CONSTRUCTION SPECIFICATION FOR PIPELINE AND UTILITY INSTALLATION IN SOIL BY HORIZONTAL DIRECTIONAL DRILLING

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450.01 SCOPE

This specification covers the requirements for the installation of underground pipelines, conduits, cable, or ducts using the trenchless technology known as horizontal directional drilling.

450.01.01 Significance and Use of Appendices

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

Use of this specification or any other specification shall be as specified in the Contract Documents.

450.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

450.02 REFERENCES

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 409	Closed-Circuit Television Inspection of Pipelines
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities and Associated Structures
OPSS 517	Dewatering for Excavations
OPSS 539	Temporary Protection Systems

450.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Active Interference means electrical interference created by magnetic fields and radio frequencies such as power lines.

Backreamer means a cutting head designed for the soil conditions and is attached to the leading end of a drill string to enlarge the pilot bore during a pullback operation to enable installation of the pipelines, conduits, cable, or ducts.

Bore Path means a drilled path according to the grade and alignment tolerances specified in the Contract Documents.

Frac Out means a condition when the drilling fluid's pressure in the bore is sufficient to overcome the in situ vertical confining stress, thereby fracturing the soil and allowing the drilling fluids to migrate to the surface at an unplanned location.

Drill Fluid Control Points means locations along the bore path when control points are constructed to manage drill fluids.

Drilling Fluids means a mixture of water and additives, such as bentonite, polymers, surfactants, and soda ash, designed to block the pore space on a bore wall, reduce friction in the bore, and to suspend and carry cuttings to the surface.

Entry Point means the location or excavation from which the bore is initiated for the installation of the pipelines, conduits, cable, or ducts.

Exit Point means the location or excavation to which the bore is directed for the installation of the pipelines, conduits, cable, or ducts.

Guidance System means an electronic system capable of indicating the position, depth, and orientation of the drill head during the drilling process.

Horizontal Directional Drilling (HDD) means directional boring or guided horizontal boring.

Inadvertent Returns means the flow of unexpected fluids encountered during the drilling process.

Loss of Circulation means the discontinuation of the flow of slurry in the bore back to the entry or exit point or at drill fluid control points.

Passive Interference means electrical interference created by adjacent structures, buried metal, salt water, and minerals in the soil.

Pilot Bore means the initial bore to set horizontal and vertical alignment between the connecting points.

Pipelines, Conduits, Cable, or Ducts Installation means a single pipeline, conduit, cable, or duct installed into a bore path. The pipeline, conduit, cable, or duct may or may not have a tracer wire attached to it.

Pullback means that part of the HDD method in which the drill string is pulled back through the bore path to the entry point, usually installing the pipelines, conduits, cable, or ducts at the same time.

Reamer means a cutting tool specifically designed for in situ ground conditions. It is attached to the leading end of a drill string to enlarge the pilot bore prior to or during a pullback operation to enable installation of the pipelines, conduits, cable, or ducts, and deliver drill fluids into the bore and mix bore cuttings to form flowable slurry.

Reaming means a process for pulling or pushing a tool attached to the end of the drill string through the bore path to enlarge the bore and mix the cuttings with the drilling fluid. This could include multiple passes prior to pipelines, conduits, cable, or ducts pullback.

Rock means natural beds or massive fragments of the hard, stable, cemented part of the earth's crust that are igneous, metamorphic, or sedimentary in origin, that may or may not be weathered and includes boulders having a volume of 0.5 m^3 or greater.

Slurry means a mixture of soil cuttings and drilling fluid.

Soil means all soils, except those defined as rock, and excludes stone masonry, concrete, and other manufactured materials.

Staging Area means an area set aside for the Contractor's drilling and pipe assembly operations.

Strike Alert means a system, audio or visual or both, that is intended to alert and protect the operator in the case of inadvertently drilling into an electrical Utility cable.

