



**Australasian Society for Trenchless
Technology
Specification for Microtunneling and Pipe
Jacking**

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|------------|---|---------------|----------------|-----------------|-------------------|-------------|
| 2 | Minor changes | JP | JP | JP | JP | 1 June 2015 |
| 1 | General Revisions | JC | MI | NH | JP | 03 Feb 2010 |
| 0 | Issued for Use – Client Comments Incorporated | JC | MB | NH | JP | 08 Sep 2009 |
| Rev | Description | Author | Checked | Approved | Authorised | Date |

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1.0 BACKGROUND

The Australasian Society Trenchless Technology (ASTT) has developed this Specification for assisting industry users in Australia and New Zealand in utilising Microtunnelling and Pipe Jacking.

This document does not replace any existing relevant manuals or standards. It remains the users responsibility to ensure that all relevant laws, standards and specifications are adhered to during the course of a Works with use of Microtunnelling and Pipe Jacking.

Additional Microtunnelling and Pipe Jacking information can be obtain from the ASTT website (www.astt.com.au), they are:

- Guideline for (Horizontal Directional Drilling, Pipe Bursting, Microtunnelling and Pipe Jacking);
- Standard for Microtunnelling and Pipe Jacking;
- National Utility Contractors Association Trenchless Assessment Guide - a web-based tool that can be used for identifying trenchless construction methods suitable for a particular set of Works attributes (i.e.: diameter, length, depth, geological conditions, etc.).

2.0 DEFINITIONS

A number of abbreviations and technical terms have been used in this specification:

ASTT - Australasian Society for Trenchless Technology.

Clients - Person or company requiring the Works to be undertaken.

CCTV - Closed Circuit Television - The use of video cameras to visually inspect the installation. Often used where manual entry is not feasible or possible.

Contingency Plan - A plan for backup procedures, emergency response, and post-disaster recovery.

Contractor - Person or company undertaking the Works required.

Intermediate Jacking Stations - A fabricated steel cylinder fitted with hydraulic jacks that is incorporated into a pipeline between two pipe segments. Its function is to distribute the jacking load over the pipe string on long drives.

MT - Microtunnelling. Method for installing an underground service conduit to a high accuracy directly behind the Microtunnelling machine, which is guided by a laser. The common range of pipe diameters are from 600mm to 1200mm.

MTBM - Microtunnelling Boring Machine. Mechanized excavating equipment that is remotely operated, steerable, connected to and thrust forward by the jacking system.

NUCA TAG - National Utility Contractors Association Trenchless Assessment Guide.

Operator - Suitably trained or qualified person who operates machinery, an instrument, or other equipment.

Pipe Jacking - Method for installing pipe that serves as initial construction lining and tunnel support, installed for stability and safety during construction. Pipe is thrust forward (jacked) as the tunnel is advanced.

PTMT – Pilot Tube Microtunnelling. A MT method that involves drilling a pilot bore prior to tunnel excavation.

Specification - A document that specifies, in a complete, verifiable manner, the requirements, design, behaviour, or other characteristics of a system, component, product, result, or service and, often, the procedures for determining whether these provisions have been satisfied.

Standard - A document that provides uniform technical criteria, methods and processes to established a norm.

Works - The project or task to be completed by the Contractor on behalf of the Client.

3.0 SPECIFICATION FORMAT

The format of this specification has been deliberately formatted to one that would typically be used in a TT project specific scope of works and specification. This has been done for the purpose of ease of use by TT industry users.

4.0 SUBMITTAL

The Contractor shall submit documentation and tenders in accordance with this specification's SUBMITTAL and GENERAL REQUIREMENTS.

- (i) Documentation detailing the training and relevant experience of the Contractors personnel shall be submitted to the Client which includes all personnel that would be undertaking the work. All Contractor's personnel are required to be fully trained in their respective duties and in the safety of operating any equipment that will be utilised during the course of the Works. Please refer to DRT03 (Training Package for the Drilling Industry)¹ and or BCC03 Civil Construction Industry Training Package² for relevant competency standards and qualifications.

