# Construction Specification for Maintenance of Traffic

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TS 1.00.01 SCOPE

This specification covers the requirements for the construction and maintenance of the following:

1) Temporary traffic lanes.
2) Temporary access to private driveways and side streets.
3) Temporary pedestrian facilities (sidewalks) for the convenience of the public.
4) Temporary bicycle facilities.
5) Site fence, crowd control barrier or other barrier as specified in the Contract Documents to separate work areas from those used by the public.

TS 1.00.02 REFERENCES

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

City of Toronto Standard Specifications
- TS 310 Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving
- TS 501 Amendment to OPSS 501 – Construction Specification for Compacting
- TS 1150 Material Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving
- TS 1010 Amendment to OPSS. MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material

City of Toronto Standard Drawings
- T-216.02-12 Crowd Control Barrier

Ontario Provincial Standard Specifications
- OPSS 740 Construction Specifications for Concrete Barriers
- OPSS 1352 Material Specification for Precast Concrete Barriers

City of Toronto
- Police Service and Transportation Services Memorandum of Understanding: Guidelines for Road Occupancy Traffic Control

Ontario Ministry of Transportation
- Ontario Traffic Manual Book 7 Temporary Conditions

Society for Protective Coatings
- Paint 20 Zinc-Rich Coating (Type II - Organic)

TS 1.00.03 DEFINITIONS

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

Crushed Aggregate means pieces of aggregate having at least one well-defined face resulting from fracture. Particles with smooth faces and rounded edges, or with only small chips removed, are not considered crushed.

HL, Hot Mix, Mixture, Mix means hot mix, hot laid asphaltic concrete.
**HL Types** means the hot mixes specified in Table 1 of TS 1150.

**Transportation Services** means City’s Transportation Services division.

### TS 1.00.04 DESIGN AND SUBMISSION REQUIREMENTS

#### TS 1.00.04.01 Hot Mix Asphalt

All submission and design requirements for hot mix asphalt shall be as specified in TS 1150, except that trial batches will not be required.

### TS 1.00.05 MATERIALS

#### TS 1.00.05.01 HL-3F (Fine) Asphalt

All HL-3F (Fine) asphalt shall meet the materials specifications of TS 1150 and construction specifications of TS 310.

#### TS 1.00.05.02 HL-8 Asphalt

All HL-8 asphalt shall meet the materials specifications of TS 1150 and construction specifications of TS 310.

#### TS 1.00.05.03 Crushed Aggregate

All crushed aggregate shall be Granular A and shall be according to TS 1010.

#### TS 1.00.05.04 Site Fence

All site fences shall consist of steel ‘T’ posts, top wire and plastic fencing.

Steel ‘T’ posts shall be 50 x 50 x 2400 mm metal stakes primed with one brush coat of black zinc rich paint according to SSPC Paint 20.

The fencing shall be constructed of heavy duty, high visibility, orange plastic and shall be a minimum of 1.2 m high.

The top wire shall be stranded wire with a minimum diameter of 4.1 mm or 8 gauge.

#### TS 1.00.05.05 Crowd Control Barrier

Crowd control barriers shall be according to T-216.02-12, and the barriers should be similar in shape and size to those supplied by Mark-All Services Incorporated for their Type ‘B’ Crowd Control Barrier with smooth rounded corners (551 Piercey Road, Bolton, Ontario, L7E 5B5, 905-951-2700), or approved equivalent.

The crowd control barrier shall be painted in yellow and have a solid piece of reflective tape placed along the top rail. The reflective tape shall be a minimum 600 mm in length and shall be centred on the top rail.
**TS 1.00.05.06  Temporary Barrier**

All temporary barriers shall be of the type listed below:

1) Precast concrete barrier, with an I-Lock connection, meeting the requirements of OPSS 1352.

2) Triton barrier as manufactured by Energy Absorption Systems Inc. (One East Wacker Drive, Chicago, Illinois, 60601, 312-467-6750). The local supplier of Triton Barrier is Lecol Co. Ltd. (689 Warden Avenue, Units 15 & 16, Scarborough, Ontario, M1L 4R6, 416-694-4420) or approved equivalent.

**TS 1.00.06  EQUIPMENT – Not Used**

**TS 1.00.07  CONSTRUCTION**

**TS 1.00.07.01  General**

The Contractor shall at all times carry on the work in a manner that will create the least interference with the traffic consistent with the faithful performance of the work. The Contractor shall not close the road or provide any detour except with the written approval of the Contract Administrator in conjunction with the representative from Transportation Services. The Contractor shall at its own expense provide for the safe passage and control of traffic by supplying, placing, maintaining, changing, and removing such barricades, signs, lights, and Traffic Control Persons (TCPs) as are required for the proper notification and protection of the public approaching or passing through any part of the Working Area and all devices so used shall be according to the Ontario Traffic Manual, Book 7 – Temporary Conditions and all aspects of the Work shall be according to the *Occupational Health and Safety Act*.

Where, with the approval of the Contract Administrator, the road is closed and traffic is diverted entirely off the road to any other public roads, the Contractor shall, at its own expense, supply and erect barricades, lights and such other protection as may reasonably be required by the Contract Administrator at all points where traffic might enter on that portion of the road so closed to traffic. The Contractor, when required by the Contract Administrator, shall supply traffic control personnel, to protect the barricades and direct traffic at each end of the portion or portions of the roadway closed to the traffic.

If, at any time, the Contractor fails to provide for the safe passage and control of traffic on any existing road or detour as prescribed in this specification, and if the Contractor fails to correct forthwith such as unsatisfactory condition upon being so directed in writing, the Contract Administrator may immediately correct the unsatisfactory condition and take such other action as they deems necessary for the safe passage and control of traffic. The City may deduct from any monies due or to become due to the Contractor, on any account, any cost or expense incurred by the City.

Failure to act on the part of the Contract Administrator under this subsection shall not relieve the Contractor from its responsibilities under this Contract.

The Contractor shall co-ordinate the removal and reinstallation of any existing parking meters, traffic control signs or signals, and other roadside furniture with Transportation Services.

The Contractor shall restore all parking meters, traffic control signs or signals, and other roadside furniture damaged by construction to the satisfaction of the Contractor Administrator and Transportation Services. All restoration is to be done at the expense of the Contractor.
Wherever roadway plates are required, they must be saw cut in, flush with the road surface, ramped with HL-3 hot mix asphalt and skid resistant. All concrete, asphalt and contaminated aggregate, used for temporary construction and in traffic maintenance, shall be excavated and disposed of off the site. All material deemed reusable, by the Contract Administrator, shall be graded into and compacted to form part of the roadway subbase or other temporary work. No additional payment will be made for the rehandling, reuse or disposal of this material.

All temporary construction and temporary traffic maintenance shall be carried out to the satisfaction of the Contract Administrator and in accordance with the temporary traffic management plan conforming to the requirements of Ontario Traffic Manual and Ontario Manual of Uniform Traffic Control Devices. The Contract Administrator will give written notification of any deficiencies, and the Contractor shall initiate repairs within 24-hours.

The City reserves the right to contract with others to complete any repairs that have not been initiated within 24-hours of written notification. All repair costs, including all overhead and office costs incurred in the remedial actions will be deducted from the final payment to the Contractor.

**TS 1.00.07.02 Site Meetings**

Regular site meetings will be held every week or every two weeks, or as required by the Contract Administrator, to discuss traffic management and progress of work. Attendance will be required by at least one representative from the Contractor.

The Contractor shall be responsible for the following:

1) Coordinating and organizing attendance of subcontractors responsible for any work to be discussed as part of the agenda.

2) Informing the Contract Administrator, in advance of the meeting, of all items to be added to the agenda.

3) Ensuring that the Contractor representatives in attendance have the required authority to commit the Contractor to actions agreed upon.

**TS 1.00.07.03 Temporary Traffic Lanes**

At least two paved lanes of a minimum width of 3.05 m each including placing temporary pavement markings shall be kept open to traffic at all times during construction. Where additional width is available, it shall be used to provide wider curb lanes. Any portions of such lanes which, in the opinion of the Contract Administrator, are required outside the edge of the existing pavement shall consist of 75 mm of HL-8 hot mix asphalt over a 225 mm thickness of Granular A, compacted to meet the requirements of TS 501.

Prior to the placing of the stone and asphalt layers, selected excavated material from either roadway or sewer excavations shall be used to fill ditches or other low areas and shall be compacted to 100% of maximum dry density.
Wherever possible, all temporary walkways, sidewalk, bus stops, pedestrian, wheel chair, bicycle and vehicular accessibility ramps shall be maintained at all times, including the provision of suitable, clean areas for bus stops. At temporary bus stops, a flat and adequately drained platform consisting of HL-3F (Fine) to 75 mm compacted thickness shall be placed on top of a 100 mm compacted thickness of Granular A base for pedestrian use. In addition, a safe walkway must be maintained between the temporary bus stop and any adjacent sidewalk.

**TS 1.00.07.04 Side Streets**

The Contractor shall maintain two-way traffic on side streets wherever possible. If necessary and subject to the approval of the City, traffic on side streets may be reduced to one lane for a limited period of time. If the side street is to be reduced to one lane, a qualified Traffic Control Person (TCP) must be present on site from the time of lane reduction until the side street is open to two-way traffic.

**TS 1.00.07.05 Private Driveways**

The Contractor shall maintain access to driveways wherever possible. Driveways greater than 6 m in width shall have access maintained at all times. Construction shall be scheduled to allow temporary access to either half of the driveway. Such temporary access shall consist of a layer of well compacted Granular A placed to a minimum thickness of 150 mm and a minimum width of 3 m, or as specified in the Contract Documents.

**TS 1.00.07.06 Temporary Sidewalks and Bus Stops**

The Contractor shall provide and maintain safe and convenient facilities for pedestrian traffic through the areas under construction. These facilities shall provide for a dry, hard and even surface at all time. Such temporary sidewalks shall have a minimum width of 2.5 m, and consist of a layer of well compacted Granular A placed to a minimum thickness of 100 mm, and a layer of well compacted smooth HL-3F (Fine) surface placed on top to a minimum compacted thickness of 75 mm. A minimum vertical clearance of 2.5 m shall be provided.

Wheelchair access shall be maintained at all times.

All pedestrian traffic shall be separated from the construction area by means of a temporary site fence or pedestrian control barrier. If the erection of a temporary site fence or pedestrian control barrier is not feasible, the Contractor shall seek approval from the City to use traffic control barrels (TC 54).

The Contractor shall provide sufficient signs to direct pedestrians around all sidewalk detours.

**TS 1.00.07.07 Bicycle Facilities**

The Contractor shall provide and maintain safe and convenient facilities for bicycle traffic through the area under construction. Where a bicycle lane or bicycle path exists within the work area, temporary facilities shall be provided. Such temporary bicycle facilities shall consist of a layer of well compacted, Granular A placed to a minimum thickness of 100 mm, a layer of well compacted smooth HL-3F (Fine) surface placed on top to a minimum thickness of 75 mm, and a minimum width of 1.5 m for one way traffic and a minimum width of 2.5 m for two way traffic. A minimum vertical clearance of 2.5 m shall be provided.

Cyclists shall be directed to follow a detour, or use pedestrian facilities after dismounting, as required. All information with regard to the use of bicycle facilities shall be supplied and maintained by the Contractor.
**TS 1.00.07.08  Site Fence**

The Contractor shall supply and maintain a continuous site fence to separate the travelled portion of the road or pedestrian area from the area under construction if the requirement for site fence is specified in Contract Documents.

Fence posts shall be spaced at a maximum of 3 m apart. Sleeves shall be placed in the concrete base on the first half of the pavement to be constructed, so that the posts are clear of the excavation for the second half. The site fence shall be removed following the completion of the road base and the sleeves shall be filled with concrete of the same type as used for the construction of the concrete road base. The construction area shall then be isolated from the public sections by the use of approved delineators, as specified in the Ontario Traffic Manual, Book 7 – Temporary Conditions.

The Contractor may, subject to the approval of the City, substitute approved delineators as specified in the Ontario Traffic Manual, Book 7 – Temporary Conditions for the site fence.

The top wire shall be threaded through the top portion of the fence, every three or fewer holes and drawn taut by machine. The top wire shall not be tightened by hand. The top wire shall be securely fastened to each post using standard tie wire. Every 100 mm or at every corner or break in the fence, the top wire of the fence shall be fastened to the bottom of the next post at every 100 mm intervals, or at every break in the fence to provide stability.

**TS 1.00.07.09  Crowd Control Barriers**

All costs associated with the requirements for crowd control barrier throughout the duration of the Contract for any reason shall be borne by the Contractor.

Crowd control barriers shall be placed between the construction areas and the pedestrian traffic. The triangular base shall be facing the construction area to minimize any obstructions to the pedestrian traffic.

Adjacent sections shall be connected at all times and pulled taut to form a continuous unbroken chain. Sections at the ends of each chain shall be secured to a section of site fence or a solid structure, such as a pole or sign. Crowd control barriers shall prevent pedestrian traffic from gaining access to the construction area.

Construction areas shall be completely isolated from pedestrian traffic at all times.

For contracts with multiple staging, the Contractor may be required to relocate the barrier sections from one stage to the next. The Contractor may also be required to relocate sections of the crowd control barrier on a daily basis to facilitate construction access or to temporarily increase the work area. The cost of relocation of crowd control barrier between stages throughout the contract is included as part of the item for staging requirements unless a separate pay item is provided in the Contract Documents for the relocation of crowd control barrier.

**TS 1.00.07.10  Temporary Barrier**

Temporary barriers shall be placed between the construction areas and the vehicular traffic, as specified on the Contract Drawings. Triton barriers require a “clear zone”, as specified by the manufacturer, between the construction area and the vehicular traffic.
Preparation of the base, if necessary, shall be according to OPSS 740, except that the slope of the foundation for the Triton Barrier shall not exceed 5 per cent when measured perpendicular to the barrier.

Supplying, placing, relocation and removal of the temporary concrete barriers shall be according to OPSS 740.

End treatments for temporary concrete barrier shall be as specified in the Contract Documents.

The supply, placing, relocation and removal of the Triton Barrier shall be according to the manufacturer’s Triton Barrier Application Manual.

**TS 1.00.07.11 Traffic Control**

**TS 1.00.07.11.01 Traffic Control Plan**

The Contractor shall at its own expense, develop Traffic Control Plans as stipulated in the Ontario Traffic Manual, Book 7 – Temporary Conditions. The Traffic Control Plan will include detours, staging sequences, vehicle access and egress from worksite, temporary barriers, and removal of old pavement markings for complex projects. For minor projects, the Contractor may select the appropriate typical layouts from the Ontario Traffic Manual Book 7.

The Contract Administrator or the Transportation Services representative or both, shall review the Traffic Control Plan. Any changes to the Traffic Control Plan shall be agreed upon by the Contract Administrator or the Transportation Services representative or both.

**TS 1.00.07.11.02 Traffic Protection Plan**

The Contractor shall at its own expense, develop Traffic Protection Plans for the protection of workers in the work zone, as required under the *Occupational Health and Safety Act* and *Regulations for Construction Projects* Ontario Regulation 213/91 and 145/00. The Traffic Protection Plan shall conform to the requirements of all pertinent acts and regulations. The Contractor shall submit the Traffic Protection Plan to the City for record before the construction begins. All traffic protection measures shall be carried out to the satisfaction of the Contract Administrator and in accordance with the Traffic Protection Plan submitted.

**TS 1.00.07.11.03 Traffic Control Persons and Traffic Control Devices**

City Council on November 29, 30 and December 1, 2011 approved with amendments to the new City of Toronto Police Service and Transportation Services Memorandum of Understanding: Guidelines for Road Occupancy and Traffic Control as outlined in Appendix A to the report dated October 11, 2011 from Transportation Services to City Council. According to the new Memorandum of Understanding, Transportation Services has authority over the issuance of permits and the determination of traffic control required for permitted activities, including all scheduled maintenance and construction work on all City roads. The Toronto Police Service, in conjunction with Transportation Services Road Inspectors / Municipal Construction Inspectors, enforces this authority on behalf of Transportation Services.
TS 1.00.07.11.04  Police Officer for Traffic Control

TS 1.00.07.11.04.01  General

All costs associated with the requirements for a police officer for traffic control throughout the Contract for any reason shall be borne by the Contractor.

In addition to complying with the Ontario Traffic Manual, Book 7 – Temporary Conditions, the Contractor is required to provide a police officer for traffic control on site in accordance with the requirements of the Memorandum of Understanding: Guidelines for Road Occupancy Traffic Control as stipulated in Table 1 – Deployment of Traffic Control in Road Construction Activities, as amended from time to time in TS 1.00.07.11.04.02.

The Ministry of Labour is the governing agency responsible for the safety of workers and the public. The Toronto Police Service, as part of their responsibility as the employer, is required to provide the training for, the equipping of, and ensuring the use by members of personal protective equipment.

TS 1.00.07.11.04.02  Traffic Control Requirements

The following criteria outline the requirements for police officers as stated in the Memorandum of Understanding: Guidelines for Road Occupancy Traffic Control.

Table 1: Deployment of traffic control in road construction activities

<table>
<thead>
<tr>
<th>Conditions under which traffic control may be required</th>
<th>Normal regulatory posted speed 60 km/h or lower, one lane or reduced to one lane</th>
<th>Normal regulatory posted speed 70 km/h to 90 km/h, one lane or reduced to one lane</th>
<th>Any speed, more than one lane in each direction</th>
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<tr>
<td>to protect workers on public way</td>
<td>Traffic Control Persons (TCP) can be used</td>
<td>TCP can be used</td>
<td>Police presence is required</td>
</tr>
<tr>
<td>to protect construction vehicles crossing roadway</td>
<td>TCP can be used</td>
<td>TCP can direct construction traffic only, not public traffic</td>
<td>Police presence is required</td>
</tr>
<tr>
<td>to protect construction vehicles entering a roadway</td>
<td>TCP can be used</td>
<td>TCP can direct construction traffic only, not public traffic</td>
<td>Police presence is required</td>
</tr>
<tr>
<td>electrical contractor work on traffic control signals</td>
<td></td>
<td></td>
<td>Police presence is required</td>
</tr>
<tr>
<td>construction, surface maintenance, utilities, Toronto Water</td>
<td>Follow Ontario Traffic Manual Book 7 – Table 6 – Deployment of Traffic Control Persons (TCP). If the TCP conditions are not met, then police presence is required.</td>
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Note 1: Table 1 is a modified version of OTM Book 7 – Table 6: Deployment of Traffic Control Persons (TCP) that takes into consideration City of Toronto Operational Guidelines.

Note 3: If conditions under Ontario Traffic Manual Book 7 – Table 6 – Deployment of Traffic Control Persons (TCP) are satisfied, the TCP(s) must be positioned in a manner which will not conflict with the traffic control device operation. If this is not possible, police presence is required.

Note 4: For City of Toronto employees, contractors, and sub-contractors, traffic control work is performed in compliance with the provisions of: The City’s Traffic Control policy and its guidelines; the Regulations for Construction Projects (sections 67-69, 104-106, and 186-187); the Ontario Traffic Manual for Temporary Conditions (OTM Book 7 and Field Edition); and the Handbook for Construction Traffic Control Persons.

Note 5: In reviewing traffic control measures related to road construction activities, Transportation Services, Toronto Police Services and the applicant must ensure that the safety of all road users is preserved.

The above guidelines does not preclude the need for a site meeting to discuss traffic safety related issues, hours of work and so forth with the Transportation Services and Toronto Police Service representative and other agencies.

**TS 1.00.07.11.04.03  Road Emergency Service**

In the event of road emergency services that have to be performed by City staff, City contractors or other utilities, and which the assistance from Toronto Police Service is required for traffic control, on-duty officers should be requested through a phone call to the Toronto Police Service Communication Centre at 416-808-2222.

Road emergency service is deemed to be any unscheduled maintenance where:

- Public safety or health is threatened
- Immediate action is required
- The public is without essential service.

Examples of road emergencies include sewer or watermain breaks, electrical failure and leaking of gas from the distribution system.

At any road emergency work site, a representative of the affected work (utility) must respond to the site as soon as possible to assess the situation, determine the necessary repairs and establish time frames required to complete the repairs. Police officers will document any instance where a representative of the affected work fails to attend the location within 1.5 hours of the call being received by the Toronto Police Service and forward this information to the Unit Commander of Traffic Services.

Where a road emergency has occurred which, through its circumstances and conditions requires that the ensuing traffic control be provided by a police officer, this traffic control shall be provided by an on-duty officer until the emergency has passed.

If the emergency resolution will be lengthy and on-duty officers are required for other service duties, then staff of Transportation Services, Toronto Police and the associated contractor will collectively determine which subsequent traffic control can be provided by means other than an on-duty police officer.
All Other Emergencies:

In the event of any other type of emergency which presents an immediate danger to the health or safety of any person, including the failure of buildings or parts of buildings, due to events such as fires, explosions, circumstances resulting in the collapse of buildings or otherwise, and which results in the need for traffic control, the required traffic control shall be provided by on-duty police officers for the duration of the emergency.

Where the City division(s) having jurisdiction over and managing the emergency determine(s) that the emergency has passed in that the immediate danger to the health or safety of persons is removed and that restoration of the site can be initiated, said division(s) in conjunction with Toronto Police Service shall determine if continued traffic control is required, and if so, whether the continued traffic control should reasonably be provided by on-duty police officers or transferred to paid duty officers.

TS 1.00.07.11.04.04  Scheduled Maintenance and Construction Work

Traffic control for all scheduled or regular maintenance activities shall be determined by Transportation Services staff, in consultation with Toronto Police Services and the applicant and the nature of the traffic control will be specified in the appropriate road occupancy permit.

The Contractor is responsible for providing traffic control at a permitted road occupancy, as required in the conditions specified in the activity permit.

A Transportation Services representative, in consultation with the Toronto Police Construction Liaison Officer, will determine the nature of traffic control and if there is a need for police officers for all other activities on City roads.

Where the permitted road occupancy creates a disruption to the rules of the road, appropriate traffic control should be established to ensure that the safety of all road users is maintained for the extent of the road occupancy, based on the criteria in Table 1.

The Contractor shall at its own expense, provide, place in service, maintain and remove all of the traffic control devices and Traffic Control Persons as required by the Ontario Traffic Manual, Book 7 – Temporary Conditions, and according to the Occupational Health and Safety Act and Regulations for Construction Projects Ontario Regulation 145/00 and shall conform to the Traffic Control Plan. The Contractor shall ensure that sufficient traffic control devices and Traffic Control Persons are always readily available to meet all the traffic control requirements on site. No claims will be considered for Contractor’s loss due to the unavailability of Traffic Control Persons and any traffic control devices.

Traffic Control Persons should be considered to control locations with a single lane of one-way traffic flow. A Traffic Control Person can also control pedestrian movements off the travelled portion of the roadway. A Traffic Control Person can also control pedestrian movements at a signalized intersection if the signal indications are clearly visible and the Traffic Control Person is not required to stop traffic. If more than one lane or direction of traffic flow is to be controlled or stopped, then a police officer will be required according to the Ontario Traffic Manual, Book 7 – Temporary Conditions.

In addition, the Contractor shall, at its own expense, provide, place in service and maintain and remove special construction signs, where appropriate, to advise of rough surface, raised maintenance covers, timber decking, steel plates, narrow lanes and detours for motor vehicles, bicycles, and pedestrians on all approaches to and within the areas under construction.
A static barrier, for example, crowd control barrier may be acceptable to close crosswalks at a signalized intersection depending on the pedestrian and vehicle volumes. Yellow 'Caution Tape' is not recognized as an acceptable barrier.

The maintenance of all signs, barricades and other traffic control devices is a 24 hours a day 7 days a week obligation. The Contractor must provide a contact person that will be available at all times, throughout the duration of the project.

The Contract Administrator will issue a verbal or a written warning or both to the Contractor when the Contractor is found failing to protect the site according to Ontario Traffic Manual, Book 7 – Temporary Conditions. Upon receipt of the warning, the Contractor shall rectify all traffic control deficiencies to the satisfaction of the Contract Administrator without delay.

All scheduled maintenance and construction requests will be staffed with appropriate traffic control requirements. All paid duties required under this specification shall be arranged through the Central Paid Duty Office. The Contractor is responsible for providing police officers, as required, on all City projects and capital projects.

Police officer shall ensure the Contractor produces a valid permit, issued by the City, for the required work and that the Contractor works within the parameters outlined in the permit prior to any work being commenced.

A filled out Paid Duty Request Form shall be faxed, along with a valid road cut permit issued by the City, to the Central Paid Duty Office 416-808-5042. Calls for further assistance can be directed to the Central Paid Duty Office 416-808-7880. In certain circumstances, a request for Paid Duty Police Officer can be made in person at any Division.

If Paid Duty Officers are determined to be the required traffic control, these officers shall be arranged through the Central Paid Duty Office by faxing your request to 416-808-5042. If further assistance is required, the Central Paid Duty Office at 416-808-7880 should be contacted.

A Paid Duty Request Form can be obtained from any police station or the Toronto Police Central Paid Duty Office at 416-808-7880. The form and the current hourly rates of police officer for traffic control pay, which are provided in the terms of agreement at the back of the form, are updated once every January of the year. To download the Paid Duty Request Form, visit www.torontopolice.on.ca/paidduty/.

**TS 1.00.07.11.04.05 Determining the Actual Need for Police Officer for Traffic Control**

The need for police officers for construction and maintenance (utility cut permit related) work on City roads generally follows the criteria in TS 1.00.07.11.04.02, herein, and has to be determined on a case-by-case basis. The Transportation Services representative shall determine the actual need for police officer according to site conditions and in consultation with the Contract Administrator, the Contractor and the Toronto Police Traffic Services Construction Liaison Officer 416-808-1952.

The actual need for police officer for traffic control shall be determined at the pre-construction meeting and site meetings. Transportation Services representatives and the Toronto Police Traffic Service Construction Liaison Officer shall be invited to the pre-construction and site meetings. It is at their discretion to decide if they will attend the meeting.

City Contract Administrators and inspectors shall monitor the use of police officers for traffic control at the site and intervene whenever the presence of police officer for traffic control is deemed necessary or not warranted based on the conditions specified in this specification.
TS 1.00.07.11.04.06  Transportation Services Representatives

The Contractor is required to contact the respective work zone traffic coordinator in your work area to determine the need for a police officer for traffic control and on any other aspect of the road emergency that requires immediate action.

TS 1.00.07.11.04.07  Disputing the Need for a Police Officer on Site

Should a dispute arise between police officers on patrol with regards to the need for traffic control at a construction site, a Traffic Services Construction Liaison Officer and a representative of Transportation Services, shall consult to determine if additional traffic control measures are required at the site. No claims for delay, resulting from these matters, will be considered by the City.

TS 1.00.07.11.04.08  Work Instructions to Police Officer

In addition to the brief description of police officer for traffic control duties provided by a Contractor in a Paid Duty Request Form, the Contractor shall provide the police officer for traffic control with detailed written work instructions. The instructions shall be related to the specific site and handed to the police officer for traffic control at the time of his/her arrival to the site.

TS 1.00.07.11.04.09  Change and Cancellation

The Contractor shall notify the Central Paid Duty Office immediately about any change, cancellation, or a need for additional police officer for traffic control. Any changes or cancellations shall be made according to the Terms of Agreement.

Toronto Police Service requires a minimum cancellation time of 12 hours prior to the scheduled start time. Failure to give sufficient notification will result in Contractor paying a minimum payment of three hours per police officer, along with all associated fees and taxes.

A police officer's maximum working period is 12 hours in a 24 hour period. The Contractor shall make bookings of additional police officer for traffic control in a timely manner, when necessary.

TS 1.00.07.11.04.10  Reimbursing Police Officer for Traffic Control

The Contractor shall be responsible to pay the Toronto Police Service for services provided by the police officer for traffic control according to the Terms of Agreement, based upon the hourly wage rate in effect at the time.

The Contractor shall record police officer's names, badge numbers and hours of work and provide the Contract Administrators and City inspectors with a summary sheet outlining the events of police officer arrangement and copies of corresponding invoices.

TS 1.00.07.11.04.11  Relocating Legally Parked Vehicles and Parking Enforcement

The procedure to relocate legally parked vehicles due to construction activities shall be discussed at the pre-construction meeting. The Contractor shall follow the Toronto Police Service procedure entitled Procedure for Construction Companies Relocating Legally Parked Vehicles to relocate legally parked vehicles in the construction zone.
Legally parked vehicles may be relocated to accommodate construction using one of the six Toronto Police Service contract towing companies provided in the Toronto Police Service procedure. The Contractor shall assume the towing costs.

The relocation will only be carried out in the presence of either a parking enforcement officer or the police officer working with the Contractor that day. The police officer must be present to record the vehicle’s information. The vehicles relocated from one legal parking location will be relocated to another legal location nearby.

Parking enforcement can be requested by calling either Parking Enforcement East in the east end of the city at 416-808-6600 or Parking Enforcement West in the west end of the city at 416-808-1600.

**TS 1.00.07.11.05 Mass Transit**

The Contractor shall coordinate all staging with any transit commission, for example TTC and GO, school or tour group, that may have a bus stop or travel within the construction limits. Special attention shall be given to loading and unloading areas for disabled persons and school buses.

The Contractor shall provide access to all existing bus stops. The relocation and reinstatement of the bus stops shall be performed by the Contractor, under the direction of the transit authority or the City.

All costs associated with relocating and providing temporary bus stops shall be borne by the Contractor, except for any temporary ramps or accesses which will be paid for under the appropriate items.

There will be no additional payment for any delays caused by the Contractor having to stage his work around the transit commissions.

**TS 1.00.07.12 Maintenance of Temporary Work**

Until the final course of asphalt and the permanent pavement markings have been placed, the travelled portion of the road shall be considered as temporary traffic lanes.

Temporary traffic lanes shall be maintained so that there are no irregularities exceeding 40 mm. All crosswalks shall be ramped using temporary HL-3F (Fine) asphalt to provide smooth transitions between the base asphalt and the top surface of the crosswalk. Utility frames and covers, valve boxes and so on shall be ramped with hot mix asphalt or covered over with a steel plate or maintained flush with the surface of the asphalt. After final adjustment to finish grade, the appurtenances shall be ramped as described above. Prior to the placement of the final course of hot mix asphalt, the ramps must be removed without disturbing the base to allow the final course asphalt to be placed to its full depth.

The cost of any necessary patching of temporary traffic lanes or regarding of temporary access to driveways and side streets or regarding of temporary sidewalks or bicycle facilities shall be paid for at the Contract Price for stone and asphalt under the general heading "Maintenance of Traffic". If no such items exist, no separate payment will be made and all costs associated with this temporary work shall be factored into other related pay items.

Should the Contractor fail to correct any unsatisfactory condition upon notification from the City staff to do so, the City may proceed to maintain the project and deduct the entire cost of such maintenance from monies due to the Contractor.
TS 1.00.07.13  Maintenance of Temporary Accesses

The Contractor shall provide safe, convenient and free of obstacles temporary vehicular, wheelchair and pedestrian access to driveways, sidewalks, storefronts, bicycle facilities, bus stops, bus shelters and other public amenities in and around the area of construction at all time during construction.

The Contractor shall at all times, keep all temporary traffic lanes, sidewalks, foot paths, pedestrian ramps, entrances and exits to buildings and facilities free from accumulation of dust, waste materials and rubbish due to its employees or the work.

The Contractor shall keep all temporary access ways free from accumulation of free standing pools of water or oily surface, snow or ice formations, and to warn users of the access ways to beware of slippery conditions. The Contractor shall apply salt and sand to the access ways when there is an accumulation of snow and ice on the ground.

Cleaning up, to the satisfaction of the Contract Administrator shall be a mandatory condition to the final acceptance of the Work.

Should the Contractor fail to maintain or, in the opinion of the Contract Administrator, not expedient to maintain the temporary accesses to the satisfaction of the City, the City may, notwithstanding section GC 4.06, GC 4.07 and GC 4.08 of the City of Toronto General Conditions of Contract, take the appropriate action to remove the obstacles and deduct the total costs of such action from the monies due to the Contractor.

TS 1.00.08  QUALITY ASSURANCE

City staff shall conduct inspections, as required, and the Contractor shall be notified of any deficiency in writing. Repairs shall be carried out according to TS 1.00.07, herein.

TS 1.00.09  MEASUREMENT FOR PAYMENT

TS 1.00.09.01  Granular A for Maintenance of Traffic
   HL-3F (Fine) Asphalt for Maintenance of Traffic
   HL-8 Asphalt for Maintenance of Traffic

Measurement for the above item(s) shall be by mass in tonne (t).

TS 1.00.09.02  Site Fence

Measurement of site fence shall be by length in metres (m) of site fence required to be in place at any one time during the life of the Contract.

TS 1.00.09.03  Relocate Site Fence

Measurement of relocate site fence shall be by length in metres (m).

TS 1.00.09.04  Crowd Control Barrier

Measurement of crowd control barrier shall be by length in metres (m) for the maximum number of barrier sections required to be in place at any one time during the life of the Contract.
TS 1.00.09.05  Relocate Crowd Control Barrier
Measurement of relocate crowd control barrier shall be by length in metres (m).

TS 1.00.09.06  Temporary Precast Concrete Barrier
Temporary Triton Barrier
Measurement for the above item(s) shall be by length in metres (m) of the maximum length of barrier required to be in place at any one time during the life of the Contract.

TS 1.00.09.07  Relocate Temporary Precast Concrete Barrier
Relocate Temporary Triton Barrier
Measurement for the above item(s) shall be by length in metres (m).

TS 1.00.09.08  Traffic Control
Measurement for the above item shall be by lump sum. Contractors shall determine the lump sum amount and submit the amount in their bids.

TS 1.00.10  BASIS OF PAYMENT

TS 1.00.10.01  General
The following items may or may not appear in the Contract Documents. If these items do not appear, then the cost of temporary work required under this specification should be factored into other pay items by the Contractor.

No separate payment shall be made for the provision of temporary drainage works. Payment for this work shall be deemed to be included in the unit prices bid for the other items.

No additional payment will be made for any rehandling required incorporating any reusable material into the final or temporary works.

No additional payment will be made for the replacement of any item that has become damaged as a result of the Contractor’s actions or by any other means.

TS 1.00.10.02  Granular A for Maintenance of Traffic – Item
HL-3F (Fine) for Maintenance of Traffic – Item
HL-8 for Maintenance of Traffic – Item
Payment at the Contract Price for the above tender item(s) shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include the supply, placing and compacting of granular materials and hot mix asphalt to construct road detours and temporary ramps, the removal, placing and compacting of all reusable materials and any excavation required for the construction of all detours.

The removal of all temporary asphalt and contaminated aggregate, by whatever means, shall be paid for under the item "General Excavation".
TS 1.00.10.03  Site Fence – 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. Payment shall include the supply, erection, maintenance and removal of all site fence and the preparations to the concrete road base, if required.

TS 1.00.10.04  Relocate Site Fence – 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. Payment shall include the relocation of all site fences.

TS 1.00.10.05  Crowd Control Barrier – 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. Payment shall include the supply, erection, maintenance, and removal of all crowd control barriers.

TS 1.00.10.06  Relocate Crowd Control Barrier – 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. Payment shall include the relocation of all crowd control barriers.

TS 1.00.10.07  Temporary Precast Concrete Barrier – Item
Temporary Triton Barrier – Item
Payment at the Contract Price for the above tender item(s) shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include the supplying, placing, maintenance, relocation and removal of all temporary concrete barriers, including tapered end treatments. All other end treatments will be paid for under the appropriate item(s).

TS 1.00.10.08  Relocate Temporary Precast Concrete Barrier – Item
Relocate Temporary Triton Barrier – Item
Payment at the Contract Price for the above tender item(s) shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include the relocation of all temporary concrete barriers, including tapered end treatments. All other end treatments will be paid for under the appropriate item(s).

TS 1.00.10.09  Traffic Control – 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. Payment shall include the production of Traffic Control Plan, Traffic Protection Plan, all costs associated with the supply of police officers, traffic control persons, the supply, placing, maintenance and removal of all signs, barricades and other traffic control devices that are not covered in other pay items of the contract.
The Contractor shall provide support documents to the Contract Administrator on the use of police officers and the supply of various traffic control measures related to the contract, including, but not limited to, the invoices charged to the Contractor by the Toronto Police Service. The City will only pay the invoices and other traffic control related charges that are proved to be actually provided in the contract. Payment shall be evenly distributed over the duration of the contract.
Construction Specification for Cold Milling of Asphalt Pavement

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**TS 3.15.01  SCOPE**

This specification covers the requirements for removing all or portions of existing asphalt pavement to a specified depth and the removal and disposal of the milled asphalt materials.

**TS 3.15.02  REFERENCES**

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

**City of Toronto Standard Specifications**

TS 3.20  Construction Specification for Tack Coating  
TS 310  Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving

**Ontario Provincial Standard Specifications**

OPSS 180  General Specification for the Management of Excess Materials

**TS 3.15.03  DEFINITIONS**

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

**Reclaimed Asphalt Pavement (RAP)** means the processed HMA material that is recovered by partial or full depth removal from milling operations.

**Excessive Grooving** means variation in milled surface in excess of 25 mm from high point to low point across width of surface milled by each pass of milling machine.

**TS 3.15.04  DESIGN AND SUBMISSION REQUIREMENTS – Not Used**

**TS 3.15.05  MATERIALS – Not Used**

**TS 3.15.06  EQUIPMENT**

The milling equipment shall be self-propelled machine, designed and built for, milling of bituminous pavements without the addition of heat. The equipment shall contain automatic grade and slope controls, capable of cold milling existing asphalt pavements to an accurate depth of cut, profile and cross slope and shall be capable of loading the milled materials directly into trucks.

The milling equipment shall be equipped with a spray-bar and water tank of sufficient size to provide thorough soaking of asphalt millings to reduce the quantity of air-borne dust and particulates. The spray-bar shall be in full working operation during actual milling.

Two high-capacity vacuum-type sweepers with 2 m pick-up heads and a minimum 225 m³/min air flow or approved equivalent meeting current standards and environmental requirements shall be used.

The machine shall be able to mill flush to all curbs and gutters, maintenance holes, catch basins and so on. The Contractor shall provide smaller milling machine if required to trim areas inaccessible to larger machine.
**TS 3.15.06.01 Cutting Operation**

The nature and condition of the equipment and the manner of performing the Work shall be such that the pavement is not torn, gouged, shoved, broken, sooted, oil-coated or otherwise damaged by the cutting operation.

**TS 3.15.07 CONSTRUCTION**

The locations to be milled shall be at all contract limits as shown on the Contract Drawings. The depth of removal shall be according to the Contract Documents.

Prior to milling operations the Contractor shall determine the location of any buried utilities or objects that may be damaged by milling operations. The onus of locating such structures and determining their susceptibility to damage by operations are the sole responsibility of the Contractor. The Contractor shall liaise with the relevant authorities to locate all underground utility services within the site of the works prior to commencement of milling operations.

If sub-surface utilities or structures are damaged by milling operations, the Contractor shall immediately notify the relevant authorities and arrange for the damage to be rectified to reinstate the utility or structure to preconstruction condition. All costs associated with such rectification works shall be at no extra cost to the City.

Milling shall not be performed when there is accumulation of snow or ice on the pavement surface.

Cold milling asphalt pavement shall be performed in a manner which prevents the tearing and breaking of underlying and adjacent pavement and the contamination of the RAP with granular, subgrade or deleterious materials. All RAP shall be loaded directly into trucks from the milling machine and hauled to stockpile or disposed of.

The milled roadway surface shall be swept clean and apply temporary pavement markings prior to opening to traffic. At locations including urban areas and bridge decks, the Contractor shall sweep the surface in a manner which minimizes dust.

Prior to covering the milled surface, the Contractor shall arrange to inspect the surface with the Contract Administrator prior to the removal of milling equipment from site.

The Contractor shall promptly repair any localized areas of distress in the milled surface that may present a hazard to traffic at no extra cost to the City.

If in the opinion of the Contract Administrator, the milled pavement contains material that is deemed unsuitable, that material shall be milled to a further depth. Additional payment shall be based on the quoted tender item rate of the works.

When the roadway is to be reopened to traffic after the daily shut down and full width pavement removal is required, the removal shall be done to essentially the same station for the full pavement width prior to the shutdown at the end of the day. Longitudinal differences in pavement elevations will not be permitted, as a result of milling operations.

Prior to reopening the milled pavement to traffic, the final milled lane shall have a transition such that the maximum lip between the milled run and the un-milled run does not exceed 10 mm. When a transition is not possible, the fall off in levels shall be ramped. Pavement transition may be omitted when vertical offset between milled surface and adjacent riding asphalt surface is less than 10 mm.
The remaining surface after milling shall have a constant and continuous crossfall matching the final surface course crossfall. The remaining surface after milling shall have an even texture, and shall be free of significantly different grooves and ridges in all directions.

The surface remaining after milling the surface irregularities out of the existing asphalt pavement such as to produce a smooth surface and, in some cases to cut the pavement down to predetermined grades and cross-fall.

The Contractor shall ensure that the line and grade of the roadway is checked during the milling operation.

Excessive grooving caused by cold milling will not be permitted.

Milled asphalt material shall not remain on the roadway after completion of the day’s operation.

When the milled material is to remain temporarily on the site due to construction operations, the material shall be temporarily placed on an asphalt or concrete surface until final removal. Milled asphalt materials which are different, due to the removal equipment used or pavement type, shall be placed in separate stockpiles.

All reclaimed asphalt pavement material shall become the property of the Contractor and shall be disposed of off the site, according to OPSS 180.

**TS 3.15.07.01** After the Milling Operation

Following the milling operation, the Contractor shall arrange for grade inspection with the Contract Administrator prior to paving with hot mix asphalt. The surface shall be tack-coated with SS-1 asphalt emulsion diluted with an equal volume of water according to TS 310 and TS 3.20. Then the Contractor shall expedite the hot mix asphalt paving.

**TS 3.15.08** QUALITY ASSURANCE – Not Used

**TS 3.15.09** MEASUREMENT FOR PAYMENT

**TS 3.15.09.01 Cold Milling of Asphalt Pavement**

Measurement of cold milling of asphalt pavement removed shall be by area, in square metres (m²).

If the Contractor is directed to remove more asphalt than the depth specified, payment will be prorated based on the maximum depth specified for the item.

**TS 3.15.10** BASIS OF PAYMENT

**TS 3.15.10.01 Cold Milling of Asphalt Pavement – 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. Payment shall include water for the milling of the asphalt, picking up, sweeping and cleaning up of all milling materials and the removal and disposal of the milling materials offsite and temporary pavement markings.
No additional payment shall be made for the removal of asphalt by hand work in areas inaccessible to a milling machine.
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TS 3.20.01  SCOPE

This specification covers the requirements for the placement and acceptance of tack coating.