450.04 DESIGN AND SUBMISSION REQUIREMENTS

450.04.01 Submission Requirements

The following information shall be submitted to the Contract Administrator 14 Days prior to the commencement of pipe bursting operations, or as specified in Contract Documents:

a) A work plan outlining the procedure and schedule to be used to execute the work.

b) A list of personnel, including backup personnel, and their qualifications and experience.

c) A traffic control plan.

d) A drilling fluid management plan, including source of fresh water and necessary permits or approvals; type of drilling fluids and potential additives and their Safety Data Sheets (SDS); method of drilling fluid containment; method of recycling drilling fluid, as applicable; method of transporting drilling fluids off site; disposal of excess drill fluids as specified in the Contract Documents; and method to continually monitor fluid properties and pressure throughout the course of drilling and pullback operations to anticipate drilling fluid related problems before they occur; and potential environmental impacts and emergency procedures and associated contingency plans.

e) A health and safety plan including the company safety manual, emergency procedures, and a list of emergency personnel contact information.

f) A drilling plan indicating the proposed type and size of directional drilling equipment; location and dimensions of staging areas; diameter of pilot hole and number and size of backreamers; guidance system; field determined elevations of the surface topography along the bore path; field determined elevations and locations of all existing Utilities within 1.5 m of the bore path; rod-by-rod profile data along the bore path; location of drill fluid control points; identification of active and passive interference along with appropriate compensation measures; method to continuously monitor and record pipelines, conduits, cable, or ducts pipe tensile installation forces and down bore fluid pressures; pipe protection procedures; pipe gripping procedures; and temporary protection systems.

g) Contingency plans for the following potential conditions, or as specified in Contract Documents:

   i. Alignment passing through unforeseen obstructions or buried structures.

   ii. Deviation from required alignment and grade.

   iii. Damage to other existing Utilities.

   iv. Soil heaving or settlement.

   v. Contaminated soil or water.

   vi. identifying potential environmental impacts and emergency containment and clean-up procedures.

h) Work permits required under the authorities having jurisdiction necessary to complete the work.

450.05 MATERIALS

450.05.01 Drilling Fluids

Drilling fluids shall be appropriately mixed for the anticipated in situ ground conditions. Only bentonite and drilling equipment manufacturer-approved polymers shall be permitted for use as drilling fluids. All additives used shall be chemically inert, biodegradable, and non-toxic. No petroleum-based or detergent additives shall be permitted.

450.05.02 Pipe Materials

Pipe and fitting type, class, and size shall be as specified in the Contract Documents.

450.05.03 Tracer Wire

Type and number of tracer wires used shall be as specified in the Contract Documents.

450.06 EQUIPMENT

450.06.01 Directional Drilling Equipment

450.06.01.01 General

The directional drilling equipment shall consist of a directional drill rig and a fluid mixing and delivery system with sufficient capacity to complete the pipelines, conduits, cable, or ducts installation.

The drill rig and all associated equipment shall be in acceptable mechanical working order.

All drill operations and equipment shall be controlled by competent, experienced, and trained personnel.

450.06.01.02 Drilling Rig

The directional drilling rig shall:

a) consist of a hydraulically powered boring system to rotate, push, and pull the drill rod into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill head.

b) have drill rod that is suitable for both the drill and the pipelines, conduits, cable, or ducts pipe installation.

c) contain a drill head that is steerable, equipped with the necessary cutting surfaces and fluid jets, and be suitable for the anticipated ground conditions.

d) have adequate reamers and down-bore tooling equipped with the necessary cutting surfaces and fluid jets to facilitate the pipelines, conduits, cable, or ducts installation and be suitable for the anticipated ground conditions.

e) support a guidance system to accurately guide boring operations.

f) be anchored to withstand the pushing and pulling forces required to complete the pipelines, conduits, cable, or ducts installation.

g) contain an active strike alert system and be properly grounded during all operations.

450.06.01.03 Guidance System

The guidance system shall be setup, installed, and operated by trained and experienced personnel. The operator shall be aware of any active and passive interference that may interfere with the guidance of the system.

The type of guidance system shall be suitable for the design bore path and as specified in Contract Documents. The calibration of the guidance system shall be verified daily prior to use.

450.06.01.04 Drill Fluid Mixing and Delivery System

The drill fluid mixing system shall be of sufficient size to thoroughly and uniformly mix the required drilling fluid.

The delivery system and reamers shall have sufficient flow and capacity to ensure that the slurry volumes are adequate for the length and diameter of the final bore and in situ ground conditions.

