

**AMENDMENTS TO OPSS 415 (FEB 90) –
CONSTRUCTION SPECIFICATION FOR TUNNELLING**

OPSS 415.06.01 is amended by adding the following to the beginning of the clause:

Any equipment used in the work shall be operated in a manner satisfactory to the Commissioner and in accordance with the City of Toronto Noise-By-law. The Contractor shall at his own cost and expense make modifications to his equipment as deemed necessary by the Commissioner.

OPSS 415.09.01.01 is superseded by:

Measurement will be in metres along the centre line of the tunnel from inside face to inside face of maintenance holes or chambers or from the end of the tunnel where no maintenance holes or chamber is installed. The measurement will not include the distance through any structure including maintenance holes and chambers.



**ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION**

**METRIC
OPSS 415
FEBRUARY 1990**

**CONSTRUCTION SPECIFICATION FOR
TUNNELLING**

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415.01 SCOPE

This specification covers the requirements for tunnel construction.

415.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction:

OPSS 517 Dewatering

Ontario Provincial Standard Specifications, Material:

OPSS 1004 Aggregates - Miscellaneous
OPSS 1350 Concrete (Materials and Production)
OPSS 1440 Steel Reinforcement for Concrete

Canadian Standards Association:

CAN/CSA-A5-M88 - Portland Cement

415.03 DEFINITIONS

For the purpose of this specification the following definition applies.

Rock: means natural beds or massive fragments, of the hard, stable, cemented part of the earth's crust, igneous, metamorphic, of sedimentary in origin, which may or may not be weathered.

415.04 SUBMISSION AND DESIGN REQUIREMENTS

The Contractor shall submit primary liner design details to the Engineer for review at least two weeks prior to commencing work where the primary liner design is not specified in the contract.

A written agreement regarding the disposal site setting out the terms, conditions and ultimate responsibility for the materials as placed, shall be obtained from the property owner and submitted to the Engineer.

415.05 MATERIALS

415.05.01 Concrete

Concrete shall conform to OPSS 1350 and the minimum compressive strength shall be 25 MPa.

415.05.02 Concrete Reinforcement

Steel reinforcing for concrete work shall conform to OPSS 1440.

415.05.03 Timber

Timber shall be sound, straight, free from cracks, shakes and large or loose knots.

415.05.04 Cement Grout

Grout shall consist of a mixture of one part Portland cement conforming to the requirements of CAN/CSA-A5-M and two parts mortar sand conforming to OPSS 1004 wetted with only sufficient water to make the mixture plastic.

415.05.05 Primary Liner

The primary liner shall be as specified in the Contract.

415.05.06 Rock Bolts

Rock bolts and nuts shall be manufactured from steel having a minimum tensile strength of 700 MPa. Rock bolts shall have a minimum diameter of 15 mm and a length adequate for the conditions encountered, shall have clean, well lubricated threads and shall be supplied with a nut, hardened round washer, expansion shell and a steel bolt plate not less than 100 mm x 100 mm by 6 mm in size.

415.06 EQUIPMENT

415.06.01 General

The Contractor shall ensure that all hoisting and compressed air equipment as required is installed and ready for operation before commencing tunnelling operations.

Shafts and tunnels are to be provided with electric lights of a sufficient number to ensure proper work and inspection.

415.06.02 Use of Compressed Air

Complete compressing equipment and air locks shall be provided as required to supply and control air pressure in tunnels.

Electrically driven compressors with stand-by diesel or gas driven equipment shall be provided.

Stand-by equipment for low pressure air shall be arranged so that equipment will start automatically in case of failure of the electric power supply.

Compressing equipment shall be installed in a weatherproof building insulated against sound transmission.

Compressors shall be provided that are equipped with silencers and receivers on the intake and exhaust lines.

415.07 CONSTRUCTION

415.07.01 General

The location of tunnels shall be established by the Contractor from the lines and elevations as indicated on the contract drawings.

Labour, instruments and materials shall be provided for setting out all reference points necessary to construct the tunnel and appurtenances.

The Engineer shall be provided with assistance and access necessary to check the layout of the tunnel and associated appurtenances.

415.07.02 Alignment Holes

Alignment holes shall be in place near each bend with at least one hole in a straight section between bends and at any other locations specified.

Alignment holes shall be located at the time of construction.

Alignment holes may be used for other purpose after their primary purpose is fulfilled.

A 250 mm diameter steel casing shall be place in a drilled hole over the centreline of the tunnel and used for alignment.

Casings shall be set vertically and provided with a removable steel cover plate.

After the tunnel section is completed, the casings shall be removed to the depth specified and any opening in the tunnel wall filled with concrete. The remainder of the casing and the hole shall be filled as specified in the contract.

Provision shall be made by the contractor for controlling alignment in the case of tunnels constructed under compressed air.

415.07.03 Construction Shafts

Construction shafts shall be provided at locations specified or as approved by the Engineer.

Shafts shall be maintained in a drained condition.

A 3.5 m high close boarded fence shall be installed around the perimeter of the working area with gates and truck entrances at the shafts and the fence shall be removed on completion of the work.