TS 3.20.02  REFERENCES

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

Ontario Provincial Standard Specifications
OPSS 308  Construction Specification for Tack Coating and Joint Painting
OPSS 1103  Material Specification for Emulsified Asphalt

Ontario Ministry of Transportation Laboratory Testing Manual
LS-200  Penetration of Bituminous Materials
LS-216  Residue by Distillation

American Society of Testing and Materials
D 3665-07e1  Standard Practice for Random Sampling of Construction Materials

American Association of State Highway and Transportation Officials
T 40-02  Standard Method of Test for Sampling Bituminous Materials

TS 3.20.03  DEFINITIONS – Not Used

TS 3.20.04  DESIGN AND SUBMISSION REQUIREMENTS

At least 5 Days prior to the first use of tack coat on the Contract, the Contractor shall submit documentation to the Contract Administrator identifying the proposed supplier and applicator of the product. As part of this submission, the Contractor shall submit material safety data sheets and any other information for the safe handling and storage of the product.

TS 3.20.05  MATERIALS

Tack coating shall consist of SS-1 emulsified asphalt according to OPSS 1103.

TS 3.20.06  EQUIPMENT

The emulsion shall be applied evenly, by means of a pressure distributor which consists of a fully insulated tank permanently and rigidly mounted on a truck or trailer provided with pneumatic tires and propelled by a power unit capable of maintaining a constant and uniform speed.

The distributor shall be provided with the following minimum equipment requirements:

a)  Hand Hose: Proper hand hose attachments to uniformly apply the tack coat to any areas unavoidably missed by the distributor.

b)  Tachometer: An approved tachometer to enable the operator to maintain the necessary speed required to ensure the specified rate of application.
c) Power Unit: An independent, mechanically governed power unit for developing uniform pressures of from 140 to 345 kPa within the distributor tank or in the spray manifold. This unit shall include an accurate pressure gauge and a calibrated pressure pump equipped with a volume metering system. This system shall be capable of applying accurately measured quantities of bituminous materials at specified rates and pressures through the spray bars and nozzles.

d) Meter: The Contractor shall supply means acceptable to the City to measure the volume of tack coat placed in the work. The accuracy of the metering system shall be certified by the manufacturer and this certificate shall be made available to the City upon request. The metering system shall be accompanied by documentation confirming that it was calibrated within the past 12 months by the manufacturer or its authorized representative.

e) Spray Bar: Rear mounted spray bars and nozzles, set parallel to the surface to be sprayed and capable of vertical and lateral adjustment. The spray bars shall be capable of adjustment to provide a minimum spraying width of 2.5 m and a maximum spraying width of 7 m. The distributor shall be equipped with a spray bar heating device, circulating spray bars, or other suitable device to ensure a uniform viscosity and pressure of the bituminous material at each nozzle, both before and during spraying operations. Feed manifolds or spray bars shall be provided with strainers to prevent clogging of bars and nozzles. The spray bar height shall be adjusted and set at such a height that the spray fan from any nozzle overlaps the spray fan from the adjacent nozzle by 50 per cent. This adjustment shall be made and the height set when the distributor is one-half full, and shall be changed only when so permitted by the City.

f) Nozzles: Spray bar nozzles shall be so designed and set as to ensure a uniform fan-shaped spray without atomization, overlapping on the surface to be sprayed, such that a uniformly sprayed surface will result. Spraying to clearly defined edges of the sprayed lane with no tapering off of the rate of application adjacent to the edges of the lane will be required. All spray nozzles shall be of the same manufacture, size and type, and shall be provided with valves capable of instant full opening and positive cutoff. All spray nozzles shall be set in the bar so that the nozzle slots make the same horizontal angle (15° – 30°) with the longitudinal axis of the bar.

g) Sampling Cock: A sampling cock shall be provided on the spray bar or connecting line, and shall be readily accessible to allow field samples of the bituminous materials to be obtained directly from the distributor.

A hand sprayer may be used for small areas provided that, the sprayer meets the requirements of a) and c), listed above and that the emulsion shall be agitated by mechanical means to provide a homogeneous mixture. Units that rely on hand operated pumps to control the pressure will not be permitted.

TS 3.20.07 CONSTRUCTION

Surfaces to be tack coated shall be free of standing water and contamination, such as mud, dust, loose aggregate, or debris. All designated pavement surfaces which are to be covered with hot mix shall be coated with SS-1 asphalt emulsion diluted with an equal volume of water.

The asphalt base course or concrete base shall be swept clean with a power broom, or other approved equipment that shall leave a clean, dry surface, free of dust and other objectionable material.
The diluted SS-1 emulsion shall be applied to the surface immediately following the cleaning of the surface, at the rate of 0.35 kg/m². The tack coating shall form a thin, unbroken film on the asphalt base course or concrete base and be allowed to dry until it is in a proper condition of tackiness to receive the asphalt course. Tack coat shall be applied ahead of the paver to accommodate no more than two hours of production of the hot mix. Paving and construction equipment shall not be permitted onto the tack coat until it has broken and set. Hot mix asphalt shall not be placed on tack-coated areas until the tack coat has cured to a proper condition of tackiness. Traffic shall be prevented from travelling upon the tack coat. The tack coat shall be protected from damage until covered by the asphalt surface course.

Tack coat shall be applied to the following:

- protection board
- existing pavement surfaces including hot mix and Portland cement concrete
- milled pavement surfaces

**TS 3.20.08 QUALITY ASSURANCE**

Representative samples of material may be taken for conformance testing according to the requirements of OPSS 1103. Samples for quality assurance testing shall be representative of the material being used and shall be obtained at the paving site according to AASHTO T40 and ASTM D 3665. The minimum quantity of quality assurance samples shall be one litre.

The Contract Administrator shall determine the acceptability of the tack coating by visual inspection. Areas of insufficient or non-uniform tack coat coverage shall be re-sprayed by the Contractor at no extra cost to the City. Where tack coating is performed using hand-held devices, the visual appearance of such areas shall be consistent with the adjacent areas of machine applied material.

All visual defective materials or work shall be rejected by the Contract Administrator irrespective of any test results. Such defective material and work shall not be incorporated into the finish Work.

**TS 3.20.09 MEASUREMENT FOR PAYMENT**

**TS 3.20.09.01 Tack Coat**

Measurement of tack coat shall be by the area in square metres (m²).

**TS 3.20.10 BASIS OF PAYMENT**

**TS 3.20.10.01 Tack Coat**

Where there is no separate tender item for tack coat, payment for tack coat shall be included in the hot mix asphalt tender item.

If the application of the tack coat was necessitated through the fault of the Contractor as determined by the Contract Administrator, no payment shall be made for any labour, Equipment and Material or incidentals involved in the application of the tack coat.

Payment for tack coating completed in association with bridge deck waterproofing shall be deemed to be included in the bridge deck waterproofing item.
**TS 3.20.10.02  Tack Coat – Item**

Where there is a separate tender item for tack coat, payment at the Contract Price shall be full compensation for all labour, Equipment and Material to do the work.

If the application of the tack coat was necessitated through the fault of the Contractor, as determined by the Contract Administrator, no payment shall be made for any labour, Equipment, Material or incidentals involved in the application of the tack coat.
Construction Specification for
Hot Mix Asphalt Sidewalks, Boulevards and Driveways

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**TS 3.30.01 SCOPE**

This specification covers the requirements for the construction of asphalt sidewalks, driveways and boulevard on prepared base and for the resurfacing of existing sidewalks and boulevards.

**TS 3.30.02 REFERENCES**

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

**City of Toronto Standard Specifications**
- TS 2.10 Construction Specification for General Excavation
- TS 3.20 Construction Specification for Tack Coating
- TS 310 Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving
- TS 501 Amendment to OPSS 501 – Construction Specification for Compacting
- TS 1010 Amendment to OPSS.MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material
- TS 1150 Material Specification for Hot Mixed, Hot Laid Asphaltic Concrete

**Ontario Provincial Standard Specifications**
- OPSS 311 Construction Specification for Asphalt Sidewalk, Driveway, Boulevard and Sidewalk Resurfacing
- OPSS 510 Construction Specification for Removal
- OPSS 1103 Material Specification for Emulsified Asphalt

**TS 3.30.03 DEFINITIONS – Not Used**

**TS 3.30.04 DESIGN AND SUBMISSION REQUIREMENTS**

**TS 3.30.04.01 General**

At least 5 Working Days prior to the commencement of the asphalt paving work, the Contractor shall submit to the Contract Administrator the hot-mix asphalt mix designs for each type of hot-mix to be used. The submitted mix designs shall be according to TS 1150.

The hot-mix type(s) shall not be supplied to the Work until the mix designs have been approved by the Contract Administrator.

**TS 3.30.04.02 Material Safety Data Sheets**

At least 5 Working Days prior to starting the Work, the Contractor shall supply the Contract Administrator with Material Safety Data Sheets (MSDS) for all materials to be incorporated in the Work.

**TS 3.30.05 MATERIALS**

**TS 3.30.05.01 Hot Mix**

The hot-mix type(s) shall be specified in the Contract Documents and shall be according to TS 1150 for the specified application.
**TS 3.30.05.02  Asphalt Emulsion**

Asphalt emulsion shall be undiluted SS-1 emulsified asphalt. The SS-1 emulsified asphalt shall be according to OPSS 1103 and tack coat application shall be according to TS 3.20.

**TS 3.30.05.03  Granular Base**

Granular base material shall be specified in the Contract Documents and shall meet the requirements of TS 1010.

**TS 3.30.06  EQUIPMENT**

Equipment shall meet the requirements of section 311.06 of OPSS 311.

**TS 3.30.07  CONSTRUCTION**

Removal of existing driveways, sidewalks and sundry asphalt pavements shall be according to OPSS 510.

Excavation and subgrade preparation for the construction of asphalt driveways, sidewalks and boulevards shall be according to TS 2.10. The ground shall be excavated to the lines and grades shown on the Contract Drawings and shall have sufficient depth to allow for the placement of granular base and asphalt layers.

The granular base shall be constructed to the lines and grades shown on the contract drawings and shall be compacted according to TS 501.

The hot mix shall be placed on the prepared granular base according to section 311.07 of OPSS 311, except that the asphalt emulsion, used in resurfacing sidewalks, shall be according to TS 3.30.05.02, herein.

**TS 3.30.08  QUALITY ASSURANCE – Not Used**

**TS 3.30.09  MEASUREMENT FOR PAYMENT**

**TS 3.30.09.01 Asphalt Sidewalk  Asphalt Driveway  Asphalt Boulevard  Sidewalk Resurfacing**

Measurement shall be by area of the finished asphalt surface, in square metres (m²).

**TS 3.30.10  BASIS OF PAYMENT**

**TS 3.30.10.01 Asphalt Sidewalk – Item  Asphalt Driveway – Item  Asphalt Boulevard – Item  Sidewalk Resurfacing – Item**
Payment at the Contract Price for the above tender item(s) shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include the ground excavation and the supply, placing and compacting of the granular base and hot mix to the lines and grades shown on the contract drawings.

No deduction will be made for the excavation of material quantities where there is an overlap.
Construction Specification for
Concrete Sidewalk and Concrete Raised Median

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TS 3.70.01 SCOPE

This specification covers the requirements for the construction of plain or reinforced concrete sidewalks and concrete raised medians.

TS 3.70.02 REFERENCES

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

City of Toronto Standard Specifications
- TS 310 Construction Specification for Hot Mixed, Hot Laid, Asphalatic Concrete Paving
- TS 3.50 Construction Specification for Concrete Curb and Concrete Curb and Gutter
- TS 3.80 Construction Specification for Concrete Unit Pavers
- TS 3.85 Construction Specification for Coloured Impressed Concrete
- TS 4.50 Construction Specification for Utility Adjustments
- TS 501 Amendment to OPSS 501 – Construction Specification for Compacting
- TS 1010 Amendment to OPSS.MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Material
- TS 1350 Amendments to OPSS.MUNI 1350 – Material Specification for Concrete – Material and Production

City of Toronto Standard Drawings
- T-310.010-1 Location and Detail of Joints for Sidewalk
- T-310.010-5 Joints at Sidewalk Openings
- T-310.010-6 Construction Stamp Location for new Sidewalk Installation
- T-310.010-7 Detail of Sidewalk Stamp
- T-310.030-7 Signalized Intersection Configurations of Pedestrian Crossings
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- T-310.030-9 Location of Dropped Curbs at Controlled Intersections
- T-310.030-10 Tactile Walking Surface Indicator and Curb Ramp Detail
- T-310.030-11 Tactile Walking Surface Indicator and Depressed Curb Detail

Ontario Provincial Standard Specifications
- OPSS 180 General Specification for the Management of Excess Materials
- OPSS 919 Construction Specification for Formwork and Falsework

Canadian Standards Association
- A 23.1 Concrete Materials and Methods of Concrete Construction
- B 651-2012 Accessible Design for the Built Environment

American Society of Testing and Materials
- A 48 Standard Specification for Grey Iron Castings
- C 174 Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
- C 501-84 Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
- C 1028 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull – Meter Method
Ontario Provincial Legislation
O. Reg. 191/11 Accessibility for Ontarians with Disabilities Act, 2005

TS 3.70.03 DEFINITIONS

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

**Base Course** means a layer of specified or selected materials of planned thickness constructed on the subgrade for drainage and to distribute pavement loads.

**Contraction Joint** means a cut or formed joint to regulate the location and degree of cracking in the plane of the pavement.

**Expansion Joint** means a physical separation between the concrete and appurtenances, or between arts of the concrete crosswalk, which allows both horizontal and vertical movement.

**Slipform** means the placing, consolidating and extruding of plastic concrete in a machine without the use of fixed side forms.

**Subgrade** means the soil prepared and compacted to support a structure or pavement.

TS 3.70.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 3.70.04.01 General

Any required submissions shall be in writing. All submissions shall be submitted to the City at least three weeks prior to the beginning of the work.

The requirements for submissions and design requirements are given in TS 1350.

TS 3.70.04.02 Materials

Prior to starting the work, the Contractor shall supply the Contract Administrator with material safety data sheets (MSDS) for all the materials to be incorporated in the work.

The Contractor shall be responsible for selecting the concrete materials and for the mix design for the concrete. The concrete mix proportions shall be according to CSA A23.1 and this specification.

The certificate of ready mix facilities and/or the certificate of mobile mix concrete production facilities along with the City of Toronto Form A or B (concrete mix details) shall be submitted as required by TS 1350.

Details of the method of curing and curing materials (including manufacturers’ literature, where applicable) shall be submitted to the Contract Administrator.

One copy of the concrete delivery ticket shall be submitted to the Contract Administrator for each load of concrete delivered.
TS 3.70.05 MATERIALS

TS 3.70.05.01 Concrete

The materials for and the production of concrete crosswalks shall meet the requirements of TS 1350 and the following:

1) Cement type
   - Normal Portland GU
   - Portland limestone GUL

2) Minimum 28 day compressive strength
   - 32 MPa

3) Class of exposure
   - C-2

4) Maximum nominal size of coarse aggregate
   - 19 mm

5) Slump at point of discharge
   - 80 ± 30 mm

6) Air content
   - 6.5 ± 1.5%

7) Maximum water/cementing materials ratio
   - 0.45

TS 3.70.05.02 Granular Base and Backfill

Granular base and backfill, if required, shall be Granular A and shall be according to TS 1010.

TS 3.70.05.03 Welded Steel Wire Fabric

Welded steel wire fabric shall be according to TS 1350.

All welded steel wire fabric detailed on the Contract Plans or ordered by the City for incorporation in the concrete sidewalk or raised median shall be 152 x 152 - MW 13.3 x MW 13.3 welded steel wire fabric at 1.46 kilograms per square metres.

TS 3.70.05.04 Expansion Joint Material

Expansion joint material shall be bituminous fibreboard having a minimum thickness of 12 mm and shall be according to TS 1350.

TS 3.70.05.05 Tactile Walking Surface Indicators

Tactile walking surface indicators shall be according to drawing T-310.030-10 and T-310.030-11 and made of cast iron according to CSA B651, follow Ontario Regulation 191/11 and meet the following requirements:

**Table 1: Tactile walking surface indicators**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Property</th>
<th>Minimum Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM A 48</td>
<td>tensile strength</td>
<td>class 30 B</td>
</tr>
<tr>
<td>ASTM C 1028</td>
<td>slip resistance</td>
<td>dry 0.8 min, wet 0.65 min</td>
</tr>
<tr>
<td>ASTM C 501-84</td>
<td>wear resistance</td>
<td>wear index: &gt; 15</td>
</tr>
</tbody>
</table>
The truncated domes shall be of uniform size and shape. Units shall be uniform in texture, be free from pouring faults, sponginess, cracks, blowholes, and other defects, and have clean-cut and well-defined edges. All surfaces shall be bare, without any coating, and be uniform and free of flaking rust or mounts of rust or debris. Tactile walking surface indicators shall have ribs cast to the underside of the unit, have vent holes, and have a minimum plate thickness of 5 mm.

**TS 3.70.06 EQUIPMENT**

**TS 3.70.06.01 Forms**

Forms shall be steel, wood or metal plate forms and shall be according to OPSS 919. They shall be of sufficient cross section and strength, and so secured as to resist the pressure of the concrete when placed, and the impact and vibration of any construction equipment they support, without springing or settlement.

Forms shall be pinned or staked in place with not less than three pins for each 3 m length, and with a pin at each side of each form butt joint. The top surface of the formwork shall comply with the specified tolerances. The inside face of the form shall be vertical. The form shall deviate from grade by no more than 3 mm in 3 m, and in alignment by no more than 6 mm in 3 m.

Forms shall be cleaned and coated with form oil before each use.

**TS 3.70.06.02 Slipforming Equipment**

The equipment shall be designed for slipforming concrete sidewalks and shall have automatic horizontal and vertical controls to be used in conjunction with at least one stringline.

**TS 3.70.06.03 Finishing Tools**

An aluminum or magnesium float shall be used to float the concrete crosswalk and a small edger shall be used to tool the edges.

**TS 3.70.07 CONSTRUCTION**

Prior to starting the work, the Contractor shall submit the verification that either the foreman/lead hand or the supervisor of the placing crew has ACI Flatwork Certification.

**TS 3.70.07.01 Excavation**

**TS 3.70.07.01.01 General**

Excavated material shall be removed from the site and disposed of according to OPSS 180, at the Contractor's expense.

**TS 3.70.07.01.02 Sidewalk**

The excavation for the sidewalk shall be to the lines and grades specified by the Contract Administrator. Care shall be taken to prevent damage to utilities, window openings, areaways, and other appurtenances such as hydrants, water services, poles and gas valves which may be in or under the proposed sidewalk.
The Contractor shall make good all damage caused during the course of the work and return the work to its initial condition at no extra cost to the City.

**TS 3.70.07.01.03 Concrete Raised Median**

Where a raised median is to be placed on an existing pavement, the existing asphalt shall be removed down to the concrete base in the case of a composite pavement, or in the case of a flexible pavement, the asphalt shall be removed to a minimum depth of 75 mm. The existing asphalt shall be removed to form a straight vertical face by saw cutting to the required depth and to a sufficient offset to accommodate framework, but shall not exceed 150 mm from the face of the curb, gutter or median. The asphalt shall be completely removed to the required depth and all loose material swept from the area over which the raised median is to be constructed.

Where a raised median is to be placed, other than as described above, the requirements of the specifications for the individual components shall be used. The individual specifications shall include TS 3.50, TS 3.80 and TS 3.85 for concrete curb and concrete curb and gutter, interlocking pavers and impressed concrete feature strip.

**TS 3.70.07.02 Subgrade**

The subgrade shall be compacted to a minimum of 95% of maximum dry density according to TS 501.

**TS 3.70.07.03 Granular Base**

The granular base shall be placed to the required lines and grades. The compacted depth of granular base shall be 150 mm or as specified in the Contract Documents. The moisture content and compaction of the granular base shall be uniform and shall be according to TS 1010.

The granular base shall be moistened prior to the placement of concrete, but without any standing water. At the time of placing concrete, the base shall not be wet, soft or frozen.

In areas of underground utilities, polyethylene film (100 μm thick) shall be placed on the base.

**TS 3.70.07.04 Form Placement**

Forms shall be set true to the lines and grades as specified in the Contract Documents and in direct contact with the base.

The crossfall of the sidewalk or raised median shall be at a slope of 2 per cent toward the gutter. When the optimum slope cannot be achieved, the Contract Administrator may instruct the Contractor to adjust the slope to a maximum of 4 per cent.

**TS 3.70.07.05 Utility Adjustment**

All utility adjustments shall be according to TS 4.50, except that no boxouts will be required. The top portion of the frame shall be encased with 12 mm expansion joint material, placed flush with the surface of the concrete and the frame and cover. The fibre shall be vertical and straight in alignment.
**TS 3.70.07.06 Utility Isolation**
Utility isolations shall be constructed in the concrete sidewalk as shown on drawing T-310.010-5 at the locations as specified in the Contract Documents.

**TS 3.70.07 Reinforcement**
Welded steel wire fabric reinforcement or hook dowels, if necessary, shall be placed in the concrete sidewalk and concrete raised median to the details and location as specified in the Contract Documents.

**TS 3.70.07.08 Placing Concrete**
Concrete shall be placed and consolidated to meet the requirements of CSA A23.1 and the requirements of this specification. The concrete delivery and spreading operations shall be coordinated so as to provide a uniform rate of progress for the placing operation. Where concrete placing is interrupted for more than 45 minutes, a 12 mm thick bituminous fibre joint filler shall be placed vertically across the sidewalk width, to form an expansion joint, before resuming concrete placement.

The concrete shall be placed to the specified thickness, line and grade. The concrete shall be thoroughly consolidated by the use of 50 mm vibrators and other suitable tools to eliminate voids, honeycombing and entrapped air.

**TS 3.70.07.09 Finishing Concrete**
The concrete surface shall be finished while it is sufficiently plastic to achieve the desired grades, elevations and texture, with no water on the surface. The surface shall be uniform, dense and free from undulations and projections apart from those specified in the drawings.

The top surface shall be screeded to true grade and cross-section and finished with a magnesium or aluminum float. The final finish shall have a light broom or swirl float texture.

The application of water, neat cement or sand to the surface shall not be permitted. Localized surface imperfections shall be dug out and repaired with fresh concrete before the concrete has set.

Sidewalks on grades of more than 5 per cent shall be broom finished transversely to the slope of the sidewalk.

The concrete adjacent to all formwork and joints shall be finished with a tool that produces a 5 mm rounded edge and a smooth, horizontal surface with a maximum width of 50 mm. All tooling shall be uniform and straight and shall be depressed no more than 1 mm below the adjacent surface. Any ridges along the tooled marks shall be removed.

The surface of the concrete sidewalk shall not have irregularities exceeding 6 mm when checked with a 3 m straight edge placed in any direction.
TS 3.70.07.10 Identification Stamp

The Contractor shall mark with an approved stamp according to T-310.010-7 at each end of the work, at each tenth bay, and all others places directed by the Contract Administrator. The stamp shall be located on the centre of the bay parallel to a transverse joint.

The stamp shall identify the Contractor's name and the year of construction.

TS 3.70.07.11 Joints

TS 3.70.07.11.01 Contraction Joints

Contraction joints shall be placed transversely as shown on drawing T-310.010-1. Contraction joints shall also be placed longitudinally—parallel to the curb—and 1.5 m from the curb when the slab is 3 m or more in width. The depth of the contraction joint shall be one quarter the concrete thickness.

The maximum distance between joints in the raised median, shall be 2 m.

TS 3.70.07.11.02 Expansion Joints

Expansion joints shall be constructed to the full thickness of the sidewalk or raised median and shall be a maximum of 6 m apart.

Expansion joints shall be filled with 12 mm wide bituminous fibre expansion joint material. The top surface of the bituminous fibre shall be flush with the concrete surface. The fibre shall be vertical and straight in alignment.

Full depth (isolation) joints shall be formed where the concrete abuts buildings and rigid structures, changes direction, encounters appurtenances and shall be constructed as shown on drawing T-310.010-1. If the face of the structure is rough or irregular, preventing a tight seal, the joint shall be placed 150 to 300 mm from the structure.

TS 3.70.07.11.03 Construction Joints

At the end of each day’s work, or in the event of an unavoidable stoppage of concrete placement extending more than 30 minutes, an expansion joint shall be constructed at the planned location of a joint. Any excess concrete is to be removed and disposed of, off the site according to OPSS 180.

TS 3.70.07.12 Concrete Curing

Concrete curing shall be according to TS 1350.

TS 3.70.07.12.01 Curing with Burlap and Water

Burlap mats shall be pre-soaked by immersion in water for at least 6 hours immediately prior to placing. The mats shall cover the entire width and edges of the exposed concrete. The mats shall overlap 300 mm and shall be held down to prevent displacement. The mats shall be maintained in place and kept saturated for a minimum period of 7 Days. The Contractor may constantly water the mats or cover them with opaque polyethylene film, or a combination of both, in order to keep the mats saturated.
Alternatively, this method shall be used for a minimum period of 3 Days following which the surface shall be cured with curing compound according to TS 1350.

**TS 3.70.07.12.02  Curing with Geotextile Fabric and Water**

Geotextile fabric shall be pre-soaked by immersion in water for at least 6 hours immediately prior to placing. Two layers of fabric shall be applied to the surface of the concrete and shall cover the entire width and edges of the exposed concrete. Strips shall overlap 100 mm and shall be held down to prevent displacement. The fabric shall be maintained in place and kept saturated for a minimum period of 7 Days. The Contractor may constantly water the mats or cover them with opaque polyethylene film, or a combination of both, in order to keep the mats saturated.

Alternatively, this method shall be used for a minimum period of 3 Days following which the surface shall be cured with curing compound according to TS 1350.

**TS 3.70.07.12.03  Curing with Polyethylene Film**

White, opaque polyethylene film (100 μm thick) shall be placed such that air flow between it and the concrete surface is prevented. The film shall be held down at the edges and laps, and shall be overlapped a minimum of 150 mm, to prevent displacement. The film shall be kept in place for a minimum period of 7 Days.

Alternatively, this method shall be used for a minimum period of 3 Days following which the surface shall be cured with curing compound according to TS 1350.

**TS 3.70.07.12.04  Curing with Membrane Compound**

Immediately prior to application, the curing compound shall be agitated by mechanical means to provide a homogeneous mixture. Curing compound shall be spray applied in two coats to the concrete surface, with the second coat applied at right angle to the first coat, such that the membrane formed is uniform in thickness and colour and is free of breaks and pinholes. The surface shall be maintained in this condition for a minimum period of 7 Days. The rate of application shall not be less than that specified by the manufacturer of the compound.

**TS 3.70.07.13  Concrete Protection**

Concrete protection shall be according to TS 1350.

**TS 3.70.07.14  Headers**

Wooden headers, 40 mm thick and 160 mm deep shall be placed at all unpaved entrances or driveways. They shall be held in place by 40 mm x 80 mm stakes driven into the ground at least 700 mm at one metre centres and with the tops flush with the surface of the sidewalk.

**TS 3.70.07.15  Ramps**

Sidewalk accessibility ramps shall be according to drawing T-310.030-7, T-310.030-8, T-310.030-9, T-310.030-10 and T-310.030-11 with tactile walking surface indicators and shall be incorporated at every location with a pedestrian crossing or as specified in the Contract Documents.
TS 3.70.07.15.01  **Installation of Tactile Walking Surface Indicators**

Tactile walking surface indicators shall be set and pressed into wet concrete to final elevation according to manufacturer’s recommendations. Remove any wet concrete that may spill onto tactile walking surface indicator surface.

TS 3.70.07.16  **Restoration of Asphalt**

The additional asphalt removed for framework is to be restored shall be according to TS 310. The asphalt shall be placed in lifts not to exceed 50 mm in depth after compaction.

TS 3.70.08  **QUALITY ASSURANCE**

Quality assurance shall be according to TS 1350.

TS 3.70.08.01  **Visibly Defective or Damaged Concrete**

Concrete that is visibly defective or damaged is not acceptable and shall be removed and replaced at no extra cost to the City.

Concrete is visibly defective or damaged when:

- The concrete is honeycombed.
- The concrete contains embedded debris.
- The concrete has been damaged by freezing.
- The concrete temperature at the time of placement exceeded the requirements of this specification.
- The concrete surface has been damaged by rain.
- The concrete contains footprints or other undesirable impressions.
- The concrete has been subjected to traffic before the concrete attained 20 MPa.
- The concrete has cracked or separated.
- The concrete surface has spalled as defined in the *General Conditions of Contract* that the Contract Administrator will be the sole judge to the determination.
- Expansion and isolation joints are not vertical.
- The concrete sections have heaved or sunk, from their original position.

TS 3.70.08.02  **Concrete Thickness**

The thickness of the concrete structure shall be determined by field measurement or in accordance with a thickness measurement method specified in Contract Documents.

The Contract Administrator reserves the right to verify the thickness of the concrete structure for structural integrity check and payment purpose using a non-destructive testing method or by coring.

When a measurement of concrete thickness is carried out by coring, the measurement shall be based on either a 100 mm or 150 mm diameter core. The diameter of the core shall be at least three times the size of the maximum coarse aggregate as per CSA A23.1.
No core shall be taken within 250 mm from the joints or edges. The length of each core shall be determined according to ASTM C 174. Core samples that are broken or obviously damaged shall not be used for concrete thickness determination. The damaged cores shall be replaced by acceptable cores taken from the same subplot(s). Core samples taken for concrete thickness determination shall not be used for compressive strength test.

Regardless of the method used, concrete thickness shall be determined on a lot basis. Each lot shall have four sublots of equal size, where each subplot is represented by a thickness measurement. The Contract Administrator will determine the size of the lot(s) and sublots for the purpose of concrete thickness acceptance and payment.

The concrete thickness for a crosswalk in a lot shall be the average concrete thickness of the lot (Tx). The average concrete thickness for a lot shall be calculated from the following formula:

\[
Tx = \frac{T1 + T2 + T3 + T4}{4}
\]

Where:  
Tx is the average concrete thickness for a lot, rounded off to the nearest mm.  
T1, T2, T3 and T4 are the concrete thickness for sublots 1, 2, 3 and 4.

For the purpose of the calculation, any individual subplot measurement that is more than 5 per cent above the specified thickness shall be assumed to be equal to the specified thickness plus 5 per cent.

A lot will be accepted, on a thickness basis, if the average concrete thickness of the lot equals or exceeds 100 per cent of the specified thickness. Payment for the lot will be determined according to TS 3.70.10.

At the sole discretion of the Contract Administrator, a lot may be accepted and allowed to remain in place, if the average concrete thickness of the lot is between 95 and 100 percent of the specified thickness. The lot accepted based on the above conditions will not be eligible for full payment. Payment for the lot will be determined according to TS 3.70.10. Adjustment of the Contract Price for the lot shall be based on Table 2.

If the concrete thickness of an individual subplot is less than 95 per cent of the specified thickness, the Contractor shall remove and replace the subplot at their expense even if the average concrete thickness of a lot is more than 95 per cent of the specified thickness.

All replacement lots shall be accepted on the same basis as the original lot.

**TS 3.70.09 MEASUREMENT FOR PAYMENT**

**TS 3.70.09.01 Concrete Sidewalk**

**Concrete Raised Median**

Measurement of concrete sidewalk and raised median placed shall be by surface area in square metres (m²), without any deduction for maintenance holes and appurtenances.

**TS 3.70.09.02 Tactile Walking Surface Indicator**

Measurement of the above tender item shall be along the curb edge of the tactile walking surface indicators in linear metres (m).
**TS 3.70.10**  **BASIS OF PAYMENT**

**TS 3.70.10.01**  **Concrete Sidewalk – 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. Payment shall include the supplying and placing of the formwork, the supplying, placing, consolidating and finishing of the concrete and the curing and protection of the concrete sidewalk.

At the discretion of the Contract Administrator, payment for the item may be adjusted according to TS 3.70.08.02 and Table 2.

The cost of thickness testing shall be borne by the City unless the results indicate a thickness deficiency of 5 per cent or more, in which case the Contractor shall bear all costs of testing.

**TS 3.70.10.02**  **Concrete Raised Median – 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. Payment shall include the removal and disposal of the asphalt and granular material, the supplying and placing of the formwork, the supplying, placing, consolidating and finishing of the concrete and the curing and protection of the concrete raised median.

At the discretion of the Contract Administrator, payment for the item may be adjusted according to TS 3.70.08.02 and Table 2.

The cost of thickness testing shall be borne by the City unless the results indicate a thickness deficiency of 5 per cent or more, in which case the Contractor shall bear all costs of testing.

**Table 2: Payment adjustment**

<table>
<thead>
<tr>
<th>Thickness Tx</th>
<th>Per cent payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 per cent of specified thickness or above</td>
<td>100</td>
</tr>
<tr>
<td>100 per cent of specified thickness to</td>
<td></td>
</tr>
<tr>
<td>95 per cent of specified thickness</td>
<td>$\frac{(Actual\ Thickness)^2}{(Specified\ Thickness)^2} \times 100$</td>
</tr>
<tr>
<td>less than 95 per cent of specified thickness</td>
<td>remove and replace at no extra cost to the City</td>
</tr>
</tbody>
</table>

**TS 3.70.10.03**  **Tactile Walking Surface Indicator – Item**

Payment at the Contract Price for the above item shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include the supplying and placing formwork, the supplying, placing, consolidating and finishing of the concrete, the supplying and placing of tactile walking surface indicators, and the curing and protection of the concrete curb, gutter and sidewalk.
## Construction Specification for Utility Cut and Restoration

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TS 4.60.01 SCOPE

This specification covers the requirements for utility cutting, excavating, backfilling, and repair of City of Toronto streets.

TS 4.60.02 REFERENCES

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

City of Toronto Standard Specifications
TS 1.00 Construction Specification for Maintenance of Traffic
TS 3.40 Construction Specification for Concrete Road Base
TS 3.45 Construction Specification for Repair of Concrete Pavement and Base
TS 3.50 Construction Specification for Concrete Curb and Concrete Curb and Gutter
TS 3.70 Construction Specification for Concrete Sidewalk and Concrete Raised Median
TS 4.70 Construction Specification for Keyhole Coring and Permanent Reinstatement of Keyhole Cores
TS 5.00 Construction Specification for Sodding
TS 5.10 Construction Specification for Growing Medium
TS 13.10 Construction Specification for Unshrinkable Fill
TS 310 Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving
TS 501 Amendment to OPSS 501 – Construction Specification for Compacting
TS 1010 Amendment to OPSS.MUNI 1010 – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material
TS 1350 Amendment to OPSS.MUNI 1350 – Material Specification for Concrete – Materials and Production

City of Toronto Standard Drawings
T-508.010-1 Anchored Hook Bolt Dowel and Concrete Repair
T-509.010-1 Composite Pavement Patching for Utility Cuts (Sheet 1 of 2)

City of Toronto Publications
MCR Municipal Consent Requirements
Tree Protection Policy and Specifications for Construction Near Trees

Ontario Provincial Standard Specifications
OPSS 180 General Specification for the Management of Excess Materials

Ontario Ministry of Transportation
Ontario Traffic Manual Book 7 Temporary Conditions

TS 4.60.03 DEFINITIONS

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

Applicant means a person applying for a permit or other consent to cut a street. This shall be extended, where applicable, to include the Applicant's direct employees and its agents, consultants and contractors.
**Boulevard** means that part of a public street that is not used, or intended to be used, for vehicle travel by the general public, and that is situated between the travelled portion of the road and the adjoining Property line.

**Contraction Joint** means a cut or formed joint to regulate the location and degree of cracking in the plane of the pavement.

**Deep trench** means a trench deeper than 1.2 m.

**Emergency Work** means work within a street that must be completed immediately due to health or safety concerns or because the provision of essential services is endangered.

**Essential Services** means energy (including natural gas, steam, and electricity), water, sanitary sewage, traffic control, and the following communication services 911 service, communications for financial transactions, business networks, and Internet.

**Excavating** means the breaking, digging up, tearing up, tunnelling, boring, coring, cutting into or removing any portion of the surface or subsurface of the street, including pavement, sidewalk, curbs, gutter or landscaping.

**Expansion Joint** means a physical separation between the concrete and appurtenances, or between parts of the sidewalk or raised median, which allows both horizontal and vertical movement.

**City** means the City of Toronto.

**General Manager** means the General Manager of Transportation Services for the City of Toronto and his or her designate or successor.

**Municipal Consent Requirements (MCR)** means the document specifying the requirements for the installation of plant within city of Toronto streets.

**Narrow trench** means the width of a trench is less than or equal to 350 mm.

**Native Material** means excavated material for placement into the exact location from which it was removed.

**Shallow trench** means the depth of trench is less than or equal to 1.2 m.

**Permanent Repair** means the process whereby a cut and/or excavation is reinstated to a condition which requires no further repair.

**Plant** means any poles, cables, pipes, conduits, ducts, pedestals, regulators, antennas, towers, wires, amplifiers, vaults, maintenance holes, hand holes, support structures and or other appurtenances or ancillary facilities or structures used for the provision of telecommunications, internet, energy, water, waste water, steam, fuel and/or other materials. Any encasement, steel plating or other non-excavatable material shall be considered to be part of the plant.

**Road** means the portion of the street designed, improved and ordinarily used by vehicle traffic. The terms pavement and roadway shall have the same meaning as road.

**Sidewalk** means that part of a public street located within the Boulevard that is improved for the exclusive use of pedestrians.
**Street** means a common and public highway, street, avenue, parkway, driveway, square, place, bridge, viaduct or trestle, any part of which is intended for or used by the general public for the passage of vehicle and includes the area between the lateral property lines thereof. The terms City’s public road allowance, right-of-way and highway shall have the same meaning as street.

**Suitable Backfill Material** means the native materials or imported granular materials that can be used as utility trench backfill materials in lieu of unshrinkable fill as defined in this specification.

**Temporary Repair** means the process whereby a cut and/or excavation is reinstated as a temporary measure pending completion of a permanent repair.

**Tree Protection Zone** means the area of the tree roots must be protected during construction according to Tree Protection Policy and Specifications for Construction Near Trees.

**TTC** means the Toronto Transit Commission

**Unshrinkable Fill** means a mixture of aggregates, cementing material and water, with or without chemical admixtures, according to TS 13.10.

**Utility Company** means a company owning, operating and maintaining plant in the public right-of-way.

**Wide trench** means a trench wider than 350 mm.

**TS 4.60.04 DESIGN AND PERMIT REQUIREMENTS**

For submission and permit requirements to make an installation within the City streets refer to the Municipal Consent Requirements:

**TS 4.60.05 MATERIALS**

**TS 4.60.05.01 Supply of Materials**

The Applicant / Contractor shall supply all materials necessary for the execution and completion of the work.

**TS 4.60.05.02 Unshrinkable Fill**

The materials for the production of unshrinkable fill shall be according to TS 13.10.

The supplied unshrinkable fill may be tested, and any material that does not meet the requirements of TS 13.10 shall be removed and replaced at the Contractor’s expense. All costs associated with the removal and replacement of deficient unshrinkable fill shall be borne by the Applicant / Contractor, including the cost of administration and retesting.

Temporary plating shall be used to support loads from pedestrian and vehicular traffic until the temporary asphalt is laid. Traffic shall not be permitted to travel directly onto the surface of the unshrinkable fill.
TS 4.60.05.03  Suitable Backfill Materials

Granular materials may be imported for use as trench backfill provided the imported materials shall be according to TS 1010.

TS 4.60.05.03.01  Imported Granular Materials

Materials excavated during trench construction may be considered for reuse as trench backfill where permitted under clause 4.60.07.02.03, herein. The materials shall have suitable physical and environmental properties; and the materials should be properly managed during construction. The excavated materials that may be considered for reuse as backfill include either a suitable existing granular material or a suitable existing cohesive material. The physical properties of the materials shall meet the following requirements:

a)  the material is free of any obvious objectionable or deleterious materials such as topsoil, organics, wood chips and metal pieces if the material is to be used in trenches located under a pavement

Note:  Material containing topsoil, organics, or wood chips, is acceptable when backfilling within sodded or soil surfaces in the boulevard.

b)  the material is free of large pieces of rock or boulders

c)  the material is free of shale pieces

d)  the compaction equipment deployed on site is able to compact the material to its required density

e)  the material is not considered to be frost susceptible

f)  the material is not wet, frozen or lumpy

All excavated materials to be reused as trench backfill shall be managed to prevent contamination, and shall be protected to preserve or maintain its moisture condition.

Where the excavated material has been identified to be contaminated, the Contractor shall comply with all applicable legislation. Contaminated soil shall not be used as backfill and shall be disposed of off-site according to the applicable requirements.

When the suitability of excavated material for reuse is in dispute, the City, in its sole discretion, shall determine the suitability of the material based on the physical properties mentioned in this section and as recommended in a report, submitted by the Applicant, from a geotechnical consultant.

TS 4.60.06  EQUIPMENT – Not Used

TS 4.60.07  CONSTRUCTION
Table 1: Repair responsibility according to surface types

<table>
<thead>
<tr>
<th>Surface type</th>
<th>Material</th>
<th>Temporary repair</th>
<th>Permanent repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>road pavement</td>
<td>asphalt</td>
<td>Applicant</td>
<td>City</td>
</tr>
<tr>
<td></td>
<td>concrete</td>
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<tr>
<td>sidewalk</td>
<td>asphalt</td>
<td>- -</td>
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<tr>
<td></td>
<td>concrete</td>
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<tr>
<td>curb</td>
<td>asphalt</td>
<td>- -</td>
<td>Applicant</td>
</tr>
<tr>
<td></td>
<td>concrete</td>
<td>Applicant</td>
<td>City</td>
</tr>
<tr>
<td>boulevard</td>
<td>asphalt</td>
<td>- -</td>
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</tr>
<tr>
<td></td>
<td>concrete</td>
<td>Applicant</td>
<td>City</td>
</tr>
<tr>
<td></td>
<td>interlocking bricks/flagstone on a granular base</td>
<td>- -</td>
<td>Applicant</td>
</tr>
<tr>
<td></td>
<td>interlocking bricks/flagstone on a concrete base</td>
<td>Applicant</td>
<td>City</td>
</tr>
<tr>
<td></td>
<td>sod</td>
<td>- -</td>
<td>Applicant</td>
</tr>
<tr>
<td></td>
<td>gravel or soil</td>
<td>- -</td>
<td>Applicant</td>
</tr>
<tr>
<td>driveway</td>
<td>asphalt with abutting concrete repair</td>
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<td>City</td>
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<tr>
<td></td>
<td>asphalt with no abutting concrete repair</td>
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<td></td>
<td>concrete</td>
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<td>interlocking bricks/flagstone on a granular base</td>
<td>- -</td>
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</tr>
<tr>
<td></td>
<td>interlocking bricks/flagstone on a concrete base</td>
<td>Applicant</td>
<td>City</td>
</tr>
</tbody>
</table>

Notes: Any repairs on private property shall be the responsibility of the Applicant.