Prior to letting the Contract, the Client should ensure:

- (ii) That a comprehensive geotechnical investigation is carried out and available at the time of tender.

¹ Australian Drilling Industry Training Committee www.aditc.com.au

² Construction Industry Training Board www.constructionskills.com.au.

5.0 MICROTUNNELLING METHODOLOGY (AND PIPE JACKING?)

Prior to commencing any work, the Contractor shall submit a clear and detailed work statement for the execution of the trenchless pipe installation to the Client, which shall include but is not limited to the following:

- Safety Management Plan,
- Risks management plan,
- Traffic Management Plan, and public relations management plan
- Quality management Plan,
- Environmental management plan and plans for the allocation of noise pollution problems,
- Calculation of thrust forces and distribution of the forces during each drive should be submitted together with the location of any intermediate jacking stations.
- General description of the construction method, sequence of operations and type of face support,
- Type of new pipe product proposed (pipe specifications) and methods of connections used,
- Manufacturer and type of tunnelling equipment and related operating system proposed and capability of equipment chosen,
- Type of lighting and ventilation system used for the entry and exit shafts,
- Location of existing underground utility services and proposed special precautions or relocation if required,
- Ground monitoring equipment and methods,
- Confirmation that the MTBM shall be capable of achieving the tolerances in line and level as specified,
- Type relevant specification of grout
- Calculation of size, depth and location of access shaft required, face support and work sites layout,
- Dewatering, flow bypass, field final product testing and CCTV inspections frequency (to be agreed with the Client),
- Location of access shafts, face support and work sites layout,
- Method of spoil transportation from face, temporary spoil, nature of haulage equipment, and disposal location,
- Programmed daily work hours and duration for the operation,
- Specialist subcontractors utilised applicable competency training records of personnel,
- Details of soil re-conditioning,(for rehabilitation?)
- Details of concrete inner lining and the methods for testing and jointing.

5.1 Microtunnelled Installation of Pipe

The Contractor shall furnish all labour, plant, material, tools and equipment required to complete the Works.

The Contractor shall establish, file and maintain up to date records that demonstrate that the contractor's quality management system is being effectively implemented.

The Contractor shall follow the recommended pipe installation procedure illustrated detailed below:

(a) Pipe Installation

- (i) Pipes used for Microtunnelling are specialised. They shall be capable of withstanding all forces on them before, during and after the installation. All pipes must be able to withstand an axial compressive loading greater than the jacking load anticipated on the Works.
- (ii) For rigid jacking pipes (concrete, Vitrified Clay and polycrete) the driving ends of the pipe and intermediate points must be protected against damage that could occur during the jacking process. The detailed method proposed to cushion and distribute the jacking force at the joint is subject to approval by the Client, However the method used to protect the joint should not impair the joints ability to close or fully seal in any way. Any pipe showing signs of failure during the installation process may be required to be jacked through to the reception (exit) shaft and removed.
- (iii) The pipe manufacturer shall be designated at the time of the tender. Any subsequent change of pipe manufacturer must be approved by the Client in writing. The Contractor shall provide a record of experience and product type information at the time of tendering.
- (iv) The Contractor shall transport, handle and store the pipes and fittings in accordance with the manufacturer's recommendations at all times. Materials that are damaged or lost shall be repaired or replaced by the Contractor at no additional cost to the Client.

(b) Drawing and Calculations

- (v) All construction drawings and design calculations used during the construction shall return to the client marked up and revised to "As-Built" status. Marks up shall include the following but not limited to the new pipe alignment, access chamber, pipe joints, and lateral service connections.

5.2 Settlement and Monitoring

- (i) The Contractor shall take all care and necessary precautions to protect existing structures, utilities and services in planning and execution of the Works. All potential affected work area shall be visually inspected to document condition prior to any work being caused by all or conducted. Any damage to adjacent properties part of this work shall be repaired and resorted to its original condition at the Contractor's expense.

