SASTT-TS-TT3:2017

Edition 1

SASTT TECHNICAL STANDARD

Trenchless construction works

Part TT3: Horizontal directional drilling

The development of these SASTT Technical Standards has been supported by the following sponsors:

Platinum	(R 15 000)	Trenchless Technologies cc TT Innovations (Pty) Ltd Vermeer Equipment Suppliers (Pty) Ltd
Silver	(R 5 000)	Peninsula Pipeline Services cc
Bronze	(R2 500)	Zutari Pty Ltd

Published by
Southern African Society for Trenchless Technology (SASTT)
P O Box 738 RASLOUW 0109
Tel: +27 (012) 653 0488 Cell: 082 551 7458
Email: director@sastt.org.za Website: www.sastt.co.za

SASTT-TS-TT3: 2017
Edition 1

Table of changes

Change No.	Date	Scope

Acknowledgement

SMEC South Africa (Pty) Ltd was appointed by the Southern African Society for Trenchless Technology (SASTT) to prepare this standard for the trenchless installation of underground pipelines by means of horizontal directional drilling.

Prior to approval the standard was posted on the SASTT website for comment and the draft was independently reviewed by A Goyns of PIPES cc. Comments were incorporated in the final document.

Foreword

This SASTT technical standard was approved by the Board of SASTT on 2 February 2018

This document was published on 04 February 2018

SASTT-TS standards consist of a number of parts in various stages of preparation, under the general title *Trenchless construction works*.

Annex A forms an integral part of this document. Annexes B, C, and D are for information only.

Introduction

The different parts of SASTT-TS each address a specific category of trenchless construction works. The prime purpose of the production of these standards is to create a set of standards that are generally applicable to trenchless construction works and which can be readily modified so that they are applicable to developments in existing techniques or development of new techniques for trenchless works.

The SANS 2001 and SASTT-TS family of standards provides technical descriptions of the materials and workmanship standards required in the execution or performance of the works when completed (or both). These standards do not make reference to the actions of those responsible for executing the works or the parties to a contract, i.e. to the constraints relating to the manner in which the construction is to be performed. Neither do they deal with the commercial arrangements of such contracts. These standards are suitable for use in any “in-house” construction work or in any engineering and construction works contracts, for example; design by employer; design and build; develop and construct construction management or management contracts.

Standard requirements pertaining to the manner in which works are constructed can be found in the SANS 1921 family of standards.

Attention is drawn to the possibility that certain content in this document might be the subject of patent rights. SASTT shall not be held responsible for identifying any or all such patent rights.

Disclaimer

Regarding this technical standard, SASTT and its sub-consultants, make no representations or warranties concerning the information or material, express, implied, statutory or otherwise, including, without limitation, warranties of accuracy, content, completeness, reliability, or the absence of errors, whether or not discoverable.

In no event will SASTT or its sub-consultants be liable on any legal theory (including contract, delict including negligence or gross negligence, or statutory claims), for any special, incidental, consequential, punitive or exemplary damages/losses arising out of the use of the information or material, even if SASTT has been advised of the possibility of such damages.

Contents

This page is intentionally left blank

Trenchless construction works

Part TT3:
Horizontal directional drilling

1 Scope

This specification covers the installation of underground pipes up to about 300 mm diameter under roads, railways, structures, watercourses, landscaped areas, wetlands and other environmentally sensitive areas without disturbing the surface, interfering with the normal flow of traffic or negatively impacting on the environment using horizontal directional drilling (HDD). This includes the use of bentonite drilling fluids which may or may not be recycled.

Firstly a pilot bore is drilled by steering the drilling rods through the ground on the proposed alignment of the pipeline, then the hole is reamed to a larger size and the product pipe pulled back through the bore, sometimes simultaneously with the reaming. To obtain the required final hole size, the bore may require reaming several times.

Horizontal directional drilling is typically used for installing new stormwater, sewer, water or gas pipelines, sleeves for the same or sleeves for power and telecommunications cables. Excavations are limited to entry or exit drilling pits and any waypoint pits resulting in minimal surface disturbance and reinstatement, reduced traffic, business and social disruption and less potential of service interruption. Horizontal directional drilling potentially eliminates the need for the dewatering and shoring of trenched excavations, the handling of excavation and backfilling materials and the associated dangers to workers.

The installation of services using HDD can be less expensive than conventional trenched methods and is often the preferred method when there are social and environmental considerations.

Bores can generally be drilled in most materials including rock but gravel, cobble or very soft formations can introduce difficulties for steering and supporting a stable bore hole.

This standard has been prepared to cover the installation of pipes up to 300 mm diameter using Mini-HDD (small) rigs typically with a mass of up to about 8 ton and a thrust/pullback of up to about 18 000 kg (40 000 lb).

This standard can be used for the installation of pipes up to 300 mm to 600 mm diameter using Midi-HDD (medium sized) rigs typically with a mass of up to about 16 ton and a thrust/pullback of up to about 45 000 kg (100 000 lb), however the design and installation risks are similar but significantly higher and due attention must be given in the planning, tendering, design and installation stages.

Projects for the installation of pipes of diameters greater than 600 mm using Maxi-HDD (large sized) rigs typically with a mass over 18 ton and a thrust/pullback of over 45 000 kg (100 000 lb), are

technically challenging with large design and installation risks, and are beyond the scope of this standard and require specialist inputs in the planning, tendering, design and installation stages. (The American Society for Testing and Materials (ASTM) has a Standard Guide for Use of Maxi-Horizontal Directional Drilling (ASTM 1962)).

NOTE 1 Annex A (normative) provides guidance to those responsible for compiling procurement documents which make reference to this standard.

NOTE 2 Annex B (informative) contains items that may need to be considered when preparing the scope of work for a particular project.

NOTE 3 Annex C (informative) provides suitable measurement and payment specifications.

NOTE 4 Annex D (informative) covers the factors that should be considered when selecting the in-service structural requirements of the pipes to ensure that they can handle the loading conditions to which they will be subject during their installation and through their design life, without detriment to their function and the environment.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from Standards South Africa.

SANS 1200, *Standardized Specification for Civil Engineering Construction*

SANS 2001, *Construction works*

SANS 4427, *Plastics piping systems - Polyethylene (PE) pipes and fittings for water supply.*

SANS 6269, *Welding of thermoplastics – Test methods for welded joints.*

SANS 10268-1, *Welding of thermoplastics – Welding processes Part 1: Heated-tool welding.*

SANS 10268-10, *Welding of thermoplastics – Welding processes Part 10: Weld defects.*

SANS 10269, *Welding of thermoplastics – Testing and approval of welders.*

SANS 10270, *Welding of thermoplastics – Approval of welding procedures and welds.*

SANS 10403, *Formatting and compilation of construction procurement documents.*

3 Definitions

For the purposes of this document, the definitions given in SANS 10403 and the following additional definitions apply:

3.1
approver
is the person or organisation responsible for approving the HDD Contractor's drill plan.