450.07 CONSTRUCTION

450.07.01 General

The Contract Administrator shall be notified at least 48 hours in advance of commencement of the drilling operations. Operations shall not begin until proper preparations are made.

When strike alerts are provided on a drilling rig, they shall be activated during drilling and maintained at all times.

The location of all Utilities in the work area shall be identified and located prior to the commencement of the drilling operations. If prior to commencement of drilling operations, a Utility is found to exist that would conflict with the installation of the pipe, the Contract Administrator shall be notified immediately.

450.07.02 Site Preparation

The site shall be graded or filled to provide a level work area for the drilling rig. No alterations beyond what is required for HDD operations are to be made. All activities shall be confined to designated work areas.

450.07.03 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

Minimum horizontal and vertical clearances to existing facilities shall be maintained as specified in the Contract Documents. Clearances shall be measured from the nearest edge of the largest reamer to the nearest edge of the facility that is parallel to or crossed by the pipeline or Utility being constructed.

Existing underground facilities shall be exposed to verify their horizontal and vertical locations when the bore path comes within 1.0 m horizontally or vertically of the existing facility. Existing facilities shall be exposed by non-destructive methods. The number of exposures required to monitor work progress shall be as specified in the Contract Documents.

Should it become necessary to excavate or disturb existing Utilities to retrieve lost boring equipment, all relevant approvals shall be obtained.

450.07.04 Transporting, Unloading, Storing, and Handling Materials

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

450.07.05 Trenching, Backfilling, and Compacting

Trenching, backfilling, and compacting for entry and exit points or other locations along the bore shall be according to OPSS 401.

450.07.06 Support Systems

Support systems shall be according to OPSS 404.

450.07.07 Dewatering

Dewatering shall be according to OPSS 517.

450.07.08 Temporary Protection Systems

The construction of all temporary protection systems shall be according to OPSS 539. Protection shall be provided when the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired. Protection may include sheathing, shoring, and piles necessary to prevent damage to works or proposed works.

450.07.09 Drilling Fluid Management

To manage drilling fluids and to mitigate the development of inadvertent returns, a containment, collection, and disposal method shall be employed. The clean-up and disposal of drilling fluids shall be managed in accordance with the drilling fluid management plan.

Fluid properties shall be continually monitored throughout the course of drilling and pullback operations to ensure that the drill fluid properties remain appropriate for the in-situ ground conditions.

450.07.10 Pilot Bore

The pilot bore shall be drilled along the bore path in accordance with the grade, alignment, and tolerances as specified in the Contract Documents. Drill rod and pipelines, conduits, cable, or ducts bend radius shall be taken into consideration when completing the pilot bore.

In the event the pilot bore does deviate, the Contract Administrator shall be notified. The Contract Administrator may require pullback and re-drill from the location along the bore path prior to the deviation. In the event that a drilling fluid frac out, inadvertent returns, or loss of circulation occurs during pilot bore drilling operations, the Contract Administrator shall be advised of the event and of the action taken.

If a drill hole beneath a road shall be abandoned, the hole shall be backfilled with grout or bentonite to prevent future subsidence.

450.07.11 Reaming

The bore shall be reamed to the appropriate size with tooling that is adequate for the in-situ ground conditions and the pipelines, conduits, cable, or ducts that is to be installed.

The final staged ream shall not exceed 1.5 times the pipelines, conduits, cable, or ducts pipe largest outside diameter.

The drilling mud in the annular region shall not be removed after installation, but permitted to solidify and provide support for the pipe and surrounding soil.

450.07.12 Pipelines, Conduits, Cable, or Ducts Installation

450.07.12.01 General

The pipelines, conduits, cable, or ducts shall be jointed and installed according to manufacturer's recommendations and shall be protected from damage in the staging area and during pullback.

The minimum allowable bending radius for the pipelines, conduits, cable, or ducts shall not be exceeded during installation at the entry point, exit point, or any other location along the bore path.

The pipelines, conduits, cable, or ducts shall be allowed to recover prior to the connection to a new or existing facility is made. Pipelines, conduits, cable, or ducts recovery time shall be according to the manufacturer's recommendations.

Tracer wire shall be supplied and installed along with the pipelines, conduits, cable, or ducts, as specified in the Contract Documents.