- (ii) The Contractor shall be responsible for the identification and protection of services where these are crossed by construction activities.
- (iii) The Client shall be notified immediately of all services encountered during the progress of the Works. The services shall be marked on the "As-Built" drawings by the Contractor.
- (iv) Where crossing of roadways and railways are involved, the Contractor shall be required to measure, record and report any ground settlement to the satisfaction of the criteria set in the tender documents.
- (v) Where utilities and pipelines are involved, the Contractor shall monitor ground settlement directly above, and 3m before and after, the utility or pipeline intersection.
- (vi) The Contractor shall ensure surface or ground monitoring points are recorded on centreline ahead of tunnelling operations at a minimum of 30m intervals or at least three locations per tunnel drive.
- (vii) The Contractor shall ensure surface settlement monitoring readings are taken prior to active excavation reaching that point, when the tunnel face reaches the monitoring point, and when the zone of active excavation has passed and no further movement is detected.
- (viii) The Contractor shall agree operation procedures with the client when monitoring points observe or indicate any surface disruption during installation period. The Contractor shall propose immediate action for review and approval by the Client to remedy the problem.

5.3 Performance Requirements

- (i) The Contractor shall provide proof of certification by the MT and PJ equipment manufacturer of the energy consumption, condition, and operational characteristics of all equipment to be used for installing the specified pipe.
- (ii) The Contractor shall provide details of all Bentonite injection operations where to be used as a lubricant during the jacking operations.
- (iii) Dewatering shall not be permitted for microtunneling, but, if required localised dewatering may be permitted for construction of access shafts and to allow launching and recovery of MTBM.
- (iv) The Contractor shall ensure the pipes are jacked into place in accordance with the manufacture spec without damaging the pipe joints or the completed pipe section.
- (v) The Contractor shall ensure that the MT equipment employs a form of spoil removal system.
- (vi) The Contractor shall ensure that the guidance system is laser controlled and monitored by the operator at all times. All functions of the system shall be monitored and transmitted to the remote operations console. The minimum information available to the operator on the consoles shall include rate of advance length of conduit installed, thrust force, deviation from line and grade, role, inclination and valve positions. This should also include Gyro control system for long curves drives.

- (vii) The Contractor shall ensure that the tunnel shield is articulated and manoeuvred by steering jacks or other approved method to enable accurate control of line and gradient.
- (viii) The performance of the machine shall also define how obstructions (such as timber or boulders) will be dealt with.
- (ix) The Contractor shall ensure that the equipment has the capability of limiting the jacking force applied to the pipe or tunnel shield so as not to exceed the manufactures recommended compressive loads for the pipe. This should also be included for the performance requirements of any intermediate jacking station.
- (x) The Contractor shall ensure that a lubrication system is provided that injects an approved lubricant at the rear of the tunnelling shield to minimize the friction developed on the exterior of the pipe during jacking.
- (xi) The Contractor shall ensure that all groundwater pressure encountered during the excavation of the tunnel be balanced by the tunnelling machine.
- (xii) The Contractor shall ensure that a slurry MT tunnelling system uses a minimum volume of water in the slurry system as per the manufactures specification.
- (xiii) The Contractor shall ensure that the tunnelling shield be capable of keeping drift and rotation or roll to a minimum in accordance with the e limits specified by the manufacturer.

5.4 Entry and Exit Shafts

The Contractor shall take all necessary action to ensure the safety of the work and shall ensure compliance with the pre-approved Safety Management Plan requirements at all times.

The sizes of all excavations shall conform with the following requirements:

- (i) Shafts shall be of the minimum size commensurate with safe working practices and located at the maintenance holes. The Contractor shall select the size and provide the design of all shafts.
- (ii) Every face of any excavation that exceeds a depth of 1.5 m shall be supported or contained by shoring unless the face is cut back to a safe slope.
- (iii) The shoring of the excavation shall be braced as the excavation progresses and where a mechanical digger is used, the shoring is to be kept as close as practicable to the excavator.
- (iv) All necessary measures must be taken to ensure that excavations are left in a safe condition, including the erection of suitable hard barricades, warning signs and hazard lights.
- (v) The earthworks shall be set out in accordance with the design.
- (vi) The Contractor shall inspect the site, and verify all existing levels, survey control points and set out points shown on the drawings, before commencing the earthworks.