3.2
butt welding
is the process for joining HDPE pipes by heating the planed ends of matching surfaces by holding them against a flat heating plate until the HDPE material reaches fusion temperature, and then quickly removing the heating plate and pushing the two softened ends against one another. Butt welding is also referred to as butt fusion welding and heated-tool butt welding.

3.3
CCTV
is Closed Circuit Television used for the internal inspection of pipelines.

3.4
drilling fluid
drilling fluid, which comprises water, sodium bentonite clay, polymers and other conditioners, is pumped through the drill rods to cool the cutting head or reamer, to lubricate the passage of the drill rods and product pipe and to assist removing the cuttings and convey them back in suspension along the annulus to the drilling machine, where the excavated material can be removed and the fluid recycled. The drilling fluid is thixotropic and gels when stationary stabilising and supporting the excavated bore hole. The drilling fluid can also seal the bore to avoid fluid loss into the surrounding ground and keep ground water out. There are many conditioners that can be added to a drilling fluid to enhance its characteristics. The design, use and monitoring of drilling fluid performance is a specialist science managed by the horizontal directional drilling contractor (HDD Contractor).

3.5
drilling log
the drilling log is a record of the actual grade, line and level measured during the drilling of the pilot bore, any corrective steering actions applied and drilling fluid types, volumes and additives.

3.6
drill plan
the drill plan comprises drawings showing the vertical and horizontal alignment, sections, calculations and specifications of the proposed horizontal directional drilling operation. Its purpose is to mitigate the risk to underground services, surface structures and the environment.

3.7
entry drilling pit
drilling pits are normally located at the ends of the pipeline that is to be installed. The entry pit is located at the start of the final pipeline. The horizontal directional drilling equipment is set back from the entry pit so that the drill penetrates the ground and is steered to traverse the entry pit on the design line and level. Drilling pits also collect the drilling fluids and may be offset from the drill path.

3.8
exit drilling pit
drilling pits are normally located at the ends of the pipeline that is to be installed. The exit pit is located at the end of the final pipeline. The drilling traverses the exit pit on the design line and level and is then steered out of the ground beyond the exit pit. Drilling pits also collect the drilling fluids and may be offset from the drill path. The exit pit may be extended to include the inclined section to where the drill reaches the surface.

3.9
HDPE
is high density polyethylene, also referred to as PE-HD. Polyethylene materials of designation PE 80 and PE 100 are high density polyethylene materials.

3.10
HDD
horizontal directional drilling is a trenchless technique for installing underground pipes along a planned path and negotiating any obstructions. It is usually a multi-stage operation involving the drilling of a pilot hole along the required path, back-reaming this to the required bore size and then pulling a product pipe into its final position.

3.11
HDD Contractor
the HDD Contractor is the specialist entity (contractor, subcontractor or in-house team) implementing the horizontal directional drilling.

3.12
hydrolock
hydrolock occurs when external hydrostatic or drilling fluid pressures grip or deform the pipeline causing the maximum pullback force to be exceeded.

3.13
informative
a supplement that provides additional information intended to assist the understanding or use of the document

3.14
mechanical joint
is the joint made by assembling one length of pipe to another that generally includes a compression part, to provide for pressure integrity, leak-tightness and resistance to end loads.

3.15
normative
that with which it is necessary to conform in order to be able to claim compliance with the standard.

3.16
specification data
is data, provisions and variations that make this standard applicable to a particular contract or works.

3.17
suitable
is capable of fulfilling or having fulfilled the intended function or fit for its intended purpose.

3.18
waypoint pit
pits excavated by hand near or next to existing services to visibly confirm that the drill string, reamer or pipe is on course and will clear the existing services. They are also called inspection pits, trial holes or potholing.

4 Requirements

4.1 Materials

4.1.1 Pipes

Typically the pipes will be high density polyethylene (HDPE) or pipes of other materials which have been specifically designed for installation by HDD.

The pipes and types of joints or couplings shall be detailed in the specification data. All pipe materials shall, where such mark has been awarded, bear the SABS mark. All materials supplied and installed shall be guaranteed to be free of defects arising from the manufacture, transportation, installation or any other process or factors. Further to this, the pipe shall:

a) resist the tensile and bending forces as well as frictional forces resulting from the HDD installation,

b) meet the in-service structural requirements described in Annex D.

c) have an actual internal diameter not less than the diameter given on the drawings or stated in the schedule.

d) if intended as a sleeve pipe, not be deformed (circular not oval), have inside walls smooth and free from projections and sharp edges.

e) have the allowable bend radius stated.

4.1.1.1 HDPE pipes with butt welded joints

Butt welded HDPE pipes shall:

a) comply with the requirements of SANS 4427 as indicated in the specification data.

b) be butt welded into continuous lengths in accordance with the pipe manufacturer's recommendations and SANS 10268-1. Furthermore:

   i. A record shall be kept of the welding including date, pipe details, weather, welding conditions, welder, initial bead height, welding times, final position of joint in the ground and a record of inspections of completed welds.

   ii. The welder shall have a Test Certificate for HS Welding (heated-tool butt welding) issued by a South African Qualifications Authority (SAQA) accredited training facility, in accordance with SANS 10269. (Currently certificates are issued by Plastics SA). The welder's certificate shall not be older than three years for Installation and Fabrication Plastic Pipe Association (IFPA) members and not more than one year old for non-IFPA members.

   iii. If specified in the specification data, welders shall be IFPA members and shall imprint each weld with his unique IFPA identification stamp displaying the IFPA company number, welder number and IFPA logo, issued in accordance with the Welder Identification System.

   iv. Unless otherwise specified in the specification data, the welded joints shall conform to the requirements of SANS 10268 Part 10, according to the quality control rating assessment class **II** (medium requirements for safety or for load carrying capacity or both). (Note that the assessment class rating is dependent on the safety or load-

carrying risk posed.)

v. If required by the specification data, welded joints shall be tested in accordance with SANS 6269.

vi. If required in the specification data, before any production welding is commenced, the following shall be approved in accordance with SANS 10270 for heated-tool butt welding of pipe joints:

1. A Welding Procedure Specification (WPS) and
2. A qualification joint

c) if required by the specification data have the internal and external welding beads removed, without leaving notches. The removed beads shall be retained for inspection.

d) be able to withstand, without damage, the longitudinal force to be transmitted by the pulling equipment.

e) not have cuts, gashes, nicks, abrasions, or any such physical damage on the outside of the pipe, which is deeper than 10% of the wall thickness. Such pipes shall be removed from site and replaced with undamaged pipes.