All work performed by the Applicant or its contractor shall be carried out according to City standards and specifications.

Restoration of areas with decorative or specialized surfaces, landscaping, and subsurface treatments such as patterned/impressed concrete, snow melting systems, sprinkler systems, granite pavers and so forth shall be the responsibility of the Applicant.

Where interlocking bricks/flagstone on a granular base are adjacent to sidewalk that must be replaced as a result of the Applicant’s work, the City will remove and relay the interlocking bricks/flagstone at the Applicant’s expense as part of the restoration work.
TS 4.60.07.01  General
Where micro-excavation (keyhole) technology is being proposed to complete utility installations or repairs or both, the work shall be carried out according to TS 4.70.

TS 4.60.07.02  Installation of Plant
TS 4.60.07.02.01  Sawcutting of Pavement, Sidewalk, Curb and Driveway
Unless judged unfeasible, the sawcut area shall have a maximum of four sides that are all parallel or perpendicular to the direction of travel. Sawcuts shall be straight and vertical to the full depth of the asphalt and concrete layers of the pavement.

Sawcutting operations shall be performed with suitable equipment and methods and not with heavy machinery or jackhammers that may cause damage to the surrounding road.

Saw cutting shall stop at, or just short of, corners to avoid overcutting. After sawcutting the edges, removal of pavement materials shall be performed with care to avoid lifting and breaking the road pavement beyond the sawcut borders.

Sawcutting of TTC surface track structure, including track base, shall not be permitted without the written consent of the TTC.

TS 4.60.07.02.02  Excavation
During the installation of any Plant, excavation equipment with stabilizers shall be suitably outfitted to prevent damage to the pavement surface or else wood or rubber pads shall be placed on the road to support the stabilizers. Any damage to the street attributable to the Applicant’s work shall be repaired, at the Applicant’s expense, in conjunction with the utility cut.

Excavation shall not extend beyond the limits of the sawcut area. Care is to be taken to ensure that undermining of the adjacent pavement, curb and sidewalk is minimized. Where the pavement, curb and/or sidewalk are undermined by construction activities or from other causes, these undermined areas shall be filled and the settled structures shall be restored to their original grades at the expense of the Applicant.

Where necessary, bracing, shoring and/or sheeting shall be according with any occupational health and safety regulations, to support the sides of the excavation and to prevent any movement that could damage other services, adjacent pavements, sidewalks and so on. This excavation support system shall be removed as backfilling proceeds to eliminate voids between the fill and adjacent soils. Appropriate restoration of all displaced services to their original positions is the responsibility of the Applicant.

The Applicant / Contractor shall, at its own expense, provide adequate support and protection of the underground and above ground plant and structures that exist inside the excavation and in the vicinity of the excavated area. Any damage to plant or structures attributable to the Applicant / Contractor’s work shall be repaired to the satisfaction of the City and/or the owner(s) of the damaged plant or structures, at the Applicant / Contractor’s expense, in conjunction with the utility cut.
Except where native cohesive material is to be used for backfill, as permitted by the City and/or under the conditions of this specification, stockpiling of excavated material within City Streets is not permitted under any circumstances for any length of time. All excavated material shall be loaded directly into appropriate haulage trucks and disposed of off-site immediately upon removal. The Applicant shall remove, transport and dispose of all excavated materials in accordance with the latest *Ontario Environmental Protection Act* and, where appropriate, the *Occupational Health and Safety Act*.

All excavations shall have a minimum horizontal clearance of one metre from the edge of a TTC surface track structure, including track base, unless otherwise authorized by written consent from the TTC.

All tunnelling shall maintain a minimum vertical clearance of 500 mm below the TTC track structure including granular sub base, all concrete construction, and, where present, track subdrains.

**Inspection of Excavation**

Prior to backfilling, the Applicant shall inspect the utility cut excavation to ensure the following requirements are met:

a) the edges of the pavement have been saw cut in a straight line and to the full depth of the pavement, or if permitted, to partial depth in composite pavement

b) the bottom of the trench has been compacted and is free of water before the bedding material is placed

c) all loose or wet material at the bottom of the trench has been removed and replaced with suitable bedding materials

d) pipe bedding, pipe cover and compaction to the bedding and cover have been carried out to City’s or utility agency’s requirements

e) necessary shoring/bracing meeting Ontario *Occupational Health and Safety Act* and regulations has been used to prevent the trench from cave-in and to protect adjacent services, pavement and sidewalk

f) undermining of the adjacent pavement and sidewalk has been prevented/repairs.

**Excavation near Trees**

Refer to the City’s Tree Protection Policy and Specifications for Construction Near Trees.

**Protection of Excavation**

All excavations must be backfilled to match the adjacent grade or properly protected at the end of each working day.

When temporary steel plates are used to maintain vehicular, bicycle and pedestrian traffic flow, the plates shall have a skid resistant surface treatment and shall be fastened down to prevent moving. The plates shall be set flush with the surface of the pavement. The recessed plates should overlap the cut by no less than 300 mm on all sides. Asphalt mix shall be used to fill the voids on the outside edges of the plates.
Plates shall be used only as a temporary measure during construction and shall not be used for extended periods of time.

**TS 4.60.07.02.03 Backfilling**

Bedding and covering material shall be compacted to at least 98% of maximum dry density, or according to the Applicant’s installation requirements, whichever is greater.

If unshrinkable fill is used, backfill trench with unshrinkable fill to within 75 mm of the top of the existing surface.

If temporary shoring or bracing has been used to support adjacent infrastructure, it shall be removed in a safe manner continuously as backfilling proceeds.

**Backfilling in Pavements**

If suitable backfill material is to be used, backfilling shall be carried out in uniform lifts not exceeding 150 mm loose thickness with the layer thickness decreased to 100 mm around obstacles. Each lift of suitable backfill material shall be compacted to a minimum of 98% of maximum dry density, or in accordance with the Applicant’s utility agency installation requirements, whichever is greater.

For temporary restoration of pavements, suitable backfill materials shall be brought to within 75 mm of the top of the existing surface.

The type of backfilling required in utility cuts made in road pavements shall be as follows:

a) Unshrinkable fill shall be used for all cuts made in road pavements unless otherwise approved by the City.

b) The City, in its sole discretion, may allow an Applicant to apply, in writing, for an exemption from using unshrinkable fill where a utility cut is to be located at the shoulder area or for backfilling of a wide and deep trench. No such exemptions will be granted on roads for reconstruction or resurfacing within the current construction season as advised by the City.

c) Where an exemption from using unshrinkable fill has been granted, the Applicant or its Contractor shall provide Geotechnical Certificates from a geotechnical consultant within 30 days of completion of work certifying that the trench backfill meets the backfill materials requirements and compaction requirements as specified in this specification.

d) Where suitable native backfill is used, a 400 mm layer of Granular A, compacted to 98% of maximum dry density, shall be placed immediately below the asphalt in flexible pavements and immediately below the concrete base in composite pavements.

**Backfilling in Boulevards**

The use of unshrinkable fill is strictly prohibited for backfilling in boulevards except in the following two scenarios:

1) Where cuts are in close proximity to the road and the limits of the excavation encroach into the 1H:1V structural prism commencing from the bottom of the adjacent curb, unshrinkable fill shall be used within the envelope of the structural prism; or
2) Where cuts are made in hard surfaces such as curbs, public sidewalks, concrete driveways, and interlocking bricks/flagstone on a concrete base that are immediately adjacent to the road, unshrinkable fill shall be used under these hard surfaces.

Where an excavation extends beyond the areas described above, the Applicant / Contractor shall ensure that the unshrinkable fill is contained within the appropriate area.

**Note:** Notwithstanding the above, unshrinkable fill is strictly prohibited for any excavation within a Tree Protection Zone (TPZ) regardless of the surface treatment.

For areas of sod or soil, see clause TS 4.60.07.04.05, herein.

For all boulevard areas other than those specifically described above, only suitable native material or Granular B shall be used. Backfill materials shall be placed in lifts not exceeding 200 mm loose thickness and each lift shall be compacted to 95% of maximum dry density. Permanent restoration of sodded area shall be performed according to TS 5.00.

**Backfilling in Tunnels**

Any facility that is placed underground in any method other than open cut trenching shall be considered as tunnelling.

In backfilling a tunnel, the final density of the backfill must match or exceed that of the surrounding soil. All voids resulted from tunnelling shall be completely backfilled using suitable materials as defined in this specification.

**TS 4.60.07.03 Temporary Repair**

Backfill material shall be brought to within 80 mm below the existing surface. The remainder of the trench shall be filled with compacted hot mix asphalt as a mean for temporary pavement restoration.

All temporary repairs shall be HL-3 hot mix asphalt. The HL-3 shall be mechanically compacted according to TS 310 and neatly match the finished grade of the existing pavement or sidewalk. Prior to placement of the asphalt, all faces, including vertical saw cut surfaces, shall be tack coated using SS-1 emulsified asphalt or equivalent.

Temporary utility cut repairs shall be marked by Applicant using paint applied with a stencil. The marking shall bear the identified code and/or name assigned by the City to the Applicant and the calendar year that the temporary repair was performed. The marking shall be placed adjacent to the cut, outside the area of the temporary repair.

**TS 4.60.07.04 Permanent Repair**

**TS 4.60.07.04.01 Extent of Permanent Restoration**

Notwithstanding the following, the nature and extent of the required reinstatement of the cuts will be at the sole discretion of the City based upon field assessment of the section of roadway prior to the permanent reinstatement.
TS 4.60.07.04.01.01  Pavement

Wherever a utility cut is parallel to and coincides with a wheel path, the cut shall be extended to include the wheel path.

If a utility cut is located within one metre of a curb or construction joint, such that the integrity of the adjacent pavement/base may be compromised, the permanent restoration will include the removal of the adjacent road base to the edge of the curb or construction joint. In all cases, the permanent repairs shall match the cross-section of the adjacent pavement.

Where keyhole cores are densely located in one area, less than 2 m apart, they will be treated as a trench cut.

Pavements with extensive trenching or numerous cuts may require milling and paving to address one or more of the following issues: to restore the quality of the driving surface; to eliminate visual impact of significant road cutting; and/or to better preserve the service-life of a pavement that has experienced excessive cutting.

For longitudinal trenches, whether in the wheel path or otherwise, the affected lane will be milled and paved for the length of the trench plus an additional 5 m at either end of the trench. If however, the total length of all trenches within a street block is: equal to or greater than 75 per cent of the block’s length (for block lengths exceeding 250 m) or equal to or greater than 60 per cent (for block lengths less than or equal to 250 m), then the total length of the block will be milled and paved, that is to say between block intersections.

Milling of the surface course, in any of the aforementioned cases, will be a minimum of 3 m width in order to accommodate the placement of the asphalt surface course with a mechanical spreader.

If the longitudinal trench affects two lanes, then both lanes will be milled and paved for lengths defined above.

Where a series of transverse cuts, pits or shafts occur in close proximity along a roadway—that is within 12 m of each other or less—with a flexible pavement structure, the permanent restoration will include milling of the asphalt surface to a depth of 40 mm for the full width of the lane (or to a minimum width of 3 m) to accommodate the placement of hot-mix asphalt using a mechanical spreader.

Where a series of transverse cuts, pits or shafts occur in close proximity along a roadway—that is within 12 m of each other or less—with a composite pavement structure, the concrete road base shall be restored and the asphalt surface shall be milled to a depth of 40 mm for the full width of the lane or lanes, as the case may be, (or to a minimum width of 3 m) to accommodate the placement of hot-mix asphalt using a mechanical spreader.

TS 4.60.07.04.01.02  Sidewalk and Curb

Wherever a side of a cut falls between expansion joints, the removal and subsequent restoration shall be extended to the nearest expansion joint.

Where the concrete sidewalk is monolithic with the curb, the sidewalk and the curb shall be cut and removed as a unit.
Wherever space for concrete forms are required to perform sidewalk or curb repairs adjacent to an existing driveway or pavement, the Contractor shall saw cut the driveway or pavement neatly parallel to the sidewalk or curb.

**TS 4.60.07.04.01.03  Driveway**

The surface asphalt restoration shall be extended 300 mm on all sides of the cut.

If the edge of the restoration area is less than or equal to one metre from the nearest edge of the driveway or edge of a previously repaired cut, the restoration area shall be extended to that edge.

Whenever the restoration area is more than half of the width of the driveway, the restoration shall be extended to include the entire width of the driveway.

Whenever a cut of any size is made in the driveway apron—the area between the edge of sidewalk and the back of curb—the entire area shall be restored.

The Applicant may request an exemption from this requirement by demonstrating that site-specific existing conditions warrant a reduced level of restoration. Any exemption shall be at the sole discretion of the City.

**TS 4.60.07.04.02  Permanent Repair to Utility Cut Surfaces**

All permanent repairs to utility cut surfaces that include sidewalks, curbs, boulevards, and driveways shall be constructed to meet the current City standards and to match the material and thickness design of the structure.

The permanent reinstatement for a roadway pavement structure that consists of asphalt over granular base/subbase (flexible pavement structure) and asphalt over concrete road base (composite pavement structure) shall also be constructed to match the material and thickness design of the structure.

Utility cuts backfilled with suitable native backfill material or imported materials will typically be subjected to one full freeze-thaw cycle before permanent repairs are completed.

All hot-mix asphalt materials shall be supplied and placed in accordance to TS 310. Prior to placement of the asphalt layers, the existing pavement shall be tack coated using SS-1 emulsified asphalt or equivalent. The perimeter of the permanent restoration shall be routed and sealed with a bead of rubberized asphalt.

**TS 4.60.07.04.03  Placing Asphalt for Permanent Repair**

In addition to TS 310 the following shall be adhered to:

Before asphalt is laid, the aggregate base shall be inspected and locations with loose material shall be re-compacted to the recommended density level. Whenever space permits, a steel roller with vibration capability shall be used on the final surface of the aggregate base. Caution shall be exercised in moving the equipment into the trench to avoid damage to the edges of the road. Prior to placement of the asphalt, the vertical faces of the saw cut shall be tack coated using SS-1 emulsified asphalt or equivalent.
The hot mix asphalt delivered to site shall be visually inspected and removed if the hot mix asphalt is non-uniform, lean or dry characterized by brown colour and fat or over-asphalted recognized by sticky or greasy appearance.

The temperature of the hot mix asphalt delivered to site shall be checked with an appropriate temperature-measuring device. Any hot mix asphalt with temperature that has fallen below 120°C at the point of discharge before spreading shall be rejected.

Asphalt shall be laid in lifts of 50 mm or less. Each lift shall be thoroughly compacted by the suitable compaction method and allowed to cool to 50°C before the next lift is laid on top. Density check shall be carried out using a nuclear gauge device. Coring is to be used only in case of doubt or disagreement or both about the accuracy of measurements made by the nuclear gauge.

After compaction, the hot asphalt surface shall be protected from the potential for accumulating excessive deformation. Cuts restored using hot mix asphalt should be protected from direct traffic for enough time to gain adequate strength before allowing traffic on the restored cut. Lanes affected by the cut are kept closed to traffic until the temperature of the air-cooled asphalt drops below 40°C. Alternatively, whenever safety considerations allow, the hot asphalt surface should be covered with steel plates until the temperature of the asphaltic concrete layer drops below 40°C.

Regardless of the thickness of the asphalt found in the existing road, proper asphalt thickness shall be re-laid without compromising drainage requirements of the road. All construction joints of the cut shall be sealed with a joint sealant to impede the flow of surface water to the cut.

**TS 4.60.07.04.04   Permanent Restoration of Cuts in Composite Pavements**

Where the existing roadway pavement structure consists of an asphalt concrete surface over concrete base (composite pavement structure), the pavement reinstatement shall be completed according to TS 3.45.

The aggregate base upon which the concrete is poured shall be free of ice and snow, and shall not be frozen.

When permanent restoration is performed on concrete composite pavement, the asphaltic concrete and Portland cement concrete layers of the road shall be cut back beyond the intended cut width to a minimum of 300 mm on each side. Cutting shall only be performed after backfilling of the utility trench reaches the level of the bottom of the concrete slab. The T-section configuration facilitates bridging of backfill layers in the cut where the concrete slab transmits critical levels of traffic-induced stresses directly to the undisturbed granular road base next to the trench.

If inspection of the cutback revealed that the granular road base in the cutback section is undisturbed, the two ends of the concrete slab should rest directly on top of the existing granular base of the road. The granular base layer in the cut shall be constructed at the same level of the road granular base for the cut structure to benefit from load distribution facilitated by this T-section design configuration.

If the road base material is disturbed during cutting, excavation or construction of layers below the concrete base, or if there is no granular base in the road structure, an additional 150 mm depth shall be excavated from the road as part of the cut back and backfilled with compacted Granular A.

The concrete slab shall be allowed to cure for a minimum of seven days in order to reach its specified strength before the road is allowed to reopen to traffic. High early strength concrete shall be used if the road is expected to reopen to traffic in less than seven days.
Permanent Restoration of Cuts in Sodded Areas

Sod shall not be laid when ground is in a frozen condition or when the site is in adverse conditions such as high wind, frozen soil or soil covered with snow, ice or standing water.

All surface areas designated for sodding shall be fine graded to a uniform surface to meet all design requirements. The surface shall be uniformly cultivated according to TS 5.00.

The Applicant or its contractor shall:

- Carry out regular inspection of utility cuts during a 2-year warranty period.
- Immediately correct any and all settlements during the 2-year maintenance warranty period.
- Maintain the sod according to subsection 5.00.07.05 of TS 5.00.

Traffic Control

Compliance with all City traffic control standards, including the latest editions of the Ontario Traffic Manual Book 7 and the Municipal Consent Requirements is required.

Management and Disposal of Excess Materials

Management and disposal of excess material shall be according to OPSS 180.

QUALITY ASSURANCE

The quality assurance requirements for all materials used for the temporary and permanent utility cut restoration shall be in full conformance the quality assurance requirements specified for the respective materials:

- The supply and placement of unshrinkable fill shall be according to TS 13.10.
- The supply and placement of concrete shall be according to TS 3.40, TS 3.45, TS 3.50, TS 3.70, and TS 1350.
- The supply and placement of hot mix, hot laid asphalt shall be according to TS 310.

The supply and placement of aggregates and backfill materials shall be according to TS 1010.

Warranty

The Applicant will warrant the utility cut repairs it undertakes in accordance with the repair responsibility—Table 1 in TS 4.60.07—for 2-years. The Applicant shall maintain a rigorous control and assurance program such that each utility cut repair will be inspected once every 12 months, during the warranty period.
Construction Specification for Sodding

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TS 5.00.01 SCOPE

This specification covers the requirements for the supplying, placing, and maintaining sod within the contract limits.

TS 5.00.02 REFERENCES

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

City of Toronto Specifications
TS 5.10 Construction Specification for Growing Medium

Canadian Nursery Landscape Association
CNLA Canadian Standards for Nursery Stock

TS 5.00.03 DEFINITIONS – Not Used

TS 5.00.04 DESIGN AND SUBMISSION REQUIREMENTS

TS 5.00.04.01 Delivery and Storage

Schedule deliveries in order to keep storage at job site to a minimum without causing delay.

Deliver and store sod on pallets on site within 24 hours of being lifted.

During wet weather allow sod to dry sufficiently to prevent tearing during lifting and handling.

During dry weather protect sod from drying and water sod as necessary to ensure its vitality and prevent dropping of soil in handling. Dry sod shall be rejected.

Broken, dry, discoloured pieces shall be rejected by the Contract Administrator.

TS 5.00.05 MATERIALS

TS 5.00.05.01 Nursery Sod

The quality and the source of nursery sod supplied shall be according to the specifications for number one grade turf grass nursery sod as set out in the latest edition of Canadian Standards for Nursery Stock. It shall be Number One Kentucky Bluegrass or Kentucky Bluegrass/Fine Fescue cultivars or as specified in the Contract Documents.

The source of sod shall be approved by the Contract Administrator before it is used in the Contract. No other source shall be used without the approval of the Contract Administrator.

TS 5.00.05.02 Sod Stakes

Sod stakes shall be wooden pegs 17 x 17 x 300 mm or approved 200 mm long steel staples.
**TS 5.00.05.03  Fertilizer**

Fertilizer shall be a complete synthetic slow release fertilizer with maximum 35 per cent water soluble nitrogen. Apply fertilizer at rates based on soil analysis recommendations.

**TS 5.00.05.04  Water**

Potable water shall be used, unless the Contractor provides testing results that demonstrate the water to be used is free of contaminants or impurities that would adversely affect the germination and growth of vegetation.

**TS 5.00.05.05  Mesh**

Mesh shall be jute or synthetic plastic.

**TS 5.00.05.06  Herbicide**

Type, rate, and method of application subject to approval by the Contract Administrator, and shall be according to Toronto Municipal Code Chapter 612 Pesticides, Use of.

**TS 5.00.06  EQUIPMENT – Not Used**

**TS 5.00.07  CONSTRUCTION**

**TS 5.00.07.01  Workmanship**

Keep site well drained. Clean up immediately any soil and debris spilled onto pavements and dispose of deleterious materials.

**TS 5.00.07.02  Preparation of Topsoil Substrate**

Verify that grades are correct. If discrepancies occur, notify the Contract Administrator and do not commence work until instructed by Contract Administrator.

Remove debris, roots, branches, stones in excess of 50 mm diameter and other deleterious materials. Remove soil contaminated with calcium chloride, toxic materials and petroleum products. Remove debris which protrudes more than 75 mm above surface. Dispose of removed material off site.

Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

Where new sod is to be installed in existing sodded areas not disturbed by construction, rototill the area, apply a topdressing of topsoil, and install sod as specified.

**TS 5.00.07.03  Laying of Sod**

Prior to sodding, obtain approval from Contract Administrator that finished grade and depth of topsoil are satisfactory.

Lay sod within 36 hours of being lifted.
Sodding during excessively wet conditions, at freezing temperatures or over frozen soil is not acceptable.

Lay sod in rows, perpendicular to slope, and with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.

Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

Water sod immediately after laying to obtain moisture penetration into top 75 mm of topsoil/growing medium.

Provide adequate protection of sodded areas against erosion and mechanical damage. Remove protection after lawn areas have been accepted.

**TS 5.00.07.04 Layering of Pegged Sod**

Place mesh on top of topsoil on slopes steeper than 3H:1V. Secure mesh in place with wooden pegs or staples at maximum intervals of 600 mm. Cover with topsoil/growing medium.

Lay sod sections perpendicular to slopes greater than 4H:1V and secure with wooden pegs. Place pegs 3 per m, 100 mm below top edge of sod roll to prevent shifting of sod. Drive pegs flush with top of sod soil.

**TS 5.00.07.05 Maintenance of Sod**

Water the sodded areas in sufficient quantities and at frequency required to maintain soil under sod continuously moist to depth of 75 to 100 mm.

Cut grass when height is above 65 mm and maintain to a 60 mm – 100mm height. Remove clippings longer than 20 mm in length.

Maintain sodded areas weed free.

Fertilize sodded areas one month after sodding with fertilizer at rate per soil analysis recommendations. Postpone fertilizing until following spring if application falls within four week period to expected end of growth season.

Overseed with perennial rye and fescue grass blends (excluding creeping fescue) in the fall.

**TS 5.00.07.06 Maintenance Period**

The Contractor shall maintain the sod for 60 Days following completion of the sod placement. During this period, the Contractor shall ensure that all placed sod is kept healthy, actively growing and green in leaf colour. At the end of the 60-day period, the Contractor Administrator will inspect the placed sod for defects. Any defective sod shall be replaced at no extra cost to the City.

Maintenance of the placed sod should be suspended during the winter dormant period (November 1 to April 30) and the 60-day maintenance period shall resume in the following spring after the winter dormant period.
The completed sod is subject to a general warranty period as specified in the Contract Documents, notwithstanding the 60-day maintenance period mentioned in this specification.

**TS 5.00.08 QUALITY ASSURANCE**

**TS 5.00.08.01 Performance Measure**

Sixty days after installation, the sod shall be green and show evidence of rooting into the underlying soil. Any areas of sod which fail to meet these requirements shall be rejected and the Contractor shall replace the rejected sod at no extra cost to the City.

Sodded areas will be considered meeting the performance measure provided that:

1) Sodded areas are properly established, healthy, actively growing, and green in leaf colour.

2) Sod is free of bare and dead spots and without weeds.

3) No surface soil is visible when grass has been cut to height of 40 mm.

4) Sodded areas have been cut minimum 2 times.

5) All placed sod shall be in the same location as originally placed and shall not have moved, eroded, slipped or slough. Lawns sodded after September 30 shall be accepted in the following spring one month after start of the growing season provided acceptance conditions are fulfilled.

**TS 5.00.08.02 Failure to Meet Performance Measure**

If the completed work does not meet the performance measures, the Contractor shall re-apply the specified materials according to this specification. All replaced sod shall be subject to a further maintenance period of 60 consecutive days.

If the Contractor cannot apply or re-apply the sod due to site condition of for any reason, the Contractor shall maintain the site and control erosion until conditions permit application of the sod.

**TS 5.00.09 MEASUREMENT FOR PAYMENT**

**TS 5.00.09.01 Nursery Sod**

Measurement of nursery sod shall be by area in square metres (m²).

**TS 5.00.09.02 Nursery Sod and Stakes**

Measurement of nursery sod and stakes shall be by area in square metres (m²).

**TS 5.00.09.03 Nursery Sod, Stakes and Mesh**

Measurement of nursery sod, stakes and mesh shall be by area in square metres (m²).
TS 5.00.10 BASIS OF PAYMENT

TS 5.00.10.01 Nursery Sod – Item
Nursery Sod and Stakes – Item
Nursery Sod, Stakes and Mesh – Item

Payment at the Contract Price for the above tender items shall be full compensation for all labour, Equipment and Material to do the work. Payment shall include the supplying and placing of sod, watering, weeding, fertilizing and maintenance until Final Acceptance, as well as, sod replacement and water for sod when no separate item for payment exists for such work.
Construction Specification for
Growing Medium

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TS 5.10.01 SCOPE

This specification describes the requirements for the following:

1) Requirements for reuse of existing site soil as growing medium.

2) Mixing and testing of topsoil, coarse sand and compost components to create several different types of growing medium, applicable for the following applications:
   - Type 1 – Standard Mix, for seeding, sodding and trees planted in turf
   - Type 2 – Planting Bed Mix, for planting of shrubs and perennials
   - Type 3 – Boulevard Mix, for trees planted in hardscaped boulevards

3) Installation of growing medium.

4) Compacting and grading of growing medium.

5) Adding organic material to the surface layer of growing medium.

TS 5.10.02 REFERENCES

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

City of Toronto Standard Specifications
TS 5.00 Construction Specification for Sodding
TS 5.30 Construction Specification for Planting

American Society of Testing and Materials
C33 / C33M-13 Standard Specification for Concrete Aggregates
D422-63(2007)e1 Standard Test Method for Particle-Size Analysis of Soils
D698-12e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))
F1647-11 Standard Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes

Canadian Council of Ministers of the Environment
Guidelines for Compost Quality (PN 1340) 2005

Compost Quality Alliance
TMECC Test Method for the Examination of Composting and Compost

Ontario Ministry of the Environment
Interim Guidelines for the Production and Use of Aerobic Compost in Ontario (November 2004)
Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act (April 2011)
TS 5.10.03  DEFINITIONS

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

CSSS means Canadian System of Soil Classification

USDA means US Department of Agriculture

TS 5.10.04  DESIGN AND SUBMISSION REQUIREMENTS

TS 5.10.04.01  Submittals

TS 5.10.04.01.01  Checklist

For checklist form, see Contractors Submittal Checklist form, at the end of this specification section. This list is a summary of the requirements and is not intended to supplant or modify the detailed descriptions of the requirements below. Note that many of the submittals must be provided a minimum of eight weeks before the installation of growing medium.

TS 5.10.04.01.02  Certificates

Submit certification for approval that all growing medium components and the growing medium meet all environmental standards of the Province of Ontario and the City of Toronto. Certificate shall state that all materials are within the required maximum levels of all biological, metal and chemical contaminants.

TS 5.10.04.01.03  Product Data

Submit manufacturer product data and literature for approval for coarse sand, aggregate, pine bark compost and yard waste compost. Provide submittal as part of the submittal of components for the growing medium prior to the submission of the growing medium.

Submit the manufacturer’s particle size analysis, pH and the manufacturer’s Fines Modulus Index for coarse sand. Provide manufacturer's identification and location for each coarse sand source.

Submit the manufacturer’s pine bark compost and yard waste compost analysis for approval. Chemical and physical testing shall be conducted by soil laboratories accredited by The Compost Quality Alliance (CQA) utilizing test methods specified in The Test Methods for Examination of Composting and Compost (TMECC) except as specified herein.

The compost analysis shall include:
Table 1: Compost analysis

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Testing Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>TMECC 4.11A</td>
</tr>
<tr>
<td>soluble salt (mmhos/cm)</td>
<td>TMECC 4.10-A</td>
</tr>
<tr>
<td>% moisture</td>
<td></td>
</tr>
<tr>
<td>% dry weight organic matter</td>
<td>TMECC 5.07-A</td>
</tr>
<tr>
<td>carbon: nitrogen (C:N) ratio</td>
<td></td>
</tr>
<tr>
<td>particle size % passing 50 mm and 10 mm</td>
<td>TMECC 2.02-B</td>
</tr>
<tr>
<td>Solvita maturity index</td>
<td>Solvita</td>
</tr>
<tr>
<td>physical contaminants (% dry weight)</td>
<td>TMECC 3.08-A</td>
</tr>
</tbody>
</table>

Submit testing for chemical and biological contaminants and pathogens as required by local government regulations.

Certified reports shall be from samples taken within four months of the date of the sample submission.

**TS 5.10.04.01.04 Material source locations**

Submit locations of topsoil and growing medium material sources. The City shall have the right to reject any material source. Submit the name, address and telephone number of the source contact, and the location of the soil source including directions to the specific field location on the property. Include a list of all crops grown on the soil, and any herbicides and pesticides applied, over the previous three years.

**TS 5.10.04.01.05 Samples**

Submit samples of each product and material where required by the specification to the Contract Administrator for approval. Label samples to indicate product, specification number, characteristics, and locations in the Work. Samples shall be reviewed for appearance only. Compliance with all other requirements is the exclusive responsibility of the Contractor. Delivered materials shall closely match the samples.

Submit duplicate samples for each of: topsoil, coarse sand, aggregate, pine bark compost, yard waste compost and growing medium, as described in this clause.

Samples should be labeled to include the location of the source of the material.

Samples of each material shall be submitted at the same time as the product data and testing data of that material. Samples and analysis of topsoil, and growing medium must be submitted within 28 Days of sampling.

Each test report shall be marked with the following information:
1) Date issued.
2) Project Title and names of Contractor and material supplier.
3) Name of material and reference number from TS 5.10.05, herein, identifying the type of material.
4) Date, place, and time of sampling.
5) Location of material source.
6) Testing laboratory name, address, and telephone number, and name(s), as applicable, of each field and laboratory inspector.
7) Type(s) of test.
8) Results of tests.
9) Suggested acceptable ranges of the test data for the types of plants to be planted.
10) Recommendations for amendments to bring the growing medium to within these acceptable ranges.

Samples of growing medium shall be submitted no less than 14 Days after the approval of the mix components.

Do not submit samples of growing medium for approval until all mix component testing has been reviewed and approved by the Contract Administrator.

**TS 5.10.04.01.06 Testing Reports**

Submit soil test analysis report for approval for each sample of topsoil and growing medium from an approved soil-testing laboratory, as below:

The testing laboratory shall be approved by the City in advance. All soil and growing medium tests shall be conducted by soil laboratories accredited by The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), except as noted below. Current listing of accredited laboratories may be obtained on the web at [www.omafra.gov.on.ca/english/crops/resource/soillabs.htm](http://www.omafra.gov.on.ca/english/crops/resource/soillabs.htm). Submit the name of the soil lab for approval prior to starting the testing process.

All tests shall be performed in accordance with the current testing standards and protocols of the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

Particle size distribution analysis for all topsoil and growing medium including the following gradient of mineral content:
Table 2: Particle size distribution

<table>
<thead>
<tr>
<th>CSSS/USDA designation</th>
<th>Size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>gravel</td>
<td>2 – 75</td>
</tr>
<tr>
<td>total sand</td>
<td>0.05 – 2</td>
</tr>
<tr>
<td>very coarse sand</td>
<td>1 – 2</td>
</tr>
<tr>
<td>coarse sand</td>
<td>0.5 – 1</td>
</tr>
<tr>
<td>medium sand</td>
<td>0.25 – 0.5</td>
</tr>
<tr>
<td>find sand</td>
<td>0.1 – 0.25</td>
</tr>
<tr>
<td>very fine sand</td>
<td>0.05 – 0.1</td>
</tr>
<tr>
<td>silt</td>
<td>0.002 – 0.05</td>
</tr>
<tr>
<td>clay</td>
<td>&lt; 0.002</td>
</tr>
</tbody>
</table>

Particle size analysis for and growing medium to include sand sieve analysis, and shall be according to ASTM D422 (hydrometer test) or ASTM F1632 (pipette test).

Chemical analysis including the following:

1) pH
2) Nutrient Levels by parts per million including:
   - Phosphorus
   - Potassium
   - Magnesium
   - Calcium

   Nutrient test shall include the testing laboratory recommendations for supplemental additions to the growing medium.

3) Soluble salt by electrical conductivity of a 1:2 soil water sample measured in mmhos/cm
4) Cation Exchange Capacity (CEC) measured in meq/100g
5) Percent Organic Matter by dry weight as determined by ignition (Ash Burn Test or Walkley/Black Test, ASTM F1647)
6) Carbon to Nitrogen (C:N) ration

Infiltration/Permeability/Hydraulic Conductivity testing shall be done using ASTM D2434 or ASTM F1815 at 85 per cent compaction at proctor density (ASTM D698-91).

Report suitability of topsoil or growing medium for growth of applicable planting material. Soil analysis tests shall include recommendations for normal acceptable ranges of soil chemical attributes for the type of plants included in the project in the same units as the test data.

The City may request additional growing medium test on different mix component ratios in order to attain results that more closely meet the mix requirements.
Laboratory’s comments or recommendations regarding amendment requirements or procedures shall not be interpreted to prescribe or dictate procedures or quantities of soil materials for the work of this Contract. Final approval of soil amendment procedures shall be approved by the Contract Administrator.

The City reserves the right to require additional soil analysis at any time such additional samples of materials are deemed necessary for verification of conformance to specification requirements. Contractor shall furnish samples for this purpose upon request and shall perform and pay for additional testing as requested by the Contract Administrator at no extra cost to the City.

Contractor to arrange for testing at start of project. All testing shall be at the expense of the Contractor.

**TS 5.10.04.01.07 In-Situ Compaction Testing**

Submit results of all compaction testing required by the specifications to the City for approval.

1) Installed growing medium shall be tested in-situ with a cone penetrometer and a soil moisture meter.
   a) Testing shall be arranged for and paid for by the Contractor.
   b) The cone penetrometer testing can be arranged through a local arborist, using a product such as the Soil Compaction Tester as manufactured by Dickey-John, and distributed by Ben Meadows [www.benmeadows.com](http://www.benmeadows.com), or approved equal.
   c) Penetration resistance shall be to the full depth of the installed soil profile or 750 mm, whichever is less.
   d) One test shall be performed once every 25 m² of growing medium surface area. The City may request additional testing locations.

2) Maintain a record log of all compaction testing for submission and approval. The record log shall include the date, location, depth and pressure reading of each test. Test location data shall be plotted on a site plan.

3) Submit the compaction log to the City at the end of installation period. The compaction log shall be kept current and available at the site for review at all times.

**TS 5.10.04.02 Sequencing and Scheduling**

Prepare a detailed schedule of the installation of growing medium for coordination with other trades, and submit to the City for approval prior to the start of the project.

Schedule the installation of growing medium after the area is no longer required for use by other trades and work or protect the growing medium from compaction and contamination.

Schedule all utility installations prior to beginning work in this section.

**TS 5.10.04.03 Delivery, Storage and Handling**

Do not mix, deliver or place growing medium in frozen, wet, or muddy weather conditions.
Where construction sequencing requires work during cold weather, protect sub grades and bulk materials from freezing using covers or as needed heated tenting. Sub grades that are sufficiently well drained to preclude the buildup of ice may be installed and built upon during freezing weather provided the surface is cleared of snow and any ice bound material.

Harvest topsoil and prepare growing medium ahead of the scheduled work during periods of warm weather. Protect stockpiles of topsoil and growing medium from freezing and saturation. Remove topsoil from within the interior of the stockpile where topsoil and growing medium are not frozen. At the end of each day cover the exposed working face of the stockpile sufficient to keep the pile from freezing.

Protect stockpiles from rain and washing that can separate fines and coarse material. Cover stockpiles with plastic sheeting at the end of each workday.

Protect growing medium stockpiles from contamination by chemicals, dust and debris that may be detrimental to plants or drainage.

Do not use delivery or installation methods that overly mix pulverize the growing medium. Soil blowing equipment and soil slinger equipment shall not be permitted to move growing medium.

**TS 5.10.04.04 Site Conditions**

It is the responsibility of the Contractor to be aware of all surface and sub-surface conditions, and to report any circumstances that will negatively impact drainage. Do not proceed with the work until unsatisfactory conditions have been corrected. Proceeding with work constitutes acceptance of existing or corrected conditions.

**TS 5.10.04.04.01 Utilities**

Determine location of all utilities including vaults, conduits, pipes and wires adjacent to, below or within the areas of work. Perform all work in a manner, which will avoid damage to any utility. Hand excavate near any utility.

**TS 5.10.04.04.02 Waterproofing**

Perform work in a manner, which will avoid damage to waterproofing membrane, protection board or other structural sealing materials.

**TS 5.10.04.04.03 Construction Sequencing**

Install all growing medium at the point in the project sequencing that they can be adequately protected from other work at the site.

**TS 5.10.04.04.04 Coordination**

Coordinate work with that of other trades affecting or affected by work of this section and cooperate to assure the steady progress of work.
**TS 5.10.04.05  Safety**

The Contactor shall be responsible for pedestrian and vehicular safety and control all movement within and around the work site. Provide the necessary barriers, warning devices and ground personnel needed to give safety, warning and protection to persons and vehicular traffic within the area of work including the Contractor's equipment and temporary storage within the public right-of-way. Provide any additional items required by the City.

**TS 5.10.04.06  Damage**

During site preparation, growing medium installation and protection, the Contractor shall be responsible for all damage to existing features above and below ground incurred as a result of work operations. Repairs or replacements or both shall be made to the satisfaction of the Contract Administrator.

Protect all installed material from compaction, contamination and erosion. Install fences; utilize mulch, mats and geofabrics over the surface of the soil as required. In the event that any soil becomes compacted, contaminated or eroded, repair the damage by removing and reinstalling the compacted material according to TS 5.10.07.11, herein.

**TS 5.10.05  MATERIALS**

**TS 5.10.05.01  Topsoil Component**

Topsoil shall be naturally occurring soil, harvested from the O or A horizon of the soil profile, suitable for the germination of seeds and the support of vegetative growth, and meeting the following requirements:

<table>
<thead>
<tr>
<th>Soil particle size distribution</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand (0.05 – 2 mm)</td>
<td>40 – 65%</td>
</tr>
<tr>
<td>Clay (&lt;0.002 mm)</td>
<td>15 – 23%</td>
</tr>
<tr>
<td>Gravel (2 – 75 mm)</td>
<td>&lt; 5%</td>
</tr>
<tr>
<td>Chemical analysis</td>
<td>pH: 5.5 – 7.8</td>
</tr>
<tr>
<td>Nutrient levels (ppm)</td>
<td></td>
</tr>
<tr>
<td>Phosphorous</td>
<td>10 – 60</td>
</tr>
<tr>
<td>Potassium</td>
<td>80 – 250</td>
</tr>
<tr>
<td>Calcium</td>
<td>&lt; 5000</td>
</tr>
<tr>
<td>Magnesium</td>
<td>100 – 300</td>
</tr>
<tr>
<td>Soluble salt</td>
<td>&lt; 0.50 mmhos/cm</td>
</tr>
<tr>
<td>Cation Exchange Capacity (CEC)</td>
<td>&gt; 20 meq/100g</td>
</tr>
<tr>
<td>Percent organic matter</td>
<td>2.5 – 5%</td>
</tr>
</tbody>
</table>
Topsoil shall retain a significant portion of the soils ped structure when stockpiled at the supplier's yard. At least 25 per cent of the soil volume shall be soil peds larger than 25 mm in diameter. Peds are defined as the clumps of soil naturally aggregated during the soil building process, by clays and soil biology. Peds of any size are permissible.

Peds are to be determined by visual approximation for both size and quantity. The City shall determine when soils have sufficient peds.

Topsoil shall not be screened through sieves or screens smaller than 50 mm to avoid eliminating the required soil peds.

Topsoil shall not contain materials and contaminants at levels that would be harmful to plant growth; or impair drainage, installation or maintenance of the resulting growing medium; or adversely impact its intended use including the following:

- Refuse; roots; construction debris; wood or sticks larger than 25 mm in diameter; brush; clumps of root mats of plants and toxic materials
- Lumps of clay or subsoil larger than 50 mm
- Stones larger than 75 mm
- Deleterious substances; plant or soil pests; undesirable grasses including crabgrass or couch grass, noxious or weeds or weed seeds.

The City shall determine if the quantities of any of these materials is sufficient to cause rejection of the topsoil. The aggregate of all the above materials shall not exceed 5 per cent of the total soil volume as assessed by visual inspection.

Topsoil shall be in conformance Toronto Municipal Code Chapter 489, Grass and Weeds. The contractor shall be responsible for removing all weeds that germinate during the plant maintenance period.

Topsoil shall be harvested from approved source locations that comply with all regulations governing the removal of topsoil.

Topsoil may be purchased from a source of collected topsoil from development sites provided the sources of the topsoil stock pile is of similar textures and meets the requirements of this specification.

