: General regulations for construction work of all types

DIN 18300: Earthworks

DIN 18303: Building works

DIN 18319: Pipe jacking works

Worksheet DWA-A 125E: Pipe jacking and related methods

Worksheet DWA-A 139: Construction and testing of drains and sewers

Worksheet DWA-A 161E: Static computation of thrust pipes

DGUV Information Sheet 201-020: Safety instructions for trenchless construction, revised

quality and testing provisions RAL-GZ 961: Manufacture and maintenance of drains and sewers

DWA : German Association for Water, Wastewater and Waste; 53773 Bad Hennef, Germany

3. Specifications

Item	Text	Unit price	Total price
1	<p>General installation of the jobsite, such as transporting to the site, setting up, moving, removing and transportation of equipment from the site, devices, machines, construction containers, site caravans, accommodation, sanitation storage and workshop containers; additionally the materials for lining construction shafts and reinforcements, as well as barriers, signage and lighting</p> <p>Billing 60 % after setting up, 40 % after clearing</p> <p>Lump sum</p>	_____ €	_____ €
2	<p>Providing the general jobsite installations, required machines, devices and equipment during the contractually agreed construction period</p> <p>Months</p>	_____ €	_____ €
3	<p>Transportation to the jobsite, transportation from the jobsite and installation and removal of the machines, devices and equipment required for performing the pipe jacking works</p> <p>Billing 60 % after setting up, 40 % after clearing</p> <p>Lump sum</p>	_____ €	_____ €



Item	Text	Unit price	Total price
4	<p>Constructing the start shaft in ...¹⁾ design, watertight²⁾, including stiffening, watertight²⁾ reinforced²⁾ concrete bottom and the required installations such as ladders, fall protection, etc. The unit cost includes the following services:</p> <ul style="list-style-type: none"> a) Manufacturing the shaft lining b) Delivering and providing all required materials c) Breaking out, loading and conveying soil and rock, also underwater where necessary d) Setting up and operating the water retention system²⁾ e) Setting up and operating the residual water retention system²⁾ f) Converting the launch shaft in case of tunnelling in multiple directions²⁾ g) Backfilling and compaction h) Remaining of the shoring²⁾ i) Removal of the shoring²⁾ j) Removal of the shoring from upper edge of terrain to ...¹⁾ m below at the edge of terrain²⁾ k) Implementation planning²⁾ l) Structural planning²⁾ <p>The dimensions¹⁾ of the start shaft are: Length: ... m Width: ... m Depth: ... m or Diameter: ... m²⁾</p> <p>The dimensions of any shaft construction to be installed at a later time must be taken into consideration here as per the specifications of the implementation planning.</p> <p>Construction in the ground condition areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>Billing 70 % on completion, 30 % after deconstruction</p> <p>... pieces</p> <p>¹⁾ Details provided by planner or bidder ²⁾ Please delete if non-applicable ³⁾ Details by planner; percentage of thickness of the respective ground condition area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
5	<p>Target shaft, however, services described as in item ³⁾,</p> <p>The dimensions¹⁾ of the target shaft are:</p> <p>Length: ... m</p> <p>Width: ... m</p> <p>Depth: ... m or</p> <p>Diameter: ... m²⁾</p> <p>Construction in the ground condition areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>Billing 70 % on completion, 30 % after removal</p> <p>... pieces</p> <p>¹⁾ Details provided by planner or bidder ²⁾ Please delete if non-applicable ³⁾ Details by planner; percentage of thickness of the respective ground condition area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
6	<p>Intermediate shaft, however, services described as in item ³, (for construction of connecting sewers). The dimensions¹⁾ of the intermediate shaft are:</p> <p>Length: ... m</p> <p>Width: ... m</p> <p>Depth: ... m or</p> <p>Diameter: ... m²⁾</p> <p>If the intermediate shaft is used as a connecting shaft, any required intermediate backfilling and re-excavation must be included in the unit cost.</p> <p>Construction in the ground condition areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>Billing 70 % on completion, 30 % after removal</p> <p>... pieces</p> <p>¹⁾ Details provided by planner or bidder ²⁾ Please delete if non-applicable ³⁾ Details by planner; percentage of thickness of the respective ground condition area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
7	<p>Disposal of soil, removing and disposing of material excavated from the start, intermediate, target or recovery shafts. Landfill fees will be reimbursed on request.</p> <p>... t</p>	_____ €	_____ €
8	<p>Delivering soil free of stones and capable of compaction for backfilling the start, intermediate, target and recovery shafts.</p> <p>... t</p>	_____ €	_____ €
9	<p>Start seal, measures to prevent water and soil ingress as per the purchaser's planning when moving the tunnelling machine out of the start shaft. The unit price must also include the expenditures for one, or a combination of multiple, ground safeguarding measures, compaction of the annular space between the tunnelling machine and/or thrust pipe and the shaft shoring during all phases of the outward move, and final sealing of the annular space between the jacking pipe and the shaft lining. All costs for planning and any required numerical simulations and their verification must be included. Remuneration will be on a one-off basis for each tunnelling length.</p> <p>Selected measures:.....</p> <p>... pieces</p>	_____ €	_____ €
10	<p>Target joint, services as described previously, however, for moving into the target shaft.</p> <p>Selected measures:.....</p> <p>... pieces</p>	_____ €	_____ €
11	<p>Intermediate shaft joint, services as described previously, however, for passing through an intermediate shaft. Remuneration will be on a one-off basis for each intermediate shaft.</p> <p>Selected measures:.....</p> <p>... pieces</p>	_____ €	_____ €