4.1.1.2 Welding of pipe materials other than HDPE

The welding together of pipes of other materials shall be detailed in the specification data.

4.1.1.3 Pipes with mechanical joints

Pipes not joined by welding shall be joined by using industry tested and approved mechanical joints or couplings and be joined in accordance with the manufacturer's specifications.

The pipes and couplings shall be certified as being able to withstand without damage, deformation or separation, the forces transmitted by the horizontal directional drilling pulling equipment.

4.2 Plant

4.2.1 General

Suitable HDD equipment shall be provided and shall consist of a HDD machine, a drilling fluid system, a guidance system and ancillary equipment.

The drilling equipment shall have sufficient capacity to drill the bore, ream and pullback the pipe.

The drilling fluid system shall consist of a fluid mixing, pumping and delivery system of sufficient capacity to successfully complete the drill, and a vacuum truck or other system of sufficient capacity to handle the volume of used drilling fluid required.

A fluid recycling system may be used to remove the cuttings from the drilling fluid so that the fluid can be re-used, or if the drilling fluid is not to be recycled it will have to be spoiled if not biodegradable.

The guidance system must be matched to the actual crossing to ensure the accuracy of the guided boring operations,

Trained and competent personnel to operate the system.

All equipment shall be in a good and safe operating condition with sufficient fuel, supplies, materials and spare parts on hand to maintain the system in good working order for the duration of the project.

4.2.2 Drilling machine

The directional drilling machine shall comprise a power system to rotate, push and pull hollow steel drill rods into the ground at a variable angle while delivering a pressurized drilling fluid mixture to a guidable drill head. The power system shall be self-contained or umbilical with sufficient pressure and volume to power drilling operations. The hydraulic system shall be free of leaks. The machine shall have a system to monitor and record pullback forces during pullback operations. The machine shall have an electrical strike alert system and all the necessary safety equipment such as an operator's presence seat switch and a remote lockout system.

4.2.2.1 Cable strike alarm

The drilling machine shall be fitted with a permanent alarm system capable of detecting an electrical current or voltage differential. The system shall have an audible alarm to warn the operator if the drill head detects or contacts electrified cables.

The strike alarm should be tested prior to commencing each drilling process and the operators must be familiar with the procedure in the event of a strike. Local authority and other emergency phone numbers must be available in the site health and safety file.

4.2.2.2 Drilling head and reamers

The drilling head shall be steerable by changing its rotational orientation and shall provide the necessary cutting surfaces and drilling fluid jets. Suitable drilling heads and reamers for bores in all soil conditions including rock shall be available.

The drilling head and reamers used shall be suitable for the subsurface soil conditions and the size of the bore.

Quick couplers should be provided to allow fast and safe tool changes.

4.2.2.3 Drill rods

Drill rods shall be constructed of high quality seamless steel tubing suitable for the expected soil conditions as recommended by the drilling machine manufacturer.

4.2.2.4 Safety tongs

Safety tongs must be used on site for connecting and disconnecting torque threaded joints in a safe manner.

4.2.3 Drilling fluid system

4.2.3.1 Mixing system

The drilling fluid mixing system shall be self-contained, closed, and have the capacity to mix and deliver sufficient drilling fluid. The mixing system shall continually agitate the drilling fluid during operations.

4.2.3.2 Drilling fluids

The drilling fluid shall be composed of clean water, sodium bentonite clay and appropriate additives. The water shall be from an approved source. The water and additives shall be mixed thoroughly and without any clumps or clods. No potentially hazardous material may be used in drilling fluid. Drilling fluids are available that are biodegradable and environmentally safe.

4.2.3.3 Delivery system

The delivery system shall have filters in-line to prevent solids from being pumped into the drill rods. Connections between the pump and drill rods shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained, collected and returned to the drilling fluid recycling system or spoiled. A berm at least 300 mm high, shall be maintained around the drilling

machine, the drilling fluid mixing system, entry and exit drilling pits and drilling fluid recycling system to prevent spills into the surrounding environment. Pumps, vacuum truck(s), or any other system must have the required capacity to convey excess drilling fluid from containment areas to storage and recycling facilities.

4.2.3.4 Drilling fluid recycling system

The drilling fluid recycling system, if used, shall separate the cuttings from the drilling fluid to render the drilling fluid re-usable. Cuttings separated from the drilling fluid will be stockpiled for later use or disposal.

4.2.3.5 Control of drilling fluids

Control shall be exercised over operational pressures and pumping volumes, drilling fluid viscosities and densities, drilling speeds, and any other operational factors required to avoid hydrofracture fluid losses, inadvertent pressure release of fluid to the surface (frac-out) and drilling fluid spillage. This includes any spillages or returns at entry and exit locations or at any intermediate point. All inadvertent returns or spills shall be promptly contained and cleaned up. Provision shall be made for on-site mobile spill removal equipment during all drilling, pre-reaming, reaming and pullback operations and for quickly removing spills. Any inadvertent returns or spills shall be reported and immediately contained and cleaned up.

The local authority and environmental requirements regarding drilling fluids shall be adhered to. The relevant material data sheets shall be kept in the health and safety file.

4.2.4 Guidance system

Tracking and guidance systems are required to ensure that the position of the drill head is correctly aligned horizontally and vertically. These systems include walkover and wireline (hardwire) systems.

The walkover system has a battery powered transmitter or sonde located near the drill head. When the receiver on the ground surface is positioned directly above the drill head it locates the position, depth and pitch of the drill head.

The wireline system has a magnetic sensor placed in a non-magnetic drill head assembly, which is connected to a computer at the surface by wires which pass through the inside of the drill rods. Magnetic readings of the inclination and direction are interpreted by the computer providing information on the alignment and pitch of the bore. The accuracy can be increased, where possible, by using electrical wires on the surface to create a magnetic field.

The guidance system shall be capable of tracking at depths of up to 10 metres and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), inclination (vertical direction), temperature and battery status. The guidance system shall be accurate to ± 5% of the vertical depth of the borehole and to
± 0,1% of the inclination (pitch).

The guidance system shall be of a proven type and shall be operated by personnel trained and experienced with the system. The operator shall be aware of any metallic objects or electromagnetic anomalies near the drill path and shall consider influences such as these in the operation of the guidance system.