Topsoil shall not be a soil mix including any combination of sand, fertilizer, or organic matter or compost added to mineral soil in order to meet the texture, chemical or organic requirements for topsoil. The organic matter content of the soil shall be residue of long term, natural soil building processes and not from added organic matter or compost.

Submit source location and a list of all crops grown on the soil and any herbicides and pesticides applied over the previous three years.

Submit duplicate 4 L samples (total 8 L) from each topsoil source with soil testing results. The sample shall be a mixture of the random samples taken around the source field or stockpile. The delivered sample shall represent the soil ped content in the stockpile.
TS 5.10.05.02  Coarse Sand Component

Coarse sand shall be clean, sharp, mineral sand, washed to remove silt and clay particles, and meeting the following requirements:

Coarse concrete sand, ASTM C33 with a Fines Modulus Index between 2.8 and 3.2.

Table 3: Physical analysis

<table>
<thead>
<tr>
<th>Sieve size (mm)</th>
<th>Per cent passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.5</td>
<td>100</td>
</tr>
<tr>
<td>4.75</td>
<td>95 – 100</td>
</tr>
<tr>
<td>2.36</td>
<td>80 – 100</td>
</tr>
<tr>
<td>1.18</td>
<td>50 – 85</td>
</tr>
<tr>
<td>0.60</td>
<td>25 – 85</td>
</tr>
<tr>
<td>0.30</td>
<td>5 – 30</td>
</tr>
<tr>
<td>0.15</td>
<td>0 – 10</td>
</tr>
<tr>
<td>0.075</td>
<td>≤ 3</td>
</tr>
</tbody>
</table>

Chemical analysis shall be as follows:

a) pH < 8.6  
b) Soluble Salt < 0.5 mmhos/cm  
c) Percent Organic Matter < 0.5%.

Coarse Sand shall not contain toxic substance at levels harmful to plant growth.

Submit duplicate 1 L (total 2 L) samples with manufacturer’s literature and material testing certification that the product meets the above requirements.

TS 5.10.05.03  Compost Component

Compost shall be a stable, humus-like material produced from the aerobic decomposition, composted and cured until the maturity status complies with indices specified below. Except as specified herein, Compost shall be according to the requirements for Category A Compost as defined in the Guidelines for Compost Quality.

- Yard waste compost feedstock shall be yard waste trimmings or source-separated municipal solid waste or both.
- Pine bark compost feedstock shall be 98 per cent pine trees with less than 10 per cent combined pine wood fiber and sawdust content.

Compost shall not contain debris such as sharp objects, plastics, trace elements and foreign matter in excess of that defined for Category A Compost. Total of all stones, recognizable branches, wood chips and roots larger than 25 mm in diameter shall be less than 5 per cent by volume.
Compost shall have moisture content between 35 and 55 per cent when blended or applied.

Compost shall be composted long enough to exhibit a dark brown color, approximately Munsell colour 7.5 R; Value 3 or lower; Chroma 2 or lower. Color shall be determined by visual comparison of the sample to the Munsell Soil Color Chart, most current edition.

Compost shall have a strong aerobic (sweet) odor. Compost lacking a strong aerobic odor or which has an anaerobic (sour) or a strong pine or alcohol odor shall be rejected. Odor may be determined during the submittal sample review and at the time of any inspections of materials by the Contract Administrator by observation of the inspector.

Certification: provide the following documentation:

A statement that the compost meets all health and safety regulations.

Feedstock type and percentage in the final compost product.

Testing: Compost shall have one (1) composite sample tested from each 100 cubic metres of material intended for use in growing medium. The results of compost analysis shall be provided by the Compost supplier for approval. Compost shall meet the following criteria as reported by the following laboratory tests:

**Physical analysis**

<table>
<thead>
<tr>
<th>Particle size yard waste compost</th>
<th>95% pass through 50 mm screen</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25% pass through 10 mm screen</td>
</tr>
<tr>
<td>Particle size pine bark compost</td>
<td>95% pass through 20 mm screen</td>
</tr>
<tr>
<td></td>
<td>25% pass through 6 mm screen</td>
</tr>
</tbody>
</table>

**Chemical analysis**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH yard waste compost</td>
<td>5.0 – 7.8</td>
</tr>
<tr>
<td>pH pine bark compost</td>
<td>4.0 – 5.0</td>
</tr>
<tr>
<td>soluble salt</td>
<td>&lt; 3.5 mmhos/cm</td>
</tr>
<tr>
<td>% moisture</td>
<td>35 – 55%</td>
</tr>
<tr>
<td>% organic matter</td>
<td>35 – 55%</td>
</tr>
<tr>
<td>Solvita maturity index</td>
<td>Solvita</td>
</tr>
</tbody>
</table>

C:N ratio 15:1 – 25:1 (for Yard Waste only)

Physical contaminants (including man-made inerts) < 1 per cent dry weight basis
Metal content shall comply with Interim Guidelines for the Production and Use of Aerobic Compost in Ontario except for copper and zinc, which must comply with Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the *Environmental Protection Act* Table 3 (medium to fine textured soils).

Pathogen reduction shall meet Section 6.0 of Interim Guidelines for the Production and Use of Aerobic Compost in Ontario.

Submit duplicate 1 L (total 2 L) samples with manufacturer’s literature and material testing certification that the product meets the requirements.

### TS 5.10.05.04 Existing Site Soil as Growing Medium

**Note:** Specifiers should note that there are likely many sites in the city of Toronto where the soil can be reused and installed into the soil zones being constructed. These would be places where the underlying soil is disturbed and compacted native soils of suitable texture and pH. In most cases the existing soil only requires loosening the compaction and adding yard waste compost. Soils that would not be suitable include: those with high clay or silt content, with very high or low pH, contaminated with chemicals and or salt, or which have been mixed with gravels or unshrinkable fills. Making the determination if this is feasible requires the examination of the soil conditions by a soil expert.

However, often, reasonable investigation of the soil is not possible until large areas of paving have been removed. This delay may make the decision for reuse difficult. Other considerations are project schedule and space to temporarily store soil at the site and to undertake the compost mixing operations. In tight urban sites these constraints may make reuse of soil overly expensive. The design team must evaluate all the factors in soil reuse before proceeding to assume that this concept is feasible. This decision should not be left to the Contractor to decide, although it might be left in the specification as an option provided it does not have a negative impact on the project cost.

Existing site soil for seeding, sodding and tree planting may be used as growing medium at sites where the existing soil has been analyzed by an agricultural soil scientist and determined to be suitable for its intended purpose. The City may approve the use of existing soils and may require additional amendments for the soil where recommended by the soil report.

The following are requirements for existing site soil to be used as growing medium.

<table>
<thead>
<tr>
<th>Soil particle size distribution</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand (0.05 – 2 mm)</td>
<td>40 – 65%</td>
</tr>
<tr>
<td>Clay (&lt; 0.002 mm)</td>
<td>15 – 23%</td>
</tr>
<tr>
<td>Gravel (2 – 75 mm)</td>
<td>&lt; 8%</td>
</tr>
<tr>
<td>Chemical analysis</td>
<td>pH: 5.5 – 7.8</td>
</tr>
<tr>
<td>Nutrient levels (ppm)</td>
<td></td>
</tr>
<tr>
<td>Phosphorous</td>
<td>10 – 60</td>
</tr>
<tr>
<td>Potassium</td>
<td>80 – 250</td>
</tr>
</tbody>
</table>
Calcium  
< 5000

Magnesium  
100 – 300

Soluble salt  
< 2 mmhos/cm

Percent organic matter  
2.5 – 5%

Infiltration/Permeability/Hydraulic Conductivity  
50 – 75 mm/hr at 85% Proctor density

Soil testing to determine the above described soil conditions shall be at sufficient intervals to accurately depict the soil quality but no less than one test per 20 cubic metres of soil.

Submit duplicate 4 L (total 8 L) samples with material testing certification that the product meets the requirements.

Submit the agricultural soil scientist report for approval. The report shall describe the extent and depth of the soil to be reused, and the soils quality relative to the required parameters. It is understood that obtaining accurate soil information in urban areas is difficult if there is paving over the soil. A preliminary soil report shall be submitted a minimum of eight weeks prior to the installation of the soil. Once the soil has been made accessible by the construction, the soil shall be reevaluated and a final report submitted. Urban Forestry may alter the approval or make additional requirements based on the final soils report.

Existing Site Soil to be reused shall be excavated to break up compaction and reinstalled at the compaction required for growing medium.

Excavation, moving, stockpiling and installation of existing site soil shall utilize means and methods that preserve soil peds. Large compacted soil peds up to 200 mm in any dimension are acceptable.

Yard waste compost shall be loosely incorporated to the soil at the time of installation at a rate of 20 per cent by volume.

Push the existing site soil into stockpiles no greater than 1.5 m tall. Cover the stockpile with yard waste compost of sufficient volume to roughly equal 20 per cent of the stockpile volume. Using the bucket of a back how, drag the pile to approximately one-third its height. Working from the bottom, turn the pile over one. Install into the soil area following the requirements for growing medium.

Fertilizer shall be added to the soil, if required to meet the chemical requirements of growing medium.

Soil shall not be contaminated with toxic chemicals harmful to humans or plants at levels regulated by provincial or federal laws.
TS 5.10.05 Type 1 – Standard Mix

For sodding, sodding and trees planted in turf, a mixture of topsoil, coarse sand and compost components mixed in the appropriate proportions, such that the growing medium shall meet the following parameters:

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total sand (0.05 – 2 mm)</td>
<td>50 – 60%</td>
</tr>
<tr>
<td>Silt</td>
<td>20 – 40%</td>
</tr>
<tr>
<td>Clay</td>
<td>6 – 10%</td>
</tr>
<tr>
<td>Chemical analysis</td>
<td>pH: 6.0 – 7.8</td>
</tr>
<tr>
<td>Nutrient levels (ppm)</td>
<td></td>
</tr>
<tr>
<td>Phosphorous</td>
<td>10 – 60</td>
</tr>
<tr>
<td>Potassium</td>
<td>80 – 250</td>
</tr>
<tr>
<td>Calcium</td>
<td>&lt; 5000</td>
</tr>
<tr>
<td>Magnesium</td>
<td>100 – 300</td>
</tr>
<tr>
<td>Soluble salt</td>
<td>&lt; 1.5 mmhos/cm</td>
</tr>
<tr>
<td>Percent organic matter</td>
<td>2 – 5%</td>
</tr>
<tr>
<td>Infiltration/Permeability/Hydraulic Conductivity</td>
<td>50 – 75 mm/hr at 85% Proctor density</td>
</tr>
</tbody>
</table>

Specifiers should note that the pH maximum of 7.8 will be acceptable for most trees and other plants in the Toronto area. However, if the design team specifies pH sensitive trees or plants, the pH maximum should be lowered to an appropriate level for those plants. Note that lower pH growing medium will cost more due to the lack of availability of lower pH components. Coordinate the specification with the design team on species requirements.

Mix the growing medium with a loader bucket to preserve topsoil peds using the following method:

Mix the coarse sand and compost together separately.

Spread a layer of topsoil approximately 300 mm thick and apply the required proportions of coarse sand/compost mix over the topsoil.

Push the topsoil, coarse sand and compost into a pile and then drag out into a layer mixing the soil with the bucket. Repeat the mixing action a second time to gain an approximate mixture of the material. Do not over mix.

This method assumes that soil will not be installed using soil blower or soli slinging equipment.

Submit duplicate 4 L (total 8 L) samples with material testing certification that the product meets the requirements.
**TS 5.10.05.06  Type 2 – Planting Bed Mix**

For horticultural beds of shrubs and perennials, a mixture of topsoil, coarse sand and compost mixed to the following proportions, by volume:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil</td>
<td>50%</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>20%</td>
</tr>
<tr>
<td>Pine bark compost</td>
<td>30%</td>
</tr>
</tbody>
</table>

The growing medium shall meet the following parameters:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical analysis (1)</td>
<td>pH: 6.0 – 7.8 (1)</td>
</tr>
<tr>
<td>Nutrient levels (ppm)</td>
<td></td>
</tr>
<tr>
<td>Phosphorous</td>
<td>10 – 60</td>
</tr>
<tr>
<td>Potassium</td>
<td>80 – 250</td>
</tr>
<tr>
<td>Calcium</td>
<td>&lt; 5000</td>
</tr>
<tr>
<td>Magnesium</td>
<td>100 – 300</td>
</tr>
<tr>
<td>Soluble salt</td>
<td>&lt; 1.5 mmhos/cm</td>
</tr>
<tr>
<td>Percent organic matter</td>
<td>&gt; 5%</td>
</tr>
<tr>
<td>Infiltration/Permeability/Hydraulic Conductivity</td>
<td>50 – 75 mm/hr at 85% Proctor density</td>
</tr>
</tbody>
</table>

(1) Specifiers should note that the pH maximum of 7.8 will be acceptable for most trees and other plants in the Toronto area. However, if the design team specifies pH sensitive trees or plants, the pH maximum should be lowered to an appropriate level for those plants. Note that lower pH growing medium will cost more due to the lack of availability of lower pH components. Coordinate the specification with the design team on species requirements.

Submit duplicate 4L (total 8 L) samples with material testing certification that the product meets the requirements.

**TS 5.10.05.07  Type 3 – Boulevard Mix**

For trees planted in hardscaped boulevards, a mixture of topsoil, coarse sand and compost mixed to the following proportions, by volume:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil</td>
<td>40 – 45%</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>40 – 50%</td>
</tr>
<tr>
<td>Pine bark compost</td>
<td>12 – 15%</td>
</tr>
</tbody>
</table>

The growing medium shall meet the following parameters:
Soil particle size distribution

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium to coarse sand (0.25 – 2 mm) plus gravel (2 – 5 mm)</td>
<td>&gt; 45%</td>
</tr>
<tr>
<td>Total combined silt and clay</td>
<td>18 – 35%</td>
</tr>
</tbody>
</table>

Chemical analysis

- pH: 6.0 – 7.8

Nutrient levels (ppm)

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Range (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phosphorous</td>
<td>10 – 60</td>
</tr>
<tr>
<td>Potassium</td>
<td>80 – 250</td>
</tr>
<tr>
<td>Calcium</td>
<td>&lt; 5000</td>
</tr>
<tr>
<td>Magnesium</td>
<td>100 – 300</td>
</tr>
<tr>
<td>Soluble salt</td>
<td>&lt; 1.5 mmhos/cm</td>
</tr>
<tr>
<td>Percent organic matter</td>
<td>3 – 5%</td>
</tr>
</tbody>
</table>

Infiltration/Permeability/Hydraulic Conductivity: 50 – 75 mm/hr at 85% Proctor density

(1) Specifiers should note that the pH maximum of 7.8 will be acceptable for most trees and other plants in the Toronto area. However, if the design team specifies pH sensitive trees or plants, the pH maximum should be lowered to an appropriate level for those plants. Note that lower pH growing medium will cost more due to the lack of availability of lower pH components. Coordinate the specification with the design team on species requirements.

Mix the growing medium with a loader bucket to preserve topsoil peds using the following method:

Mix the coarse sand and compost together separately.

Spread a layer of topsoil approximately 300 mm thick and apply the required proportions of coarse sand/compost mix over the topsoil.

Push the topsoil, coarse sand and compost into a pile and then drag out into a layer mixing the soil with the bucket. Repeat the mixing action a second time to gain an approximate mixture of the material. Do not over mix.

This method assumes that there is an additional mixing of the materials as it is moved to the final stockpile, placed into the delivery trucks, deposited at the project site, and spread into the planting space.

This method assumes that soil will not be installed using soil blower or soil slinging equipment.

Submit duplicate 4L (total 8 L) samples with material testing certification that the product meets the requirements.
TS 5.10.05.08 Soil Amendments

Chemicals and other materials designed to increase soil fertility as recommended in soil testing report. All products shall be delivered to the site in unopened containers and stored in a dry enclosed space suitable for the material and meeting all environmental regulations. All products shall be freshly manufactured and dated for the season in which the products are to be used.

Fertilizer for planting shall be organic fertilizer, as defined under the Fertilizers Act. Submit manufacturer’s product literature.

Fertilizer selections shall be based on the recommendations of the soil test.

TS 5.10.06 EQUIPMENT – Not Used

TS 5.10.07 CONSTRUCTION

TS 5.10.07.01 Site Examination
Examine the surface grades and soil conditions for any circumstances that might be detrimental to soil drainage, such as uneven sub grades and waterproofing that may hold or pond water, deposits of construction-related waste or soil contamination, storage of material or equipment, soil compaction or poor drainage. Confirm that all utility work and installation of planter drainage has been completed and tested. Examine the grading, verify all elevations.

Confirm that all other work in the area of growing medium installation is completed. Notify the Contract Administrator in writing of any unsatisfactory conditions.

TS 5.10.07.02 Coordination with Project Work
The Contractor shall coordinate with all other work that may impact the completion of the work. Protect installed growing medium from compaction by other trades.

TS 5.10.07.03 Grade and Elevation Control
Provide grade and elevation control during installation of growing medium. Utilize grade stakes, surveying equipment and other means and methods to assure that grades and contours are as specified on the Contract Drawings.

Maintain grade stakes until the grades have been viewed by the Contract Administrator.

TS 5.10.07.04 Site Preparation
In areas not above structure, excavate to the proposed sub grade. Maintain all required angles of repose of the adjacent materials as shown on the drawings or as required to support adjacent materials or structures. Do not over excavate compacted subgrades of adjacent pavement or structures. Remove all construction debris and material.

Confirm that the subgrade is at the proper elevation and compacted as required. Subgrade elevations shall slope parallel to the finished grade or toward the subsurface drain lines as shown on the Contract Drawings.
Do not proceed with the installation of growing medium, until all utility work in the area has been installed.

Do not begin growing medium installation until all subsurface drainage, and irrigation main lines shown on the Contract Drawings are viewed and approved by the City.

Protect adjacent walls, walks and utilities from damage or staining by the soil. Use 12 mm plywood or plastic sheeting or both to cover existing concrete, metal and masonry work and other items as directed during the progress of the work.

1) Clean up any soil or other materials spilled on any paved surface, including at the end of each working day.

2) Any damage to the paving or architectural work shall be repaired by the Contractor at no extra cost the City.

**TS 5.10.07.05 Growing Medium Installation**

Prior to installing any growing medium, the Contract Administrator shall approve the condition of the subgrade and the previously installed sub grade preparation and the installation of subsurface drainage material.

In areas of soil installation above existing subsoil, till the growing medium into the bottom layer of subsoil.

1) Loosen or till the subsoil of the subgrade to a depth of 50 to 75 mm with a backhoe or other suitable device.
2) Spread a layer of the specified growing medium 50 to 75 mm deep over the subgrade. The use of soil blowing equipment or “soil slinging” equipment is not permitted to install growing medium.
3) Thoroughly till the growing medium and the subgrade together.
4) Protect the tilled area from traffic. Do not allow the tilled sub grade to become compacted.
5) In the event that the tilled area becomes overly compacted, re-till the area again prior to installing the growing medium.

Immediately install the remaining growing medium in 300 to 400 mm lifts to the required depths. Work out from the installed soil such that equipment does not have to pass over the installed soils.

The depths and grades shown on the drawings are the final grades after settlement and shrinkage of the organic material. The contractor shall install the growing medium at a higher level to anticipate this reduction of growing medium volume depending upon predicted settling properties for each type of growing medium as indicated on the drawing.

Utilize grading and earth moving equipment that uses low impact tracks that is rated to exert a static force on the ground of no more than 20 kg/m². All equipment used to install soil shall have buckets equipped with teeth to loosen soil compaction.

When any equipment passes over previously prepared subgrade or installed soil it shall reverse out of the soil area over the same path dragging the teeth of the bucket over the tracks to break surface compaction created by the equipment.

Coordinate the installation of water harvesting system and drain lines within the growing medium.
**TS 5.10.07.06 Growing Medium Compaction**

Provide adequate equipment to achieve consistent and uniform compaction of the growing medium. Use the smallest equipment that can reasonably perform the task of spreading and compaction.

Maintain moisture conditions within the growing medium during installation to allow for satisfactory compaction. Suspend installation operations if the growing medium becomes wet. Do not place growing medium on wet or frozen sub grade.

Lightly compact each 300 to 400 mm lift to achieve the following test results.

Growing Medium compaction shall be tested at each lift using a cone penetrometer to between 70,000 and 140,000 kg/m$^2$ (100 and 200 psi) when the soil is between 12 and 20 per cent moisture.

Compact growing medium under the root balls of all trees to between 200,000 and 250,000 kg/m$^2$ (275 and 350 psi) when the soil is between 12 and 20 per cent moisture to reduce settlement and provide a stable base for the tree as indicated on the drawings.

At the end of the installation of the growing medium and prior to the installation of additional organic matter and plants, take a minimum of four undisturbed samples from locations selected by the City to determine bulk density. Submit test results for approval.

Confirm Infiltration Rate of installed growing medium is 50 to 75 mm/hr.

**TS 5.10.07.07 Protection**

Protect growing medium from compaction and contamination by dust, debris, and any toxic material harmful to plants or humans after placement. Any area, which becomes compacted, shall be tilled to a depth of 150 mm. Any uneven or settled areas shall be filled and re graded.

Phase the installation of the growing medium such that equipment does not have to travel over already installed growing medium.

**TS 5.10.07.08 Growing Medium Fine Grading**

The City shall view all rough grading prior to the installation of organic matter, fine grading, planting, and mulching.

Set grades at time of installation high enough relative to the type of growing medium and settlement anticipated so that the growing medium will be at the correct grades after the 12 month settlement period.

This specification assumes that initial settlement during the first 12 months after installation will be between 10 and 15 per cent of the installed depth. Assure that the grading is mounded sufficiently high enough to accommodate this settlement.

At the end of the planting warrantee period, if grades have settled greater than 5 per cent of the depth below the grades shown on the drawings, reset the grades to the final grades shown on the grading plan.

Adjust the finish grades to meet field conditions as directed.
Provide for positive drainage from all areas toward the existing inlets, drainage structures and or the edges of planting beds. Adjust grades as directed to reflect actual constructed field conditions of paving, wall and inlet elevations. Notify the City in the event that conditions make it impossible to achieve positive drainage.

Provide smooth transitions between slopes of different gradients and direction. Modify the grade so that the finish grade is flush with all paving surfaces or as directed by the drawings.

Fill all dips and remove any bumps in the overall plane of the slope.

The tolerance for dips and bumps in shrub and ground cover planting areas shall be a 25 mm deviation from the plane in 2000 mm.

Restore all grades after the installation of plants. Remove any excess soil removed during the planting process.

**TS 5.10.07.09 Installation of Yard Waste Compost**

In all areas of growing medium in open planting beds, after the specified growing medium is installed, and just prior to the installation of tree, shrub or groundcover plantings, spread 100 mm of yard waste compost and roto-till into the top 150 mm of the growing medium. Restore grades after tilling.

**TS 5.10.07.10 Clean-Up**

During installation, keep pavements clean and work area in an orderly condition.

Keep the site clear of trash and debris at all times. Immediately dispose of wrappings or waste materials associated with products necessary for the completion of the work.

All trash and debris shall be kept in a central collection container. Do not bury trash and debris in back-fill.

Once installation is complete, remove any excess soil from pavements or embedded fixtures.

**TS 5.10.07.11 Protection During Construction**

The Contractor shall protect work and materials from damage including: compaction, contamination, and erosion due to operations by other Contractors or trespassers. Maintain protection during installation until acceptance. Treat, repair or replace damaged growing medium installation work immediately.

Till compacted growing medium and replace growing medium that has become contaminated as determined by the City. Growing medium shall be tilled or replaced by the Contractor at no extra cost the City.

**TS 5.10.07.12 Repair of Settled Growing Medium**

At the end of 12 months after the date of substantial completion of the growing medium installation work, inspect the site and restore any areas where the grades have settled beyond the elevations shown on the drawings by an amount greater than 5 per cent of the design depth.
In shrub planting areas where the settlement is 75 mm or less, remove the mulch, top dress the area with the specified growing medium and re-mulch. All ground cover areas and shrub planting areas where the settlement is greater than 75 mm remove the mulch and plants, add the specified growing medium, re-plant and re-mulch.

**TS 5.10.08** QUALITY ASSURANCE – Not Used

**TS 5.10.09** MEASUREMENT FOR PAYMENT

**TS 5.10.09.01** Existing Site Soil Mix
Measurement of existing site soil mix shall be measured by volume in cubic metres (m³).

**TS 5.10.09.02** Type 1 – Standard Mix, 100 mm Thick
Type 1 – Standard Mix, 200 mm Thick
Type 1 – Standard Mix, 300 mm Thick
Measurement of standard mix growing medium shall be measured by area in square metres (m²).

**TS 5.10.09.03** Type 2 – Planting Bed Mix, 100 mm Thick
Type 2 – Planting Bed Mix, 200 mm Thick
Type 2 – Planting Bed Mix, 300 mm Thick
Measurement of planting bed growing medium shall be measured by area in square metres (m²).

**TS 5.10.09.04** Type 3 – Boulevard Mix, 100 mm Thick
Type 3 – Boulevard Mix, 200 mm Thick
Type 3 – Boulevard Mix, 300 mm Thick
Measurement of boulevard mix growing medium shall be measured by area in square metres (m²).

**TS 5.10.10** BASIS OF PAYMENT

**TS 5.10.10.01** Existing Site Soil Mix – Item
Type 1 – Standard Mix, 100 mm Thick – Item
Type 1 – Standard Mix, 200 mm Thick – Item
Type 1 – Standard Mix, 300 mm Thick – Item
Type 2 – Planting Bed Mix, 100 mm Thick – Item
Type 2 – Planting Bed Mix, 200 mm Thick – Item
Type 2 – Planting Bed Mix, 300 mm Thick – Item
Type 3 – Boulevard Mix, 100 mm Thick – Item
Type 3 – Boulevard Mix, 200 mm Thick – Item
Type 3 – Boulevard Mix, 300 mm Thick – 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.
Form 1: Contractors Submittal Checklist

<table>
<thead>
<tr>
<th>✓</th>
<th>Section #</th>
<th>Item</th>
</tr>
</thead>
<tbody>
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<td><strong>Certificates</strong></td>
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<td>TS 5.10.04.01.02</td>
<td>Certification that all growing medium components and the growing medium meet all environmental standards</td>
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<td><strong>Product Data</strong></td>
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</tr>
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<td></td>
<td>TS 5.10.04.01.03</td>
<td>Product data: Coarse sand</td>
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<td></td>
<td>TS 5.10.04.01.03</td>
<td>Product data: Pine bark compost</td>
</tr>
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<td></td>
<td>TS 5.10.04.01.03</td>
<td>Product data: Yard waste compost</td>
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<tr>
<td></td>
<td><strong>Material Source Locations</strong></td>
<td></td>
</tr>
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<td>Location of all topsoil and growing medium components sources</td>
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<td><strong>Samples</strong></td>
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<td>TS 5.10.04.01.05</td>
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</tr>
<tr>
<td></td>
<td>TS 5.10.04.01.05</td>
<td>Duplicate 1L samples: Coarse sand / submitted with required testing results</td>
</tr>
<tr>
<td></td>
<td>TS 5.10.04.01.05</td>
<td>Duplicate 1L samples: Pine bark compost / submitted with required testing results</td>
</tr>
<tr>
<td></td>
<td>TS 5.10.04.01.05</td>
<td>Duplicate 1L samples: Yard waste compost / submitted with required testing results</td>
</tr>
<tr>
<td></td>
<td>TS 5.10.04.01.05</td>
<td>Duplicate 4L samples: Growing medium / submitted with required testing results</td>
</tr>
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<td><strong>Testing Reports</strong></td>
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<td>Particle size analysis: Topsoil including sand fractions</td>
</tr>
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<td></td>
<td>TS 5.10.04.01.06</td>
<td>Particle size analysis: Growing medium including sand fractions</td>
</tr>
<tr>
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<td>Chemical analysis: Topsoil</td>
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<td>In-Situ Compaction Testing: Installed growing medium</td>
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<td>TS 5.10.04.01.06</td>
<td>Infiltration Rate Testing: Installed growing medium</td>
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<td><strong>Contractor's Qualifications</strong></td>
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<tr>
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<td>TS 5.10.04.01.08</td>
<td>Documentation of contractor’s qualifications</td>
</tr>
</tbody>
</table>
Construction Specification for Hot-Spot Cathodic Protection of Existing Iron Watermains

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TS 7.21.01 SCOPE

This specification covers the materials required and the work to be undertaken to provide hot-spot cathodic protection to existing ductile and grey cast iron watermains in the city of Toronto.

Hot-spot cathodic protection is the application of cathodic protection to a localized area on a watermain, by installing a sacrificial anode at a break repair site or any other watermain excavation.

TS 7.21.01.01 Workmanship

Skilled labour shall only be used for all work.

All work shall be performed according to instructions and specifications given by the City, using the most suitable equipment.

TS 7.21.01.02 Handling and Storage of Materials

Material shall be stored so as to prevent injury to persons and to prevent the delay of work by others.

Sacrificial anodes and other materials which can be damaged by exposure to the environment must be stored in a clean, dry enclosure.

Sacrificial anodes shall not be handled by their lead wires.

TS 7.21.01.03 Units

Units of measurement given in this specification are based on the International System of Units (SI) and the National Standards of Canada Metric Practice Guide.

TS 7.21.02 REFERENCES

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

City of Toronto Standard Drawings
T-1106.02 Thermite Welding of Metallic Watermains
T-1106.03 Electrical Bonding of Iron Watermains

American Society of Testing and Materials
B843-93 Standard Specification for Magnesium Alloy Anodes for Cathodic Protection
G97-89 Standard Test Method for Laboratory Evaluation of Magnesium Sacrificial Anode Test Specimens for Underground Applications

Where a discrepancy exists between the drawings and the specification, the specification shall have priority.

TS 7.21.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:
TS means Toronto Specification

AWG means American Wire Gauge

**TS 7.21.04** DESIGN AND SUBMISSION REQUIREMENTS – Not Used

**TS 7.21.05** MATERIALS

**TS 7.21.05.01** Manufacture of Sacrificial Anodes

Lead wire silver-soldered to steel core.

Soldered connection encapsulated in heat shrinkable tubing.

Magnesium casting centered in anode package and surrounded by a minimum of 25 mm of special backfill.

**TS 7.21.05.02** Magnesium Anodes

Packaged magnesium anodes shall have a 14.5 kg magnesium casting having a length of 560 mm +20 mm and a high potential alloy composition according to ASTM B843-93, Type M1C specification or equal.

The magnesium casting shall be contained in a rugged moisture-absorbent cardboard container of the following dimensions: 200 mm diameter x 700 mm long. The core shall be a 3 mm diameter steel core extending a minimum of 75 per cent of the length of the casting.

The magnesium anode shall be no less than 45 per cent efficient for each sample tested according to ASTM G97-89.

The magnesium casting within the container shall be supplied surrounded with a special backfill material having an electrical resistivity of less than 45 ohm-cm when saturated with distilled water and the following composition by volume:

- Gypsum 77% ±2%
- Bentonite 15% ±1%
- Anhydrous Sodium Sulphate 8% ±1%

Packaged magnesium anode shall be supplied with 3000 mm of AWG No 10/7 strand copper with RWU90 blue insulation.

**TS 7.21.05.03** Thermite Welds

Thermite weld materials to be CADWELD, as manufactured by Erico Products Inc.

Thermite weld metal:

- Anode lead wires: Cat. N° CA25XF-19
- Bond cables: Cat. N° CA45XF-19
Thermite weld moulds:

- Anode lead wires: Cat. Nº CAHBA-1G-PD, where PD is pipe Ø in inches
- Bond cables: Cat. Nº CAHBA-1G-PD, where PD is pipe Ø in inches

**TS 7.21.05.04**  
**Miscellaneous**

Bond cables:

- AWG Nº 4/7 strand copper conductor having RWU90 black insulation.

Mastic:

- Roskote A-51 Mastic.

Ground clamps – Blackburn as manufactured by Thomas & Betts:

- Water services up to 25 mm Ø, Cat Nº JD
- Water services of greater than 25 mm Ø, Cat Nº J2D

**TS 7.21.06**  
**EQUIPMENT – Not Used**

**TS 7.21.07**  
**CONSTRUCTION**

**TS 7.21.07.01**  
**Anode Installation**

The anodes shall be kept dry prior to installation.

The anode shall not be handled or lowered by their lead wires.

Anodes shall be installed complete with their cardboard container and enclosed special backfill.

Anodes shall be installed horizontally at pipe depth a minimum of 500 mm to the side of the pipe, and shall be backfilled with native soil.

The anode lead wire shall be wrapped around the watermain and secured, that is to say knotted.

Sufficient slack shall be left in the wire to prevent any stress on the anode during backfilling and subsequent soil settlement.

The anode lead wire shall be attached to the water piping by connecting to either:

- A copper service pipe, using a ground clamp, according to the clamp manufacturer’s instructions; or
- The watermain, using the thermite weld process.
TS 7.21.07.02  Installation of Bond Cables

Bond cables shall be installed to maintain electrical continuity between all metallic components of the water distribution system that are exposed within the excavation.

Bond cables shall be connected to the watermain, fittings, and couplings, using the thermite weld process.

Install one bond cable across each exposed Tyton joint which is not already bonded.

Where a repair clamp is installed across a circumferential break, install one bond cable across the break, following the installation of the repair clamp.

Where a cut-out is required, install one bond cable:

- From each coupling to the watermain.
- From the new section of pipe to each side of the existing watermain, only if the new section of pipe is metallic.
- Across the cut-out, from one side of the existing watermain to the other, only if the new section of pipe is non-metallic.

TS 7.21.08  QUALITY ASSURANCE

TS 7.21.08.01  Quality Assurance

Contractor shall ensure that the anodes supplied conform to this specification.

The Contractor or anode supplier shall forward a copy of the Certificate of Compliance acquired from the anode manufacturer to the City for each anode shipment, prior to either their installation of delivery acceptance.

The City may randomly select samples of anodes supplied by the Contractor for testing, by an independent laboratory, with testing costs to be borne by the City.

Any batch of anodes found not to conform to the specification shall be replaced immediately by the Contractor at no extra cost to the City. No additional work shall take place until such time that the anodes are approved and accepted by the Contract Administrator.

Any installed anodes found not to conform to the required specifications shall be replaced by the Contractor at his own expense.

TS 7.21.09  MEASUREMENT FOR PAYMENT – Not Used

TS 7.21.10  BASIS OF PAYMENT – Not Used
Construction Specification for
Cathodic Protection
of New Watermains

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TS 7.22.01 SCOPE

This specification covers the materials required and the work will be undertaken to cathodically protect new watermains in the city of Toronto.

New watermains include:

- Ductile iron watermains
- Metallic components of non-metallic watermains

The work shall include the following:

- Supply all labour, material, tools, equipment, and transportation to complete the works as outlined herein, as shown on the drawings and as necessary by evidence.
- Supply and installation of sacrificial anodes, cathodic protection monitoring probes, bond cables and test stations and their associated lead wires.
- Recording of GPS coordinates of all test stations and submission of data to the City.

TS 7.22.01.01 Workmanship

Skilled labour shall only be used for all work.

All work shall be performed according to instructions given by the City, using the most suitable equipment.

TS 7.22.01.02 Handling and Storage of Materials

Material shall be stored so as to prevent injury to persons and to prevent the delay of work by others.

Sacrificial anodes and other materials, which can be damaged by exposure to the elements, must be stored in a clean, dry enclosure.

Anodes shall not be stored on site.

Sacrificial anodes and cathodic protection monitoring probes shall not be handled by their lead wires.

TS 7.22.01.03 Units

Units of measurement given in this specification are based on the International System of Units (SI) and the National Standards of Canada Metric Practice Guide.

TS 7.22.02 REFERENCES

This specification refers to the following standards, specifications or publications:
American Society of Testing and Materials
A418-01 Standard Specification for Cast and Wrought Galvanic Zinc Anodes

Where a discrepancy exists between the drawings and the specification, the specification shall have priority.

**TS 7.22.03 DEFINITIONS**

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

**TS** means Toronto Specifications

**AWG** means American Wire Gauge

**TS 7.22.04 DESIGN AND SUBMISSION REQUIREMENTS – Not Used**

**TS 7.22.05 MATERIALS**

**TS 7.22.05.01 Manufacture of Sacrificial Anodes**

Lead wire silver-soldered to steel core.

Soldered connection encapsulated in heat shrinkable tubing.

Zinc casting centred in anode package and surrounded by a minimum of 25 mm of special backfill.

**TS 7.22.05.02 Zinc Anodes**

Packaged zinc anodes shall have a high potential alloy composition as per ASTM B418-01, Type II specification or equal.

The table below indicates the weight and length for each zinc anode type:
### Table 1: Zinc anode type

<table>
<thead>
<tr>
<th>Anode type</th>
<th>Casting weight (kg) min</th>
<th>Casting length (mm) ±10</th>
<th>Package diameter (mm) min</th>
<th>Package length (mm) min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z-24-48</td>
<td>10.9</td>
<td>1220</td>
<td>100</td>
<td>1300</td>
</tr>
<tr>
<td>Z-12-24</td>
<td>5.4</td>
<td>610</td>
<td>100</td>
<td>700</td>
</tr>
</tbody>
</table>

The zinc casting shall be contained in a rugged moisture-absorbent cardboard container of the following dimensions: 200 mm diameter x 700 mm long. The core shall be a 6 mm diameter electro-galvanized steel core extending 100 percent of the length of the casting.

The zinc casting within the container shall be supplied surrounded with a special backfill material having an electrical resistivity of less than 45 ohm-cm when saturated with distilled water and the following composition by volume:

- Gypsum 77% ±2%
- Bentonite 15% ±1%
- Anhydrous Sodium Sulphate 8% ±1%

Packaged zinc anode shall be supplied with 3000 mm of AWG Nº 10/7 stand copper with RWU90 red insulation.

**TS 7.22.05.03 Test Stations**

Test stations shall be Street Fink manufactured by Cott Industries Ltd. or equivalent with:

- Colour: Blue
- Terminals: 6
- Support Post: 150 mm Ø x 600 mm long
- Bonding Straps: 2

**TS 7.22.05.04 Monitoring Probes**

Cathodic protection monitoring probes shall be Model Nº CPMP-WM as manufactured by Corrosion Service Company Ltd. or equivalent.

**TS 7.22.05.05 Thermite Welds**

Thermite weld materials to be CADWELD, as manufactured by Erico Products Inc.

Thermite weld metal:

- Anode lead wires: Cat. Nº CA25XF-19
- Bond cables: Cat. Nº CA45XF-19
Thermite weld moulds:

- Anode lead wires: Cat. N° CAHBA-1G-PD, where PD is pipe Ø in inches
- Bond cables: Cat. N° CAHBA-1G-PD, where PD is pipe Ø in inches

**TS 7.22.05.06 Conductor**

Watermain lead wires shall be AWG N° 10/7 strand copper conductor having RWU90 black insulation.

Bond cables shall be AWG N° 4/7 strand copper conductor having RWU90 black insulation.

**TS 7.22.05.07 Electrical Connectors**

Electrical connectors shall be manufactured by Thomas & Betts Inc. or equivalent.

Test lead terminals:

- Anode headers and pipe lead wires, Sta-Kon Cat. N° D8-14.

Ground clamps:

- Water services up to 25 mm Ø, Blackburn Cat. N° JD.
- Water services of greater than 25 mm Ø, Blackburn Cat. N° J2D.

**TS 7.22.05.08 Miscellaneous**

Bond cables:

- AWG N° 4/7 strand copper conductor having RWU90 black insulation

Mastic:

- Roskote A-51 Mastic

Ground clamps:

- Water services up to 25 mm Ø, Blackburn Cat. N° JD.
- Water services of greater than 25 mm Ø, Blackburn Cat. N° J2D.

**TS 7.22.06 EQUIPMENT – Not Used**

**TS 7.22.07 CONSTRUCTION**

**TS 7.22.07.01 Anode Installation**

The anodes shall be kept dry prior to installation.
The anode shall not be handled or lowered by their lead wires.

Anodes shall be installed complete with their cardboard container and enclosed special backfill.

Anodes shall be installed horizontally at pipe depth a minimum of 600 mm to the side of the pipe, and shall be backfilled with native soil.

The anode lead wire shall be wrapped around the watermain and secured with a knot. Sufficient slack shall be left in the wire to prevent any stress on the anode during backfilling and subsequent soil settlement.

The anode lead wire shall be attached to the water piping by connecting to either:

- A copper service pipe, using a ground clamp, according to the clamp manufacturer’s instructions;
  or
- The iron portions of the watermain, using the thermite weld process.

**TS 7.22.07.02 Anode Locations**

Install one Z-12-24 anode on each copper water service.

Install one Z-24-48 anode on the lateral piping of each hydrant.

On non-metallic watermains only, install one Z-12-24 anode on each metallic fitting such as a cross, tee, or reducer and on all buried valves.

On ductile iron watermains only, install Z-24-48 anodes at the following maximum intervals along the entire watermain, starting within 2 m from the end of the watermain:

**Table 2: Anode spacing interval**

<table>
<thead>
<tr>
<th>Watermain diameter mm</th>
<th>Spacing m</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>22.0</td>
</tr>
<tr>
<td>150</td>
<td>8.0</td>
</tr>
<tr>
<td>200</td>
<td>6.0</td>
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<tr>
<td>300</td>
<td>4.0</td>
</tr>
<tr>
<td>400</td>
<td>3.0</td>
</tr>
<tr>
<td>600</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**TS 7.22.07.03 Installation of Bond Cables**

On ductile iron watermains only, all pipe joints and fittings shall be bonded to ensure electrical continuity throughout the piping system.

Bond cables shall be connected to the watermain using the thermite weld process.

Install one bond cable across each pipe-to-pipe and pipe-to-fitting joint.

Remove and discard any bare copper bond straps that are supplied with the piping.
Bare copper bond straps, conductivity screws, and conductivity wedges shall not be used as a means of providing electrical continuity.

**TS 7.22.07.04 Test Station Installation**

Test stations shall only be installed on ductile iron watermains.

Install test stations:

- As shown on drawing T-1106.07.
- Within 10 m of each end of the watermain.
- At minimum intervals of 150 m along the watermain.
- At locations which where they will not interfere with, or present a hazard to, pedestrian or vehicular traffic.
- At the nearest property line, whenever possible.
- Flush with the pavement or boulevard.

At each test station location, connect two lead wires to the watermain.

Install the lead wire from the nearest anode into the test station, rather than connecting it directly to the watermain.

Connect all lead wires to the appropriate test station terminals using test lead terminal connectors.

Horizontal, underground wiring runs shall be at least 500 mm deep.