- (vii) All excavations shall be made to the depth and extent as shown on the Drawings with proper allowance for fill, additional cover where required and formwork. The excavations shall be kept free and clear of loose materials, water and rubbish. Should excavation to the nominated depth reveal unstable or unsuitable ground, the Contractor shall immediately notify the Client.
- (viii) Thrust wall configuration, softeye arrangement and arrangements when the same shaft is used for the directional Jacking Operation.

5.5 Grade and Alignment Tolerances

- (i) Tolerances in the gradient and alignment of the final lining shall comply with the Client's specifications.
- (ii) The overcut diameter shall not exceed the outside pipe diameter by more than 2% or 30mm whichever is the smaller, unless agreed by prior approval in writing from the Client.
- (iii) The Contractor should measure and record the exact position of the MTBM, TBM or shield after each shove to ensure alignment is within the specified tolerances. The Contractor shall make immediate corrections to alignment before allowable tolerances are exceeded if a mis-alignment is recorded.
- (iv) The Contractor shall require to measure and record survey control for the tunnel against an above-ground undisturbed reference at least once for each 7.5m of tunnel constructed.

5.6 Obstructions and Loss of Ground

After satisfactory complete installation of installation of MT&PJ the new pipe and removal of all equipment and excavated materials for the operations, the Contractor shall conduct inspection outlined as follow.

- (i) If a stoppage in the forward progress of the Works is encountered, the cause of the stoppage shall be determined by the Contractor. When the cause has been identified, the installation method shall be modified to the satisfaction of the client to best suit the actual conditions encountered.
- (ii) Should appreciable loss of ground occur during the microtunnelling operation, the voids shall be backfilled with soil promptly as far as practicable Where the soil is not suitable for this purpose, the Contractor shall import suitable materials.

5.7 Pipe or Tunnel Testing and Inspection

After satisfactory completion of the installation of the new pipe and removal of all equipments and excavated materials for the tunnelling operations, the Contractor shall conduct inspection outlined in the tender documents and or as follows:.

- (i) Where the pipe is of sufficiently large diameter to allow man access, during the course of the installation the Contractor shall periodically perform internal inspections of the pipe or tunnel. The frequency of internal inspections shall be agreed with the Client prior to the start of installation.
- (ii) Testing of individual pipe joints shall be applied to the appropriate methods (in compliance with ASTM C828, ASTM C1103, ASTM C969, BS5911) to complete the testing requirements. Other methods relating to pipe joints testing with liner shall also be presented if required.
- (iii) Hydrostatic pressure testing and CCTV inspection for pipe shall be used to complete the necessary test requirements.
- (iv) Further testing may be required to ensure the pipeline is leak proof, based on manufacturer provided material properties. If sewer pipeline is installed, the testing shall be as recommended in the following standards(EN160,EPA)
- (v) All test records shall be provided to the Client as part of the "As-Built" documentation.

5.8 Closing of Shaft

After satisfactory completion of all testing and removal of all equipment and excavated materials, the Contractor shall prepare the bottom of all pits to the same specification as required by the rest of the pipeline. The Contractor shall remove all loose and disturbed materials below pipe grade to the undisturbed earth level and shall re-compact the materials to the agreed specification.

5.9 Quality Control and Assurance

- (i) The Contractor shall submit a description of the method and frequency of survey control that will be utilised (e.g. Daily tunnel log).
- (ii) The Contractor shall maintain a record of "As-Built" drawings and other data in accordance with the General Conditions of Contract, this Specification and the Approved Scope of Works, throughout the duration of the contract.
- (iii) The Client reserves the right to reasonable access to the Contractor's facilities and Quality Assurance records for the purposes of Quality Assurance Audit and inspection throughout the contract period.
- (iv) The Contractor's Quality Management System shall be subject to formal audits as required by the Client.
- (v) The Contractor's Quality Management System shall define the method for performing its own internal audits.