Item	Text	Unit price	Total price
12	<p>Jacking pipes ID ...¹⁾ made of vitrified clay, reinforced concrete, ...^{1) 2)} as per DIN ...¹⁾ including seals³⁾, joints³⁾ and pressure transfer devices³⁾ delivering and unloading. As for ID 800 the thrust pipes may need to be equipped with injection ports for injecting a lubricant and support agent into the annular gap between the jacking pipe and the ground. All costs for delivering launch pipes, adapting tailskins, delivering fit pipes and shortening thrust pipes must be included in the unit price. Structure of the jacking pipes and their design, taking into consideration the anticipated and permissible thrust forces and the purchaser's specifications, is the responsibility of the contractor. The costs of this must be included in the unit price.</p> <p>Tests of the jacking pipes, seals, joints and pressure transfer devices required as per DIN EN 12889 and DWA -A 125E must be documented. Pipes and components that fail the test must not be installed. The expenditures this involves must be included in the unit price.</p> <p>... m</p> <p>¹⁾ Details provided by planner ²⁾ For reinforced concrete jacking pipes, the exposure class and any internal and/or external corrosion protection must be specified by the planner or designer. ³⁾ Specific requirements for seals, joints or pressure transfer components must be specified by the planner.</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
13	<p>Unmanned, controlled pipe jacking ID ...¹⁾ using the microtunnelling or pilot pipe jacking method as per worksheet DWA-A 125, section 6.1.3.1 or 6.1.3.2.</p> <p>Selected method:.....²⁾</p> <p>The unit cost also includes the following services:</p> <ul style="list-style-type: none"> a) Planning, structural design, construction and removal of the thrust walls a) Planning, structural design, construction and removal of working bases or working platforms c) Providing and removing electricity and water connections d) Provide, setup, operate and removal of power generators e) Loading, transportation away and disposal of excavated material (including landfill costs) f) Providing all required materials <p>Construction in the homogeneous areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>... m</p> <p>¹⁾ Details provided by planner ²⁾ Details provided by planner or bidder ³⁾ Details by planner; percentage of thickness of the respective homogeneous area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>