Sufficient slack shall be left in the watermain test leads and the anode wires to prevent any stress on either the anode or pipe connections during backfilling and subsequent soil settlement.

Measure and record the GPS coordinates of each test station to within ± 0.25 m, and submit all data to the City.

**TS 7.22.07.05 Installation of Cathodic Protection Monitoring Probes**

Install cathodic protection monitoring probes:

- On ductile iron watermains only.
- As shown on drawing T-1106.08.
- At every second test station along the watermain.
- At pipe depth.
- At a distance of between 300 mm and 500 mm from the watermain.

After placement of the monitoring probe, but prior to backfilling, saturate coupon with water to ensure immediate operation of internal reference electrode.

**TS 7.22.07.06 System Deficiencies**

Any system deficiencies as identified by the City’s corrosion consultant, shall be corrected at the contractor’s expense. Such deficiencies shall include, but not be limited to:
• Missing anodes
• Broken lead wire connections
• Use of improper materials

Deficiencies shall be corrected within 90 Days of notification by the Contract Administrator.

**TS 7.22.08 QUALITY ASSURANCE**

**TS 7.22.08.01 Quality Assurance**

Contractor shall ensure that the anodes supplied conform to this specification.

The Contractor or anode supplier shall forward a copy of the *Certificate of Compliance* acquired from the anode manufacturer to the City for each anode shipment, prior to either their installation or delivery acceptance.

The City may randomly select samples of anodes supplied by the contractor for testing, by an independent laboratory, with testing costs to be borne by the City.

Any batch of anodes found not to conform to the specification shall be replaced immediately by the contractor at no extra cost to the City. No additional work shall take place until such time that the anodes are approved and accepted by the Contract Administrator.

Any installed anodes found not to conform to the required specifications shall be replaced by the contractor at his own expense.

**TS 7.22.09 MEASUREMENT FOR PAYMENT**

**TS 7.22.09.01 Anode Installation**

If the Contract contains separate items for the work required by this specification, payment shall be based on the unit price or lump sum price tendered by the Contractor.

**TS 7.22.09.02 Test Station Installation**

If the Contract contains separate items for the work required by this specification, payment shall be based on the unit price or lump sum price tendered by the Contractor.

**TS 7.22.09.03 Monitoring Probe Installation**

If the Contract contains separate items for the work required by this specification, payment shall be based on the unit price or lump sum price tendered by the Contractor.

**TS 7.22.10 BASIS OF PAYMENT**

Payment at the Contract Price shall be full compensation for all labour, Equipment and Material to do the work.
# Procedure for Disinfecting Watermains

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**TS 7.30.01** SCOPE

This procedure covers the disinfection of watermain systems. This procedure applies to new mains, cleaned mains, cleaned and relined mains, repaired mains, temporary mains and mains that have been out of service for a significant period of time.

**TS 7.30.02** REFERENCES

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

**Provincial Statute**
- Ontario Drinking Water Quality Standards
- Ontario Regulation 170/03 Drinking Water Systems

**Toronto Water Practices**
- Practice No. 8 Watermain, Reservoir and Elevated Tank Disinfection

**American Water Works Association**
- B300 Hypochlorites
- C651 Disinfecting Water Mains
- M20 Water Chlorination Principle and Practice
- AWWA RF Development of Disinfection Guidelines for the Installation and Replacement of Water Mains

**NSF International**
- NSF/ANSI Standard 60 Drinking Water Treatment Chemicals – Health Effects

**TS 7.30.03** DEFINITIONS – Not Used

**TS 7.30.04** DESIGN AND SUBMISSION REQUIREMENTS – Not Used

**TS 7.30.05** MATERIALS

**TS 7.30.05.01** Disinfectants

Use sodium hypochlorite that meets or exceeds AWWA B300 and is certified against standard ANSI/NSF 60.

**TS 7.30.05.02** De-chlorinating Agents

See Appendix C, AWWA Standard C651.
Keep pipes clean and dry. Take precautions to protect the interiors of pipes, fittings, and valves against contamination. Cap all openings with watertight plugs/seals. Remove plugs only when making connections. Complete joints of all pipes in trenches before any stoppage of work, such as at the end of the workday. Pipes shall not be laid in water.

**Material Handling**
Handle all materials including sealing gaskets and lubricants in a manner to avoid damage and contamination.

**Precautions before Disinfection**
Contractor shall adhere to the following requirements to ensure proper disinfection:

a) Complete testing for leakage and allow only one feed to the section to be disinfected. Always feed through an isolating valve or bypass of an isolating valve.

b) Provide a 50 mm diameter tap with sampling cock and pressure gauge on the dead side of the isolating valve and a 25 mm diameter tap with sampling cock and pressure gauge on the live side of the isolating valve.

c) Provide a minimum 50 mm diameter blow-off at the end of all pipe sections to be disinfected.

d) Flush the source water as near the shut-off as possible.

**Supervision of Disinfection, Inspection, and Testing of Samples**
Contractor performing the disinfection shall submit *Disinfection Proposal Plan* to the Contract Administrator. The Contract Administrator shall review the proposal plan prepared by the Contractor prior to any work commencing. The proposal plan is to include the following:

1) Disinfection criteria, including; watermain dimensions, watermain material, disinfection method, contact time, concentration, receiving location and source of supply water.

2) Disinfection site map and key map, including; location of mainline valves, sodium hypo-chlorite application, dechlorination agent application, flushing, receiving, live side residual and pressure monitoring and sampling.

3) Calculation sheets including; chemical volumes, watermain volume, flushing discharge rate and chemical application rates.

4) Emergency response for spills and exfiltration to the distribution or transmission systems.

5) Traffic protection plan—in accordance with the Occupational Health and Safety Act (OHSA).
6) Confined space entry procedure—in accordance with the OHSA.

If the site is determined to be unsuitable by the Contract Administrator, the Disinfection Proposal Plan shall be returned to the requestor for corrective work to be performed.

If the site is determined to be suitable by Contract Administrator, the Disinfection Proposal Plan shall be distributed to the applicable Toronto Water supervisor(s) to notify them of the scheduled disinfection before proceeding with the disinfection.

All valve or flushing operations on the distribution or transmission systems adjacent to the section of watermain to be disinfected will be suspended until the disinfection activity is completed.

**TS 7.30.07.02.02 Supervision, Testing and Records**

The inspector or Contract Administrator shall witness all swabbing and disinfection activities. The Contractor carrying out the disinfection shall take and record the readings on City approved forms. All such records shall be submitted to the inspector or Contract Administrator.

All microbiological samples shall be tested by an accredited laboratory that is licensed by the Ministry of the Environment and Climate Change (MOECC) to test drinking water.

The inspector or Contract Administrator shall witness, confirm and record all disinfection activities including:

- flushing discharge rate;
- sodium hypo-chlorite application rate;
- turbidity checked;
- chlorination application time and residual;
- live side residual monitoring;
- 24-hour residual confirmation;
- flushing, to sanitary sewer, time and discharge residual;
- dechlorination, to storm sewer, dechlorination application rate, time and discharge residual;
- flushing residual confirmation;
- sampling time and locations; and
- approvals and notifications.

Forms shall be submitted to Toronto Water.

**TS 7.30.07.02.03 Valve Operation**

During the disinfection, a licensed Toronto Water operator, certified under Ontario Regulation 128/04, will be on site to operate hydrants and valves on the active distribution system. The Contract Administrator shall notify Toronto Water operations section at least 48 hours in advance to make arrangements for the valve operation.

**TS 7.30.08 DISINFECTION PROCEDURE**

Refer to AWWA C651.
**TS 7.30.08.01 General**

A standard disinfection procedure shall ensure the following:

a) Preventing contaminating material from entering the watermain during storage, construction, or repair.

b) Removing, by flushing or other means, those materials that may have entered the watermain.

c) Protecting the existing distribution system from backflow due to hydrostatic pressure and disinfection procedures.

d) Chlorinating any residual contamination that may remain, and flushing the chlorinated water from the main.

e) Following disinfection, determining the bacteriological quality of the water in the main by laboratory testing.

f) Connecting the approved, disinfected watermain to the active distribution system.

**TS 7.30.08.01.01 Flushing and Swabbing**

Flush and swab new, replaced or relined watermains prior to the start of disinfection. Where achievable, flushing shall attain a scouring velocity of 0.8 m/s. A physical separation shall be maintained at all times between the active (potable) distribution system and the new (installed) watermain.

The physical separation shall consist of two 50 mm ball valves and approved reduced pressure assembly back flow preventer.

When a section of a new watermain is satisfactorily disinfected and the connection(s) to the active (potable) distribution system is completed, it is then considered part of the active (potable) distribution system.

The Contractor shall:

1) Confirm watermain is isolated. Blow-off pressure at highpoint of watermain.

2) Confirm isolating valve(s) are properly tagged or locked out on site.

Prior to disinfection, all new watermains, service connections, and side street connections 100 mm in diameter and greater shall be swabbed.

Swabbing outlets will connect to the new mains and connections using a 45 degree vertical bend and riser pipe that extends above the surrounding ground surface. Swabbing outlets shall be the same diameter as the pipe to which they are connected.

Swabbing outlets will be mechanically capped prior to and after swabbing to prevent entry of debris into watermains and service connections. During swabbing, discharge water shall be directed to a sanitary sewer inlet and the Contractor is to take all necessary measures to avoid flooding and erosion of adjacent properties, and build up of ice during cold weather.
Swabs shall have a diameter 50 mm larger than the pipe that is going to be swabbed. The new watermain and service connections shall be filled with water a minimum of 24 hours in advance of the swabbing operation. Swabs shall be propelled using potable water with sufficient velocity to remove debris from the watermain. The swabbing operation should continue until the discharge water runs clear and the swab is clean. The Contractor shall demonstrate to the Contract Administrator that all swabs or parts thereof have been retrieved from the new watermain.

**TS 7.30.08.01.02 Valve Operation Sequence**

During flushing and disinfection, sequence the valve operation so as not to pressurize the main to be disinfected to a level equal to or greater than that of any connected in-service watermains.

A licensed Toronto Water operator certified under Ontario Regulation 128/04 will operate all distribution and transmission hydrants and valves.

**TS 7.30.08.01.03 Flush to Reduce Turbidity**

Flush the main at all hydrants and blow-offs to eliminate all air pockets and particulates, and to achieve and sustain a turbidity of less than one nephelometric turbidity units (NTU) or, at the City’s discretion, no higher than that of the incoming water. Do not proceed with chlorination until these turbidity levels are achieved. Verify that the main to be disinfected is isolated from the system and not pressurized.

**TS 7.30.08.02 Standard Chlorination**

Before beginning chlorination, establish the proper flow rate in the main and adjust the flushing rate and dosage rate as required to achieve the proper chlorine dosage. During the chlorination procedure, perform ongoing residual chlorine checks on the live side of the watermain to ensure there is no leakage or contamination of super chlorinated water entering the active distribution system.

The following two methods of chlorination are acceptable for standard disinfection of watermains including temporary bypass systems.

**TS 7.30.08.02.01 Continuous Feed**

Refer to AWWA C651.

The flow is adjusted to a constant known rate and sufficient chlorine is added to completely fill the main with chlorinated potable water to produce a homogeneous chlorine solution as specified in Table 1. Once this steady state is achieved the chlorinated water is left standing for a specified minimum contact time. For concentration and contact time see Table 1.

To assure that the desired concentration is achieved, the disinfection crew shall measure the chlorine concentration at regular intervals using the appropriate chlorine test kits. Chlorine application is to continue until the entire main is filled with heavily chlorinated water.
**TS 7.30.08.01.01 Free Chlorine Residual at the End of Contact Time**

Successful disinfection is achieved only when the free chlorine residual in the watermain is greater than 50 per cent of the original concentration at the end of the contact time. Perform residual checks on the live side of the watermain during the waiting period to ensure there is no leakage or contamination of super chlorinated water entering the active distribution system.

**TS 7.30.08.02 Slug Method**

Refer to AWWA Standard C651.

Chlorine and water are applied to the main at a constant measured rate so that a solid column of highly chlorinated water is achieved and moved intact along the watermain so that all interior surfaces have a minimum contact time as specified in Table 1.

The free chlorine residual must be monitored as the slug progresses along the main. If the free chlorine residual falls below 50 per cent of the original concentration, the flow is to be stopped, the chlorination equipment relocated to the head of the slug, and additional chlorine must be added at the head of the slug to re-establish the predefined concentration. As the slug advances along the main, all valves, hydrants and side branches will be exposed to the disinfecting solution.

**Table 1: Chlorine concentration and contact time**

<table>
<thead>
<tr>
<th>Chlorination method</th>
<th>Concentration for main type</th>
<th>Contact time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Feed</td>
<td>25 mg/L (PPM) – temporary by-pass service connections</td>
<td>24 hours</td>
</tr>
<tr>
<td>Continuous Feed</td>
<td>100 mg/L (PPM) – mortar lined and concrete pipes</td>
<td>24 hours</td>
</tr>
<tr>
<td>Continuous Feed</td>
<td>250 mg/L (PPM) – PVC</td>
<td>24 hours</td>
</tr>
<tr>
<td>Continuous Feed</td>
<td>250 mg/L (PPM) – cast iron and ductile iron</td>
<td>48 hours</td>
</tr>
<tr>
<td>Slug Method</td>
<td>300 mg/L (PPM) – all pipe materials</td>
<td>3 hours</td>
</tr>
<tr>
<td>Slug Method</td>
<td>300 mg/L (PPM) – transmission main</td>
<td>3 hours</td>
</tr>
<tr>
<td>Slug Method</td>
<td>300 mg/L (PPM) – temporary bypass mains</td>
<td>3 hours</td>
</tr>
<tr>
<td>Slug Method</td>
<td>temporary bypass service connections</td>
<td>not permitted</td>
</tr>
</tbody>
</table>

**TS 7.30.08.03 Flushing after Disinfection**

Measure the free chlorine residual before beginning the process for final flushing. If after the prescribed contact time the free chlorine residual is greater than 50 per cent of the original level at all sample points, flush the heavily chlorinated water from the main through hydrants and blow-offs until the chlorine residual does not exceed 2.0 milligrams/litre or is the same as the chlorine residual level of the incoming water in the active water distribution system and the turbidity is less than one NTU or no higher than incoming water. Once these parameters are achieved, flushing should continue for at least an extra 30 minutes during which the total chlorine residual should consistently be less than 2.0 milligrams/litre. The maximum chlorine residual level in the watermain after final flushing shall be less than 2.0 milligrams/litre or the same as the chlorine residual level of the incoming water at the time of disinfection. Testing of the incoming water for chlorine residual level may be required if the residual chlorine level of the watermain after final flushing exceeds 2.0 milligrams/litre.
If the chlorine residual level is greater than 2.0 milligrams/litre or higher than the chlorinated mains, continue to flush for 30 minutes beyond the achievement of the correct levels.

**TS 7.30.08.04 Short Filler Pieces and Appurtenances**

Where normal disinfection methods are not possible or work is accomplished in manner that precludes the possibility of contamination of the main, clean short filler pieces—less than one pipe length—and appurtenances, remove dirt and debris and disinfect the entire interior surface area by spraying or swabbing the filler pieces, fittings and couplings with a minimum 5 per cent solution of fresh sodium hypochlorite, and flush the affected section of main until the total chlorine residual is equal to the source water. Prior to tapping, clean and wipe the exterior of the main with a 5 per cent solution of fresh sodium hypochlorite.

**TS 7.30.08.05 Disposal of Chlorinated Water**

To minimize the risk of backflow into the active distribution system, ensure all hydrants and blow-offs within the newly chlorinated main are open prior to opening the isolation valve connecting the active system to the newly chlorinated main.

After the retention period, discharge chlorinated water into a sanitary sewer. If a sanitary sewer is not available, do not discharge to a storm sewer, open ditch or watercourse unless the chlorinated water has been de-chlorinated. A list of de-chlorinating (neutralizing) agents may be found in Appendix C of AWWA C651. All discharges must comply with Toronto Municipal Code, Chapter 681 Sewers.

**TS 7.30.09 BACTERIOLOGICAL AND WATER QUALITY SAMPLING**

**TS 7.30.09.01 (Not Used)**

**TS 7.30.09.02 Water Sampling and Analytical Tests**

Collect samples from points along the main, including both ends. At least one set of samples shall be collected from every 350 m of the main and one set from each branch. In areas where the Contract Administrator suspects possible contamination, sampling shall be taken at intervals no greater than 60 m.

After de-chlorination and flushing of the watermain and if the turbidity count is less than or equal to one NTU and the chlorine residual is less than 2.0 ppm (milligrams/litre), the first set of samples at all sampling points shall be collected according to AWWA C651. A second set of samples shall be collected from the new watermain that has stood for at least 24 hours after the first set of samples is collected.

All samples shall be collected in a manner as to avoid contamination from the environment surrounding the main. Collect samples for bacteriological analysis in sterile bottles treated with sodium thiosulfate as required by handbook *Standard Methods for the Examination of Water and Wastewater*. Do not obtain samples from a hose or fire hydrant unless there are no alternative sampling points available.

**TS 7.30.09.03 Re-disinfection**

If the initial disinfection fails to produce satisfactory results, re-flush and re-sample, or re-disinfect the main as required by the Contract Administrator. If check samples also fail to produce acceptable results, disinfect the main again until satisfactory results are obtained.
To confirm the source water parameter levels, take samples representative of the water in an unaffected part of the distribution system, upstream of the newly disinfected main (upstream samples).

**TS 7.30.09.04 Sampling for Short Filler Pieces and Appurtenances**

For short filler pieces and appurtenances, where standard disinfection methods are not applied, take samples immediately after flushing. Process the samples immediately and analyze the results to confirm that there is no deterioration of water quality based on acceptance standards.

**TS 7.30.09.05 Water Quality Guidelines for Disinfection Approval**

Table 2 represents results deemed acceptable for placing the watermain back in service.

**Table 2: Water quality guidelines for disinfection approval**

<table>
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<th>Standard</th>
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<tbody>
<tr>
<td>Total Coliform</td>
<td>0/100 ml</td>
</tr>
<tr>
<td>E. Coli</td>
<td>0/100 ml</td>
</tr>
<tr>
<td>Background Colony Counts</td>
<td>≤ 20/100 ml</td>
</tr>
<tr>
<td>Heterotrophic Plate Counts</td>
<td>≤ 50/1 ml</td>
</tr>
<tr>
<td>Total Chlorine Residual</td>
<td>0.5 to 2.0 mg/L</td>
</tr>
<tr>
<td>pH Level</td>
<td>7.0 – 8.5</td>
</tr>
<tr>
<td>Turbidity</td>
<td>≤ 1.0 NTU</td>
</tr>
</tbody>
</table>

Match the chlorine residual levels of the incoming water of the water distribution system at the time of disinfection. If a chlorine residual level of 0.50 milligram/litre cannot be reached, continue to flush the main until the chlorine residual level is equal to the chlorine residual level in the existing water distribution system at the time of disinfection.

While samples meeting the above criteria are indicative of a satisfactory disinfection, Toronto Water – District Operations may apply discretion and approve disinfections where certain non health related criteria are not met due to incoming water quality.

**TS 7.30.09.06 Test Results**

Fax copies of all laboratory water quality test results to the Contract Administrator.

Upon receipt of the water quality test results, the Contract Administrator will determine if the test results are satisfactory. The Contract Administrator will provide a copy of the test results to Toronto Water. On receipt of confirmation of satisfactory results from the Contract Administrator, Toronto Water staff will put the new main into service.

**TS 7.30.09.07 Connecting to Existing System**

For new watermain replacement projects, the Contractor shall use a tapping sleeve and valve to connect to the existing water distribution system before starting to construct the new watermain. Upon completion of live tapping, a coupon shall be provided to the Contract Administrator.
Prior to making the connection, the Contractor is to provide each affected customer with a copy of the City’s standard “Notification to Customer”, advising the customer to flush all their taps prior to using the water.

**TS 7.30.10 DISINFECTION OF WATERMAINS IN EMERGENCY SITUATIONS**

When an existing main develops a leak and repairs are carried out while the main remains under positive pressure, no disinfection is required. However, as a precautionary measure, dewater the excavation, and if necessary, apply fresh hypochlorite granules to the open trench. Spray the exterior of the watermain and all materials used in the repairs with 5 per cent solution of fresh sodium hypochlorite.

Where pipe sections are removed to facilitate repairs, the following action shall be taken:

a) Dewater open trench areas.

b) Spray and swab all portions of all pipes, fittings, and materials used in repairs that will be in contact with the water supply, with a 5 per cent solution of fresh sodium hypochlorite.

c) Apply liberal quantities of hypochlorite to the open trench. In the event that the trench water cannot be pumped to a sanitary sewer, the trench waters must be de-chlorinated before entering a storm sewer or catch basin with the use of a de-chlorination device.

d) Using unidirectional flushing on the section of the system that contains the repaired watermain, flush out the system from all connection points with the system until the water is clear and returns an acceptable chlorine residual result.

e) The isolation valve at one end of the repaired section of main shall be opened to charge the main and place the main it into partial service.

f) When there is suspicion of contamination in the main, a standard disinfection of the main shall be completed.

g) Take bacteriological samples after completion of repairs to provide a record for determining the procedure's effectiveness. If the direction of flow is unknown, take bacteriological samples on each side of the main break. If water sample results do not meet the guidelines specified in Table 2, Toronto Water staff shall evaluate the situation, initiate appropriate corrective action, and continue with daily sampling until bacteriological samples have recorded two consecutive acceptable results.
Construction Specification for 
Watermain and Water Service Tracer Wire

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TS 7.40.01      SCOPE

This specification covers the work to be undertaken for watermain and water service tracer wire installation.

Supply all labour, materials, tools, equipment, and transportation to complete the works as described in this document, as shown on the drawings, and as necessary by evidence.

TS 7.40.01.01     Workmanship

Skilled labour only shall be used for all work.

All work shall be performed according to instructions given by the Contract Administrator or his duly appointed representative using the most suitable equipment.

TS 7.40.01.02     Handling and Storage

Material shall be stored so as to prevent injury to persons and to prevent the delay of work by others.

All materials which can be damaged by exposure to the elements must be stored in a clean and dry enclosure.

TS 7.40.02     REFERENCES – Not Used

TS 7.40.03     DEFINITIONS – Not Used

TS 7.40.04     DESIGN AND SUBMISSION REQUIREMENTS – Not Used

TS 7.40.05     MATERIALS – Not Used

TS 7.40.06     EQUIPMENT – Not Used

TS 7.40.07     CONSTRUCTION

TS 7.40.07.01     General

i. Tracer wire shall be installed on all non-ductile iron watermains, hydrant laterals and water services except where such water service pipe is of copper material. The wire shall be installed in such a manner as to be able to properly trace all watermains, hydrant laterals and water services without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.

ii. Tracing wire shall be RWU90, AWG N° 10 single or seven strand, insulated copper wire with 60 mil of black, cross-linked polyethylene (XLPE) insulation specifically manufactured for direct burial applications.
iii. All tracer wire welds onto existing cast or ductile iron pipe shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. The mastic shall be TC Mastic (Tapecoat of Canada) or approved equivalent and shall be applied in a thick coat a minimum of 12 mm thick and shall be protected from contamination by the backfill material with the use of a plastic membrane. As an alternative, Royston Handy Cap prefabricated assemblies used in conjunction with Royston Roybond 747 Primer may be used. In all cases, the pipe is to be properly cleaned and material applications shall be according to the manufacturer’s instructions.

iv. All spliced or repaired wire connections in the tracer wire system shall be made using a Model Number 454, Catalogue Number 30-454, Wing Nut Wire Connector (for 2 - 4 AWG N° 10 wires), or approved equivalent, and made waterproof using an approved buried service wire closure. The buried service wire closure shall be either a Klik-It II Model C8816 Buried Service Wire Closure or a Raychem GHFC-2-90 H-Frame Gel Closure or approved equivalent.

TS 7.40.07.02 Installation Procedure

i. At the point of connection between cast or ductile iron watermains, with any non iron watermain, the tracer wire shall be properly connected to the iron pipe with a thermite weld or approved equivalent.

ii. Tracer wire shall be laid flat and securely affixed to the pipe at three metre intervals. The wire shall be protected from damage during the execution of the works. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At water service saddles, the tracer wire shall not be allowed to be placed between the saddle and the watermain.

iii. Except for approved spliced in connections, tracer wire shall be continuous and without splices from valve chamber to valve chamber, valve chamber to fire hydrant or fire hydrant to fire hydrant.

iv. At fire hydrants, no spliced in tracer wire connections shall be allowed regardless of the type of material of the hydrant lateral. The main line tracer wire shall follow and be secured to the hydrant lateral up to and back from the hydrant and then continue along the watermain. The tracer wire shall be wrapped neatly around the hydrant above grade and above the breakaway flange with at least 2 m of slack in the tracer wire above grade.

v. At existing iron or copper water service connections where any portion of the water service is replaced with a non-ductile iron or non-copper material, a water service tracer wire shall be spliced into the watermain tracer wire and then connected to, the remaining iron water service by means of a thermite weld, or the remaining copper water service using a ground clamp sized appropriately for the copper pipe.

vi. At water service connections where there is no tracer wire on the existing watermain and the water service connection is neither iron nor copper pipe, tracer wire shall be thermite welded to the watermain tee or tapping valve and placed along the water service to a point where the water service enters either inside the building or water meter chamber and shall be configured at the valve box according to TS 7.40.07.02 (viii) herein. The tracer wire inside the water meter chamber shall be brought up and attached under the access cover. The tracer wire brought into the building shall be left with a minimum of one metre of slack.
vii. In valve chambers, a 12 mm diameter stainless steel eyebolt complete with stainless steel nut and 50 mm diameter stainless steel flat washer shall be installed between the layers of frame and cover adjustment rings. The eyebolt shall be of sufficient length to allow the nut and washer to be positioned on the outside of the adjustment rings. The tracer wire is to be securely affixed to the eye of the bolt with enough slack in the wire to extend a minimum of one metre above grade. The wire shall be brought through the wall into the chamber with the pipe and placed neatly along the inside wall of the chamber and brought up to the eyebolt.

viii. Where a valve box is used instead of a valve chamber, the tracer wire from both directions shall be secured every 500 mm to the outside of the valve box and be brought up on the outside of the valve box to a point 100 mm below grade and then brought into the valve box and left with an additional 500 mm of slack.

ix. At all watermain end caps, a minimum of 2 m of tracer wire shall be extended beyond the end of the pipe, coiled and secured for future connections. The end of the tracer wire shall be spliced to the wire of a 2.7 kg zinc anode and is to be buried at the same elevation as the watermain.

x. For directional drilling, augering or boring installations, four #8 tracer wires shall be installed with the pipe and connected to the tracer wire at both ends, or thermite welded to the existing iron pipe at both ends.

The installation procedure is illustrated in Figure 1.

Figure 1: Illustration of installation procedure

**TS 7.40.07.03 Repairs and Watermain Cleaning and Lining Contracts**

i. At all repair locations in cast or ductile iron pipe, double tracer wires shall be placed across the repaired section and securely thermite welded to the iron pipe within 300 mm of both ends of the repair according to TS 7.40.07.01 (iii) herein.

ii. At all repair locations where there is existing tracer wire, the tracer wire shall be properly reconnected and spliced according to TS 7.40.07.01 (iv) herein.
iii. Whenever any valve or pipe repair occurs within or at a valve chamber, tracer wire shall be thermite welded to the existing cast or ductile iron pipe on both sides of the replaced section. Tracer wire within the valve chamber shall be configured and secured according to TS 7.40.07.02 (vii) herein.

iv. Whenever any valve or pipe repair occurs at valve box locations, tracer wire shall be thermite welded to the existing cast or ductile iron pipe on both sides of the replaced section. Tracer wire shall be configured and secured according to TS 7.40.07.02 (viii) herein.

**TS 7.40.07.04 Spliced Connections**

Spliced connections between the main line tracer wire and branch connection tracer wire shall only be allowed at watermain tees, crosses or at iron or copper water services where a portion of the branch connection watermain or water service is replaced with a non iron or non copper material. The branch connection tracer wire shall be a single tracer wire properly spliced to the main line tracer wire. Where the existing branch connection is neither iron nor copper, then the new branch connection tracer wire shall be properly spliced to the existing tracer wire on the branch connection. All spliced connections shall be made according to TS 7.40.07.01 (iv) herein.

**TS 7.40.08 QUALITY ASSURANCE**

**TS 7.40.08.01 Tracer Wire System Testing**

The Contractor shall conduct and produce a Tracer Wire Certification that the entire tracer wire system is installed and functioning properly according to TS 7.40.07.01 (i) herein.

If deficiencies are found in the tracer wire system when tested by City forces, then the Contractor shall be charged the full cost incurred by the City for all subsequent visits to site to confirm functionality and acceptability of the tracer wire system. Such costs shall be deducted from the Contractor’s final payment.

**TS 7.40.09 MEASUREMENT FOR PAYMENT**

**TS 7.40.09.01 Watermain and Water Service Tracer Wire Installation**

Not applicable.

**TS 7.40.10 BASIS OF PAYMENT**

**TS 7.40.10.01 Watermain and Water Service Tracer Wire Installation - Item**

There is no separate payment for the supply and installation of tracer wire on any construction or installation of non-ductile iron watermain, hydrant laterals and non-copper water services by the Contractor. The Contractor shall consider the supply and installation of tracer wire incidental to all construction of non-ductile watermain, hydrant laterals and non-copper water services, and any construction and installation of other related utility structures as specified in the Contract.
# Specification for the Cured-In-Place Pipe Lining of Watermains

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TS 7.60.01 Scope

This specification is for Cured-in-Place Pipe (CIPP) tight fit lining of the various sizes of watermains pipes in the city of Toronto. The Work shall include performing the following operations: traffic control, temporary water lines and services, pavement cutting, excavation and access pits, cutting the watermain, measuring the watermain (including inside diameters), dewatering, replacement of necessary valves or valve parts, replacement of hydrants, cleaning and preparing the watermain, grinding of service taps, disposal of water and waste products from cleaning operations, installing and curing the CIPP lining, liner samples and testing, reinstatement of all services, protection of the lining, CCTV inspections at various stages, chlorination and disinfection, cathodic protection, jumper and tracer wires, pressure testing, flushing, close-up of the watermain, back-filling of the excavation, restoration, repairs to pavement, repairs to the boulevard, clean-up of the site of the work, the guarantee and all other incidental work and services.

Where hydro pole support is required it shall be the responsibility of the Contractor. The Contractor shall make arrangements with Toronto Hydro. The Contract Administrator will assist in coordinating with Toronto Hydro if necessary.

The work involved requires special equipment to be handled by persons experienced in all phases of the work.

TS 7.60.02 Information to be Submitted with Bid

The Tender Call requires the following information to be submitted with the Bid for the review and approval of the Contract Administrator. Further information could be required to be submitted elsewhere in the Tender Call other than in TS 7.60 herein.

Submit with Bid:

1) The name of a professional engineer licensed in the province of Ontario who will provide the CIPP liner engineering designs required according to the liner design requirements in TS 7.60 herein. The professional engineer shall be authorized to perform such work by Professional Engineers Ontario (PEO).

2) An engineered liner design for each watermain size to be lined that clearly shows the proposed liner thickness. The designs shall be according to TS 7.60 herein and shall identify all design parameters including the short-term and long-term CIPP properties used in the design. A one page designs summary shall be provided showing for each watermain size, the design liner thickness, the design pressure and the design watermain depth. The designs shall approved by an Engineer bearing the seal and signature of an Engineer.

3) Independent test data shall be provided to substantiate the CIPP material strength and modulus used in the design.

4) Approval certifications complete with supporting literature of NSF/ANSI Standard 61 for potable waters for the CIPP watermain liner to be used.

5) Material specifications of the proposed watermain liner in sufficient detail to enable confirmation by the Contract Administrator that the materials proposed will meet the design requirements in TS 7.60 herein.
6) Structural details of the proposed watermain liner in sufficient detail to enable confirmation by the Contract Administrator that the design will meet the design requirements in TS 7.60 herein. Include sufficient detail pertaining to the tight fit of the CIPP liner to the existing watermain that clearly indicates how the completed CIPP liner will not have any gap or annular space between the liner and the existing pipe.

7) A summary of the Contractor’s proposed installation procedure including an example of the design process wet-out plan and curing cycle summary sheet to be submitted for each liner diameter.

8) A certified original copy complete with supporting literature from the resin manufacturer of the Infrared Spectrograph of the catalyzed resin mixture proposed for the Contract.

**TS 7.60.03 Operation of Valves and Hydrants**

In the event that in-service watermain valves require operation during the course of construction, Toronto Water staff will be the only individuals permitted to operate these valves. The operation of all live valves and hydrants, in connection with cleaning and lining watermains and disinfection shall be done by a the City’s crew certified under Ontario Regulation 128/04 or under the direct supervision of a representative of the Contract Administrator.

In districts North York and Toronto /East York (former city of York, east of the Humber River) all valves supplied to these areas will open by operating in a clockwise direction.

In districts Etobicoke /York (former city of Etobicoke, west of the Humber River) and Scarborough all valves supplied to these areas will open by operating in a counter clockwise direction.

The Contractor will be required to keep and maintain a real time log book which logs the operation of any system valves—main line and bypass—found within the limits of the contract including valves on the temporary bypass system. Such a log book is to be presented daily for copy and signature to the on-site Inspector. The log book layout/format will be decided upon at pre-construction meeting. Primarily the Contractor will be asked to record the address of the valve, the date, time and reason for operation, time opened and/or closed as appropriate as well as the name of the individual operating the system valves.

**TS 7.60.04 Notification to Public and Log Record**

Unless otherwise required in the Special Specifications, three notices, as described below, shall be distributed to properties that will be affected by the work. Notice #1 shall be delivered by the City. Notices #2 and #3 shall be delivered by the Contractor. The Contractor shall maintain a log record of notices delivered by the Contractor and follow-up activities by the Contractor at each property throughout the contract work.

**Notice #1 (Initial Notice)**

A City notice, delivered by the City, that provides a brief introduction to the upcoming watermain CIPP lining construction contract, identifies the Contract Administrator and provides a contact phone number for the Contract Administrator. Notice #1 shall be delivered by the City to all properties in the contract area sometime well in advance of the start of onsite activities by the Contractor.
Notice #2
A City notice, delivered by the Contractor, that identifies the Contract Administrator and provides a detailed description of the upcoming construction work, contact phone number for contractor, including periodic interruptions of water service and details of temporary water servicing etc. Notice #2 may include information sheet(s) from the City for the property resident. Notice #2 shall be delivered to all effected properties in the contract area one week before any temporary bypass lines, temporary water services or excavations take place. Delivery of Notice #2 should be zoned based on construction activities and therefore may be separately distributed for different construction zone areas. The Contractor shall produce the number of copies of the notices including any information sheets required for distribution.

Notice #3
A Contractor notice, delivered by the Contractor that advises the property resident of the opportunity to obtain a price for replacement of the private side of the water service by the Contractor. Such work is between the Contractor and the property owner and is not related to the contract or the City. Notice #3 shall be delivered to all effected properties once the construction activities have commenced and may be delivered by construction work zones using separate delivery schedules. The Contractor shall produce the number of copies of the notices required for distribution.

Record Log of Notifications and Follow-up Work
The Contractor shall make and maintain a log record. The log shall record the address where each notice was delivered, the date of delivery and any other information relevant to maintaining a record of notifications, such as follow-up telephone calls or property visits. The log shall also record date and description of any work performed at a property, such as installation of shut-off ball valves, disconnection of water meters and installation of hose bibs or other devices for temporary water service to the property, activation of temporary water service and deactivation of temporary water service. The log shall be maintained in a common electronic format, such as an MS Excel document. The log shall be provided to the Contract Administrator.

TS 7.60.05 Temporary Watermain Bypass Lines
The Contractor shall supply, install temporary and maintain watermain bypass lines for watermains removed from service for CIPP lining operations. The work shall include the supply of all labour, Equipment and Material required for the following operations: installing the temporary line, temporary fire hydrants and connections, valves and check valves where required, supply connections, chlorination, protection of the installation from damage, temporary shut-off of private services by operation of curb-stops or such other means as required, removal of temporary service connections and bypass line and restoration of the site upon completion of the work. All bypass line materials shall conform to the NSF/ANSI Standard 61.

Temporary bypass lines shall be supplied by connections at each end of the line where practical. Where the ends are at different pressure districts, a check valve shall also be installed. Valves shall be installed in the bypass in the vicinity of existing main line valves on the line being cleaned and lined and also where 50 mm bypass line connects into 100 mm bypass line or at such other locations as the Contract Administrator may direct. The existing watermain shall not be removed from the service until the Contract Administrator has approved the installed bypass line.
Progress payment(s) for the temporary bypass lines will be pro-rated based on the estimated quantity of watermain in the Pricing Form and length of existing watermain taken out of service and only paid when temporary bypass lines are placed in service.

The Contractor shall maintain temporary water service lines shall be maintained in a safe operative condition at all times and shall be responsible for the prevention of injury to persons and damage to property. The Contractor shall provide safeguards, but such provisions shall not relieve the Contractor of full responsibility for the adequacy of protection.

The Contractor must repair any leaks that are found or that may develop on any portion of the temporary bypass line. If a leak is not repaired, the Contract Administrator may deduct from the Contractor's progress payment the cost of the water lost as a result of the leak. Moreover, should it be necessary for City forces to repair any portion of the bypass system as a result of the Contractor not responding within a 2-hour period, any costs incurred by the City for such repairs will be deducted from the Contractor’s progress payment.

**TS 7.60.06 Temporary Water Services**

The Contractor shall supply, install and maintain temporary water services where required to properties affected by CIPP watermain lining operations. All temporary service connection materials should conform to the NSF/ANSI Standard 61. All hose used for individual property connections, shall be minimum 20 mm internal diameter, designed for a working pressure of 860 kPa and be free from defects in material and workmanship. The pipe, hose and all other materials which are to be furnished by the Contractor for use in conjunction with the temporary service pipe and temporary connections to property services and branches shall be approved by the Contract Administrator, and shall be fully adequate to withstand the pressures and all other conditions of use and shall be of material which does not impart any taste or odour to the water in accordance with NSF/ANSI Standard 61.

Pipe and fittings shall provide adequate water tightness and care shall be exercised throughout the installation of any temporary pipe and service fittings to avoid the possible pollution of any City main or property services or contamination of the temporary service pipe proper. Flushing of the private service connections and chlorination of the bypass line prior to their use will be required.

The temporary service connections shall be valved near the point of connection to the bypass and also to the private plumbing system so that both the bypass line and private services may be chlorinated separately from the final connection.

During freezing, stormy or inclement weather, no work shall be done except that which is incidental to cleaning or lining, unless otherwise directed by the Contract Administrator.

No bypass service pipe or property service connections shall be installed during freezing or inclement weather and pipes already in use shall be removed or drained and services restored when so directed by the Contract Administrator.

Each home shall have its own temporary water service connection to the bypass pipe and a connection to the private plumbing via a wye at an outside tap. The branching of wyes from a single spigot shall not be permitted; nor will connecting homes in series.

It shall be the responsibility of the Contractor to ensure an adequate water supply at all times. During the construction process, the Contractor will be responsible to restore a customer’s water supply within a two hour time period upon notification from the Contract Administrator.
**TS 7.60.07 Temporary Hydrants**

The Contractor shall supply, install and maintain temporary fire hydrants and the necessary valves and fittings. These temporary hydrants shall be connected to 100 mm diameter bypass pipe and placed in locations as instructed by the Contract Administrator. The temporary hydrants shall be 62 mm nozzles with 5-threads per 25 mm. The operating nuts shall be 32 mm square.

The hydrants will be set in such a manner that the Toronto Fire Services will have no difficulty making a connection with a fire hose, and where they will cause least obstruction to vehicular and pedestrian traffic and will be least likely to be damaged. Temporary fabricated fire hydrants are acceptable.

A detailed sketch of the hydrant the Contractor proposes to use must be submitted prior to commencement of work.

All temporary hydrants, valves, fittings, and service pipe and all other material shall be adequate to withstand the pressures and conditions of use and shall provide adequate water-tightness. Before permanently shutting down the watermain that is to be cleaned and lined, the Contractor shall test all temporary hydrants and valves to be sure that they are in proper working order.

All temporary hydrants must have reflective tape on the barrel for increased visibility. The temporary hydrants must stand in an upright position at all times. Once put into use, the temporary hydrants shall be maintained until the existing hydrants are restored to service. The hydrants which are out of service during construction operations shall be bagged and clearly marked with a "Hydrant Out of Service" tag.

**TS 7.60.08 Burying Temporary Bypass Lines**

The Contractor shall cut and remove asphalt across streets to permit burying the bypass pipe without disturbing the concrete base, and shall replace the asphalt when the pipe is removed. Under no circumstance is a pipe road crossing to remain open and unprotected from vehicular and pedestrian traffic.

**TS 7.60.09 Connection to Hydrants**

All temporary bypass service attachments and any other attachments to fire hydrants shall be made with an approved backflow prevention device and shall be made in such a manner that if it becomes necessary they can be easily removed so that the hydrant can be used for fire fighting purposes.

**TS 7.60.10 Disinfection of Temporary Bypass Lines and Service Connections**

Disinfection shall be according to TS7.30 – Procedure for Disinfecting Watermains.

All temporary bypass lines and service connections shall be disinfected by the Contractor under the supervision of the Contract Administrator.
The Continuous Feed Method of Disinfection can be used by adjusting the flow to a constant known rate and sufficient chlorine is added to completely fill the main with chlorinated potable water to produce a homogeneous chlorine solution as specified in TS 7.30, Table 1. Once this steady state is achieved the chlorinated water is left standing for a specified minimum contact time. For concentration and contact time, see Table 1 in TS 7.30.

To assure that the desired concentration is achieved, the disinfection crew shall measure the chlorine concentration at regular intervals at available ferrules using appropriate chlorine test kits. Chlorine application is to continue until the entire temporary service pipe is filled with heavily chlorinated water.

Where temporary service connections are disinfected in conjunction with the temporary bypass watermain no physical connections to hose bobs will be permitted until after successful disinfection.

Where temporary bypass service connections are disinfected offsite in a controlled environment one set of samples shall be collected from every 350 m of service hose connected in a series. One set of samples shall also be taken from the source and at each end of any hose group connected in series, regardless of total length. Where temporary bypass service connections are disinfected in conjunction with the temporary bypass watermain additional samples must be taken at the end of any two temporary bypass service connections for every 350 m of temporary bypass watermain disinfected.

Each sample taken shall be properly labeled and sealed as approved by the Contract Administrator.