450.07.12.02 Pullback

After completion of reaming the bore to the required diameter, the pipelines, conduits, cable, or ducts shall be pulled into the bore path as soon as possible.

The pullback operation shall be a continuous operation, if possible, until the pipelines, conduits, cable, or ducts pipe is installed.

The pipelines, conduits, cable, or ducts pipe gripping method shall allow the full tensile rating of the pipelines, conduits, cable, or ducts to be developed.

A swivel of sufficient capacity shall be used between the reamer and the pipelines, conduits, cable, or ducts being installed. The swivel shall prevent rotational forces from the reamer being transferred to the pipelines, conduits, cable, or ducts.

When specified in the Contract Documents, a pipe load measuring device shall be used to ensure that the manufacturer's recommended pullback force is not exceeded. (i.e., gauges, down-hole devices, weak links).

When specified in the Contract Documents, a weak link or breakaway connector shall be used to prevent excess pulling force from damaging the pipelines, conduits, cable, or ducts.

The pipelines, conduits, cable, or ducts shall be inspected for damage, when visible, at excavation pits and when it exits the bore.

Any damage shall be repaired to the satisfaction of the Contract Administrator.

450.07.13 Pipelines, Conduits, Cable, or Ducts Testing

When required, pipelines, conduits, cable, or ducts testing shall be as specified in the Contract Documents.

450.07.14 Record Keeping

Verification record requirements of the alignment and depth of the installed pipelines, conduits, cable, or ducts shall be as specified in the Contract Documents. A copy of the verification records shall be given to the Contract Administrator at the completion of the HDD operations.

450.07.15 Closed Circuit Television (CCTV) Inspection

When required by the Contract Documents, a CCTV inspection shall be according to OPSS 409.

450.07.16 Site Restoration

When required, site restoration shall be according to OPSS 492.

450.07.17 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

450.07.18 Tracer Wire

Proper techniques shall be applied to safely pull all tracer wires during the drilling operation. Welding a hook to connect the tracer wires on to the pull head shall be required.

450.09 MEASUREMENT FOR PAYMENT

450.09.01 Actual Measurement

450.09.01.01 Pipelines, Conduits, Cable, or Ducts Installation by HDD

Measurement for a pipelines, conduits, cable, or ducts installation shall be by length, in metres, along the centreline of the useable pipelines, conduits, cable, or ducts between final connection points or work completed. No additional payment shall be made for end pieces to achieve the design elevation.

450.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

450.10 BASIS OF PAYMENT

450.10.01 Pipelines, Conduits, Cable, or Ducts Installation by HDD, *"Diameter, Material, and Use of Pipelines, Conduits, Cable, or Ducts,"* - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work.

Appendix 450-A, November 2021
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

The designer should include the following in the Contract Documents:

- Grade and alignment tolerances. (450.03)

- Subject to the scope of operations, the designer may wish to specify in the Contract Documents a more detailed work plan prior to the commencement of work, particularly for multiple pipe installations, multiple Day projects, congested work areas, or environmentally sensitive sites. (450.04)

- Consideration should be given to adjusting the submission timeline to be shorter or longer, as needed. When deciding, consider including provisions for time required by the Contract Administrator for reviewing the submission and providing feedback to the Contractor in a timely fashion, prior to commencement of pipe bursting operations. (450.04.01)

- Disposal of excess drill fluids. (450.04.01)

- Contingency plan. (450.04.01)

- The designer should give careful consideration, in consultation with the pipe manufacturer, to ensure the installed pipe is suitable to resist all installation and long-term in-service loads, the design shall specify the minimum pipe and fitting type, class, size, maximum bend radius, and safe tensile load. (450.05.02)

- To ensure successful continuity of at least one tracer wire, post installation, consideration should be given towards the type and number of tracer wires to account for the various forces that the tracer wires may be subjected to (including, but not limited to bursted pipe fragments, over burden materials, etc.). (450.05.03)

- Guidance system. (450.06.01.03)

- The designer should specify the following elements in the Contract Documents: the minimum horizontal and vertical clearances to existing facilities; and the number of exposures required to monitor the work progress. (450.07.03)

- The designer should specify the trenching, backfilling, and compacting requirements for entry and exit points or other locations along the bore, if different than the requirements in OPSS 401. (450.07.05)