Item	Text	Unit price	Total price
14	<p>Construction of the recovery shaft for removing obstacles²⁾ in ...¹⁾ design, including stiffening and the required installations such as ladders, fall protection, etc. The unit cost includes the following services:</p> <ul style="list-style-type: none"> a) Manufacturing the shoring b) Delivering and providing all required materials c) Breaking out, loading and conveying soil and rock, also underwater where necessary d) Setting up and operating the water retention system²⁾ e) Backfilling and compaction f) Removal of the shoring g) Implementation planning h) Structural planning <p>The dimensions¹⁾ of the recovery shaft are:</p> <p>Length: ... m</p> <p>Width: ... m</p> <p>Depth: ... m or</p> <p>Diameter: ... m¹⁾</p> <p>Construction in the ground condition areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>This item is only reimbursed in the case of removal of an obstacle for which the purchaser is responsible.</p> <p>... pieces</p> <p>¹⁾ Details provided by bidder ²⁾ Details by planner; statement of dimensions (length, width) ³⁾ Details by planner; percentage of thickness of the respective ground condition area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>
15	<p>Removal of obstacles from the tunnel cross section in the recovery shaft. Remuneration will be from the start of exposure to completion of removal of the obstacle. This item is only reimbursed in the case of removal of an obstacle for which the purchaser is responsible.</p> <p>... h</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
16	<p>Idle time for the tunnelling- and all associated equipment, e.g., during removal of obstacles through a recovery shaft. A max. of 8 waiting hours per working day will be reimbursed. This item is only reimbursed in the case of removal of an obstacle for which the purchaser is responsible.</p> <p>... h</p>	_____ €	_____ €
17	<p>Removal of obstacles from the tunnel cross section by means of a tunnelling device. Reimbursement is for the reduction in tunnelling performance demonstrated by the contractor only. This item is only reimbursed in case of removal of an obstacle for which the purchaser is responsible.</p> <p>... h</p>	_____ €	_____ €



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PREFACE BY AUTHOR

(notes for constructors and planners)

This specification template is designed to provide the author of the draft with instructions on the possible tendering of controlled pipe jacking ID 150 – ID 800. It contains only those RFQ items that are necessary for the actual pipe jacking tendering in view of the author of this guideline.

The most important standards, rulesets, accident prevention regulations, recommendations and contractual provisions to be observed and/or applied are listed under item 3.

This specifications template must be individually checked and customized for each case. The author of the draft must edit all points in section 0 „Notes on creating the RFQ specification of the general technical contractual provisions for building services DIN 18299 ff“ as per section 7 para. 1 no. 7 VOB/A (General Local Authorities Code for the Delegation of Building Services) For unmanned, controlled pipe jacking ID 150 – ID 800, this specifically means ATV DIN 18299 and ATV DIN 18319.

Various pipe jacking methods can be suitable for controlled pipe jacking ID 150 – ID 800. The applicability of a specific method is determined by the ground conditions. Notes on this are provided in this guide and in Annex B of worksheet DWA-A 125E. DIN 18319 assigns responsibility for selecting the pipe jacking method and construction sequence, as well as for providing the construction equipment to the contractor (section 3.1.2.). This approach means that the purchaser can benefit from the special civil engineering company's specific experience in this sector without unnecessarily restricting competition. For this reason, the following RFQ specification template does not use any method designations. However, in individual cases, it may be necessary for the purchaser to define the pipe jacking method. This approach is permissible as per section 0.3.2 DIN 18319. In such a case, the authors recommend calling an recognized expert in this sector to determine the pipe jacking method, or to call in such experts for support.

Surveying and describing the ground in the course of the planning process is a mandatory precondition for selecting a suitable pipe jacking method. The basic approach is regulated in sections 2.2 – 2.4 of DIN 18319. The notes in sections 0.2.2 – 0.2.6 and 0.2.8 of DIN 18319 must be observed in addition.



On publication of the supplementary volume 2015 for VOB 2012, the system of describing the ground in the RFQ documents was changed. The surveyed ground must now be broken down into homogeneous areas as per the respective maintenance group regulations. The properties and characteristics as well as the determined bandwidth must be specified for each ground condition area (homogeneous area). This can be done in the respective RFQ items. For a better overview, the recommendation is to only state the various homogeneous areas, possibly the depth graduations (as per DIN 18300 and 18303 for start, intermediate and target shafts) or length graduations (as per DIN 18319 for pipe jacking work) for each RFQ item, and to list the matching properties and characteristic values in a separate document, which must be marked as a part of the request for quotation.