415.07.04 Stability of Excavation

The Contractor shall employ such construction methods, plant, procedures and precautions that will ensure that excavations are stable, free from disturbance and maintained in a drained condition.

Such construction methods may include, but are not limited to tight timber and/or steel primary liner; ground water control systems employing well points, deep wells, educators, or compressed air; free water control

systems employing drains, pipes and pumps, and soil stabilization methods employing cement grouting, chemical grouting or chemical freezing.

The Contractor shall employ such construction methods, plant and materials that will prevent the migration of soil material into tunnels or shafts from adjacent ground.

415.07.05 Tunnelling

The method of tunnelling selected by the Contractor shall be reviewed with the Engineer prior to commencement of the work.

A competent superintendent, experienced in the construction of tunnels, shall supervise the work at all times.

The tunnelling method shall be modified as needed due to changing conditions which may be encountered during the progress of the work.

The tunnel is to be kept sufficiently dry at all times to permit work to be performed in a safe and satisfactory manner.

415.07.06 Dewatering

Dewatering shall conform to OPSS 517.

415.07.07 Excavated Materials

Satisfactory re-usable excavated material shall be separated from unsuitable excavated material.

415.07.08 Disposal of Materials

Unsuitable or surplus material shall be disposed off site.

Excavated material which cannot be incorporated into the work shall be disposed as specified. If the Authority cannot make use of the unwanted excavated material, arrangements for disposal sites shall be made by the Contractor.

The disposal site shall be kept stable and materials shall be dumped in a manner not to cause nuisance, injury or inconvenience until the property owner assumes responsibility under the terms of the agreement referred to in Section 415.04.

415.07.09 Primary Lining

The primary lining shall be designed to support all soil and hydrostatic pressures and to withstand any additional loads caused by grouting or jacking thrusts.

The primary liner shall be installed so that the exterior is as tight as possible to the excavated surface of the tunnel and allows the placement of the full design thickness of the secondary lining.

All voids between the primary lining and the surface of the excavation shall be filled with grout as the primary lining is placed. If a continuous liner is used, the space outside the liner plates shall be grouted at least daily.

Tunnels excavated in sound rock shall be supported in a manner that prevents scaling and unravelling of the rock and also protects from weathering or deterioration.

Where a tunnel is excavated in unstable rock the Contractor shall supply and install rock bolts or equivalent acceptable to the Engineer. The rock bolts shall be of such length and spacing that they safely sustain the tunnel crown and walls to the satisfaction of the Engineer. Rock bolts complete with hardened round washers and bolt plates shall be installed as soon as possible after the surface to be supported has been exposed and the rock has been scaled down.

415.07.10 Secondary Lining

A secondary lining of air-entrained concrete to the strength and dimensions specified shall be provided.

415.07.11 Mixing Grout

Grout shall be mixed in a mechanical mixer capable of maintaining a continuous supply of grout.

Grout shall not be left in the mixer for more than 30 minutes.

415.07.12 Placing Grout

The space outside the finished secondary liner shall be pressure grouted. Pumps for grouting shall be capable of supplying grout at a pressure of 1 MPa.

Grout holes shall be provided in the locations and at the spacings specified.

Grouting shall be done through pipes a minimum of 40 mm in diameter or through holes drilled in the finished secondary liner. The pipes shall be set at the time of placement of the concrete for the secondary liner.

Grout shall not be placed until the lining has achieved 85% of its specified strength. Grouting shall be limited to such operating pressures, sequences and programs as are necessary to avoid damaging any part of the works or any other structure or property.

415.07.13 Wiring

Separate circuits shall be installed for each lighting and power purpose.

All wires shall be installed and securely supported in shafts in waterproof conduits.

All wiring and conduits in shafts and tunnels shall be removed as directed by the Engineer.

415.07.14 Approaching Closure

Caution shall be exercised when approaching a closure while operating under compressed air.

Air pressure shall be reduced to a safe limit when closure is approached.

415.09 MEASUREMENT FOR PAYMENT

415.09.01 Actual Measurement

415.09.01.01 Tunnel

Measurement will be in metres along the centre line of the tunnel from centre to centre of manholes or chambers or from the end of the tunnel where no manhole or chamber is installed.

415.09.01.02 Rock Excavation in Tunnelling

Measurement will be in cubic metres based on the neat lines of the tunnel as shown in the Contract.

415.09.02 Plan Quantity Measurement

415.09.02.01 Tunnel

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity, of the length in metres along the centre line of the tunnel from centre to centre of manholes or chambers or from the end of the tunnel where no manhole or chamber is installed.

415.09.02.02 Rock Excavation in Tunnelling

Measurement is by Plan Quantity, as may be revised by Adjusted Plan Quantity of the volume in cubic metres.

415.10 BASIS OF PAYMENT

**415.10.01 Tunnel - Item
 Rock Excavation in Tunnelling - Item**

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and material required to do the work.

The removal of boulders having a volume in excess of 0.5 cubic metres will be paid for as extra work.