6.0 GENERAL REQUIREMENTS

6.1 Environmental Impact Assessment

- (i) The Contractor shall undertake all Works in accordance with the appropriate local environmental requirements.
- (ii) Prior to commencing any earthworks or excavation operations, the Contractor is obtain an "Excavation Permit" from the Client and to identify the location of underground installations (i.e. gas, sewer, water, fuel, electrical and communications cabling) in the area. If required, the Contractor shall obtain all approvals require from external agencies e.g. local councils, State Road Authorities, and other affecting controlling agencies. The Contractor shall take all measures necessary to ensure that all such installations are protected from damage or displacement during the course of the work.
- (iii) The Contractor shall obtain a "Gain Access approval", and be responsible for clearing any construction spillage, waste and debris from the appropriate local Regulator.

6.2 Geotechnical Data Report

- (i) The contractor shall ensure that the geotechnical data report (GDR) provided is sufficient to complete the work. Additional geotechnical investigation maybe requested by the contractor if it is deemed that the provide GDR is insufficient. In detailed to complete the work without under risk to the project.

6.3 Traffic Control Management Plan

- (i) The Contractor shall undertake works in accordance with requirements of an approved Traffic Management Plan, (per the provisions of AS 1742 - Manual of Uniform Traffic Control Devices) and any additional requirements of the local and state authority.
- (ii) The Contractor shall ensure that access is maintained for public and construction traffic. Traffic shall be isolated from construction traffic wherever practicable. In areas where access for public traffic cannot be separated from construction traffic, appropriate traffic measures shall be cleared identify in the Traffic Management Plan.
- (iii) The Traffic Management Plan shall clearly identify what traffic control devices shall be implemented for the duration of the work. All traffic control devices shall be kept in good order to ensure visibility and reflectivity is maximised for both day and night traffic.
- (iv) Any by-pass roads, detours and other temporary works proposed should be clearly identified in the Traffic Management Plan. Details of the proposed temporary works shall be provided to the Client and other relevant traffic authorities for approval prior to the start of the Works.

- (v) Pursuant to these requirements, a traffic management diagram shall be provided to parties nominated by the Client for distribution and display on all safety notice boards. This diagram shall be updated to display the current conditions at all times.
- (vi) Traffic management actions implemented on site shall be inspected daily or at greater frequency as required to ensure they are maintained in accordance with the plans. A register of traffic management actions shall be maintained to reflect inspections and maintenance undertaken.
- (vii) The Contractor shall provide a public relationship management plan.

6.4 Safe Work Practice

- (i) Toolbox meetings (toolbox meeting) shall be conducted before the commencement of daily works and a written record of attendance (and safety topic) will be submitted to the Client.
- (ii) The Contractor shall undertake the Work in accordance with appropriate safety requirements by local, state and federal regulations. Safety measures shall include but not be limited to personal protective equipments, operating of machinery within job site, storage & transport of materials and equipments.

7.0 CONTINGENCY PLANNING

The Contractor shall prepare a contingency plan specific to the site of operation.

The plan should address, but not be limited to the following:

- (i) General procedures and labour issue for the duration of the project
- (ii) Labour issues
- (iii) Equipment requirements on the basis of duty and standby
- (iv) Time considerations
- (v) Clean up and monitoring ground movement methods
- (vi) Client and regulatory contact(contact details for the clients and any local regulator bodies that may affected by the project)
- (vii) Disposal plans
- (viii) General Public Relations requirements

8.0 MEASUREMENT AND PAYMENTS

Payment shall be based on the Contract Schedule and paid in accordance with the contracted terms and conditions.

All work necessary to complete the Works, including but not limited to shafts, manholes, dewatering, connections, and similar items are considered subsidiary to the bid items. Payment will be made based on the bid items complete and in place.

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