In addition to performance and reliability, the professional suitability of the bidders for implementation of the pipe jacking work must be verified. RAL GZ 961 paragraph 3.5 or 3.6 can be referenced as criteria for this, depending on the quoted pipejacking method.

The items listed in the following relates directly to pipe jacking-specific work. Planners must formulate additional items, such as acceptance criteria, visual inspection, leakage testing of the components, etc.



TENDER FOR UNMANNED, CONTROLLED PIPE JACKING ID 150 TO ID 800

1. Service description

Preliminary remarks on the specifications

DWA-A 161, DWA-A 125 and DIN EN 14457, as well as the respective product standards must be observed for the design of the jacking pipes.

Design of the supporting structure for jacking pipes must be implemented in line with DWA-A 161E.

The planning of the supporting structure and evidence of suitability for purpose must be verified by a qualified test engineer where appropriate. The test report must be submitted to the purchaser two weeks before the scheduled start of the section of the building works in question at the latest. The test engineer's fees will be reimbursed on request.

DIN 18319, DIN EN 12889 and DWA-A 125E must be observed in the implementation of the pipe jacking work.

The contractor must have a quality assurance system (in-house and external auditing) in place for the pipe jacking work. Quality assurance in sewer construction RAL-GZ 961 contains a system of this type for implementation section V. The bidder must include the costs of this in the unit costs for controllable pipe jacking.

With respect to occupational and health protection of the staff employed, reference is made to DGUV Information Sheet 201-020.

Note for the planner: You may need to add further preliminary remarks here!



2. Applied German standards and directives

The current versions of the following standards and directives must be applied. The list does not claim to be complete.

DIN EN 1610: Construction and testing of drains and sewers

DIN EN 12889: Trenchless construction and testing of drains and sewers

DIN EN 14457: General requirements for components specifically designed for use in trenchless construction of drains and sewers

DIN 18299: General regulations for construction work of all types

DIN 18300: Earthworks

DIN 18303: Building works

DIN 18319: Pipe jacking works

Worksheet DWA-A 125E: Pipe jacking and related methods

Worksheet DWA-A 139: Construction and testing of drains and sewers

Worksheet DWA-A 161E: Static computation of thrust pipes

DGUV Information Sheet 201-020: Safety instructions for trenchless construction, revised

quality and testing provisions RAL-GZ 961: Manufacture and maintenance of drains and sewers

DWA : German Association for Water, Wastewater and Waste; 53773 Bad Hennef, Germany

3. Specifications

Item	Text	Unit price	Total price
1	<p>General installation of the jobsite, such as transporting to the site, setting up, moving, removing and transportation of equipment from the site, devices, machines, construction containers, site caravans, accommodation, sanitation storage and workshop containers; additionally the materials for lining construction shafts and reinforcements, as well as barriers, signage and lighting</p> <p>Billing 60 % after setting up, 40 % after clearing</p> <p>Lump sum</p>	_____ €	_____ €
2	<p>Providing the general jobsite installations, required machines, devices and equipment during the contractually agreed construction period</p> <p>Months</p>	_____ €	_____ €
3	<p>Transportation to the jobsite, transportation from the jobsite and installation and removal of the machines, devices and equipment required for performing the pipe jacking works</p> <p>Billing 60 % after setting up, 40 % after clearing</p> <p>Lump sum</p>	_____ €	_____ €