4.2.5 Other equipment

4.2.5.1 Pipe rollers

Pipe rollers, if used, shall be of sufficient size to fully support the forces and the weight of the pipe

during pullback operations. The bearing capacity of the soil under the rollers should be checked to ensure that it will not settle during pipe insertion.

4.2.5.2 Pipe grip or pulling head

The end of the pipe shall be connected to the swivel and reamer with a pipe grip or pulling head. The type may be a basket, internal, internal/external clamp or bolting device, or a fused HDPE pipe adaptor with a built in pulling eye.

4.2.5.3 Pipe rammers

Pipe rammers shall only be used if necessary to assist the pullback operation and only with approval.

4.3 Construction

4.3.1 General

4.3.1.1 Competence

The HDD operations shall be undertaken and supervised only by competent persons experienced with this work. Operators should have certified manufacturers and/or City and Guild's training and should have a good theoretical understanding of HDD operations.

4.3.1.2 Authority to install pipeline under facilities controlled by third parties

The specification data will specify when permission is required from a third party who controls the land or any structure on the land (or both) under the surface of which the pipeline is to be installed and any requirements for warnings and procedures to be observed before and during the horizontal directional drilling operations.

4.3.1.3 Geotechnical information

Geotechnical information is provided in the specification data. This information shall be used in planning the drill path, selecting suitable tooling and the drilling fluid design and management plan.

Additional investigations may be undertaken to supplement the geotechnical information provided.

For measurement and payment purposes, the classification of rock is stated in the specification data.

4.3.1.4 Traffic

Any specific requirements regarding traffic, such as lane closures for the purpose of tracking and guiding the drill under wide carriageways, are described in the specification data.

4.3.1.5 Existing services

The requirements for obtaining the necessary wayleaves and the protection of existing services are described in the specification data.

The installation of underground pipes using HDD may necessitate some additional requirements to protect existing underground services.

4.3.1.5.1 Verification

All existing underground services shall be located on site in liaison with the relevant service authorities by means of maps, plans, access covers, ground penetrating radar, cable locating equipment and/or excavations. Each service shall be exposed by hand or vacuum excavations and surveyed to confirm its exact horizontal and vertical position as well as size, number and type of service pipes or cables.

4.3.1.5.2 Ground penetrating radar survey

Where prescribed in the specification data, a ground penetrating radar survey shall be performed along the route of the proposed drill path in an endeavour to detect any other unknown underground services or obstructions and reduce the chance of conflicting with any unforeseen obstacles.

4.3.1.5.3 Waypoint pits

Where specified in the specification data or where required by a service authority pits shall be excavated by hand at waypoints near or next to existing services to visibly confirm that the drill string, reamer or pipe is on course and will clear the existing services. As an alternative vacuum excavated potholes may be used.

4.3.1.6 Design criteria
The design criteria shall be as follows, unless stated otherwise in the specification data:

1	2
Pipeline location	**Minimum cover**
Under roads	Greater of 10 x O.D. or 1,2 m
Under sidewalks	Greater of 10 x O.D. or 1,0 m
Elsewhere, where surface disruption is not important	0,9 m
Minimum setback from road edge	1,5 m
Minimum clearances to existing services	
Crossings (vertical clearance)	1,0 m
Parallel (horizontal clearance)	2,0 m
Minimum clearance between parallel bores	10 x larger O.D.

O.D. = Outside Diameter (Pipe) ≤ ±300 mm

The setbacks from road edge shall be the minimum distance from the existing road edge to any pits, drilling equipment or plant.

The clearances to existing services shall be the clear distance between the nearest outside of the existing service and the nearest outside of the largest reamer to be used in the installation.

In designing a drill path to achieve the above criteria, there should be as few as possible curves and the drill path should preferably be in a straight line in plan.

4.3.1.7 Drill plan
The drill plan shall be prepared by the HDD Contractor based on the specification data and include detailed design calculations, specifications, drill path and working drawings to show the proposed methods of installation and methods of providing temporary support for any road, rail track, or other service or structure and any modifications to structures required before HDD operations commence.

The drill plan shall include:

(a) the final bore diameter to be reamed, based on the pipe size and conditions, shall be stated in the drill plan.

(b) drawings showing the detailed alignment of the drill path both horizontally and vertically. The drill path shall be designed to take into account surface features, structures, roads, railways, ground surface profile, required minimum depths, confirmed position of existing services, positions of pits and required clearances including setbacks from roads.

(c) the drilling machine entry and exit angles, the pipe size, the number of pipes if in a bundle and the allowable rates of curvature of the drill rods and the product pipe.

(d) the characteristics of the drilling machine including pumping capacity and available tooling

that must be taken into account, plus any other parameters specific to the plant, equipment and method of working. The potential for drilling fluid loss can be reduced with deeper bores.

(e) the proposed positions and approximate sizes of waypoint pits, entry and exit drilling pits shall be shown as well as the proposed locations, plus the foot print dimensions, required for stringing out and supporting of the pipeline ready for the pullback.

(f) shall show the ends of the pipeline to be installed for measurement purposes. The drill plan shall also show any allowances to counteract the recovery of axial strain on the product pipe.

(g) shall state the planned selection of drilling and reaming tools and the preliminary drilling fluid design suitable for the geotechnical conditions and volume calculations.

(h) shall show the radius of curvature of the drill path and the calculations determining this. The curvature of the drill path is limited by the steering capabilities of the drilling equipment, the minimum allowable bending radius of the drilling rods and the product pipe, and the allowable tensile stress in the curved pipe due to pulling loads. A rod-by-rod plan can be prepared using bore planning software.

The HDD Contractor is responsible for the design of the directional bore and shall determine the maximum allowable pullback force for the pipe and conditions. The need to reduce the buoyancy of the pipeline and determine any measures to counteract this buoyancy shall also be considered.

The drill plan comprising drawings showing vertical and horizontal alignment, sections with positions of services, calculations and specifications, shall be signed by a competent person, with adequate experience in the field and responsible for their preparation. No work shall commence until the drill plan has been completed and approved in terms of the specification data.

4.3.1.8 HDD Contractor solely responsible

Any permission to proceed given in terms of 4.3.1.7 or otherwise shall not indicate acceptance by the approver of any responsibility for safety or adequacy of the works executed on the basis of the HDD drawings, designs, operations and methods of working and, in terms of Subclause 2.5 of SANS 1200 A or SANS 1200 AA, as applicable, shall not limit the obligations and liabilities of the HDD Contractor in regard to such safety or adequacy.