The Contractor is responsible to arrange with the approved accredited laboratory to fax or e-mail all copies of water quality test results to the Contract Administrator or the City’s representative where specified.

During the disinfection, an operator, certified under Ontario Regulation 128/04, shall be on site to operate hydrants and valves on the active distribution system. If no certified operator is available, the Contractor shall notify Toronto Water, District Operations section at least 48 hours in advance to make arrangements for a certified operator.

All water sampling equipment for field-testing must be properly maintained and calibrated to factory specifications and be accurate within 5 per cent of the required water quality standards.

**TS 7.60.11 Operation of Service Boxes**

The Contractor shall locate, inspect and ensure that all curb stops operate properly in advance of working on the street. During construction, if a curb box becomes inoperable, the Contractor may be required to repair the curb box by an approved method. The Contractor shall adjust curb boxes to grade where necessary.

Before carrying out the repair of curb boxes the Contractor shall submit a list, in a format approved by the Contract Administrator, of defective curb boxes for inspection and approval by the Contract Administrator’s representative.

The defective curb boxes shall be repaired or excavated/replaced as required with new curb box and stainless steel rod, using a vacuum excavation method, connecting the rod to the curb stop with a cotter pin; adjustable ball bearings will not be permitted to make this connection.
The replacement shall be complete up to and including 25 mm water services including restoration according to the Special Specifications and supply and installation of extensions fittings, if required, to raise new curb box to grade site restoration. Where required, the work shall include raising or chip out or both of existing curb boxes.

**TS 7.60.12 Shut-Off of Water Services**

The Contractor shall make all shut-offs of property services and shall furnish water for the temporary bypass service from a hydrant or other temporary source.

**TS 7.60.13 Protection of Public**

The Contractor shall be required, at no extra cost to the City, to mound over the bypass pipe with asphalt or other acceptable material, wherever it crosses a street, driveway or sidewalk in order to prevent injury to pedestrians or damage to vehicles. The use of a polyethylene sheet shall be required as a barrier on concrete or interlocking driveways or both. If the work performed or the material used is not to the satisfaction of the Contract Administrator, action will be taken to rectify the problem to ensure the safety of the public. All costs incurred in such rectification shall be deducted from the Contractor's payment.

Safety flashers and barricades as may be required shall be furnished and maintained by the Contractor. In general, the temporary service pipe shall be laid where it will cause the least obstruction and is least liable to get damaged.

**TS 7.60.14 Access Pits**

The Contractor shall excavate pits for accessing the watermain for the CIPP lining process. The Contractor should use locations of existing tees, crosses, reducers and valves for access pits locations wherever this is feasible. When an access pit is excavated and a fitting is contained within it, the Contractor shall replace the fitting. The Contractor shall use existing valve, bend and tee locations as access pits as often as possible.

The Contractor shall note that the locations for all access pits shall be approved by the Contract Administrator prior to the beginning of construction. The work shall include all excavation, shoring, dewatering, bracing protection and restoration of access pits. Valves and fittings in close proximity to access pits shall be braced as required.

At the request of the Contract Administrator or due to unforeseen conditions, the Contractor shall excavate, supply and replace complete tees, bends including vertical bends, crosses, reducers and obstructions etc. including cathodic protection, jumper and tracer wire. The backfill and restoration shall be according to the Special Specifications.

When excavating bends/fittings/access points to watermains, and the access point requires the Contractor to remove water service connections, the Contractor shall be responsible to re-establish the water service connections to the watermain prior to backfill by re-tapping or relocating the service connection within the excavation.

Additional access pits may be required for the CIPP lining process due to unforeseen conditions. Such additional pits shall include all the work required for a regular pit. Payments for such additional pits shall be made at the Contract Price.
**TS 7.60.15  Cathodic Protection, Jumper Wires and Tracer Wires**

At all locations where cast or ductile iron watermain have been exposed and accessed, including all pit locations, sacrificial anode shall be installed. The Contractor shall supply and install 14.5 kg magnesium anode and the lead thermite welded to the iron pipe or fitting in accordance to TS 7.20 – *Construction Specification for Cathodic Protection of Existing Iron Watermains*.

At all locations where the iron pipe has been accessed, the Contractor shall install jumper wires to create or maintain the electrical continuity of the iron watermain including for existing and new iron pipe and iron fittings. Jumper wire shall be RWU90, number 10 gauge, single strand, insulated copper wire with 60 mil of polyethylene insulation. Jumper wire shall be attached to all pipe and fittings by thermite welding.

Where plastic pipe has been installed between sections of iron pipe, a tracer wire shall be installed directly above the plastic pipe. The tracer wire shall be thermite welded to the adjacent iron pipe at each end of the plastic pipe section to maintain electrical continuity of the iron watermain. Tracer wire shall be RWU90, number 10 gauge, single strand, insulated copper wire with 60 mil of polyethylene insulation.

**TS 7.60.16  Cutting of Pipe**

Where reconnection is required, watermain pipe shall be cut with proper cutting devices such as power operated cut-off saws or other approved methods. Cuts shall be neat and square to the watermain and be free of jagged ends or lips. Watermain pipe shall not be broken apart unless all pieces with broken ends are to be discarded.

**TS 7.60.17  Capping Open Pipe Ends**

All watermain pipes shall be capped, plugged or bulk-headed using a mechanical joint plug/cap anytime there is no work being performed on the pipe. The bulkhead must be capable of preventing water from entering or exiting the watermain pipe, and should be equipped with a relief valve and be properly braced when the possibility exists that the capped section could be pressurized.

**TS 7.60.18  CCTV Equipment, Inspections and Reports**

The Contractor shall carry out two CCTV inspections, the V2 and V3 as part of their contact deliverables. The Contract Administrator will use these CCTV inspections as part of the approval process for the work covered in the CCTV inspections.

The V2 CCTV inspection shall be carried out on the completion of all cleaning and preparation of the existing watermain and prior to lining installation. The V3 CCTV inspection shall be carried out on completion of the liner installation including after all service connections have been reinstated. See further requirements for V2 and V3 CCTV inspections elsewhere in TS 7.60.

Other CCTV inspections may be carried out by the Contractor for the Contractor’s own purposes. These other CCTV inspections shall be done in accordance with the Contractor’s own requirements. The CCTV inspection requirements outlined below are only applicable to V2 and V3 and not applicable to CCTV inspections done for the Contractor’s own purposes.
At the sole discretion of the Contractor, the Contractor may opt to undertake an initial CCTV inspection of the watermain in its as is condition. Should the Contractor elect to do this initial CCTV inspection, it shall be referred to as the V1 inspection. The V1 is not mandatory under the requirements of TS 7.60. The Contractor may choose to perform a V1 inspection for the purpose of documenting the baseline condition of the watermain.

**Requirement for CCTV Equipment to Be Dedicated for Watermains**

All CCTV camera equipment including the cable, any other related equipment that enters the watermain and any external containment or operating equipment, such as the cable reel shall be equipment that is dedicated to the inspection of watermains and shall not be used and shall not have been used for other purposes, such as inspection of sewers.

All CCTV equipment used shall be kept clean and free of contamination by periodically dousing of the equipment with chlorine as needed to assure cleanliness. The Contractor shall be responsible for the frequency of chlorine dousing to prevent any contamination of the watermain by the CCTV equipment.

The requirement for watermain dedicated CCTV equipment applies to any CCTV inspection of watermains and applies regardless of whether the CCTV inspections are Contract required or done for the Contractor’s own purposes.

**Requirements for CCTV Inspection V2 and V3**

The required V2 and V3 CCTV inspections shall be carried out in accordance with the following:

1) The CCTV equipment shall be suitable for and allow viewing of the full perimeter of pipe for all watermain sizes included in the contract. The CCTV equipment shall employ a suitable colour camera with pan and tilt capability. The range of the camera equipment from one access shall allow single pass inspections of not less than 200 m of watermain length.

2) The Contractor shall provide 48 hours notice prior to a required CCTV inspection in order that the Contract Administrator can arrange, if required, to be present for the CCTV inspection.

3) The watermain shall be sufficiently dry so that any remaining water does not obscure any part of the interior of the watermain during the CCTV inspection. The inspection speed shall allow proper analysis of the watermain condition with a maximum travel speed of 5 metres/minute. The inspection must stop and view each service connection clearly and completely for at least 5 seconds. The camera shall provide sufficient light and proper focus to enable clear viewing of the pipe surface at all locations. The video inspection equipment shall be disinfected prior to insertion into the watermain and care shall be taken to avoid contamination of the main during inspection. If required by the Contract Administrator, the Contract Administrator shall be present to view the live CCTV inspection.

4) Each individual CCTV inspection shall be continuous over the watermain section. The CCTV shall have on-screen identification of the location of the inspection including a start screen (or screens) that shown all the information necessary to describe and locate the CCTV inspection. During the inspection the screen shall continuously show a brief watermain section identification and the metered location of the camera within the watermain.
5) Each individual watermain section, CCTV inspection shall be recorded and the recording shall be the complete continuous CCTV inspection. The recorded CCTV inspection shall be provided to the Contract Administrator on digital video disc (DVD) or other approved media. The file name in the DVD shall clearly and concisely identify the CCTV inspection. A DVD may contain more than one CCTV inspection providing that the file name for each inspection properly identifies the CCTV inspection. Filenames that do not properly identify the inspection video will result in rejection of the DVD by the Contract Administrator.

Video inspection file format shall be an MPEG-2 (or other Contract Administrator approved format) that is suitable for proper playback on commonly used video file playing software applications. The video files must play properly in correctly configured, up to date versions of Microsoft Windows Media Player, VideoLAN VLC Player, Apple QuickTime Player Windows and Apple QuickTime Player Mac. Video files that do not play properly on all these five players shall be rejected. In regard to Apple QuickTime, play properly includes meaning that the video may be advanced at any speed (by slider bar or jog shuttle) and the CCTV inspection video will play in a continuous fashion without jumping or other discontinuities in the playback. Video files that fail to play properly in Apple QuickTime Player are typically indicative of improper or inappropriate settings in the CCTV equipment itself in the way it converts the analog CCTV signal to digital format. The contractor shall make sure that the CCTV equipment produces the required digital format.

6) The video inspection shall be accompanied by an inspection report in PDF format on the same DVD. The report shall list and locate all features noted in the CCTV inspection including service connections. The CCTV inspection file and the PDF report file shall be grouped together on the DVD along with any other information relevant to the specific CCTV inspection. The inspection report for each section of watermain inspected shall report as a minimum: contract number, street name, date of inspection, pipe type and size, start and end locations, length of pipe inspected, summary comments, disk, tape and file numbers. The summary comments should identify all distinguishing features of the watermain to include but not limited to service locations, condition of liner (or pre-lining condition of watermain), bends, valves, ponding water and poor visibility.

7) CCTV inspections including reports shall be submitted to the Contract Administrator. These submissions will be used by the Contract Administrator to determine, in part, that the CIPP watermain lining work meets contract requirements and is acceptable to the Contract Administrator.

**TS 7.60.19 Preliminary CCTV Inspection – V1**

At the sole discretion of the Contractor, a CCTV inspection may be carried out to document the existing condition of the watermain prior to any work being performed on the watermain. Should this CCTV inspection be carried out, it shall be done in accordance with the Contractor’s requirements and be referred to as the V1 in keeping with established industry terminology. TS 7.60 requirements for V2 and V3 CCTV inspections are not applicable to a V1. TS 7.60 requirement for CCTV equipment dedicated to watermain use applies to any CCTV inspection of watermains including a V1.
**TS 7.60.20 Water Services Statement**

For each section of watermain to be lined, a *Water Services Statement* form shall be prepared by the Contractor. The form shall list all the service connections, including relevant street address, size, location and so forth. Information shall be started with known service connections from the drawings and curb stops. Additional service connections or service connection information determined from the V1 and V2 CCTV inspections shall be added to the form and include service connections that are to be abandoned and ground flush.

The format for the *Water Services Statement* form shall be an MS Excel spreadsheet or equivalent suitable for electronic information handling. As the information on the form will evolve during the course of the work on the watermain section to be lined, the form shall clearly identify by section of watermain lining and the current date of the form.

A *Water Services Statement* form, finalized for commencement of lining, shall be submitted to the Contract Administrator before start of liner installation. Liner installation shall not proceed without the *Water Services Statement* submission. Where possible the form should accompany the V2 CCTV submission.

The *Water Services Statement* shall be used as a control document for reinstatement of service connections into the lined watermain. Once all service connections have been reinstated, the form shall be updated to identify the reinstatements.

A *Water Services Statement* finalized after lining to include a record of service reinstatements, shall be submitted to the Contract Administrator and accompany the V3 CCTV submission.

For a sample of the *Water Services Statement* form, see appendix herein.

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**TS 7.60.21 Cleaning and Preparation of Watermain**

All rust, tuberculation, deposits, coatings, linings and any foreign materials shall be removed from the inside of the pipe and valves by a method approved by the Contract Administrator. Candidate methods include water-propelled cleaning devices, cable pulled scrapers, rack boring and suitable very high pressure water blasting. The Contractor shall pass the cleaning device through the main as many times as is necessary and in each direction as necessary to obtain results satisfactory to the Contract Administrator.

The cleaned and prepared surface shall be suitable for CIPP liner installation and its long-term performance including the necessary bonding of the liner to the watermain surface. Where any small hard deposit cannot be removed by cleaning and preparation operations and that such deposit is of a size and in a location that will not negatively affect long-term liner performance then, at the discretion of the Contract Administrator lining shall be permitted.

In the event that any service taps protrude too far into the interior of the existing watermain resulting in interference with required cleaning and preparation, or protrude to the extent that they will have a negative effect on the liner including its long-term performance, the service taps shall be trimmed back to an acceptable protrusion length. The method of trimming shall not damage the service taps and the method must be approved by the Contract Administrator.
Cleaning and preparation operations shall be carried out in a manner that will avoid the application of vertical or horizontal loads on the pipe. Boxes of adequate size with compartments or other suitable and approved means shall be provided to function as settling tanks for the retention of solids removed during cleaning, flushing and pumping operations.

On total completion of the cleaning and preparation including grinding of any service taps, the post cleaning and preparation V2 CCTV inspection shall be made.

**TS 7.60.22 Measuring Inside Diameter of Watermain**

The inside diameter of the watermain to be lined shall be accurately measured throughout the length of the lining run using a suitable device. Suitable devices include a laser measuring device that will travel along the inside of the existing watermain. Inside diameter measurements shall be obtained at a maximum of 300 mm spacing along the watermain. The measurements shall be accurate to within 1.5 mm.

The inside diameter measurements to be obtained shall be the size of the watermain to which the liner will be applied. The measurements shall be for the final inside diameter before lining and therefore shall be made after the existing watermain has been fully cleaned and prepared for lining.

The results of the inside diameter measurements shall be used for sizing the liner to be used for each lining run. These measurements shall be used for each lining runs to ensure each liner will provide the required tight fit to the inside surface of the watermain. The final installed liner shall leave no gap or annular space between the liner and the watermain at any location around the perimeter of the watermain along the full lined length.

Where the measurements indicate that the proposed liner will not assure a 100 per cent tight fit over the full range of the diameters measured, the proposed liner shall not be installed and a different sizing of liner shall be used that will assure the 100 per cent tight fit.

Where the range of measurements is such that no liner sizing will assure a 100 per cent tight fit, the Contractor shall advise the Contract Administrator of this finding within 48 hours. No lining shall take place until this situation has been resolved to the satisfaction of both the Contract Administrator and the Contractor. Where no resolution is possible due to the measured size range, the watermain shall not be lined.

**TS 7.60.23 Grinding Flush of Abandoned Service Taps**

Service connections that have been identified as no longer required, that is to say abandoned, shall be ground back flush with the inside surface of the watermain prior to the installation of the CIPP lining and prior to the V2 CCTV inspection. These service connections and their grind-off shall be identified on the *Water Services Statement*. 
TS 7.60.24 Post Cleaning and Preparation CCTV Inspection – V2

When the cleaning and preparation has been fully completed for a watermain section, a post preparation CCTV inspection including report—called the V2—shall be done, recorded and submitted to the Contract Administrator. CCTV inspection and report shall be in accordance with the requirements in this specification. The V2 shall be a record that the watermain section has been cleaned and prepared for lining in accordance with requirements. Where the V2 shall demonstrate that the cleaning and preparation is proper, complete and in accordance with requirements the liner installation may take place at the Contractor’s option prior to any submission to or review by the Contract Administrator of the V2.

When the Contractor opts to install the liner before the V2 has been submitted to and reviewed by the Contract Administrator, the Contractor accepts complete responsibility that the watermain has been cleaned and prepared as necessary for liner installation and in accordance with Contract cleaning and preparation requirements. In the case that the Contract Administrator finds that the V2 does not demonstrate that the cleaning and preparation requirements were met, the Contractor shall rectify any deficiencies to the satisfaction of the Contract Administrator, whether or not the lining has already been installed.

Regardless of the timing of the liner installation, the V2 shall always be submitted to the Contract Administrator for review no later than 48 hours after completion of the V2. At the Contract Administrator’s option the 48 hour limit may be waived providing that the V2 is received no later than the V3.

TS 7.60.25 Materials and Standards

The lining shall be cured-in-place-pipe (CIPP) according to ASTM F1216-09, ASTM F1743-08 or ASTM F2019-03(2009) with exceptions made for where the watermain liner is required to differ specifically from requirements in these standards. For CIPP liner design requirements refer to the section TS 7.60.26 herein.

The liner shall be approved for potable water use. Approval certifications, such as NSF/ANSI Standard 61 are to be provided with tender submission for approval by the Contract Administrator.

The liner potable water certification from various agencies must be submitted with Contract Documents for the Contract Administrator’s review. The Contract Administrator reserves the right to accept/reject these certifications. All materials must be delivered to the site in their appropriate containers that clearly show that the product has various agencies’ approvals.

The liner shall utilize a thermally cured epoxy type resin where the cure does not rely on ambient heat for curing. The liner shall be uniformly impregnated with the correct quantity of resin to produce a cured result that has homogeneous and uniform physical properties throughout the liner wall that meet or exceed the required physical properties premised in the liner design. In this context the liner wall does not include with the surface waterproof membrane layer. The correct quantity of resin shall be determined by the Contractor and be in accordance with the specifications of the liner manufacturer. The liner shall be provided with sufficient resin to effect the required bonding to the inside surface of the existing watermain including around the service connections.

The liner shall be capable of remote reinstatement of service connections from within the interior of the watermain and no further work shall be required to seal or otherwise connect the service connections for the liner to function for its design life.
TS 7.60.26 Tight Fit of Liner to Watermain

On completion, the liner shall fit completely tightly to the inside surface of the watermain around the full perimeter and over the full length of the installation. There shall be no measurable gaps or annular space at any location. The liner shall have a fabrication, size and resin quantity that ensures the required 100 per cent tight fit will be obtained.

Where the liner has a diametric tight fit range, whereby the tight fit is achieved either by stretch capability or variable fold size capability, the contractor shall verify, before installation of the liner, that the diametric range of the liner is a suitable match for the diametric range of the watermain to be lined. Where the diametric range of the liner to be installed will not assure a 100 per cent tight fit, a differently sized liner shall be used.

The required tight fit shall be verified by inspection by the Contractor of all pieces of lined watermain that have been removed for samples or other reasons. All such removed pieces shall be made available to the Contract Administrator. Should the Contractor, in its inspections, identify any liner that did not obtain the required tight fit—either in removed liner pieces or by other means—the Contractor shall report such findings to the Contract Administrator within 24 hours.

Where the required tight fit has not been achieved throughout the entire installation, the liner shall not be acceptable and the liner shall be removed and replaced with a new liner that is a tight fit. If the forgoing removal and replacement is not possible then a new watermain shall be installed.

TS 7.60.27 Diametric Sizing

The Contractor shall measure and record the internal diameters of each watermain section to be lined by measuring the watermain internal diameters as per the requirements of TS 7.60 herein. Measurements shall be taken for each individual liner installation run. The internal diameter measurements made by the Contractor shall be available to the Contract Administrator for review if requested. The Contractor shall immediately notify the Contract Administrator of any step size discrepancy between any internal diameter measurements and the diameter identified in the Contract Documents, for example a nominal 300 mm instead of nominal 250 mm.

The Contractor shall size the liner to be installed based on watermain section’s inside diameter that will be in effect when the liner is installed, that is, the post cleaning and preparation size of the watermain. The Contractor shall be aware that measurements taken after cleaning and preparation may differ significantly—for the purpose of liner sizing—from measurements taken before cleaning and preparation.

The Contractor’s sizing of the liner shall ensure the requirement of tight fit in TS 7.60 herein will be obtained in the completed watermain liner installation.

To assure required tight fit and bonding to the watermain inside surface, it is acceptable that the Contractor over-size the liner by a small amount to assure that the required tight fit is achieved. This over-sizing may result in a small longitudinal ridge, typically called a fold, along the lined watermain, or other excess liner material in the completed installation. Due to existing small variations in the watermains actual size along the section, correspondingly the size of the fold may also have variations along the watermain that are acceptable. Such folds along the lined watermain are acceptable providing they meet the requirements in section TS 7.60.29 herein.
**TS 7.60.28 Design Requirements**

The lining wall thickness shall be designed by the Contractor in accordance with ASTM F1216-07a, Appendix X1, Design Considerations, Section X1.3.2 (fully deteriorated design). The design method in later editions of the ASTM F1216 shall not be permitted. The design method and the design parameters for the liner are prescribed below. Engineering designs shall be approved by an Engineer bearing the seal and signature of an Engineer authorized to perform such work by PEO. The Contract Administrator reserves the right to reject the design, design method or design parameters should they differ from those prescribed in this section.

The thickness determined by the liner wall thickness design shall be the required wall thickness of the completed in place liner. The wall thickness shall be the wall thickness of the liner’s structural zone only. Wall thickness measurements of the finished liner used to compare with design thickness shall not include such non-structural zones. If these zones have been included in the measurement, they shall be subtracted to determine the effective thickness of the liner. The determination of the actual thickness of the installed liner shall be in accordance with the method in ASTM D5813-04(2008). It is noted that among its provisions for measuring liner thickness and for calculating the effective thickness from these measurements, the ASTM 5813 requires that no thickness can be less than 87.5 per cent of the required thickness.
Table 1: CIPP liner design parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Method</td>
<td>ASTM F1216-07a, Appendix X1 for Fully Deteriorated Pressure Pipe. Design by later versions of the ASTM F1216 is not permitted.</td>
</tr>
<tr>
<td>Design Life</td>
<td>50 years or greater.</td>
</tr>
<tr>
<td>Safety Factors</td>
<td>External Loads: 2.0; Internal Pressure: 2.0; Vacuum: 2.0</td>
</tr>
<tr>
<td>Design Pressure</td>
<td>862 kPa (125 psi) internal pressure.</td>
</tr>
<tr>
<td>Vacuum</td>
<td>50 kPa below atmospheric pressure.</td>
</tr>
<tr>
<td>External Hydrostatic Pressure</td>
<td>Based on ground water table at 2.0 m below ground surface.</td>
</tr>
<tr>
<td>External Earth Load</td>
<td>For 2.0 m cover or the cover at the liner location, whichever is greater.</td>
</tr>
<tr>
<td>Live Load</td>
<td>AASHTO HS-20</td>
</tr>
<tr>
<td>Ovality</td>
<td>2 %</td>
</tr>
<tr>
<td>Soil Weight</td>
<td>1920 Kg per cubic metre</td>
</tr>
<tr>
<td>Soil Modulus</td>
<td>6.9 MPa</td>
</tr>
<tr>
<td>CIPP Liner Flexural Modulus</td>
<td>The flexural modulus for design equations X1.1, X1.3 and X1.4 shall be the long-term flexural modulus. The long-term flexural modulus used in design shall be the amount of short-term flexural modulus (according to ASTM D790) retained for the design life. The retention factor shall be derived from long-term testing and be appropriate for stress and stress duration in the installed liner. Independent third party test data is required (submit with tender) to substantiate the short-term and long-term values used in design. Minimum short-term value shall be in accordance with the minimum requirement in ASTM F1216-07a (1724 MPa).</td>
</tr>
<tr>
<td>CIPP Liner Tensile Strength</td>
<td>The liner tensile strength for design equation X1.7 shall be the long-term tensile strength. The long-term tensile strength to be used in design shall be the amount of short-term tensile strength (according to ASTM D638) retained for the design life. The retention factor shall be derived from long-term testing and be appropriate for stress and stress duration in the installed liner. Independent third party test data is required (submit with tender) to substantiate the short-term and long-term values used in design. Minimum short-term value shall be in accordance with the minimum requirement in ASTM F1216-07a (21 MPa).</td>
</tr>
</tbody>
</table>

**Vacuum**

In accordance with the ASTM F1216 design method, vacuum is treated as an external pressure. For design purpose use of short-term liner flexural modulus is acceptable for vacuum resistance. Alternately, an equivalent vacuum may be used with long-term flexural modulus that has the same result as specified vacuum using short-term flexural modulus.

**Short-term Flexural Modulus and Short-term Tensile Strength**

The short-term values of flexural modulus and tensile strength according to ASTM D790 and ASTM D638, respectively, used as the starting values from which the long-term design values are derived shall be values that will be reliably and repeatedly obtained in the installed liners as substantiated by testing samples from installed liners. These short-term values shall be identified in the liner design.
Designs Correct for Field Conditions

The Contractor shall check and determine that actual field conditions for any liner installation watermain section correspond with the liner design for that installation. The field conditions to be checked shall include deepest cover over top of the watermain and live load situation. Where the existing liner design is not appropriate for the field conditions, the Contractor shall adjust the liner design accordingly and the liner installed shall meet the requirements of the adjusted design. The adjusted liner design shall be submitted to the Contract Administrator for approval.

Where a liner design previously approved by the Contract Administrator is found needing adjustment due to determined actual field conditions, the Contractor shall advise the Contract Administrator within 48 hours and wait for the Contract Administrator’s instructions. Where the adjusted design results in a thicker liner to be installed, any additional cost involved shall be determined according to the Contract Price where applicable, and if Contract Price are not applicable, then shall be negotiated with the Contract Administrator.

No liner shall be installed that does not meet the requirements for actual field conditions, including required liner thickness for actual field conditions.

Liner Thickness and Stretching Out for Tight Fit

Where it is expected that the liner will stretch out to a tight fit with the existing watermain this stretching may result in a thinning of the liner’s finished wall. In this case the liner thickness to be installed shall compensate for this potential loss of thickness should the potential loss of thickness reduce the structural performance of the finished liner below TS 7.60 requirements.

TS 7.60.29 Liner Fit, Finish and Properties

The cured liner within the watermain shall meet the following requirements for fit, finish and properties.

Liner Fit to Existing Watermain

The outside surface of the finished liner shall be in 100 per cent contact with the inside surface of the existing watermain and shall be bonded to the inside surface as may be required. One hundred per cent contact means that there shall be no measurable or visible gap or annulus space between the liner and the watermain over the full circumference/perimeter and over the full length of the liner installation. The level of bonding shall correspond to the design and performance parameters for the liner. The inside surface of the existing watermain is the surface after the watermain has been prepared for lining in accordance with the cleaning and preparation requirements. Where any space or gap exists between the outside surface of the liner and the inside surface of the existing watermain the liner fit (and liner) will be considered deficient.

Where the required tight fit has not been achieved throughout the entire installation, the liner shall not be acceptable and the liner shall be removed and replaced with a new liner that is a tight fit. If the forgoing removal and replacement is not possible then a new watermain shall be installed.

Should the lining be damaged as a direct result of the Contractor’s operation or reveal evidence of defective work or materials prior to the completion of the contract, such damaged or defective portions shall be removed and replaced.
Finished Liner Installation
The liner shall be free of any interior bulges, ribs, ripples, or other irregularities except where these
irregularities correspond with irregularities in the existing watermain after cleaning and preparation in
accordance with TS 7.60 requirements.

Where folds, ridges, ripples and wrinkles are a direct result of obtaining the required tight fit, they
shall be acceptable providing that the liner installed was correctly and properly sized for the existing
watermain based on the inside diameter measurements made as required in TS 7.60 herein. Where
such folds, ridges, ripples and wrinkles are due to improper or incorrect sizing of the liner, they shall
not be acceptable.

Liner Terminations at Ends of Liner Runs
Liner terminations at the ends of liner runs shall be smooth, square and neatly cut. There shall be no
separation from the inside surface of the existing watermain. The terminations shall be watertight to
the requirements for external and internal hydrostatic pressure.

Liner Termination at Valves
At valves, the interface between the exterior surface of the liner and the valve shall be watertight to
the requirements for external and internal hydrostatic pressure. The finished ends of the liner shall be
neat and smoothly cut.

Liner Fold
A fold is defined as a longitudinal ridge in the liner that is due to the liner’s circumference being in
excess of the circumference of the post cleaning and preparation circumference of the watermain.
Some types of liner tubes require sizing with an excess circumference to assure that the liner fully
contacts the inside surface of the watermain and to provide the needed level of bonding. Where such
folds occur they shall be tightly compressed and have no void space either within the fold or behind
the fold. A fold configuration shall not result in any annular space between the liner and the
watermain. Folds shall not have any tube inner membrane material trapped within the fold.

Fold size may vary along the lined section in correspondence with variations in the watermain size
along the same section.

Regardless of fold size and configuration, no fold shall be permitted that will negatively affect the
long-term performance of the liner for its intended purpose including liner performance in accordance
with design requirements.

Liner Wall Thickness and Tolerance
The liner's finished in place wall thickness shall be as specified in the engineered design submitted
with the Tender (or as submitted at a later date) meeting the requirements of the Contract and as
approved by the Contract Administrator, subject to the following tolerances:

- Liner wall thickness minus tolerance is 0 per cent.
- Liner wall thickness plus tolerance shall not result in the watermain lined inside diameter being
  less than 92.5 per cent of the watermain pre-lining inside diameter.
The thickness for comparison purposes shall be determined according to ASTM D5813-04(2008). The effective thickness for comparison to required thickness shall not include any non-structural layers or membranes.

**Liner Physical Properties**

The final installed liner shall have the following required physical properties.

- Flexural modulus: Shall meet or exceed the short-term value used in the liner design or the minimum value in ASTM F1216, whichever is greater.
- Tensile strength: Shall meet or exceed the short-term value used in the liner design or the minimum value in ASTM F1216, whichever is greater.

The final installed liner shall possess long-term retention characteristics equal or better than the long-term retention characteristics used in the liner design submissions.

**TS 7.60.30 Installation**

The installation of the liner into the watermain complete with curing is the responsibility of the Contractor. The Contractor shall follow the liner manufacturer’s installation recommendations to the extent that they are appropriate for specific circumstances.

**Installation Procedure**

The actual lining installation procedure shall be in accordance with the submission with Tender. Any proposed deviation from the submitted procedure shall be submitted, with explanation, to the Contract Administrator for approval and the submission shall include the approval of the lining manufacturer or senior licensor.

**Equipment Ready for Lining**

The Contractor shall ensure that all required equipment (including as required by the Contract) is on site and in satisfactory working order prior to commencing the installation of a lining section.

**Wet Out and Curing Requirements**

The Contractor shall maintain wet out and curing quality assurance records that shall include the following requirements at the minimum.

For the wet out of each watermain section lining run records shall include documentation identifying the resin batch numbers and product name and confirming that the liner to be installed complies with the product specification and tender design submissions. The wet out documentation shall include an information sheet recording the dimensions of the liner and the quantity of each material (including resin components) used in the watermain section liner run.

For curing of each watermain section lining run, records shall include documentation recording the boiler parameters and liner cure cycle temperatures, for example thermocouple temperatures. The format of the documentation shall allow for direct comparison with the process curing cycle submitted with the tender submission.
All records and documentation shall be readily available to the Contract Administrator upon request.

**Quality Control and Assurance**

The Contractor shall have in place and follow a quality control and assurance program for the CIPP watermain liner that addresses: cleaning and preparation of the existing watermain, liner sizing, correct liner for the installation such as tube size, materials and design, liner thickness such as design and as cured, liner resin such as mix, impregnation and uniform distribution, liner fit and finish, liner service connection reinstatements and liner as cured physical properties. On the Contract Administrator’s request, the Contractor shall provide full details of this program to the Contract Administrator. Where in the Contract Administrator’s opinion, the program is not adequate, or not being followed, the Contract Administrator will require the Contractor to make rectification to the Contract Administrator’s satisfaction.

**Records**

The Contractor shall keep detailed records that are sufficient to track the progress and parameters of each liner run installation. These records shall easily allow identification of individual liner runs and include, at a minimum: preliminary and final liner sizing, specifics of liner tube ordered, specifics of liner tube installed, location information independent of pit locations, number and size of services, GPS locating information (when required), installation dates, return to service dates and quality problems (if any). On the Contract Administrator’s request, the Contractor shall show or provided these records. Where, in the Contract Administrator’s opinion, the records are not adequate, the Contract Administrator will require the Contractor to make rectification to the Contract Administrator’s satisfaction.

**TS 7.60.31 Reinstatement of Service Connections**

The water service connections shall be reinstated from inside of the lined pipe, using a mechanical robot equipped with a camera and activated by an operator using a remote control and television unit. The robot shall be equipped with a drilling tool that allows the operator to drill a hole in the liner at the precise location of the connection. The service connection shall be opened to the full pre-existing flow opening size, including the removal of any resin slugging in or up the service connection that will impede flow. After opening the connections, the lined watermain shall be flushed clean, disinfected and restored to service.

The Contractor will be fully responsible to locate and successfully reinstate the existing service connection, without damaging the lining. Any damage to the service connection or the lining caused by the reinstatement process will require immediate corrective action by the Contractor.

If the Contractor is unable to reinstate a service connection from the inside, a suitable excavation will be required to access the main stop and to disconnect the existing copper pipe and reconnect the copper piping with the Contract Administrator’s approved fittings.

If the Contractor is unable to effectively reconnect the service connection to the Contract Administrator’s satisfaction, the Contractor shall be required to re-tap the watermain in accordance to the City’s standards.
Clearing of Obstruction in Water Services

Should any services be partially or fully obstructed due to the ingress of liner resin or other foreign materials it shall be the Contractor's responsibility to remove such obstructions in a manner approved by the Contract Administrator. Where an excavation of a water service is required and not caused by the negligence of the Contractor, payment will be made at the unit price under the applicable tender item. The work shall include all labour, Equipment, Material and tools for cutting pavement, excavating and removing restrictions in main stops or services or replacing the main stop as ordered by the Contract Administrator, reconnecting the service, backfilling and restoration.

Pay Limit on Clearing Water Services Plugged/Obstructed by Resin Using Excavation

Payment by the City to clear water services plugged or obstructed with liner resin by excavating and clearing blockage via main stop shall be limited to six per cent of the total number of properties within the project limit. Contractor should take precaution to minimize the number of plugged services need to be cleared.

TS 7.60.32 Field Lining Samples and Testing

Samples of Finished Liner

The Contractor shall provide samples of completed liner within the watermain. A sample shall be at least 300 mm long and fully contained within a piece of the existing watermain. One sample shall be provided for each 600 m (on average) of lined watermain. The Contract Administrator has the right to request that these samples be taken from any particular location at any time. The samples shall be used for inspection and testing purposes.

The samples shall be marked with contract number, size, street address and date removed. Immediately upon removal the Contractor shall give the samples into the custody of the Contract Administrator. Where samples have been removed, the watermain shall be closed up with new pipe and fittings in accordance with the specifications.

The Contractor shall provide for testing of the samples at a testing agency approved by the Contract Administrator. The testing shall determine the liner sample’s tensile strength, flexural strength, flexural modulus and thickness. Thickness measurement shall be in accordance with ASTM D5813. Flexural modulus and strength testing shall be in accordance with ASTM D790. Tensile strength testing on full cylindrical samples shall be on accordance with ASTM D2290 or, in the case of flat plate samples, shall be in accordance with ASTM D638. Where flat plate samples are used, the testing for tensile strength and flexural properties shall be on test specimens form the flat plate oriented in the direction of the flat plate that would be around the circumference (hoop direction) of the installed liner.

The Contractor shall authorize the testing agency to forward the test reports to the Contract Administrator and communicate with the Contract Administrator concerning the testing and results. The Contract Administrator will arrange for delivery of the samples to the testing agency.
TS 7.60.33 Pressure Test

The lined watermain shall be pressure tested before the reinstatement of the service connections. The test pressure shall be 120 per cent of the operating pressure for the watermain location being tested. The Contract Administrator will provide the operating pressure to the Contractor for the test section(s). The test pressure shall be maintained for a minimum of one hour during which time the maximum water loss shall not exceed 0.5 L/hour/100 m.

TS 7.60.34 CCTV Inspection of Completed Liner – V3

On completion of the lining of a watermain section, including all reinstatements of services, a CCTV inspection—called the V3—shall be done and recorded. The CCTV recording and reports shall be submitted to the Contract Administrator for approval. The Contract Administrator shall use the V3 CCTV submission as part of its process for approving the watermain liner installation.

TS 7.60.35 Close Up of Watermain after Lining Complete

Upon completion of the CIPP liner, the openings in the watermain shall be closed as soon as possible using PVC watermain pipe and approved couplings. When using PVC pipe, approved restrainers shall be used to carry out the work. When PVC pipe used at fittings and change in direction of watermain shall be restrained with pipe restrainers according to Chapter 6, Material Specifications from the Design Criteria for Sewers and Watermains manual and installed in accordance to manufacturers instructions.

Cathodic protection, jumper wires and tracer wires shall be installed as required before back fill of the close up location.

Close up of the watermain shall be done within 24 hours following CIPP lining of the watermain.

TS 7.60.36 Disinfection

Disinfection shall be according to TS 7.30 – Procedure for Disinfecting Watermains.

TS 7.60.37 Removal of Bypass and Temporary Services

After the tests on all water samples have been approved, the watermain shall be flushed, water service connections restored, excavations backfilled, the watermain returned to service and the temporary service lines removed.

The Contractor will be permitted to reuse temporary bypass service connections previously disinfected without re-disinfecting provided that precautions are taken, to avoid the potential for contamination, that include: immediately capping each end of the temporary bypass service prior to storage and reuse; and storing the temporary service lines in a manner that will lessen the likelihood of contamination.

Prior to the reconnection of the previously disinfected temporary service connection, the connection ends of the service pipe must be submerged in a 5 per cent sodium hypochlorite solution. The service pipe must then be flushed, the outside hose bib and “Y” connector sprayed with a 5 per cent sodium hypochlorite solution before final hook up of the temporary service pipe to provide service.
The Contractor shall satisfactorily restore the permanent property connections and leave streets, sidewalks and adjacent property in a neat and orderly condition. Any valves, corporation stops or other appurtenances which have been damaged due to cleaning and lining operations shall be replaced by the Contractor.

**TS 7.60.38 Payment**

Payment at the Contract Price shall be full compensation for all labour, Equipment and Material to do the Work.

**APPENDIX**

Appendix A: Water Services Statement
# WATER SERVICES STATEMENT (WSS)

<table>
<thead>
<tr>
<th>Contract #:</th>
<th>Contractor’s Name:</th>
<th>Street Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Material:</td>
<td>Pipe Internal Diameter:</td>
<td>Pipe Measurement (m):</td>
</tr>
<tr>
<td>Preliminary CCTV Inspection (V1) Date:</td>
<td>Post Cleaning &amp; Preparation CCTV Inspection (V2) Date:</td>
<td></td>
</tr>
<tr>
<td>Start Pit #:</td>
<td>Finish Pit #:</td>
<td></td>
</tr>
<tr>
<td>V1 Comments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V2 Comments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V1 Camera Operator’s Name:</td>
<td>V2 Camera Operator’s Name:</td>
<td></td>
</tr>
</tbody>
</table>

| W/S ON LEFT SIDE OF MAIN | W/S ON RIGHT SIDE OF MAIN | HOUSE # | DISTANCE FROM START PIT (M) | CLOCK POSITION | ESTIMATED W/S DIAMETER | ACTUAL W/S DIAMETER | UPGRADED W/S | MAIN STOP VISUALLY PLUGGED (YES/NO) | GRIND W/S | W/S DRILLED | W/S BLOW BACK | W/S IN THE FOLD | W/S PLUGGED WITH RESIN | DRILLING REMARKS | REMARKS |
|-------------------------|---------------------------|---------|----------------------------|----------------|------------------------|-------------------|-------------|-------------------------------------|----------|-------------|---------------|----------------|----------------|------------------|----------------|---------|

**Notes:**

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Watermain Replacement and Connection Procedure

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**TS 7.70.01 Scope**

The work involves the procedure for making watermain replacement and connection to an existing watermain system. All work shall be done to the satisfaction of the Contract Administrator. Instructions for making a connection are based on the scenarios in Figure 1 and Figure 2.

**TS 7.70.02 New Watermain System**

1. Pressure test, flush, swab and chlorinate new watermain. Pressure testing and chlorination of new watermains will be in isolation from the existing water distribution system.

2. Service connections larger than 50 mm in diameter shall be installed to street line. The service connection will be pressure tested, flushed, chlorinated and water sampled as part of the watermain system.

3. Contractor will use a portable field test kit to check for residual chlorine and turbidity. If the sample passes, then the two consecutive sampling procedures can begin.
   - The residual chlorine should be better or equivalent to the source sample.
   - Turbidity should be less than < 1 nephelometric turbidity units (NTU). Engineering & Construction Services division Contract Administrator to discuss with Toronto Water operations representative to accept if non-health related.

4. Take two consecutive samples at sampling stations S1, S2, S3, S4 and S5 as shown on Figure 1 and according to TS 7.30 Procedure for Disinfecting Watermains.

5. If samples pass at all five sampling stations, then the new watermain can be connected to the existing watermains.

6. All valves which are part of the isolated section of new watermain shall remain closed until Contractor's bacteriological sample from the filler spool piece has passed. The Contractor shall notify the Contract Administrator with an e-mail message that the sample results indicate a pass. Contractor shall request valving 48-hours in advance. After valving is scheduled, Toronto Water can then begin to open the valves.

7. The new watermain pipe permitted to be dewatered is from the isolation valve on the new watermain to the connection point on the existing watermain which shall be less than 6.1 m in distance. An exception to the above is allowed when making a connection to the source feeder watermain according to section 7.70.04 and illustrated in Figure 2.

8. After all branch connections to side streets are connected, the Contractor shall begin reconnecting all existing water services from the existing live watermain to the newly installed watermain.
The following is a typical procedure for the connection of a replacement watermain to an existing watermain on street B as shown in Figure 1.