Item	Text	Unit price	Total price
4	<p>Constructing the start shaft in ...¹⁾ design, watertight²⁾, including stiffening, watertight²⁾ reinforced²⁾ concrete bottom and the required installations such as ladders, fall protection, etc. The unit cost includes the following services:</p> <ul style="list-style-type: none"> a) Manufacturing the shaft lining b) Delivering and providing all required materials c) Breaking out, loading and conveying soil and rock, also underwater where necessary d) Setting up and operating the water retention system²⁾ e) Setting up and operating the residual water retention system²⁾ f) Converting the launch shaft in case of tunnelling in multiple directions²⁾ g) Backfilling and compaction h) Remaining of the shoring²⁾ i) Removal of the shoring²⁾ j) Removal of the shoring from upper edge of terrain to ...¹⁾ m below at the edge of terrain²⁾ k) Implementation planning²⁾ l) Structural planning²⁾ <p>The dimensions¹⁾ of the start shaft are: Length: ... m Width: ... m Depth: ... m or Diameter: ... m²⁾</p> <p>The dimensions of any shaft construction to be installed at a later time must be taken into consideration here as per the specifications of the implementation planning.</p> <p>Construction in the ground condition areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>Billing 70 % on completion, 30 % after deconstruction</p> <p>... pieces</p> <p>¹⁾ Details provided by planner or bidder ²⁾ Please delete if non-applicable ³⁾ Details by planner; percentage of thickness of the respective ground condition area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
5	<p>Target shaft, however, services described as in item ³⁾,</p> <p>The dimensions¹⁾ of the target shaft are:</p> <p>Length: ... m</p> <p>Width: ... m</p> <p>Depth: ... m or</p> <p>Diameter: ... m²⁾</p> <p>Construction in the ground condition areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>Billing 70 % on completion, 30 % after removal</p> <p>... pieces</p> <p>¹⁾ Details provided by planner or bidder ²⁾ Please delete if non-applicable ³⁾ Details by planner; percentage of thickness of the respective ground condition area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
6	<p>Intermediate shaft, however, services described as in item ³, (for construction of connecting sewers). The dimensions¹⁾ of the intermediate shaft are:</p> <p>Length: ... m</p> <p>Width: ... m</p> <p>Depth: ... m or</p> <p>Diameter: ... m²⁾</p> <p>If the intermediate shaft is used as a connecting shaft, any required intermediate backfilling and re-excavation must be included in the unit cost.</p> <p>Construction in the ground condition areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>Billing 70 % on completion, 30 % after removal</p> <p>... pieces</p> <p>¹⁾ Details provided by planner or bidder ²⁾ Please delete if non-applicable ³⁾ Details by planner; percentage of thickness of the respective ground condition area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
7	<p>Disposal of soil, removing and disposing of material excavated from the start, intermediate, target or recovery shafts. Landfill fees will be reimbursed on request.</p> <p>... t</p>	_____ €	_____ €
8	<p>Delivering soil free of stones and capable of compaction for backfilling the start, intermediate, target and recovery shafts.</p> <p>... t</p>	_____ €	_____ €
9	<p>Start seal, measures to prevent water and soil ingress as per the purchaser's planning when moving the tunnelling machine out of the start shaft. The unit price must also include the expenditures for one, or a combination of multiple, ground safeguarding measures, compaction of the annular space between the tunnelling machine and/or thrust pipe and the shaft shoring during all phases of the outward move, and final sealing of the annular space between the jacking pipe and the shaft lining. All costs for planning and any required numerical simulations and their verification must be included. Remuneration will be on a one-off basis for each tunnelling length.</p> <p>Selected measures:.....</p> <p>... pieces</p>	_____ €	_____ €
10	<p>Target joint, services as described previously, however, for moving into the target shaft.</p> <p>Selected measures:.....</p> <p>... pieces</p>	_____ €	_____ €
11	<p>Intermediate shaft joint, services as described previously, however, for passing through an intermediate shaft. Remuneration will be on a one-off basis for each intermediate shaft.</p> <p>Selected measures:.....</p> <p>... pieces</p>	_____ €	_____ €