4.3.2 Safety control requirements

4.3.2.1 Safety of personnel

Horizontal directional drilling has particular requirements regarding safety that must be addressed in the Health and Safety Plan. These requirements include the operation and use of cable strike alarms, electric grounding rods and safety mats, ignition key procedures, operation of two-way radios, safety perimeters around equipment, procedures for safely connecting/disconnecting tooling, personal protection equipment, dielectric boots, gloves, hard hats, dust masks, high visibility vests and safety glasses.

4.3.2.2 Safety not to be impaired

Horizontal directional drilling operations shall be performed under any road, railway, or under, over or past any other service or structure, as applicable, without disrupting traffic and without disturbing the alignment or levels of the road surface, the tracks, or other service or structure, as applicable, to an extent that may impair the safety of traffic or of the service or structure.

4.3.2.3 Examination of structures at risk

Before commencing work in the vicinity of any structure, there shall be a detailed examination of the structure, record of its condition (including photographs), and the record filed.

4.3.2.4 Recording of movements

4.3.2.4.1 General

Where required by the specification data, measurements shall be taken before, during and after the construction period and any change in line or level (or both) of any road, rail track, or other service or structure being traversed, recorded. A copy of such record shall be kept on file.

4.3.2.4.2 Temporary supports

Except when such support is provided by others, or is specified in the specification data, temporary support shall be provided when necessary to carry road and rail traffic, and in the case of railway tracks, to prevent horizontal or vertical misalignment.

4.3.3 Excavation

4.3.3.1 Drilling pits

Drilling pits shall be excavated at each end of the section of pipeline or sleeve that is to be installed. The pits shall be normally located at the ends of the proposed pipeline to define the extent of the installation and facilitate containment of drilling fluids and the fixing and removal of tooling if necessary. The pits shall be of dimensions at least equal to the minimum dimensions needed for the equipment and for safe and efficient working. If possible, the capacity of the pits should be at least equal to the volume of the final bore between the pits. The position and approximate dimensions of the pits shall be included in the drill plan before work commences. The excavated material shall be stockpiled for later backfilling and compaction in layers not exceeding 150mm to 93% of modified AASHTO maximum density (100% for sand).

The sides of the pits shall be adequately supported by shoring or other approved means. Where a pit adjoins a railway or a heavily used road, the sides of the pit shall be shored during the entire operation to prevent any movement caused by vibration arising from rail or road traffic. (Attention is drawn to the requirements of the Factories, Machinery and Building Work Act, 1941 (Act 22 of 1941). (See Subclause 5.1 of SANS 1200 D or SANS 1200 DA, as applicable).)

It is to be ensured that at all times, each pit has barriers and provides a safe working environment.

4.3.4 HDD procedures

4.3.4.1 Preparation

4.3.4.1.1 Notification

After the drill plan has been approved, the HDD Contractor shall give 48 hours minimum notice that he intends commencing drilling. The drilling may not commence until the preparation work has been completed.

4.3.4.1.2 Photographic site record

Prior to commencing any work on the site, inspections shall be made of the site of work and a record with photographs of the existing condition of the areas that will be affected by the work. A similar set of photographs shall be taken after completion. Copies of the inspections shall be filed.

4.3.4.1.3 Drilling pits

Any necessary drilling pits shall be constructed and ready.

4.3.4.1.4 Drill path

The drawings showing the drill path in plan and long section, with cross sections where necessary, showing all services shall be on the drilling site for reference at all times. In addition to this the drill operator will have his own drill procedure detailing rods, pitch and distance schedule.

4.3.4.1.5 Survey control and guidance system

The setting out of the drill path shall be completed and the drill guidance system prepared.

4.3.4.1.6 Water supply and drilling fluid system

The water supply for drilling operations shall be in place and the drilling fluid system ready for set up.

4.3.4.1.7 Stringing out of pipes

The work area required for the welding, storage and stringing out of pipes ready for pullback shall be planned and staked out.

4.3.4.2 Pilot bore

4.3.4.2.1 Guidance

The pilot bore shall be drilled along the path shown on the drawings. The guidance system shall be on site at all times and operational. The guidance system shall be used to locate the drill both horizontally (longitudinally and laterally) and vertically. The position of the drill shall be plotted on the drill plan drawings to confirm its correct position. The position shall be recorded at least once per drill rod length.

The pitch, line and level shall be checked continuously during the drilling of the pilot bore, and corrective steering action shall be applied as necessary. A copy of the results of all checks including the plot of the bore and a statement of any corrective measures taken shall be recorded in a drilling log and be available for inspection on the site. As soon as the pilot bore has been completed a copy of the drilling log and as-built drill plan shall be filed for the record.

4.3.4.2.2 Service crossings

Care shall be exercised at service crossings to ensure the required clearances are achieved. This may require excavating waypoint pits to confirm the position of the drill during the pilot bore and all reaming passes.

4.3.4.2.3 Drilling instrumentation

The drilling machine operator shall continuously monitor the instruments showing torque and axial forces, and drilling fluid pressure, flow rates and volumes and rod changes during the drilling of the pilot bore.

4.3.4.2.4 Unexpected subsurface conditions

Any unexpected subsurface conditions, such as an underground obstruction, or cavities that impede, or otherwise influence drilling operations shall immediately be reported.

4.3.4.3 Pullback

4.3.4.3.1 Pre-reaming

Sometimes reaming and pipe pullback are performed simultaneously with pipe diameters not exceeding 300 mm. Pre-reaming allows bores, particularly larger ones, to be created in stages, reducing the required torque and thrust loads on the machine as well as the amount of spoil in the drilling fluid returns.

4.3.4.3.2 Reamer size

The final bore diameter shall be not more than 50% greater than the outside diameter of the pipe to provide clearance for the pipe grip or pulling head, allow spoils flow and reduce the required loads during the pipe pullback operation.

4.3.4.3.3 Swivel

A swivel shall be provided between the reamer and the pipe grip or pulling head to prevent the transmission of torsion loads to the pipe.

4.3.4.3.4 Pipe grip or pulling head

The end of the product pipe shall be connected to the swivel and reamer with a pipe grip or pulling head. The product pipe end shall be sealed and suitably prepared. The pipe grip or pulling head shall be securely fastened to the pipe end.

4.3.4.3.5 Breakaway links and pullback gauges

A breakaway link may, or where specified in the specification data shall, be provided between the main swivel and the pipe grip or pulling head to ensure the pipe is installed within the maximum allowable pulling force. The breakaway link shall be rated at or not more than the maximum allowable pulling force. Broken links will require the removal of the pipe from the entry end, or possible abandonment. Following a determination of the problem, and an appropriate solution, another attempt may be made, possibly requiring a new bore path.