1. Toronto Water to close valves, V_C, V_D and V_J on the existing watermain system.
2. Toronto Water to open fire hydrant on street B so as to depressurize existing watermain system.
3. Toronto Water to close valve V_E.
4. Contractor to cut into watermain pipe before valve V_E, that is to say the left side of valve V_E on Figure 1 and install mechanical cap on existing water main. Contractor to pump out water and ensure all discharge water in excavation is below open ends of existing pipes.
5. Valve V_3 is to remain closed. Contractor shall ensure valve V_3 is properly restrained. Contractor to remove blow-off used as a sampling point S_2 for the two samples.
6. Contractor to manually swab and disinfect filler piece which makes up pipe B if length is less than 6.1 m. If length of filler piece is greater than 6.1 m, then standard disinfection methods apply.
7. Contractor to install filler piece of watermain pipe between valve V_3 and V_E.
8. Contractor to install new 25 mm corporation stop and new 25 mm copper sampling pipe to grade with blow-off on watermain pipe between V_3 and V_E.
9. Contractor to open valve ATV_1 and then open valve V_3.
10. Contractor to flush main in one direction—V_3 to V_E—through new 25 mm copper sampling pipe.
11. Toronto Water to open valve V_C, V_D and V_J. Valve V_E to remain closed.
12. Contractor to take a water sample from new copper sampling pipe. Contractor to close valve V_3. Contractor shall notify the ECS Contract Administrator whether the water sample results passed. ECS Contract Administrator to advise Toronto Water of sample results. For water samples with passing results, Toronto Water to advise ECS Contract Administrator when Contractor can proceed with removal of 25 mm copper sampling pipe and backfilling of access pit. Proceed to Step 14.
13. If water sample fails, Contractor to reopen valve V_3, and flush main in one direction—V_3 to V_E—through new 25 mm copper sampling pipe. Go back to Step 12.
14. Contractor to reopen valve V_3 and Toronto Water to reopen valve V_E after pipe segment water sample has passed.
15. Existing valve V_E will remain in place in an open position. Existing valve box shall be removed or existing valve chamber to be broken down one metre below subgrade according to TS 510. Toronto Water to confirm valve V_E is in the open position. In the event of failing water sample results, Contractor to coordinate with Toronto Water for operation of valve V_3 for any additional sampling.
16. Valves V_C and V_D to remain in the open position.
Figure 1: Scenario one – connecting to branch connections
TS 7.70.04 Connecting to Source Feeder Watermain

Procedure for connecting new watermain system to existing watermain system. For this example the connection will be for a permanent connection on street A as shown on Figure 2.

1. Toronto Water staff to close valves V_A, V_B and V_C on the existing watermain system.

2. Contractor to close TS&V only on new watermain system. The Contractor to close valve V_1 and release pressure in the main by partially opening blow-off through the temporary bypass to avoid blowing out valve V_1. Ensure valve V_1 is properly restrained to avoid blowing-out and injuring a worker.

3. Toronto Water to depressurize existing watermain through fire hydrant on street A. If there is no fire hydrant between the valves, Contractor shall tap in a blow-off on the existing watermain.

4. Pump out excess water from trench.

5. Remove temporary backflow protected by-pass and blow-off connection. There is a possibility a short length of watermain pipe greater than 6.1 m will need to be dewatered between the TS&V and new isolation valve. If the filler piece of watermain pipe is less than 6.1 m, only one water sample is required, otherwise standard disinfection methods apply.

6. Manually swab and disinfect filler pieces of watermains

7. If length of filler piece of watermain pipe is greater than 6.1 m, then standard disinfection methods apply.

8. Contractor to install filler piece of watermain pipe between TS&V and valve V_1

9. Contractor to install new 25 mm corporation stop and new 25 mm copper sampling pipe to grade with blow-off on watermain filler piece.

10. Toronto Water to open fire hydrant on street A.

11. Toronto Water to open valve V_A.

12. Contractor to open TS&V and flush main in one direction—TS&V to V_1.

13. Contractor to take a water sample from new copper sampling pipe. Contractor to close TS&V. Contractor shall notify the ECS Contract Administrator whether the water sample results passed. ECS Contract Administrator to advise Toronto Water of sample results. For water samples with passing results, Toronto Water to advise ECS Contract Administrator when Contractor can proceed with removal of 25 mm copper sampling pipe and backfilling of access pit. Proceed to Step 15.

14. If water sample fails, Contractor to reopen valve TS&V and flush main in one direction through new 25 mm copper sampling pipe. Go back to Step 13.

15. The Contractor can begin reconnecting all existing water services from the existing live watermain to the newly installed watermain. All branch connections to side streets shall be connected before transferring water services.
Note 1: Contractor shall collect the sample while the excavation is open and notify the Engineering & Construction Services division Contract Administrator whether water sample results passed. ECS Contract Administrator to advise Toronto Water of sample results. For water samples with passing results, Toronto Water to advise Contract Administrator when Contractor can proceed with removal of 25 mm copper sampling pipe and backfilling of the access pit.

Note 2: As a good practice, valves V_1 and V_B should remain closed while valve V_A is left open until acceptable disinfection results are obtained. If there are any existing water services between valves V_A to V_1 or V_B to V_1 or both, the valves should remain closed except for valve V_B until acceptable disinfection test results are confirmed. Only open more than one valve at an intersection, if there is a water supply issue for the area.
Figure 2: Scenario two – connecting to source feeder watermain
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TS 310.01 SCOPE

This specification covers the requirements for placing and compacting of hot mixed, hot laid asphaltic concrete.

TS 310.02 REFERENCES

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

City of Toronto Standard Specifications
- TS 206 Amendment to OPSS 206 – Construction Specification for Grading
- TS 1003 Material Specification for Aggregates – Hot Mixed, Hot Laid Asphaltic Concrete
- TS 1150 Material Specification for Hot Mixed, Hot Laid Asphaltic Concrete

Ontario Provincial Standard Specifications, General Conditions
- OPSS 102 Weighing of Materials

Ontario Provincial Standard Specifications, Construction
- OPSS 314 Untreated Granular Sub base, Base, Surface, Shoulder and Stockpiling

Ontario Provincial Standard Specifications, Material
- OPSS 1103 Emulsified Asphalt

Ontario Ministry of Transportation, Laboratory Testing Manual
- LS-264 Theoretical Maximum Relative Density of Bituminous Paving Mixtures
- LS-287 The Determination of Percent Compaction of Compacted Bituminous Paving Mixture (MRD Method)

TS 310.03 DEFINITIONS

For the purpose of this specification, the definitions given in TS 1003, TS 1101 and TS 1150, and the following definitions apply:

Advisory Clause means the information provided [Note: ] to assist Contractors.

Binder Course means an asphalt course between a surface course and either a base course (aggregate base, stabilized base, etc.), an existing pavement or another asphalt binder course.

HL-8 (HS, 10% RAP) means HL-8 high stability hot mix asphalt incorporating Reclaimed Asphalt Pavement (RAP), with a replacement limit of 10 per cent (recycling ‘ratio’ limit of 10/90, RAP to new aggregate). HL-8 (HS, 10 per cent RAP), if any is designated in the Contract Documents, will be specified through a special provision.

Fat Spot means an area of pavement substantially blacker than the surrounding acceptable pavement due to high asphalt cement content and/or dust content.

HL, Hot Mix, Mixture, Mix means hot mixed, hot laid asphaltic concrete.
**Hot Mix Miscellaneous** means hot mix asphaltic concrete which is placed in areas other than the roadway, and is designated as hot mix miscellaneous in the Contract Documents.

**Hot Mix Padding** means a hot mix layer used for correcting crossfall and profile deficiencies in the existing pavement before placing the levelling, binder, and/or surface course.

**Hot Mix Patching** means a hot mix surface course placed over segments of distressed pavement generally for the purpose of improving strength, rideability or safety.

**HL (HS) Types, High Stability Types** means the high stability hot mixes.

**Hydraulic Strike-off** means an extension of the paver mould board and strikeoff which can be extended beyond the screed while the paver is operating, to place, shape and strike off mixtures in narrow widenings of variable width.

**Joint** means a contact between an asphalt pavement course and any asphalt pavement, or any rigid object which exists at the time the course is laid, other than such contacts as occur on the underside of the course.

**Large Stone Binder Course (LSBC)** means the dense graded, large-size crushed aggregate (minus 37.5 mm), hot mix binder course.

**Levelling Course** means a course of variable thickness used to eliminate irregularities in the contour of an existing surface prior to placing an asphalt binder and/or surface course.

**Lot** means a specific quantity of material or a specific amount of construction normally from a single source and produced by the same process.

**Mean** means the arithmetic average of the test results within a lot.

**Modified Mixes** means those mixes which conform to the requirements specified in this specification but for which some aspect of the mix has been altered. These deviations would be specified in the Contract.

**MTO** means the Ministry of Transportation of Ontario.

**Paving in Echelon** means the situation when the trailing paver is not more than 60 m behind the lead paver and uses a joint matching shoe to match the undisturbed mat laid by the lead paver when placing the mixture in the adjacent lane.

**Random Number** means a number generated by chance and obtained from a random number table.

**Random Sample** means a sample from a location chosen by the Contract Administrator based on random numbers, such that any portion of a lot or sublot, as appropriate, has an equal probability of being selected.

**Range** means the numerical difference between the maximum and minimum test results within a lot.

**RAP** means processed reclaimed asphalt pavement.

**Recycling Ratio, Ratio** means the percentage relationship between the reclaimed asphalt pavement (RAP) and new (virgin) aggregate which make up the recycled hot mix. For example, a 20/80 ratio is 20 per cent RAP and 80 per cent new (virgin) aggregate.
Screed means the unit of the paver which strikes off and imparts an initial compaction to the mix.

Screed Extension means the sections of screed plate, mould board, tamper bar/vibrator, and spreading screw which are used to extend the basic screed to the desired paving width.

Segregation means a lack of surface uniformity where areas of pavement are either too coarse or too fine in relation to the surrounding acceptable pavement. Segregation is visually classified as:

- Slight: An area where the matrix is in place between the coarse aggregate, however there is locally, slightly more coarse aggregate in comparison with the surrounding acceptable pavement.
- Medium: An area which has significantly more coarse aggregate than the surrounding acceptable pavement and usually exhibits some lack of matrix.
- Severe: An area which appears very coarse, with coarse aggregate against coarse aggregate and little or no matrix.

Special Mixes means those mixes occasionally used for special purposes such as patching, padding, levelling, the paving of shoulders, boulevards and sidewalks, and the construction of curb, gutter, or combination curb and gutter, and may not fall within the normal gradation and mix design requirements. Special mixes, if any, will be designated as ‘Hot Mix Used in Sidewalks, Boulevards and Driveways’ in the Contract Documents and specified through a special provision.

Stone Mastic Asphalt (SMA) means the gap-graded, dense, surface course hot mix with a large proportion of coarse aggregate and a rich asphalt cement/filler mastic.

Sublot means approximately equal divisions or portions of a lot.

Surface Course means the top course of an asphalt pavement, sometimes called a wearing course.

TS 310.04 DESIGN AND SUBMISSION REQUIREMENTS

Any required submissions shall be in writing. All information and test data forms must be legible. Faxed or electronic copies are acceptable provided the original is submitted to the Contract Administrator within three Working Days following receipt of the fax or e-mail.

TS 310.04.01 Material Safety Data Sheets

At least five Working Days prior to starting the Work, the Contractor shall supply the Contract Administrator with Material Safety Data Sheets (MSDS) for all materials to be incorporated in the Work.

TS 310.04.02 Frames and Appurtenances

At least five Working Days prior to the commencement of any adjustment work indicated in the Contract Documents and Pricing Form, the Contractor shall notify the Contract Administrator as to how frames and appurtenances will be adjusted. This information will be reviewed jointly by the Contractor and Contract Administrator so that they are all familiar with the methods to be used in the Work.
**Note:** Contractors should note that in some cases, the appropriate utility must be notified before adjusting an appurtenance(s) or the utility will be responsible for completing the necessary adjustment(s) or both.

**TS 310.04.03 Grade and Slope Control of Paver(s)**

At least two Working Days prior to the commencement of the asphalt paving work, the Contractor shall notify the Contract Administrator as to the number of pavers, type of grade and transverse slope control and all pertinent information with respect to setting grades and controlling the pavers to follow these grades. This information will be reviewed jointly by the Contractor and the Contract Administrator so that they are all familiar with the methods to be used in the Work.

**TS 310.05 MATERIALS**

**TS 310.05.01 Asphaltic Concrete**

Asphaltic concrete (hot mix asphalt) shall be according to TS 1150.

**TS 310.05.02 Tack Coating Material**

Tack coating material shall be SS-1 emulsified asphalt and shall be according to OPSS 1103.

**TS 310.06 EQUIPMENT**

**TS 310.06.01 Spreading Equipment**

**TS 310.06.01.01 Mechanical Pavers**

Asphalt pavers shall be self-propelled and capable of laying a consistent, satisfactory mat which is true to the specified geometrics, cross-section and alignment. Pavers shall be equipped with hoppers and distributing screws capable of placing the hot mix evenly in front of the screeds. Pavers shall be capable of simultaneously placing the shoulder asphalt pavement and roadway asphalt pavement where the shoulder asphalt pavement is at the same or different crossfall from the roadway pavement and the shoulder pavement is placed coincidentally with the adjacent lane.

In all cases, asphalt pavers shall be equipped with automatic longitudinal and transverse grade and slope controls which are capable of being operated from either side of the paver. The longitudinal grade control shall be readily adjustable for mat thickness in small increments without the necessity of stopping the paver and shall be equipped to operate from either a 12 m ski or floating beam, a 3 m ski, or a joint matching shoe, as required. Where the ski is a flexible unit, it shall be equipped with a spring-tensioned wire extending between brackets fitted on and slightly above each end of the ski. The sensing grid shall ride on the wire, not on the ski.

Screeds shall be capable of being heated and adjusted for crossfall and crown.

Plows or other edge ramping devices which are attached to, or towed by, the screed portion of the paver, shall not be permitted.

A 3 m straight edge shall be provided on each paver. This straight edge shall be of metal or wood, with a level recessed in its upper surface parallel to the lower edge, and be kept in good condition.
Note: Contractors should note that all electronic equipment and sensors for mat thickness and grade control must be functioning properly and not introduce variability in mat consistency and ride ability.

The Contract Administrator will discontinue the use of any paver that is experiencing difficulty in achieving a consistent, satisfactory mat in conformance with this specification until the Contractor carries out, and demonstrates, suitable corrective measures.

All pavers shall be equipped with a gas-fired torch joint heater to heat joints. All costs associated with the gas-fired torch, its fuel and its operation shall be borne by the Contractor.

**TS 310.06.01.02 Blade Graders**

Self-propelled blade graders shall have sufficient gross mass, blade length, wheel base, and power to shape a full 3.75 m lane width of hot mix asphalt in one pass. The hot mix so shaped shall yield, after compaction, the final desired elevation of the lift being placed.

**TS 310.06.01.03 Rakes**

Dimensions and tine-configuration of rakes, and the use of rakes, shall be such as to avoid segregation of the hot mix during hand spreading.

**TS 310.06.02 Rollers**

**TS 310.06.02.01 Classification of Rollers**

Rollers shall be classified into categories as follows:

- Class S: Self-propelled steel-tired, tandem or three-wheel rollers according to Table 1.
- Class R: Self-propelled pneumatic-tired rollers according to Table 2.

<table>
<thead>
<tr>
<th>Table 1: Requirements for class “S” rollers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller class</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>S1</td>
</tr>
<tr>
<td>S2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Requirements for class “R” rollers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller class</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>R1</td>
</tr>
<tr>
<td>R2</td>
</tr>
<tr>
<td>R3</td>
</tr>
</tbody>
</table>
Class V: Self-propelled vibratory roller specifically designed for hot mix compaction, having either dual vibratory drums or a combination of vibratory drum and pneumatic tires with a contact area equal to or greater than 70 per cent of the drum width and according to Table 3.

<table>
<thead>
<tr>
<th>Roller class</th>
<th>Minimum roll diameter m</th>
<th>Minimum roll with m</th>
<th>Minimum static mass per mm total roll/tire width kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>1.0</td>
<td>1.4</td>
<td>2.0</td>
</tr>
<tr>
<td>V2</td>
<td>1.2</td>
<td>1.6</td>
<td>2.6</td>
</tr>
<tr>
<td>V3</td>
<td>1.4</td>
<td>1.9</td>
<td>2.9</td>
</tr>
</tbody>
</table>

**TS 310.06.02 Requirements for All Rollers**

All rollers shall be capable of reversing without backlash.

The mass of all rollers, except for Class V rollers, shall be determined in the presence of the Contract Administrator and they shall be ballasted, if required, immediately before commencing work on the Contract and whenever subsequently required by the Contract Administrator.

**TS 310.06.02.03 Requirements for Steel-Tired Rollers**

Steel-tired rollers shall be according to the following requirements:

1) To prevent adhesion of hot mix asphalt to the roller, the rolls shall be kept moist, but excess water shall not be permitted.

**Note:** Contractors should note that for hot mix incorporating a performance graded asphalt cement with elastic recovery (PGAC-E), it may be necessary to use a soap/detergent solution on the rolls to prevent adhesion of hot mix asphalt to the rolls.

2) The rear rolls of three wheel rollers shall each be not less than 0.45 m in width.

3) The rolls of tandem rollers shall each be not less than 1.20 m in width.

**TS 310.06.02.04 Requirements for Pneumatic-Tired Rollers**

Pneumatic-tired rollers shall be constructed such that wheels on either the front or back shall oscillate either independently or in pairs. The wheels shall be mounted with smooth rubber tires. Tire inflation pressure shall be a minimum of 350 kPa when the tires are cold. All tires shall have equal pressure. Skirts or windbreaks shall be provided at all times to protect all tires from the cooling effects of ambient conditions. Each roller shall be equipped with a suitable tire pressure gauge for checking tire inflation pressure.
Note: Contractors should note that for hot mix incorporating a performance graded asphalt cement with elastic recovery (PGAC-E), it may be necessary to heat the rubber tires or use a soap/detergent solution on the rubber tires to prevent adhesion of hot mix asphalt to the tires.

TS 310.06.02.05 Requirements for Vibratory Rollers
Vibratory rollers shall conform to the following requirements:

1) To prevent adhesion of hot mix asphalt to the rolls, the rolls shall be kept moist. Excess water will not be permitted.

Note: Contractors should note that for hot mix incorporating a performance graded asphalt cement with elastic recovery (PGAC-E), it may be necessary to use a soap/detergent solution on the rolls to prevent adhesion of hot mix asphalt to the rolls.

2) Frequency of vibrations shall be not less than 2200 vibrations per minute.

3) Rollers shall be equipped with provision for automatic shutoff of vibrations before coming to a stop.

4) Not cause vibration levels that could potentially damage services and structures, or cause nuisance complaints. If there is any concern with potential vibration problems for the Contract, vibratory rollers shall not be used in such areas.

TS 310.06.03 Truck Scales
Truck scales shall be according to OPSS 102.

TS 310.07 CONSTRUCTION

TS 310.07.01 Hot Mix HL-1, 2, 3, 3 HS, 3 Fine, 3 Mod, 8, 8 (HS) Recycled Hot Mix HL-8 (up to 20% RAP), HL-8 (HS, 10% RAP) Dense Friction Course Mix (DFC) Stone Mastic Asphalt (SMA) Large Stone Binder Course Mix (LSBC) Specialty Mixes

The work required for the above hot mix items is detailed in this subsection.

The work required for all hot mix items shall include the application of tack coat, where specified in the Contract Documents, except when a tender item ‘Tack Coat’ is included in the Pricing Form and some or all of the tack coat application is designated in the Contract Documents as being required under the tack coat item.

TS 310.07.01.01 Quality Control

The Contractor shall conduct such quality control (QC) procedures, including sampling and testing, as is necessary to ensure that all hot mix aggregates, all PGAC and PGAC-E and all hot mix to be used in the Work is according to the requirements of the Contract. The Contractor shall determine the type and amount of quality control (process control) sampling and testing to be completed.
The Contractor shall be responsible for the interpretation of the quality control test results and the determination of any action to be taken to ensure that all materials and work conform to the requirements as specified in the Contract Documents.

Reclaimed asphalt pavement (RAP) shall be considered as an aggregate for the purposes of quality control.

**TS 310.07.01.02 Preparation of Foundation, Existing Pavement and Shouldering**

a) A soil sterilant shall be applied as specified in the Contract Documents. All costs associated with the application of a soil sterilant will be deemed to be included in the unit price for soil sterilant in the Pricing Form in the Contract Documents.

b) Prior to placing any course of hot mix asphalt on a granular grade, a conventional steel-tired roller having a minimum mass of 7 tonnes, or an equivalent vibratory roller in terms of compactive effort with a drum width of at least 1.2 m, shall be used to finish roll the grade ahead of the asphalt paver to ensure a compacted smooth and float free surface. This roller shall operate continuously within 300 m of the paver.

The Contractor shall check grades, cross fall, surface tolerance, compaction and moisture content. The Contractor shall correct deficiencies, and check and adjust all frames and appurtenances to grade, including longitudinal and transverse slope. All costs associated with the preparation of granular grade will be deemed to be included in the unit price(s) for hot mix, hot laid asphaltic concrete in the Pricing Form in the Contract Documents. All costs associated with the adjustment of frames and appurtenances will be deemed to be included in the unit prices for frame and appurtenance adjustments in the Pricing Form in the Contract Documents.

c) Edge ramping and shouldering shall be constructed in accordance to OPSS 314. All costs associated with edge ramping and shouldering will be deemed to be included in the unit prices for edge ramping and shouldering in the Pricing Form in the Contract Documents.

d) Excavation for pavement widening shall be completed in accordance with TS 206. All costs associated with excavation for pavement widening will be deemed to be included in the unit price for excavation for pavement widening in the Pricing Form in the Contract Documents.

e) Prior to placing hot mix asphalt on a concrete base, the Contractor shall check grades and cross fall with special attention to intersections and flat sections of profile. The Contractor shall correct deficiencies where directed by the Contract Administrator, with hot mix padding, and check and adjust all frames and appurtenances to grade, including longitudinal and transverse slope. All costs associated with hot mix padding will be deemed to be included in the unit price for hot mix padding in the Pricing Form in the Contract Documents. All costs associated with the adjustment of frames and appurtenances will be deemed to be included in the unit prices for frame and appurtenance adjustments in the Pricing Form in the Contract Documents.

f) Prior to placing any hot mix padding, patching or asphalt pavement, all existing asphalt and concrete surfaces and previously laid asphalt courses shall be cleaned of all dirt, grime, loose, broken and foreign material, or other contaminants, that might prevent proper bonding of the hot mix asphalt.
The Contractor shall carry out such brooming and flushing as necessary to comply with this requirement. All costs associated with cleaning, brooming and flushing will be deemed to be included in the unit price(s) for hot mixed, hot laid asphaltic concrete in the Pricing Form in the Contract Documents.

**TS 310.07.01.03  Application of Tack Coat**

**TS 310.07.01.03.01  General**

All surfaces that require tack coat shall be uniformly sprayed with SS-1 asphalt emulsion diluted with an equal volume of water. The diluted SS-1 emulsion shall be uniformly applied immediately following any necessary cleaning of the surface, at the rate of 0.5 litre/m².

Hot mix asphalt shall not be placed upon the tack coated surface until the tack coat has dried to a proper condition of tackiness.

**TS 310.07.01.03.02  Standard Surfaces and Areas to Tack Coat**

Tack coat shall be uniformly applied using suitable spray equipment to all vertical surfaces and an area with 0.3 m width along/or around all existing curbs, appurtenances, service covers and catch basins. Where the hot mix asphalt contacts gutter bricks, granite sets or street car rails, these areas shall have tack coat uniformly applied. At both limits of the area being paved, as well as adjacent to steel bridge joints, a 0.6 m width of surface shall have tack coat uniformly applied. All costs associated with the application of tack coat to these surfaces and areas shall be deemed to be included in the unit price(s) for hot mixed, hot laid asphaltic concrete in the Pricing Form in the Contract Documents.

**TS 310.07.01.03.03  Other Surfaces or Areas**

When and where any other surfaces or areas are to have tack coat applied to them, they shall be given in the Contract Documents by a special provision. All costs associated with the application of tack coat to these other surfaces or areas will be deemed to be included in the unit price for tack coat in the Pricing Form in the Contract Documents.

**TS 310.07.01.04  Transportation of the Hot Mix**

The hot mix shall be transported from the asphalt plant to the work in trucks with smooth metal boxes in good and leakproof condition, previously cleaned of all foreign materials.

Truck boxes shall be lightly coated with a uniform application of a release agent, such as soap/detergent solution, just before loading. If liquid agent is used, the truck boxes must be drained after each application and before loading.

Each truck shall be equipped with a suitable insulated tarpaulin of sufficient size to cover the load. Such insulated tarpaulins shall be on the trucks at all times and will be used to cover the load completely.

**Note:** Contractors should note the importance of properly insulated tarpaulin use in cold weather to maintain the hot mix at placement temperature.
When insulated tarpaulins are in use, they shall be securely fastened down on all sides of the truck box.

Tarpaulins shall be rolled off the hot mix before the load is dumped into the paver or shuttle buggy.

In no case shall hot mix temperatures be increased at the asphalt plant to offset long distance hauling.

Delivery of hot mix to the site shall be scheduled such that spreading and compaction of the hot mix is completed during daylight, except when night work is permitted by the Contract, or as approved by the Contract Administrator.

Communication between the asphalt paving operation and the asphalt plant shall be the responsibility of the Contractor, and inability to control the delivery of the hot mix, or to make changes in the composition of the hot mix, will not be cause for acceptance of hot mix asphalt which does not conform to the requirements of the Contract, nor will it relieve the Contractor of any responsibility for rejected loads.

**TS 310.07.01.05  Hot Mix Padding**

Hot mix padding shall be carried out to correct geometric deficiencies on the surface of the existing pavement as specified in the Contract Documents. All costs associated with hot mix padding will be deemed to be included in the unit price for hot mix padding in the Pricing Form in Contract Documents.

**TS 310.07.01.06  Hot Mix Patching**

Prior to hot mix patching, any cold mix patching material shall be removed from the locations designated for such removal in the Contract. The resulting holes shall be filled with the specified hot mix asphalt and properly compacted.

Prior to placing hot mix patching material, the areas of the existing pavement designated to be tack coated shall be treated with undiluted SS-1 emulsified asphalt at the rate of 0.35 litre/m². The hot mix patching material shall be machine laid to the required thickness, grade and crossfall.

The ends of the patch, and along the centre line when only one lane is to be patched, shall be feathered down to provide a smooth transition between the existing pavement and the patch.

The transverse joint between the existing pavement and the patch shall be either diagonal or fishtailed as determined by the Contract Administrator at the time of construction.

All costs associated with hot mix patching will be deemed to be included in the unit price(s) for hot mix patching in the Pricing Form in the Contract Documents.

**TS 310.07.01.07  Placing Hot Mix Asphalt**

Asphalt paving shall not be carried out if, in the opinion of the Contract Administrator, the roadbed is frozen. In case of disagreement, the Contractor has the option of demonstrating at the Contractor’s own expense and to the satisfaction of the Contract Administrator that the roadbed is frost-free.

Hot mix surface courses shall not be placed unless the air temperature at the surface of the road is at least 7°C and rising except as follows:
When single course asphalt pavement is laid on granular grade, the air temperature shall be at least 2°C.

When single course asphalt pavement is laid on HL-2 which is laid on a granular grade, the air temperature shall be at least 2°C.

All other courses shall not be placed unless the air temperature at the surface of the road is at least 2°C.

When placing the hot mix asphalt on a granular grade, the granular grade shall be free of standing water. Not less than 300 m of prepared grade shall be maintained ahead of the asphalt paver. This requirement shall be waived at the end of the lane, or at the end of the paving operation for that day.

The surface of an existing pavement or previously laid course, upon which hot mix is to be placed, shall be clean and dry at the time of placing the hot mix asphalt. Not less than 30 m of prepared surface shall be maintained ahead of the asphalt paver laying the subsequent course. This requirement will be waived at the end of the lane, or at the end of the paving operation for that day.

A course shall not be placed upon a previously laid course within the 12 hours following final compaction of the latter, or until the temperature of the previous course is 50°C or less, whichever occurs first. For small pavement areas or bridge decks, the Contract Administrator shall issue instructions if any modification to this requirement is to be made.

The temperature of the hot mix asphalt immediately after spreading and prior to initial rolling shall not be less than 120°C.

Immediately after each course is laid and before compaction using rollers is started, deficiencies in the surface geometrics and hot mix asphalt texture shall be corrected. Irregularities in alignment and grade along the outside edge shall be corrected.

A course on the through lane shall be placed beyond the junction where side road tapers, bus bays, acceleration lanes and so on end, before the corresponding course is placed on such adjacent pavements.

For all courses, each adjacent lane shall be completed to approximately the same location at the end of each day’s paving.

The temperature of any placed and compacted course shall be less than 60°C before traffic is allowed on it.

**Note:** Contractors should note that this may require the use of staged paving procedures and/or cooling methods, at no extra cost to the City.

At the end of each completed portion, prior to opening of the lanes to traffic, the completed sections of hot mix asphalt course shall be ramped down to the existing pavement at a slope of 25 mm to 3 m. The hot mix to be used for construction of the ramps shall be determined by the Contractor and approved by the Contract Administrator. In all cases, the ramp shall not form part of the permanent asphalt pavement and shall be removed before the paving of the adjacent section.

For testing purposes, the City may take small hot mix asphalt samples or asphalt concrete cores from the courses. Holes made during such sampling, shall be carefully repaired by the Contractor at no extra cost to the City.
The Contractor shall take care during the transportation, placement and compaction of hot mix to avoid the spillage of any petroleum products such as gasoline, hydraulic oil, oil and diesel on the existing pavement(s) and new pavement(s). Any spill areas will be considered to be defective areas and dealt with in according to clause TS 310.07.01.13, herein.

**TS 310.07.01.07.01  Course Thickness**

The mass of hot mix being placed shall be adjusted as necessary during the asphalt paving operations so that the specified course thickness is uniformly maintained.

**TS 310.07.01.08  Use of Paving Equipment**

Levelling, binder and surface courses shall be laid by means of mechanical self-propelled pavers and a load transfer vehicle such as a shuttle buggy. The hot mix shall be dumped in the centre of the paver hopper or shuttle buggy and care shall be exercised to avoid overloading and spillage of the hot mix and segregation.

The longitudinal alignment of the spreader shall be controlled by following a string line which is set from the curb and gutter or alignment stakes. This means of control shall be placed at each outer edge of the pavement so that the spreader is directed at all times by a string line and not by the edge of the preceding course, except for the trailing paver(s) when pavers are operated in echelon.

The automatic screed controls and all compaction aids on the paver shall be in operation while the hot mix is being placed, except that the automatic screed controls shall not be used when placing HL-2 or a single course on granular grade.

Except for HL-2, when laying the first course adjacent to concrete gutters and similar structures, a short ski not less than 3 m in length shall be used and shall ride on the structure.

Single pavers, or the lead paver when pavers are operated in echelon, shall be controlled as to longitudinal grade by a 12 m ski or floating beam.

**Note:** Contractors should note that the City may, when paving major routes in echelon, require all pavers to be controlled by a 12 m ski, floating beam or global positioning system.

The paver(s) shall operate continuously at a uniform speed as necessary to match the output of the plant; however, in no case shall the speed of a paver exceed 18 m/min.

**Note:** Contractors should note that paving operations will often involve working with traffic.

If the hot mix for surface course paving comes from more than one hot mix plant, the mix from each plant shall be placed by a separate paver. Regardless, all hot mix shall be consistent in materials, gradation and properties.
TS 310.07.01.09  Widenings and Irregular Sections

TS 310.07.01.09.01  Widenings

When widening existing pavements, hot mix asphalt shall be placed in the widening such that when compacted, the top of the widening portion is flush with the top of the existing pavement. When stepped joints are specified, the courses placed in the widening shall be placed to the top of each step in separate operations.

The hot mix asphalt shall be placed in the widening using special equipment designed or adapted for this purpose.

TS 310.07.01.09.02  Irregular Sections

In intersections, turn-outs, driveways, and other irregular sections where it is impractical to spread and finish the binder, levelling or surface hot mix asphalt by paver methods, the Contractor shall use other spreading equipment or shall spread the mixture by hand. Regardless, all through lanes shall be placed by paver.

When laying surface courses, the use of feed augers for placing mix in these areas is permitted only when supplying hot mix to a hydraulic strike-off device.

When it is necessary to hand-spread the hot mix in sections adjacent to paver laid areas, such hand-spread shall be carried out concurrent with paver-laying.

For any handwork, care shall be taken to avoid hot mix segregation or open hot mix asphalt, and any coarse mix or excess mix from raking shall be removed.

TS 310.07.01.10  Longitudinal and Transverse Joints

TS 310.07.01.10.01  Requirements for all Joints

All joints shall be made to ensure a thorough and continuous bond between jointed materials and to provide a smooth riding surface.

All dirt or other foreign material and all loose material shall be removed from faces at which a joint is to be made.

When matching existing surfaces, the depth of the uncompacted mat shall be set to allow for compaction and the paver screed should overlap the adjacent surface by no more than 50 mm.

TS 310.07.01.10.02  Tacking of Joints

Faces at which joints are made shall be tacked (painted) with a thin uniform and continuous coating of tack coat material, with the exception of joints that are still hot, the joint(s) between pavement lanes laid in echelon and joints between adjacent lanes of HL-2. All costs associated with the tacking of joints shall be deemed to be included in the unit price(s) for hot mixed, hot laid asphaltic concrete in the Pricing Form in the Contract Documents.
**TS 310.07.01.10.03  Requirements for Longitudinal Joints**

Longitudinal joints shall be properly "set up" with the back of a rake or lute if necessary, at the proper height and grade prior to rolling.

With the exception of HL-2 courses, the width of subsequent courses shall be adjusted to an offset of 150 to 300 mm so that longitudinal joints do not coincide vertically. This shall also apply to the joint between through lanes and speed change lanes and other similar longitudinal joints. The longitudinal joints in the surface course shall correspond to the demarcation between driving lanes, speed change lanes and tapers as specified in the Contract Documents.

For surface courses, the method of making joints shall be such that the excess hot mix is not scattered on the surface of the freshly laid mat. Such excess material shall be removed.

At widenings, longitudinal joints between asphalt pavement laid under this Contract and existing asphalt pavement shall be treated as follows:

- Where a butt joint is to be constructed, the existing asphalt pavement edge shall be trimmed to a straight, clean, vertical face.

- Where a stepped joint is to be constructed, the existing asphalt pavement edge shall be trimmed to a straight, clean, vertical face and the asphalt pavement shall be removed to the depth and width as specified in the Contract Documents to form the stepped joint.

Where a resurfacing course is to be placed flush against a rigid object, for example curb and gutter, a butt joint shall be constructed by removing the existing pavement to provide an exposed face of at least 35 mm at the face of the rigid object and feathered out to zero along a line 1.25 m from and parallel to the exposed face of the rigid object to provide a depth of at least 35 mm of resurfacing hot mix asphalt over the area of removal.

**TS 310.07.01.10.04  Requirements for Transverse Joints**

Except for end joints with hot mix patching, transverse joints between asphalt pavement laid under this Contract and asphalt courses previously laid under this Contract shall be constructed by trimming the end of the previously laid course back to its full depth, to expose a fresh, straight vertical surface.

The asphalt paver shall not move more than 15 m from any transverse joint until that joint has been rolled and checked with a straight edge. If the joint is not satisfactory, it shall be corrected immediately before the paver is allowed to proceed.

Joints between asphalt pavement laid under this Contract and existing asphalt courses not laid under this Contract shall be constructed as follows:

- Where a binder course is placed flush against an existing asphalt pavement and a butt joint is to be made, the existing pavement shall be trimmed back to form a straight vertical face.

- Where a surface course is placed flush against an existing asphalt pavement, the binder course shall be feathered out and a butt joint shall be constructed in the surface course by removing the existing asphalt pavement to a depth of 25 mm and for a longitudinal distance of not less than:

  i. 3 m where the maximum speed is to be posted at 70 km/h or greater; and
ii. 1.25 m where the maximum speed is to be posted at less than 70 km/h.

**TS 310.07.01.10.05 Disposal**

All materials removed for joint construction shall be disposed of away from the Work by the Contractor.

**TS 310.07.01.11 Compaction**

**TS 310.07.01.11.01 Compaction Testing Based on Nuclear Density Gauge Testing**

Each completed course of asphalt pavement shall be compacted to at least the minimum percent compaction of the hot mix’s theoretical maximum relative density given in Table 4, regardless of the depth of the course being laid. Compaction shall be determined by calibrated nuclear density gauge testing (nuclear density gauge densities calibrated against core densities for each hot mix type for the Contract).

**Table 4: Compaction requirements**¹

<table>
<thead>
<tr>
<th>Hot mix type</th>
<th>Minimum per cent compaction of theoretical max relative density</th>
</tr>
</thead>
<tbody>
<tr>
<td>all except HL-3 Fine</td>
<td>92.5</td>
</tr>
<tr>
<td>HL-3 Fine</td>
<td>91</td>
</tr>
</tbody>
</table>

Note 1: Determined according to MTO LS-264 and LS-287.

**TS 310.07.01.11.02 Rolling**

Rolling shall be completed to provide uniform compaction of the hot mix asphalt.

All rolling shall be completed during daylight, except when night work is permitted by the Contract, or as approved by the Contract Administrator.

The Contractor shall supply and use at least the minimum number of roller compaction units in the sequence specified in Table 5.

When vibratory or pneumatic rollers are used, one shall be supplied for each paver.

The operating speed of steel-tired rollers shall not exceed 5 km/h and shall be slow enough to avoid undue displacement of the hot mix asphalt. Rollers shall operate with the drive wheel forward in the direction of paving.

At all places not accessible to rollers, the hot mix asphalt shall be compacted by other suitable means.
Table 5: Maximum rates per paver and roller sequence¹

<table>
<thead>
<tr>
<th>Maximum production per paver t/s</th>
<th>Minimum roller combinations per paver breakdown + intermediate + finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>120 or less</td>
<td>S2 + R1 + S1</td>
</tr>
<tr>
<td></td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>V1 + R1 + S1</td>
</tr>
<tr>
<td>more than 120</td>
<td>S2 + 2xR1 + S1</td>
</tr>
<tr>
<td></td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>S2 + R2 + S1</td>
</tr>
<tr>
<td></td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>V2 + 2xR1 + S1</td>
</tr>
<tr>
<td></td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>V2 + R2 + S1</td>
</tr>
</tbody>
</table>

Note 1: For each pair of rollers used in echelon, only one S1 roller shall be required.

Rolling procedures shall be as follows:

i. Breakdown Rolling

The hot mix asphalt shall be thoroughly and uniformly compacted as soon after placing as it will bear the roller without checking or undue displacement. Rolling shall start longitudinally at the lower edge and proceed towards the higher edge of the course, overlapping on successive trips. Alternate trips of the roller shall be staggered.

ii. Intermediate Rolling

The intermediate roller shall follow the breakdown rolling as closely as possible. Passes shall be so arranged as to ensure overlapping successive tire paths. The rolling operation shall be such as to prevent pick-up of the mixture on the tires.

iii. Finish Rolling

Finish rolling shall be accomplished with the minimum number of passes required to produce a satisfactory surface without any checking of the compacted asphalt concrete. Finish rolling shall start longitudinally at the higher edge and proceed towards the lower edge of the course.

Note: Contractors should note that additional rollers, beyond the combinations given in Table 5, may be required to achieve satisfactory compaction. DFC, HL-1 and HS (High Stability) may be difficult to compact and require close attention to roller selection and operation. The influence of lower ambient temperatures/wind on compaction should also be noted by Contractors.

**TS 310.07.01.11.03 Compaction of Irregular Sections and Inaccessible Areas**

All irregular and inaccessible areas that cannot be compacted to the required minimum compaction, given in clause TS 310.07.01.11.01, herein, by the use of the specified rollers, shall be compacted with mechanical tampers. The hot mix asphalt may be heated without "burning" to a temperature of 130°C to facilitate this compaction.
**TS 310.07.01.11.04  Rolling Requirements for Stone Mastic Asphalt**

The compaction of SMA shall be completed using steel-tired (steel-wheel) rollers in the static mode. No pneumatic-tired rollers shall be used on the SMA.

**Note:** Contractors should note that the proper compaction of SMA requires the breakdown compaction steel-wheel roller(s) to be kept right up to the paver screed. The SMA must be at the proper temperature (typically 145 to 155°C) for compaction. Contractors should also note that SMA is quite resistant to compaction and has only about 30 per cent of the compactibility of conventional mixes. Care must be taken to remove any cold or spilled SMA mix during paving and compaction operations.

**TS 310.07.01.12  Tolerances**

Each course after final compaction shall be smooth and true to the established crown and grade. The surface of each binder course shall be free from deviations exceeding 5 mm as measured in any direction with a 3 m straight edge. The surface of each surface course shall be free from deviations exceeding 3 mm as measured in any direction with a 3 m straight edge.

**TS 310.07.01.13  Surface Appearance**

Each course, after final compaction, shall be of uniform texture and shall be free of segregation, fat spots, oil spills, roller marks and any other defects. Areas of medium segregation may be left in place for binder courses, subject to approval of the Contract Administrator, but are considered defective areas for surface course. Areas of severe segregation are considered defective areas for binder and surface courses. Defective areas shall be removed and replaced with acceptable hot mix asphalt of the same type and compacted to the satisfaction of the Contract Administrator.

**TS 310.07.02  Crack Repair**

All crack repair shall be carried out in advance of paving operations.

Cracks which are to be repaired shall be cleaned and all loose and broken material removed. Hot mix of the type specified in the Contract Documents shall be placed in the crack, feathered to 0.3 m on each side of the crack and rolled with a steel-tired roller having a mass of at least 3 tonnes.

All costs associated with crack repairs will be deemed to be included in the unit price for crack repair in the Pricing Form in the Contract Documents.

**TS 310.07.03  Depressed Fault Repair**

Depressed fault repair shall be carried out in advance of paving operations as specified in the Contract Documents.

Faults which are to be repaired shall be cleaned, and all loose and broken material shall be removed. Hot mix of the type designated in the Contract shall be placed in the fault and feathered 0.3 m on each side of the fault, and shall be rolled with a steel-tired roller having a mass of at least 3 t.

All costs associated with depressed fault repairs shall deemed to be included in the Contract Price for depressed fault repair in the Pricing Form.
**TS 310.07.04  Milling Existing Asphalt Pavement**

The existing asphalt pavement shall be milled off for the area and depth indicated.