Item	Text	Unit price	Total price
12	<p>Jacking pipes ID ...¹⁾ made of vitrified clay, reinforced concrete, ...^{1) 2)} as per DIN ...¹⁾ including seals³⁾, joints³⁾ and pressure transfer devices³⁾ delivering and unloading. As for ID 800 the thrust pipes may need to be equipped with injection ports for injecting a lubricant and support agent into the annular gap between the jacking pipe and the ground. All costs for delivering launch pipes, adapting tailskins, delivering fit pipes and shortening thrust pipes must be included in the unit price. Structure of the jacking pipes and their design, taking into consideration the anticipated and permissible thrust forces and the purchaser's specifications, is the responsibility of the contractor. The costs of this must be included in the unit price.</p> <p>Tests of the jacking pipes, seals, joints and pressure transfer devices required as per DIN EN 12889 and DWA -A 125E must be documented. Pipes and components that fail the test must not be installed. The expenditures this involves must be included in the unit price.</p> <p>... m</p> <p>¹⁾ Details provided by planner ²⁾ For reinforced concrete jacking pipes, the exposure class and any internal and/or external corrosion protection must be specified by the planner or designer. ³⁾ Specific requirements for seals, joints or pressure transfer components must be specified by the planner.</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
13	<p>Unmanned, controlled pipe jacking ID ...¹⁾ using the microtunnelling or pilot pipe jacking method as per worksheet DWA-A 125, section 6.1.3.1 or 6.1.3.2.</p> <p>Selected method:.....²⁾</p> <p>The unit cost also includes the following services:</p> <ul style="list-style-type: none"> a) Planning, structural design, construction and removal of the thrust walls a) Planning, structural design, construction and removal of working bases or working platforms c) Providing and removing electricity and water connections d) Provide, setup, operate and removal of power generators e) Loading, transportation away and disposal of excavated material (including landfill costs) f) Providing all required materials <p>Construction in the homogeneous areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>... m</p> <p>¹⁾ Details provided by planner ²⁾ Details provided by planner or bidder ³⁾ Details by planner; percentage of thickness of the respective homogeneous area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
14	<p>Construction of the recovery shaft for removing obstacles²⁾ in ...¹⁾ design, including stiffening and the required installations such as ladders, fall protection, etc. The unit cost includes the following services:</p> <ul style="list-style-type: none"> a) Manufacturing the shoring b) Delivering and providing all required materials c) Breaking out, loading and conveying soil and rock, also underwater where necessary d) Setting up and operating the water retention system²⁾ e) Backfilling and compaction f) Removal of the shoring g) Implementation planning h) Structural planning <p>The dimensions¹⁾ of the recovery shaft are:</p> <p>Length: ... m</p> <p>Width: ... m</p> <p>Depth: ... m or</p> <p>Diameter: ... m¹⁾</p> <p>Construction in the ground condition areas with the following properties and characteristic values:³⁾</p> <p>... % in ground condition, area A:</p> <hr/> <p>... % in ground condition, area B:</p> <hr/> <p>... % in ground condition, area C:</p> <hr/> <p>This item is only reimbursed in the case of removal of an obstacle for which the purchaser is responsible.</p> <p>... pieces</p> <p>¹⁾ Details provided by bidder ²⁾ Details by planner; statement of dimensions (length, width) ³⁾ Details by planner; percentage of thickness of the respective ground condition area related to the maximum excavation depth of the construction shaft</p>	<p>_____ €</p>	<p>_____ €</p>
15	<p>Removal of obstacles from the tunnel cross section in the recovery shaft. Remuneration will be from the start of exposure to completion of removal of the obstacle. This item is only reimbursed in the case of removal of an obstacle for which the purchaser is responsible.</p> <p>... h</p>	<p>_____ €</p>	<p>_____ €</p>



Item	Text	Unit price	Total price
16	<p>Idle time for the tunnelling- and all associated equipment, e.g., during removal of obstacles through a recovery shaft. A max. of 8 waiting hours per working day will be reimbursed. This item is only reimbursed in the case of removal of an obstacle for which the purchaser is responsible.</p> <p>... h</p>	_____ €	_____ €
17	<p>Removal of obstacles from the tunnel cross section by means of a tunnelling device. Reimbursement is for the reduction in tunnelling performance demonstrated by the contractor only. This item is only reimbursed in case of removal of an obstacle for which the purchaser is responsible.</p> <p>... h</p>	_____ €	_____ €