A pullback gauge may, or where specified in the specification data shall, be provided and attached to the pipe grip or pulling head to continuously monitor the actual tension applied to the product pipe.

4.3.4.3.6 Pipe support

The length of pipe to be installed shall be laid out and supported during the pullback operations so that it moves freely without the pipe being damaged. A sufficient number of rollers shall be used to avoid excess sagging. Any curves in the pipeline shall be at more than the pipe's allowable radius of curvature.

4.3.4.3.7 Continuity of pullback

Once pullback operations have commenced the operation must continue without interruption until the pipe is completely pulled through the bore hole. The constraints of any permitted working hours shall be considered in the planning of the pullback.

The frictional resistance is normally the highest just prior to movement and decreases with movement. When pullback ceases, frictional forces and drag forces increase due to the thixotropic nature of the drilling fluid. The drilling fluid starts to gel when it is undisturbed and could result in the pipeline being held in place (freezing). Therefore pullback should never be stopped, except for drilling rod removal, until the pipe is completely pulled into its permanent position.

4.3.4.3.8 Instrument monitoring and pulling force

The drilling machine operator shall continuously monitor the instruments showing torque and pullback forces, and drilling fluid pressure and flow rates during reaming and pullback operations.

The pulling force during pullback shall not exceed the maximum allowable pullback force.

4.3.4.3.9 Buoyancy

Any requirements for reducing the buoyancy of the pipeline shall be applied prior to pullback.

4.3.4.3.10 Unexpected subsurface conditions

Hydrolock can occur where the soil conditions, a bore collapse, cuttings not being effectively removed, or where external hydrostatic and/or drilling fluid pressure holds the pipeline and/or deforming it, causing the maximum allowable pullback force to be exceeded. The pulling operations shall halt to allow the pressure to subside, then an attempt should be made to continue pulling as soon as possible to prevent the drilling fluid gelling and holding the pipeline in place (freezing).

Any unexpected subsurface conditions, such as hydrolock, that impede drilling operations, shall immediately be reported.

4.3.4.3.11 Surface damage

The pipe shall be installed in a manner that does not cause upheaval, settlement, cracking and movement or distortion of surface features.

4.3.4.3.12 Length of pipe and shrinkage

Adequate lengths of pipe shall be provided at both launching and receiving ends to facilitate service connection assemblies.

After pullback, the pipe may take several hours to recover from the longitudinal axial strain.

The pipe ends should be pulled out longer than the bore, in accordance with the drill plan, to avoid having the pipe end retreat back into the bore due to stretch recovery and thermal contraction.

4.3.4.3.13 Pipe bundles

Where shown on the drawings more than one pipe can be installed as a pipe bundle.

4.3.5 Completion

4.3.5.1 Testing

Any tests and inspections that are required in terms of this specification shall be performed, recorded and put on file.

4.3.5.2 Pipe end caps and seals

Pipe end caps shall be installed on the ends of empty pipes to prevent the ingress of water and soil. Where cables are inserted, the remaining annulus between the outside of the pipe and the inside of the bored hole at the pipe ends shall be sealed with an appropriate compound.

4.3.5.3 Draw wires

Where required in the specification data, draw wires shall be inserted through the length of pipe installed after testing.

4.3.5.4 Markers

Where required in the specification data, permanent markers shall be installed at the pipe ends.

4.3.5.5 Acceptance

The installed pipe shall only be accepted once it is within the specified tolerances and has passed all inspections and tests.

4.3.5.6 Backfilling and disposal of excavated material

When the pipe installation has been completed and the plant removed, any drilling pits shall have any remaining drilling fluid removed for disposal or recycling and the pits backfilled. Surplus excavated materials shall be disposed of as specified in the specification data.

4.3.5.7 Record drawings

If an alternative design has been accepted or if the layout shown on the drawings has been modified to suit the HDD construction method, record drawings showing details of the completed works shall be provided before the final payment is made. Each such drawing shall be certified to be an accurate reflection of the details of the work as constructed.

5 Compliance with the requirements

5.1 Tolerances

Unless stated otherwise in the specification data, the allowable tolerance between the position of any point on the finished pipeline and the designed position is dependent on the accuracy of the guidance system which is typically ± 5% of the vertical depth of the bore.

Any other requirements for tolerances (eg. due to the gradients of gravity pipelines) shall be stated in the specification data.

5.2 Testing

5.2.1 General

The specification data shall prescribe any tests that shall be applied to pipes installed by horizontal directional drilling. Any pressure tests shall be applied both before and after installation and the results recorded and filed.

5.2.2 Pipe sleeves

Where the pipe installed by horizontal directional drilling is to be a sleeve for carrying other service cables or service pipes, the pipe sleeve will only be accepted once the service cables or pipes have been successfully installed through the sleeve or a mandrel has been successfully pulled through the pipe sleeve in accordance with the specification data.

5.2.3 Inspection

5.2.3.1 CCTV Inspection

Immediately after installation the pipeline shall be inspected, using CCTV equipment, a video recording made and submitted for assessment.

5.2.3.2 CCTV Inspection assessment

The video recording of the CCTV inspection of the installed pipe shall be assessed to check that the pipe is continuous over its entire length and has no leaks, deformations or other defects that will affect the performance or structural integrity of the pipe. Any such defects shall be recorded.

5.2.4 Acceptance

5.2.4.1 Leaks, deformations or defects

All leaks, deformations or defects shall be rectified and a further CCTV inspection undertaken and re-submitted for assessment.

5.2.4.2 Approval of installed pipeline

The section of pipeline that has been installed may only be accepted once it has passed all the required tests and a CCTV inspection assessment done confirming that any defects have been rectified, has been accepted.

Annex A
(normative)

Preparation of specification data associated with this part of SASTT-TS-TT3 for inclusion in the scope of work

This specification data forms an essential element of this part of SASTT-TS-TT3; without such data, the requirements are incomplete.

The format for the specification data has been developed to be compatible with the requirements of table D.1 of SANS 10403:2003. The specification data should be incorporated in the scope of work as illustrated in table A.1.

Table A.1 — Incorporating this part of SASTT-TS-TT3 in the scope of work

<table>
<tr><td>1</td><td>2</td><td>3</td></tr>
<tr><td>Topic</td><td>Aspect</td><td>Text</td></tr>
<tr><td colspan="3">CONSTRUCTION</td></tr>
<tr><td rowspan="3">Works specifications</td><td>Applicable part(s) of SASTT-TS</td><td>The following parts of SASTT-TS and associated specification data are applicable:
1) SASTT-TS …..
2) SASTT-TS …….
The associated specification data are as follows:
<table><tr><td rowspan="3">Specification data pertaining to SASTT-TS - ……</td><td>Essential Data:
The requirements for ……. are …….
The requirements for ……. are …….</td></tr><tr><td>Variations:
1)……
2)……..</td></tr><tr><td>Additional clauses:
1)…….</td></tr></table></td></tr>
<tr><td>Applicable national and international standards</td><td></td></tr>
<tr><td>Particular/generic specifications</td><td></td></tr>
</table>

Develop the specification data based on the contents of table A.2.