- The designer may consider special provisions for backfilling and compacting, including the consideration of unshrinkable backfill to ensure proper compaction in critical locations. (450.07.05)

- The designer should specify the support systems requirements, if different than the requirements in OPSS 404. (450.07.06)

- The designer should provide the necessary grade, alignment, and tolerances for the pipelines, conduits, cable, or ducts installation in the Contract Documents. (450.07.10)

- The designer may consider a lower reaming diameter than that specified if the ground conditions are suitable. The designer should understand that multiple passes of the reaming operation can be expected and is to be included in the unit cost for the pipelines, conduits, cable, or ducts installation. (450.07.11)

- The designer should specify the method of verifying the pipelines, conduits, cable, or ducts installation location. The designer may consider the use of the reporting information available from the drill rig, daylighting, installation of tracer wire with the pipelines, conduits, cable, or ducts, or the use of acoustic/magnetic locating equipment. The designer should consider specifying the required maintenance, submission of a daily drill records, drilling fluid pressures, records of any problems encountered, along with alignment and depth of bore. (450.07.12)

- The designer should review pipelines, conduits, cable, or ducts-jointing specifications as provided by manufacturers. Experienced personnel with jointing accreditation may be added as a requirement of the Contract Documents depending on the type of installation. For fusible pipe pipelines, conduits, cable, or ductss, the pipe should be completely jointed prior to the pull back operation to avoid delays during installation. All pipe jointing shall be to manufacturer specifications. (450.07.12.01)

- The designer should specify the supply and installation of the tracer wire with the pipelines, conduits, cable, or ducts. (450.07.12.01)

- When required, the designer should specify the use of a pipe load measuring device to ensure that the manufacturer's recommended pullback force is not exceeded. (450.07.12.02)

- For certain pipelines, conduits, cable, or ducts installations, the designer may wish to consider the requirement of a weak link or breakaway connector or pull load measuring system to prevent excess pulling force from damaging the pipelines, conduits, cable, or ducts. (450.07.12.02)

- The designer may consider specifying physical pipelines, conduits, cable, or ducts testing through the use of pipelines, conduits, cable, or ducts coupons from the exit pit. In addition, in situ pressure or vacuum tests can be used to ensure the integrity of the pipelines, conduits, cable, or ducts installation. (450.07.13)

- Record keeping. (450.07.14)

- CCTV. (450.07. 15)

- The designer's careful preparation of the project should greatly assist in the success of the installation. However, there may always be a risk of encountering unexpected problems that may require a fair resolution for payment. It is recommended that the designer consider a process regarding payment for failed attempts for inclusion in the Contract Documents. (450.10)

- The tender item description for pipelines, conduits, cable, or ducts installation by HDD shall include reference to one or more of the attributes shown (i.e., diameter of pipelines, conduits, cable, or ducts, pipelines, conduits, cable, or ducts material, use of pipelines, conduits, cable, or ducts, to be complete). (450.10.01)

The specification was written to encompass the majority of HDD drilling operations for small and medium sized projects with diameters generally up to 914 mm and drill lengths of less than 1,000 m. The basic design considerations should always include: minimum cover to prevent inadvertent drill fluid frac out releases; geology of the area, including future river "scour" or meander projections; site logistics; connection requirements; and site-specific issues (e.g., river crossings, wet lands, and archaeological sites).

Geotechnical and site condition information are required for a successful project design, and to ensure that the Contractor has the proper equipment and materials (i.e., drilling fluid mixtures, methods, or equipment), and pipe design.

The principal safety concern in HDD is ensuring that the drilling equipment does not contact existing underground infrastructure. The risk of contacting other Utilities can be mitigated by knowing the precise locations of all underground Utilities in close proximity to the HDD bore path. Detailed knowledge of all subsurface Utility locations is a critical component of a directional drilling project, and this information should be included in the Tender Documents.

Throughout the commentary, the designer is provided with guidance on the consideration of Quality Assurance and Quality Control (QA/QC) techniques. However, it should be noted that evolving technology and techniques for improved QA/QC are in development and the designer should refer to trade publications to identify the latest available methods. In all cases, the designer should specify the quality assurance acceptance criteria to be used for each specific project.

Related Ontario Provincial Standard Drawings

No information provided here.