Table A.2 — Specification data associated with this part of SASTT-TS-TT3

1	2	
Specification data associated with this part of SASTT-TS	**Guidance notes.**	
	Clause number	**Consideration**
Essential Data		
Pipes shall …….	4.1.1	State requirements for pipes and types of joints or couplings if other than butt welded high density polyethylene (HDPE). The welding of pipes if other than HDPE. Allowable pipe bend radius.
The pipe shall be a solid wall high density polyethylene (HDPE) PE …….. pipe colour …… of ..... mm nominal outside diameter and SDR …….. (…….. mm nominal pipe wall thickness) (Pressure rating PN……..).	4.1.1.1 a)	
Welders shall be IFPA members and shall imprint each weld with their unique IFPA identification stamp displaying the IFPA company number, welder number and IFPA logo, issued in accordance with the Welder Identification System.	4.1.1.1 b) iii	Specify if welders are to be IFPA members and must stamp welds.
The welded joints shall conform to the requirements of SANS 10268 Part 10, according to the quality control rating assessment class .....(.....).	4.1.1.1 b) iv	State assessment class if other than class `II`. (Medium requirements for safety or for load carrying capacity or both) (Note that the assessment class rating is dependent on the safety or load-carrying risk posed.)
Welded joints shall be tested in accordance with SANS 6269.	4.1.1.1 b) v	Specify if welded joints are to be tested.
Before any production welding is commenced, the following shall be approved in accordance with SANS 10270 for heated-tool butt welding of pipes: 1. A Welding Procedure Specification (WPS) and 2. A qualification joint	4.1.1.1 b) vi	Specify if welding procedures and test weld required.
The internal and/or external welding beads shall be removed. The removed beads from each joint shall be retained in separate labelled transparent bags and handed to ……	4.1.1.1 c)	The beads may be inspected for quality purposes.
..... pipes shall be welded together according to specification	4.1.1.2	State the specification for the welding together of pipes other than HDPE.

1	2	
Specification data associated with this part of SASTT-TS	**Guidance notes.**	
	Clause number	**Consideration**
The letter dated …….. from …….. gives permission for the HDD crossing of …… with a list of conditions that are to be complied with.	4.3.1.2	Attach a copy of the letters of permission to the documentation.
The geotechnical information in Report …….. describes the geotechnical investigation and findings.	4.3.1.3	Append the report to the documentation.
For measurement and payment purposes, the classification of rock is …….	4.3.1.3	
The specific requirements from …… regarding traffic is prescribed in ……...	4.3.1.4	Include the specific requirements in the documentation.
The letter/wayleave dated …….. from …….. has a list of conditions that are to be complied with.	4.3.1.5	Attach a copy of the letters/wayleaves to the documentation.
Ground penetrating radar shall be used along the proposed drill path ……..	4.3.1.5.2	Should be used if available.
Waypoint pits are compulsory for …….	4.3.1.5.3	
The design criteria is amended/supplemented by …….	4.3.1.6	
The HDD Contractor is …….	4.3.1.7	The specialist organisation implementing the horizontal directional drilling, whether contractor, subcontractor or in-house team. Consider contractual relationships in terms of 4.3.1.8.
The drill plan shall be approved by …….	4.3.1.7	The responsible person/organisation must be identified
Movements of ……. shall be monitored as follows…….	4.3.2.4.1	
Temporary support shall be provided for ……..	4.3.2.4.2	
A breakaway link shall be used …….	4.3.4.3.5	
A pullback gauge shall be used …….	4.3.4.3.5	
Draw wires shall be inserted ……..	4.3.5.3	
Pipe end markers shall be installed ……	4.3.5.4	
Surplus excavated material shall be removed, transported and disposed of at ……..	4.3.5.6	
The tolerances stated are amended/supplemented by ……	5.1	
The following tests shall be performed on the pipeline ……	5.2.1	
Pipe sleeves ……. shall be proved by having a mandrel pulled through as follows ……	5.2.2	

1	2	
Specification data associated with this part of SASTT-TS	**Guidance notes.**	
	Clause number	**Consideration**
Additional clauses: 1 …… 2 ……		*State additional requirements, if any.*
Variations: 1 Replace … with the following: 2 The provisions of … do not apply.		*State variations, as applicable.*

Annex B
(informative)

Items that may need to be considered when preparing the scope of work for a particular project

B.1 The following may have to be addressed in the construction and management section of the scope of work when compiling that section for a particular project (refer to annex D of SANS 10403: 2003).

1) Specific requirements for equipment, particularly the suitable horizontal directional drilling techniques and insertion methods. In particular a description of the proposed pipe sizes, lengths and depths.

   (It is important that someone experienced in HDD applications confirms that HDD is a suitable method of installation.)

2) The provision of good geotechnical information from on-site investigations and reports is the most important factor in any horizontal directional drilling project and confirms not only the feasibility but also affects the tooling and drilling fluid requirements. Potential problems can then be addressed and highlighted at the planning stage.

   The report must provide information that will be considered to be the foreseen conditions. Should adverse conditions be encountered on site, they will be considered unforeseen conditions if not described in the geotechnical report. The geotechnical report will be used to determine if conditions are foreseen (HDD Contractor's risk) or unforeseen (Employer's risk).

   (As an example, if the geotechnical report indicates only sandy conditions and the drill hits a rock under a road and the bore is abandoned the contractor should be paid for that work. Then the Employer has to consider the similar risks of attempting another bore nearby or negotiating with the HDD Contractor on alternative machines and tooling to deal with potential rocks in the bore.)

3) Arrangements made with the controlling authorities for drilling under their facilities and services and the conditions under which permission is granted.

4) Requirements relating to the lighting of the works.

5) Requirements for detailed design calculations and working drawings showing details of the HDD installation.

6) Requirements for the examination of surfaces, structures and services at risk before commencing the work.

7) Safety requirements.

It should be noted that SANS 1921-1 Construction and Management Requirements: General contains general requirements in respect of most of the abovementioned considerations.

B.2 Unless full information is made available to tenderers, it is not possible for tenderers to make cost-effective and accurate assessments of the techniques required and to properly assess the risks associated with carrying out the work. Information on the layout of the pipelines to be installed and a detailed geotechnical investigation and report must be communicated to the tenderers.

B.3 The following information should be communicated to tenderers:

a) Layout of the pipelines to be installed:

1) pipe sizes;
2) pipe classes;
3) lengths;
4) gradients;
5) depths;
6) position of manholes etc.
7) topographical survey
8) location of roads, railways, rivers and other underground and overhead services.
9) location of possible sources of electromagnetic interference such as powerlines, underground cables, microwave towers, traffic loops, electrical fences
10) any space limitations for equipment and stringing out of pipes

This information is best presented with layout plans and longitudinal sections.

b) Geotechnical conditions likely to be encountered:

1) soils and subsoils;
2) sand, clay, cobbles, boulders, bedrock;
3) rock hardness (compressive strength);
4) abrasiveness of the material;
5) variability of material;
6) details of the water table;
7) salt water;
8) fractures/fissures

c) Existing underground services in the vicinity:

1) type;
2) position;
3) size;
4) depth;
5) manholes, valves etc.;
6) nature (pressurised, live voltage);
7) wayleave requirements;
8) any protection required;
9) authority contact details;

d) Local authority and/or environmental requirements regarding drilling fluids.

Annex C
(informative)

Items that may be needed to cover measurement and payment

The following may have to be addressed in the Pricing Data section of the project document when compiling that section for a particular project (refer to annex D of SANS 10403: 2003).

At present the SANS 2001 series of standards are being prepared to replace the existing SANS 1200 series of specifications.

It is planned that for measurement and payment SANS 2001 will adopt the Third Edition of the Civil Engineering Standard Method of Measurement (CESMM3) published by the UK Institution of Civil Engineers (ICE) or a South African version thereof.

Until SANS 2001 is fully completed and introduced, it will be necessary to refer back to the SANS 1200 measurement and payment clauses and/or the following particular measurement and payment clauses. This also applies to the SASTT-TS series of standards.

The following are measurement and payment clauses that would be suitable for such reference:

1 MEASUREMENT AND PAYMENT

1.1 General

The basis of payment for a pipeline installed by horizontal directional drilling, takes cognizance of the fact that, although the Engineer may design and specify the pipeline, he cannot provide detailed drawings and dimensions for the horizontal directional drilling operations and any drilling pits, because these depend on equipment and methods that the HDD Contractor intends to use for carrying out the work.

In view of the considerations set out above and the nature of the operations, the provision and installation of horizontal directional drilled pipelines is scheduled with:

a) an item for establishment on the contract site of works;
b) an item for setting up at each installation;
c) items for provision and installation of pipelines

1.2 Scheduled items

1.2.1 Horizontal directional drilling (HDD) establishment on site

HDD establishment on site ..... Unit: Sum

The sum for the above shall cover the charges for providing and establishing on the contract site of works, the personnel, plant, equipment, and materials necessary for the installation of pipes, and the subsequent removal on completion of the HDD work.

A payment of 80 % of the sum will be made on the HDD establishment on site and the balance of 20 % on the HDD removal from site.

1.2.2 HDD installation setup

HDD installation setup ..... Unit: No

A setup may be for drilling for a single pipeline, a bundle of pipes or a group of pipes that are parallel and not more than 1.5 m apart.

The rates for the above shall cover the cost of setting up for each HDD installation, for providing and establishing on site the personnel, plant, equipment and materials necessary for the HDD procedures to install the pipeline including obtaining wayleaves, protecting services, the verification of existing services, a ground penetrating survey if specified, preparing the drill plan, implementing safety control requirements, giving notice, site inspection and photographic records, providing any watching and lighting and maintaining all temporary works until the installation is complete and the subsequent removal of temporary works, plant and equipment and making good.

Payment will be made on completion and approval of the installation.

1.2.3 Excavation of drilling pits

Excavation of drilling pits ..... Unit: No

Drilling pits are normally located at the ends of the pipeline that is to be installed.

The rates for the above shall cover the cost of excavation, shoring, backfilling and compaction in accordance with SANS 1200 DB Clause 8.3.2.

The construction of drilling pits should be measured and paid per number where the pits are simple and similar in accordance with a typical detail or where the pits are individually drawn and detailed. Where it is not possible to design the pit details, standard SANS 1200 pay items for excavation, backfilling and compaction as well as hand excavation, shoring, dewatering and reinstatement should be quantified and scheduled for measurement and payment.

1.2.4 Hand excavation of pits

Hand excavation of pits ..... Unit: m^3

Excavation of pits by hand to locate existing services or provide waypoint pits to check on drilling progress.

The rates for the above shall cover the cost of excavation, shoring, backfilling and compaction in accordance with SANS 1200 DB Clause 8.3.2.

1.2.5 HDD installation of pipes

HDD installation of pipes ..... Unit: m

The quantity measured and paid shall be the length in linear metres of the size, class, material and number of pipes installed.

Measurement shall be along the centreline of the pipe or pipe bundle installed as shown on the drawings. The start and end of the final pipeline to be measured as installed by HDD shall be clearly shown.

Payment for installed pipe shall be full compensation for the preparatory work, drilling of the pilot bore, pre-reaming, reaming and pullback of the pipe(s), including operation of the drilling fluid system and guidance system, and survey control, safety control, protection of existing services and structures, disposal of excavation spoil and drilling fluids and testing of the pipeline. The payment shall include for supply and assembly of the pipes into a continuous pipeline, whether by welding or mechanical joints as specified. Payment shall also include for the installation of any draw wires, end caps and markers specified.

1.2.6 HDD installation of pipes in rock

Extra over HDD installation of pipes in rock ..... Unit: m

The quantity measured and paid shall be extra over Pay Item 1.2.5 per the length in linear metres of each size of pipe or pipe bundle installed requiring drill and reamer rock tooling.

1.2.7 CCTV inspection of installed pipes

CCTV inspection of installed pipes ..... Unit: m

The quantity measured shall be the length of pipe installed.

Payment shall include for all labour, plant, equipment, supervision necessary to inspect the installed pipes and provide a video recording and report.

Annex D
(informative)

Factors that need to be considered when selecting the in-service structural requirements of the pipe

Selecting the in-service structural properties of the pipe is beyond the scope of this standard. These should be determined by a competent engineer or technologist taking into account:

1) material to be used for the pipe;
2) type of pipe joints or welds;
3) physical dimensions such as pipe length, diameter and wall thickness;
4) drill path radius;
5) surrounding soil conditions and properties;
6) depth of installation;
7) traffic loading;
8) internal pressure;
9) external ground water pressure;
10) allowable pullback forces