All costs associated with milling existing asphalt pavement will be deemed to be included in the Contract Price for milling existing asphalt pavement in the Pricing Form.

**TS 310.07.05  Sealing**

All joints between frames and appurtenances and the asphalt pavement shall be sealed with a bead of hot-poured rubberized asphalt.

All costs associated with sealing joints between frames and appurtenances and the asphalt pavement will be deemed to be included in the Contract Price for adjustment of frames and appurtenances in the Pricing Form.

**TS 310.07.06  Hot-Poured Rubberized Asphalt Joints**

When and where hot-poured rubberized asphalt joints are to be constructed, they shall be given in the Contract by a Special Provision. All costs associated with hot-poured rubberized asphalt joints will be deemed to be included in the Contract Price for hot-poured rubberized asphalt joints in the Pricing Form.

**TS 310.08  QUALITY ASSURANCE**

**TS 310.08.01  General**

Quality assurance (QA) acceptance testing of the Work shall be conducted by the City. Compaction acceptance requirements are given in subsection TS 310.08.02. Aggregates acceptance requirements are given in TS 1003. PGAC and PGAC-E acceptance requirements are given in TS 1101. Hot mixed, hot laid asphaltic concrete acceptance requirements are given in TS 1150.

All visually defective hot mix asphalt (clause TS 310.07.01.13) or work will be rejected by the Contract Administrator, irrespective of any quality assurance test results. Such defective hot mix asphalt or work shall not be incorporated into the Work.

The Contractor may have a qualified representative present during any quality assurance testing. During the quality assurance testing, the qualified representative shall immediately comment on any aspects of the testing which the representative does not consider valid and the Contract Administrator will respond to the comments in order to resolve them. Prior to leaving the quality assurance testing laboratory, any unresolved comments regarding the testing procedures are to be given to the Contract Administrator in writing. Any comments on the testing procedures which are made subsequent to the Contractor’s representative leaving the laboratory will not be considered.

**TS 310.08.02  Compaction Requirements**

Compaction testing of the placed hot mix asphalt course, completed by the City (based on calibrated nuclear density gauge testing), shall be according to clause TS 310.07.01.11.01, herein.
TS 310.08.02.01 Acceptance/Rejection

If the average compaction of a placed hot mix asphalt course does not meet the requirements of clause TS 310.07.01.11.01, herein, or if the compaction is variable, the Contractor will be warned, and shall take immediate corrective action. The adequacy of any corrective action shall be checked by the Contract Administrator (calibrated nuclear density gauge testing). This may result in delays to the asphalt paving until the necessary corrective compaction measures are proven.

Note: Contractors should note that nuclear density gauge testing compaction process control is of advantage to setting roller patterns and the number of roller passes required to achieve the required compaction.

TS 310.09 MEASUREMENT FOR PAYMENT

TS 310.09.01 Hot Mix HL-1, 2, 3, 3 HS, 3 Fine, 3 Mod, 8, 8 (HS)
Recycled Hot Mix HL-8 (up to 20% RAP), HL-8 (HS, 10% RAP)
Dense Friction Course Mix (DFC)
Stone Mastic Asphalt (SMA)
Large Stone Binder Course Mix (LSBC)
Specialty Mixes

TS 310.09.01.01 Methods of Measurement

Measurement of hot mixed, hot laid asphaltic concrete shall be by mass in t (megagrams or tonnes) or by area in square metres (m²).

All hot mix that is delivered to the site shall be accompanied by a truck weigh ticket showing the truck number, type of hot mix, contract number, truck time in and out of the hot mix plant, tare mass in kilograms to the nearest 50 kg, gross mass to the nearest 50 kg, net mass in kilograms and driver's signature.

The truck weigh ticket shall be printed by an electronic printer interfaced with the truck scale readout and capable of recording the tare mass, gross mass and net mass. The weigh ticket shall carry a cumulative total for the day. The tare mass for the truck shall include the vehicle, operator, fuel, spare tire and so on. The tare mass of the truck shall be taken at least twice per shift.

The Contractor, or Contractor's representative, shall be responsible for ensuring that the truck weigh ticket (delivery ticket) for each load is handed to the City's representative inspecting the asphalt paving operation at the time the delivery truck unloads at the paving site. The Contract Administrator will not accept any responsibility for delivery tickets that are not submitted at the proper time, or are submitted in groups after the delivery trucks have left the paving site.

The Contractor shall permit the Contract Administrator to make random checks of the gross mass and tare mass of trucks hauling hot mix by requiring them to be driven over an independent scale. No additional payment shall be made for any delays or costs attributable to such verification of loads.

TS 310.09.01.02 Theoretical Mass

Where the thickness of a hot mix asphalt course is specified by being given in the Contract Documents, shown on the Contract Drawings, or in written instructions from the Contract Administrator, the theoretical mass shall be determined as follows:
Theoretical Mass = the area of the surface covered x the specified thickness x 97 per cent of the hot mix bulk density from the job mix formula for the mix type.

Levelling courses and padding courses, if any, shall not be checked for theoretical mass.

**TS 310.09.01.03 Payment Mass**

When the Pricing Form specifies the thickness of hot mix asphalt course(s) and that the hot mix item(s) shall be measured by mass, the actual mass of hot mix used to produce the course shall not exceed the theoretical mass by more than 15 per cent.

If the mass of hot mix type placed is less than 115 per cent of the theoretical mass for the hot mix type, the payment mass will be the mass of hot mix actually placed as recorded by the weigh tickets, multiplied by the density factor for the hot mix type and composition given in Table 6, as applicable.

If the mass of hot mix type placed exceeds 115 per cent of the theoretical mass for the hot mix type, the payment mass will be based on no more than 115 per cent of the theoretical mass, multiplied by the density factor for the hot mix type and composition given in Table 6, as applicable.

**TS 310.09.01.04 Payment Area**

When the Pricing Form specifies that the hot mix type item(s) is to be measured by area, a check will be carried out for each course laid to confirm the thickness of the course. The actual thickness of the course will be calculated as follows:

$$\text{actual thickness} = \frac{\text{specified thickness} \times \text{actual mass}}{\text{theoretical mass}}$$

When the actual thickness is more than 95 per cent of the specified thickness, the payment area will be the total surface area of the hot mix type laid for the course.

When the actual thickness is less than 95 per cent of the specified thickness, the surface area for payment purposes will be calculated as follows:

$$\text{payment area} = \frac{\text{actual area} \times \text{actual thickness}}{\text{specified thickness}}$$
### Table 6: Density factors for DFC, HL-1 and SMA

<table>
<thead>
<tr>
<th>Mix type</th>
<th>Coarse aggregate</th>
<th>Fine aggregate</th>
<th>Density factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>DFC</td>
<td>trap rock</td>
<td>trap rock</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>dolomitic sandstone</td>
<td>dolomitic sandstone</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>meta-arkose</td>
<td>meta-arkose</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>diabase</td>
<td>diabase</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td>gneiss</td>
<td>gneiss</td>
<td>1.10</td>
</tr>
<tr>
<td>HL-1</td>
<td>trap rock</td>
<td>100 % crushed find aggregate asphalt sand</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>dolomitic sandstone</td>
<td>100 % crushed find aggregate asphalt sand</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td>meta-arkose</td>
<td>100 % crushed find aggregate asphalt sand</td>
<td>1.06</td>
</tr>
<tr>
<td></td>
<td>diabase</td>
<td>100 % crushed find aggregate asphalt sand</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td>andesite</td>
<td>100 % crushed find aggregate asphalt sand</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>gneiss</td>
<td>100 % crushed find aggregate asphalt sand</td>
<td>1.04</td>
</tr>
<tr>
<td>SMA</td>
<td>trap rock</td>
<td>trap rock</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>dolomitic sandstone</td>
<td>dolomitic sandstone</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>meta-arkose</td>
<td>meta-arkose</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>diabase</td>
<td>diabase</td>
<td>1.03</td>
</tr>
</tbody>
</table>

Note 1: The density factor for HL-2, HL-3 (HS), HL-3, HL Fine, HL-3 Mod, HL-8 (HS), and HL-8 and LSBC is 1.00.

Note 2: Other approved combinations of DFC, HL-1 or SMA aggregates, if any, shall have density factors applied proportional to those given in Table 6.

Note 3: The density factor for DFC is based on a combination of trap rock coarse aggregate and trap rock fine aggregate.

Note 4: The density factor for HL-1 is based on a combination of trap rock coarse aggregate, 100% crushed fine aggregate asphalt sand.

Note 5: The density factor for SMA is based on a combination of trap rock coarse aggregate and trap rock fine aggregate.

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**TS 310.09.01.05 Density Factors**

Density factors for DFC, HL-1 and SMA are given in Table 6. The density factor for all other hot mix types is 1.00.

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**TS 310.10 BASIS OF PAYMENT**

**TS 310.10.01**

- Hot Mix HL-1, 2, 3, 3 HS, 3 Fine, 3 Mod, 8, 8 (HS)
- Recycled Hot Mix HL-8 (up to 20% RAP), HL-8 (HS, 10% RAP)
- Dense Friction Course Mix (DFC)
- Stone Mastic Asphalt (SMA)
- Large Stone Binder Course Mix (LSBC)
- Specialty Mixes

Where there is no separate tender item for tack coat, payment at the Contract Price for the tender item for hot mixed, hot laid asphaltic concrete to be placed on the tack coat shall include full compensation for all labour, Equipment and Material to do the work.
**TS 310.10.01.01  Mass Basis**
When the Pricing Form specifies that the hot mix type item(s) is to be measured by mass, payment will be based on the payment mass.

**TS 310.10.01.02  Area Basis**
When the Pricing Form specifies that the hot mix type item(s) is to be measured by area, payment will be based on the payment area.

**TS 310.10.01.03  PGAC and PGAC-E**
A measurement of the PGAC or PGAC-E used shall not be made. The cost of asphalt cement shall be included in the respective hot mix type unit price in the Pricing Form.

In the event that the results of extraction tests carried out by the City indicate that the average PGAC or PGAC-E content for a hot mix type lies below the acceptable tolerance shown in subsection 1150.08.02 of TS 1150, and the Contract Administrator elects to allow this hot mix asphalt to remain in the Work, the payment quantity for this hot mix type will be reduced 10 per cent for each 0.1 per cent that the average PGAC or PGAC-E content lies below the tolerance.
Amendment to OPSS 401 (Nov 2013) – Construction Specification for Trenching, Backfilling and Compacting

OPSS 401.05 MATERIALS

OPSS 401.05.01 Embedment Material

Subsection 401.05.01 of OPSS 401 is deleted in its entirety and replaced with the following:

Embedment material shall be Granular A according to TS 1010.

OPSS 401.05.04 Granular Material

Subsection 401.05.04 of OPSS 401 is deleted in its entirety and replaced with the following:

Granular material shall be according to TS 1010.

OPSS 401.05.06 Unshrinkable Fill

Subsection 401.05.06 of OPSS 401 is deleted in its entirety and replaced with the following:

Unshrinkable fill shall be according to TS 13.10.

OPSS 401.07 CONSTRUCTION

OPSS 401.07.04 Removals

Subsection 401.07.04 of OPSS 401 is deleted in its entirety and replaced with the following:

Removals shall be according to TS 510.

OPSS 401.07.10.01 General

Clause 401.07.10.01 of OPSS 401 is amended by deleting the third sentence in its entirety and replacing it with the following:

Compacting of embedment, bedding, cover, and backfill materials during pipe installation shall be according to TS 501.
OPSS 401.07.10.03  Bedding

Clause 401.07.10.03 of OPSS 401 is amended by deleting the fifth sentence in its entirety and replacing it with the following:

Bedding material shall be placed in uniform layers not exceeding 200 mm in thickness, loose measurement, and each layer shall be compacted according to TS 501 before a subsequent layer is placed.

OPSS 401.07.10.04  Cover

Clause 401.07.10.04 of OPSS 401 is amended by deleting the second sentence in its entirety and replacing it with the following:

Cover material shall be placed in uniform layers not exceeding 200 mm in thickness, loose measurement, and each layer shall be compacted according to TS 501 before a subsequent layer is placed.

OPSS 401.07.10.05  Backfill

Clause 401.07.10.05 of OPSS 401 is amended by deleting the first sentence in its entirety and replacing it with the following:

Backfill material shall be placed in uniform layers not exceeding 300 mm in thickness, loose measurement, for the full width of the trench and each layer shall be compacted according to TS 501 before a subsequent layer is placed.
CONSTRUCTION SPECIFICATION FOR TRENCHING, BACKFILLING, AND COMPACTING

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401.07 CONSTRUCTION
401.08 QUALITY ASSURANCE - Not Used
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APPENDICES

401-A Commentary

401.01 SCOPE

This specification covers the requirements for excavating, backfilling, and compacting trenches for the installation of sanitary and storm pipe sewers; pipe culverts and end sections; pipe subdrains; forcemains and associated appurtenances; watermains and associated appurtenances; and other underground Utilities.

401.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.
401.01.02 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.

401.02 REFERENCES

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

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**

<table>
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Ontario Provincial Standard Specifications, Material

OPSS 1010  Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1359  Unshrinkable Backfill

Provincial Statute

*Occupational Health and Safety Act*
R.S.O. 1990, c. O.1, as amended
Ontario Regulations 213/91 - Regulations for Construction Projects, as amended

**401.03 DEFINITIONS**

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

**Additional Excavation** means all excavation ordered in writing by the Contract Administrator beyond excavation specified in the Contract Documents.

**Associated Appurtenances** means as defined in OPSS 412 and OPSS 441.

**Backfilling** means the operation of filling the trench with bedding, cover, and backfill material or embedment and backfill material.

**Backfill Material** means fill material used above the embedment or cover material and below the lower of the subgrade or finished grade or the original ground.

**Bedding Class** means a classification system that defines the depth of the bedding material.

**Bedding Material** means material as it relates to rigid pipe, from the bottom of the trench to the bottom of the cover.

**Cover Material** means the material placed from the top of the bedding to the bottom of the backfill for rigid pipe.

**Embedment Material** means material as it relates to flexible pipe, from the bottom of the trench to the bottom of the backfill.

**Excavation, Earth and Rock** means the excavation classified as earth and rock according to OPSS 206.

**Flexible Pipe** means pipe that can deflect 2% or more without cracking such as polyvinyl chloride, polyethylene, or steel pipe.

**Imported Material** means material obtained from a source other than the Work Area.

**Native Material** means the material removed to form an excavation within the Work Area for return to the same or other excavation.

**Pipe** means sanitary or storm pipe sewers, watermains, forcemains, pipe culverts, and subdrains.

**Rigid Pipe** means pipe that cannot deflect more than 2% without cracking such as concrete pipe.

**Trench** means the definition as provided in the *Occupational Health and Safety Act* and Regulations for Construction Projects.
Trenching means the earth or rock excavation required to construct a trench in which to install pipes and their associated appurtenances.

Trench Width means the horizontal distance between the trench walls as measured at the bedding grade.

Unshrinkable Fill means as defined in OPSS 1359.

401.05 MATERIALS

401.05.01 Embedment Material
Embedment material shall be one of the following, as specified in the Contract Documents:

a) Granular A.

b) Granular B, Type I, II, or III, with 100% passing the 26.5 mm sieve.

c) Unshrinkable fill.

401.05.02 Bedding Material
Bedding material shall be one of the following, as specified in the Contract Documents:

a) Granular A.

b) Granular B, Type I, II, or III, with 100% passing the 26.5 mm sieve.

c) Unshrinkable fill.

401.05.03 Cover Material
Cover material shall be one of the following, as specified in the Contract Documents:

a) Granular A.

b) Granular B, Type I, II, or III, with 100% passing the 26.5 mm sieve.

401.05.04 Granular Material
Granular material shall be according to OPSS 1010.

401.05.05 Backfill Material

401.05.05.01 General
Backfill material shall be one of the following, as specified in the Contract Documents:

a) Granular A.

b) Granular B, Type I, II, or III.

c) Unshrinkable fill.

d) Native material.
Native and imported material shall be approved by the Contract Administrator. All material shall be free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks and boulders over 150 mm in any dimension, and other deleterious material.

Unshrinkable fill shall be according to OPSS 1359.

Unshrinkable fill shall be according to OPSS 1359.

Site preparation shall be according to OPSS 490.

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

Removals shall be according to OPSS 510.

Dewatering shall be according to OPSS 517 for placement of pipe or to OPSS 902 for placement of structure.

Support systems shall be according to OPSS 404.

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

Written permission shall be obtained from the Contract Administrator prior to starting any excavation in frozen ground. The method used for removal of frozen ground shall not cause damage to adjacent structures or Utilities.

Trenches shall be excavated to the lines, grades, and dimensions specified in the Contract Documents. The width of the trench at the bottom shall not exceed the width at the top.
Trenching for pipe culverts shall include the excavation for frost tapers and end sections.

No more than 15 m of trench shall be open in advance of the completed pipe system.

The Contract Administrator shall be notified immediately if the bottom of the trench appears to give an unsuitable foundation.

When installing rigid pipe, if the trench is excavated wider than the allowable width without authorization, the Contract Administrator may require the use of a stronger pipe or a higher class of bedding or both.

If the trench depth is excavated beyond the limits of the required excavation without the Contract Administrator's authorization, granular material shall be placed and compacted in the trench to reinstate the required trench limits prior to backfilling the trench as specified in the Contract Documents. Alternatively, another structurally accepted design shall be provided by adjusting the limits of the excavation prior to backfilling.

Rock excavation for trenches shall be according to OPSS 403.

**401.07.10 Backfilling and Compacting**

**401.07.10.01 General**

The diameter or the span and rise of flexible pipes shall not vary from the manufactured dimensions by more than 5% during cover and backfill placing operations.

Pipe installation and backfilling shall be completed prior to the start of subbase and base course construction over the pipe location.

Compacting of embedment, bedding, cover, and backfill materials during pipe installation shall be according to OPSS 501.

Prior to allowing the movement of any construction equipment or vehicular traffic over the buried infrastructure, the depth of backfill shall be sufficient enough to protect the buried infrastructure from damage.

**401.07.10.02 Embedment**

Placement of embedment material shall be as described in the Bedding and Cover clauses.

**401.07.10.03 Bedding**

Pipe bedding shall be of the class specified in the Contract Documents.

The surface upon which the pipe is to be laid shall be true to grade and alignment.

The pipe bedding shall be shaped to the dimensions specified in the Contract Documents. When bell and spigot pipe is to be laid, recesses shall be shaped to receive the bells.

Bedding material placed in the haunches shall be compacted prior to continued placement of cover material.

Bedding material shall be placed in uniform layers not exceeding 200 mm in thickness, loose measurement, and each layer shall be compacted according to OPSS 501 before a subsequent layer is placed.
Bedding material shall be placed on each side of the pipe and shall be completed simultaneously. At no time shall the levels on each side differ by more than the 200 mm uncompacted layer.

**401.07.10.04 Cover**

Cover material shall be placed so that damage to or movement of the pipe is avoided.

Cover material shall be placed in uniform layers not exceeding 200 mm in thickness, loose measurement, and each layer shall be compacted according to OPSS 501 before a subsequent layer is placed.

Cover material shall be placed on each side of the pipe and shall be completed simultaneously. At no time shall the levels on each side differ by more than the 200 mm uncompacted layer.

**401.07.10.05 Backfill**

Backfill material shall be placed in uniform layers not exceeding 300 mm in thickness, loose measurement, for the full width of the trench and each layer shall be compacted according to OPSS 501 before a subsequent layer is placed.

Backfill material shall be placed to a minimum depth of 900 mm above the crown of the pipe before power operated tractors or rolling equipment shall be used for compacting. Uniform layers of backfill material exceeding 300 mm in thickness may be placed with the approval of the Contract Administrator.

When the Contract specifies native backfill material, acceptable earth backfill material may be substituted with the approval of the Contract Administrator. In areas within the roadway, for a depth equal to the frost treatment, the earth backfill material shall have frost susceptible characteristics similar to the adjacent material.

**401.07.11 Additional Trenching, Backfilling, and Compacting**

Additional trenching, backfilling, and compacting shall be as described in the Trenching and Backfilling and Compacting subsections.

Unsuitable material shall be excavated and the resulting excavation shall be backfilled and compacted to obtain a suitable foundation.

**401.07.12 Site Restoration**

Site restoration shall be according to OPSS 492.

**401.07.13 Management of Excess Material**

Management of excess material shall be as specified in the Contract Documents.

**401.09 MEASUREMENT FOR PAYMENT**

**401.09.01 Actual Measurement**

**401.09.01.01 Additional Trenching, Backfilling, and Compacting**

Additional trenching, backfilling, and compacting shall be based on the volume of the additional excavation measured in cubic metres prior to installation of the pipe.

The volume of the excavation that is in addition to the limits specified in the Contract Documents shall be determined.
401.10  BASIS OF PAYMENT

401.10.01  Trenching, Backfilling, and Compacting

Payment at the Contract price for the appropriate tender items for the installation of sanitary and storm pipe sewers, pipe culverts and end sections, subdrains, forcemains and associated appurtenances, watermains and associated appurtenances, and other underground Utilities shall be full compensation for all labour, Equipment, and Material to do the work.

When the Contract contains separate items for work required by this specification, payment shall be at the Contract prices and according to the specifications for such work.

Any expenses for remedial work resulting from unauthorized over-excavation of the trench width and depth shall be borne by the Contractor.

When native material is deemed unsuitable for backfill for reasons other than those attributed to the Contractor's mode of operation, any additional work done to provide acceptable backfill beyond the work herein specified shall be paid for as Extra Work.

401.10.02  Additional Trenching, Backfilling, and Compacting - 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.

401.10.03  Rock Excavation for Trenches

Payment for rock excavation for trenches shall be according to OPSS 403.
Appendix 401-A, November 2013
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 may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the tender documents.

The designer may consider specifying requirements for a pre-condition survey in the Contract Documents.

The designer should specify the following in the Contract Documents:

- Type of embedment material. (401.05.01)
- Type of bedding material. (401.05.02)
- Type of cover material. (401.05.03)
- Type of backfill material. (401.05.05.01)
- Trench line, grade, and dimensions. (401.07.09)
- Pipe bedding class and dimensions. (401.07.10.03)

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

Related Ontario Provincial Standard Drawings

OPSD 802.010 Flexible Pipe Embedment and Backfill, Earth Excavation
OPSD 802.013 Flexible Pipe Embedment and Backfill, Rock Excavation
OPSD 802.014 Flexible Pipe Embedment in Embankment, Original Ground: Earth or Rock
OPSD 802.020 Flexible Pipe Arch Embedment and Backfill, Earth Excavation
OPSD 802.023 Flexible Pipe Arch Embedment and Backfill, Rock Excavation
OPSD 802.024 Flexible Pipe Arch Embedment in Embankment, Original Ground: Earth or Rock
OPSD 802.030 Rigid Pipe Bedding, Cover and Backfill, Type 1 or 2 Soil - Earth Excavation
OPSD 802.031 Rigid Pipe Bedding, Cover and Backfill, Type 1 or 2 Soil - Earth Excavation
OPSD 802.032 Rigid Pipe Bedding, Cover and Backfill, Type 3 Soil - Earth Excavation
OPSD 802.033 Rigid Pipe Bedding, Cover and Backfill, Type 4 Soil - Earth Excavation
OPSD 802.034 Rigid Pipe Bedding and Cover in Embankment, Original Ground: Earth or Rock
OPSD 802.050 Horizontal Elliptical Rigid Pipe Bedding, Cover and Backfill, Type 1 or 2 Soil - Earth Excavation
OPSD 802.051 Horizontal Elliptical Rigid Pipe Bedding, Cover and Backfill, Type 3 Soil - Earth Excavation
OPSD 802.052 Horizontal Elliptical Rigid Pipe Bedding, Cover and Backfill, Type 4 Soil - Earth Excavation
OPSD 802.053 Horizontal Elliptical Rigid Pipe Bedding, Cover and Backfill, Rock Excavation
OPSD 802.054 Horizontal Elliptical Rigid Pipe Bedding and Cover in Embankment, Original Ground: Earth or Rock
OPSD 803.010 Backfill and Cover for Concrete Culverts
OPSD 803.030 Frost Treatment - Pipe Culverts, Frost Penetration Line Below Bedding Grade
OPSD 803.031 Frost Treatment - Pipe Culverts, Frost Penetration Line Between Top of Pipe and Bedding Grade
Amendment to OPSS 441 (Nov 2012) – Construction Specification for Watermain Installation in Open Cut

OPSS 441.05 MATERIALS

OPSS 441.05.09.01 General

Clause 441.05.09.01 of OPSS 441 is deleted in its entirety and replaced with the following:

Direction to Open Valves

Open Clockwise

In districts Etobicoke/York (former city of York, east of the Humber River), North York, Toronto/East York all valves supplied to these areas of the city will open by operating in a clockwise direction and the operating nut supplied will be painted in red.

Open Counter Clockwise

In districts Etobicoke/York (former city of Etobicoke, west of the Humber River), and Scarborough all valves supplied to these areas of the city will open by operating in a counter clockwise direction and the operating nut shall be painted in black.

Valve Design

Valves shall be designed for a minimum cold water working pressure of 1035 kPa.

Valve types shall be one of the following:

- Valves less than 75 mm shall be brass or bronze gate valves;
- Valves greater than or equal to 75 mm, and less than or equal to 300 mm, shall be cast or ductile iron gate valves;
- Valves greater than 300 mm up to and including 500 mm shall be gate or butterfly valves;
- Valves greater than 500 mm shall be butterfly valves.

Fasteners shall be made from material meeting the strength requirements of ASTM A307 with dimensions according to ASME B18.2.1. Bolts, studs, and nuts shall be cadmium plated according to ASTM B766 or zinc coated according to ASTM A153 or ASTM B633. Fasteners for mechanical joints shall be ductile iron according to AWWA C111/A21.11.
Valves shall be supplied with flanged ends conforming to ANSI B16.1 Class 125. Valves shall be capable of a seat differential test pressure equal to the design pressure and to a hydrostatic shell test pressure at least 50 per cent in excess of the design pressure.

Valves for buried installation shall have mechanical flanged ends as required.

Shaft spindles shall have O-ring seals of resilient materials.

Valves shall have non-rising spindles.

Valve operators shall be a waterproof type suitable for continuous submergence duty. Operators shall be grease-packed, enclosed gear type. The work gear and the input shaft shall be stainless steel.

**OPSS 441.05.10** Hydrants

Subsection 441.05.10 of OPSS 441 is amended by the addition of the following paragraphs:

Isolation or secondary valves shall be included in all hydrant installations. The secondary valve shall open in the same direction as the mainline watermain valve. The secondary valve shall be a minimum of one metre away from the hydrant.

The hydrant shall open in the counter-clockwise direction.

**OPSS 441.07** CONSTRUCTION

**OPSS 441.07.07** Transporting, Unloading, Shoring, and Handling Pipe

Subsection 441.07.07 of OPSS 441 is amended by deleting the fifth paragraph in its entirety and replacing it with the following:

Pipes delivered to the construction site with damaged or missing end covers shall be rejected.

**OPSS 441.07.20** Installation of Service Connections

Subsection 441.07.20 of OPSS 441 is deleted in its entirety and replaced with the following:

Water service connections shall be installed from the watermain to the property line at locations as specified in the Contract Documents.

Service piping shall be installed by pressure tap connection, double bolt service clamp or saddles. Service connections on plastic watermains shall be installed using double bolt all stainless steel service saddles.

Curb stop valve boxes shall be installed vertically and flush with the final grade elevation at the street line unless otherwise specified.
OPSS 441.07.25 Flushing and Disinfecting Watermains

Subsection 441.07.25 of OPSS 441 is deleted in its entirety and replaced with the following:

Flushing and disinfecting operations shall be according to TS 7.30.

Costs related to repeated disinfection procedure and bacteriological and water quality testing shall be at no extra cost to the Owner.

The Contractor shall not be entitled to any extension of time nor any additional compensation as a result of a delay caused by failed bacteriological and water quality testing.

OPSS 441.10 BASIS OF PAYMENT

OPSS 441.10.01 Watermains – Item
Valves – Item
Hydrant Sets – Item
Service Connection Pipes – Item
Service Connection Appurtenance Sets – Item
Connections to Existing Watermains – Item

Subsection 441.10.01 of OPSS 441 is amended by the addition of the following paragraphs:

For all non-ductile watermains, hydrant laterals and non-copper water services, the “watermains” item shall also include the supply and installation of tracer wire according to TS 7.40 Construction Specification for Watermain and Water Services Tracer Wire.

Cathodic protection of all new ductile iron watermains and metallic components of non-metallic watermains is paid either separately or as a part of the "watermain" item, shall be according to TS 7.22 Specification for Cathodic Protection of New Watermains.
CONSTRUCTION SPECIFICATION FOR
WATERMAIN INSTALLATION IN OPEN CUT

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APPENDICES

441-A Commentary

441.01 SCOPE

This specification covers the requirements for the installation of watermains, service connections, and associated appurtenances in open cut.

441.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.
441.01.02 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.

441.02 REFERENCES

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

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 206 | Grading |
| OPSS 401 | Trenching, Backfilling, and Compacting |
| OPSS 404 | Support Systems |
| OPSS 490 | Site Preparation for Pipeline, Utilities, and Associated Structures |
| OPSS 491 | Preservation, Protection, and Reconstruction of Existing Facilities |
| OPSS 492 | Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures |
| OPSS 493 | Temporary Potable Water Supply Services |
| OPSS 510 | Removal |
| OPSS 517 | Dewatering of Pipeline, Utility, and Associated Structure Excavation |
| OPSS 539 | Temporary Protection Systems |
Ontario Provincial Standard Specifications, Material

OPSS 1004  Aggregates - Miscellaneous
OPSS 1301  Cementing Materials
OPSS 1302  Water
OPSS 1350  Concrete - Materials and Production
OPSS 1842  Pressure Polyethylene Pipe Products

CSA Standards

B64.5-11  Double Check Valve (DCVA) Backflow Preventers
[Part of B64 Series-11, Backflow Preventers and Vacuum Breakers Compendium]
B137.1-09  Polyethylene Pipe, Tubing and Fittings for Cold-Water Pressure Services
[Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.2-09  Polyvinyl Chloride (PVC) Injection-Moulded Gasketed Fittings for Pressure Applications
[Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.3-09  Rigid Polyvinyl Chloride (PVC) Pipe and Fittings for Pressure Applications
[Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.3.1-09  Molecularly Oriented Polyvinyl Chloride (PVCO) Pipe and Fittings for Pressure Applications
[Part of B137-09, Thermoplastic Pressure Piping Compendium]
B137.10-09  Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene Composite Pressure-Pipe Systems
[Part of B137-09, Thermoplastic Pressure Piping Compendium]

ASTM International

A 153M-09  Zinc Coating (Hot Dip) on Iron and Steel Hardware
A 276-10  Stainless Steel Bars and Shapes
A 307-10  Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
B 88-09  Seamless Copper Water Tube
B 633-11  Electrodeposited Coatings of Zinc on Iron and Steel
B 361-11  Reinforced Concrete Low-Head Pressure Pipe
D 3193-98 (2011)  Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

American Water Works Association (AWWA)

C104/A21.4-08  Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
C110/A21.10-08  Ductile-Iron and Gray-Iron Fittings for Water
C111/A21.11-07  Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C151/A21.51-02  Ductile-Iron Pipe, Centrifugally Cast, for Water
C153/A21.53-06  Ductile-Iron Compact Fittings for Water Service
C200-05  Steel Water Pipe - 6 In. (150 mm) and Larger
C205-07  Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in. (100 mm) and Larger
C206-11  Field Welding of Steel Water Pipe
C208-07  Dimensions for Fabricated Steel Water Pipe Fittings
C301-07  Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids
C302-11  Reinforced Concrete Pressure Pipe, Non-Cylinder Type
C303-08  Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
C502-05  Dry-Barrel Fire Hydrants
C504-10  Rubber-Seated Butterfly Valves
C509-09  Resilient-Seated Gate Valves for Water Supply Service
C510-07  Double Check Valve Backflow Prevention Assembly
C800-05  Underground Service Line Valves and Fittings
C900-07 Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 in.-12 in. (100 mm - 300 mm), for Water Transmission and Distribution
C905-10 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 350 mm Through 1,200 mm (14 in. Through 48 in.) for Water Transmission and Distribution
C907-12 Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in.-12 in. (100 mm - 300 mm), for Water Distribution
C909-09 Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 100 mm Through 600 mm (4 in. Through 24 in.), for Water Distribution

American Society of Mechanical Engineers (ASME)

B18.2.1-2010 Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

NSF International

61-2008 Drinking Water System Components - Health Effects

441.03 DEFINITIONS

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

Associated Appurtenance means structures, devices, and appliances, other than pipe and conduit, which are used in connection with a water distribution system, such as valves, hydrants, corporation cocks, services, and thrust restraints.

Backfilling means the operation of filling a trench with bedding, cover, and backfill material, or embedment and backfill material.

End Covers means temporary cover installed at the factory over both ends of uninstalled watermain pipe to prevent the entry of contaminants during shipping and storage.

Excavation, Earth and Rock means the excavation classified as earth and rock according to OPSS 206.

Fitting means connections, appliances, and adjuncts designed to be used in connection with pipe: for example, elbows and bends to alter the direction of a pipe; tees and crosses to connect a branch with a main; plugs and caps to close an end; and bushings, diminishers, or reducers to couple two pipes of different diameters.

Service Connection means the system used to supply water from the watermain to the property line.

Service Connection Appurtenance Set means the main stop, curb stop, couplings, service box, service box support, and service saddle used in the installation of a service connection.

Watermain means an installation designed for the conveyance of water under pressure using circular pipe.

441.05 MATERIALS

441.05.01 General

The pipe size shall be according to the size specified in the Contract Documents. Pipe type and class shall be as specified in the Contract Documents.
Fittings shall be suitable for and compatible with the pipe material and class with which they are used.

All material for watermains shall be NSF/ANSI 61 compliant.

441.05.02 Ductile Iron Pipe

Ductile iron pipe shall be according to AWWA C151/A21.51.

Fittings shall be gray iron according to AWWA C110/A21.10 or ductile iron according to AWWA C110/A21.10 or AWWA C153.

Ductile iron pipe and fittings shall be cement lined according to AWWA C104/A21.4.

Rubber gaskets for push-on or mechanical joints shall be according to AWWA C111/A21.11.

441.05.03 Concrete Pressure Pipe

Concrete cylinder pipe including joints and fittings shall be according to AWWA C301 or AWWA C303.

Non-cylinder pipe and joints shall be according to AWWA C302 or ASTM C 361. Fittings shall be according to AWWA C302.

441.05.04 Polyvinyl Chloride Pipe

441.05.04.01 General

Flexible elastomeric seals for bell and spigot joints shall be according to ASTM D 3139.

Fittings for polyvinyl chloride (PVC) and molecularly oriented polyvinyl chloride (PVCO) pipe shall be either:

a) Gray iron according to AWWA C110/A21.10.

b) Ductile iron according to C110/A21.10 or AWWA C153 and shall be cement lined according to AWWA C104/A21.4.

c) Injection moulded polyvinyl chloride, blue in colour and according to AWWA C907 and CSA B137.2.

d) Prefabricated polyvinyl chloride, blue in colour and according to AWWA C905 and CSA B137.3.

441.05.04.02 Polyvinyl Chloride Pipe (PVC)

Polyvinyl chloride pipe shall be according to AWWA C900 or AWWA C905 and CSA B137.3, and shall be blue in colour and supplied complete with gaskets.

441.05.04.03 Molecularly Oriented Polyvinyl Chloride Pipe (PVCO)

Molecularly oriented polyvinyl chloride pipe shall be according to AWWA C909 and CSA B137.3.1, and shall be blue in colour and supplied complete with gaskets.

441.05.05 Polyethylene Pipe

Polyethylene pressure pipe shall be according to OPSS 1842.
Fittings shall be either:

a) Flanged gray iron according to AWWA C110/A21.10.

b) Flanged ductile iron according to AWWA C110/A21.10 or AWWA C153 and shall be cement lined according to AWWA C104/A21.4.

c) Polyethylene according to OPSS 1842.

d) Heat fusion or insert or compression type fittings according to CSA 137.1.

441.05.06 Steel Pipe

Steel pipe shall be according to AWWA C200. Fittings shall be according to AWWA C208. Steel pipe shall have a cement-mortar protective lining and coating according to AWWA C205.

441.05.07 Copper Pipe

Copper pipe for service connections shall be according to ASTM B 88 and shall be type K soft copper.

441.05.08 Composite Pipe

Crosslink polyethylene/aluminum/crosslink polyethylene composite pressure pipe for service connections shall be according to CSA B137.10.

441.05.09 Valves

441.05.09.01 General

All valves shall open by operating in a counter clockwise direction.

Valves shall be designed for a minimum cold water working pressure of 1,035 kPa.

Valve types shall be one of the following:

a) Valves less than 75 mm shall be brass or bronze gate valves.

b) Valves greater than or equal to 75 mm, and less than or equal to 300 mm, shall be cast or ductile iron gate valves.

c) Valves greater than 300 mm up to and including 500 mm shall be gate or butterfly valves.

d) Valves greater than 500 mm shall be butterfly valves.

Fasteners shall be made from material meeting the strength requirements of ASTM A 307 with dimensions according to ASME B18.2.1. Bolts, studs, and nuts shall be cadmium plated according to ASTM B 766 or zinc coated according to ASTM A 153 or ASTM B 633. Fasteners for mechanical joints shall be ductile iron according to AWWA C111/A21.11.

441.05.09.02 Service Line Valves

Valves shall be according to AWWA C800. Type, pressure class, and end connections shall be as specified in the Contract Documents.
441.05.09.03  Gate Valves
Gate valves shall be according to AWWA C509.

Stem sealing on non-rising stem valves shall use O-ring type seals that do not require adjustment.

The gate valve end configuration shall be as specified in the Contract Documents.

441.05.09.04  Butterfly Valves
Butterfly valves shall be according to AWWA C504.

Valves shall be short body flanged or mechanical-joint, class 150B.

Valve shafts shall be stainless steel and, when they project through the body, shall have seals that do not require adjustment.

A vertical operating nut shall be provided. Valves shall be provided with an external indicator showing valve position by means of a pointer operating through a 90% arc from open to close.

441.05.09.05  Air Release and Air/Vacuum Valves
Air release and air/vacuum valves shall be single acting type.

441.05.10  Hydrants
Hydrants shall be according to AWWA C502. The type shall be as specified in the Contract Documents.

441.05.11  Double Check Valve Backflow Preventers
Double check valve backflow preventers shall be according to CSA B64.5 or AWWA C510.

441.05.12  Service Connection Fittings and Appurtenances
Main stops, curb stops, couplings, service boxes, and service saddles shall be as recommended by the manufacturer of the service connection pipe.

441.05.13  Concrete
Concrete for thrust blocks and fitting and appurtenance supports shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 20 MPa.

441.05.14  Mortar
Mortar for joints shall be composed of one part Portland cement and three parts mortar sand, wetted with sufficient water to make the mixture plastic.

The mortar sand shall be according to OPSS 1004, the Portland cement shall be according to OPSS 1301, and the water shall be according to OPSS 1302.

441.05.15  Straps, Tie-Rods, Angles, Nuts, and Bolts
Stainless steel straps, tie-rods, angles, nuts, and bolts used with concrete thrust blocks shall be according to ASTM A 276, Type 316 stainless steel.
441.07 CONSTRUCTION

441.07.01 General

The work for the installation of watermains shall include all watermain pipe, bends, tees, fittings, and thrust restraints and the testing of the watermain system.

The interior of all pipe, fittings, and other accessories shall be kept clean and free from undesirable material at all times.

441.07.02 Site Preparation

Site preparation shall be according to OPSS 490.

441.07.03 Removals

Removals shall be according to OPSS 510.

441.07.04 Preservation and Protection of Existing Facilities

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

441.07.05 Protection Against Floatation

Damage to the pipeline due to floatation shall be prevented during construction and until completion of the works.

441.07.06 Cold Weather Work

All work shall be protected from freezing. Pipe and bedding material shall not be placed on frozen ground.

441.07.07 Transporting, Unloading, Storing, and Handling Pipe

All pipe, fittings, and gaskets that are unsound or damaged shall be rejected.

All pipe up to and including 600 mm diameter shall be delivered to the Work Area with end covers and a tamper evident seal on only the bell end. These components shall adhere sufficiently to withstand the stresses caused during shipment.

A waterproof seal is not required on the end covers.

Tamper evident seals shall display the manufacturers name or logo or both. Seals shall straddle the end cover and the pipe. Removal of the cover shall render the tamper evident seal unusable either by breaking the seal or by leaving a message such as "VOID" on the pipe. Tamper evident seals are not required for non-reusable heat shrink plastic covers or foam plugs with punch-out centres.

Pipe delivered to the construction site with damaged or missing end covers shall be field cleaned to remove all undesirable material along the entire length of the interior of the pipe and the end covers reinstalled.

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

Excavation for the installation of watermains shall be according to OPSS 401.

441.07.09  Support Systems

Support systems shall be according to OPSS 404.

441.07.10  Dewatering

Dewatering shall be according to OPSS 517.

441.07.11  Temporary Protection Systems

The construction of temporary protection systems shall be according to OPSS 539.

When the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired due to the method of operation, protection shall be provided. Protection may include sheathing, shoring, and piling when necessary to prevent damage to such works or proposed works.

441.07.12  Temporary Potable Water Supply Services

Temporary potable water supply services shall be according to OPSS 493.

441.07.13  Backfilling and Compacting

Backfilling and compacting shall be according to OPSS 401.

441.07.14  Installation of Pipe

Pipe shall be laid in a dry trench.

Pipe shall be laid within the alignment and grade tolerances specified in the Contract Documents. The barrel of each pipe shall be in contact with the shaped bed throughout its full length.

When the Owner raises or lowers the invert of a watermain by up to 150 mm, it shall not constitute a Change in the Work and no adjustment shall be made to the payment. When the invert of a watermain is raised or lowered by more than 150 mm, then this shall constitute a Change in the Work for the full extent of the change from the original grade.

Pipe shall be kept clean and dry as work progresses. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

Pipe shall not be laid until the preceding pipe joint has been completed and the pipe carefully embedded and secured in place.

441.07.15  Jointing

441.07.15.01  General

End covers shall be removed immediately prior to jointing. Joint surfaces shall be clean. Pipe ends shall be lubricated with material recommended by the pipe manufacturer.

Manufacturer's instructions for jointing pipe shall be followed.
Joints and all connections shall be made watertight.

All bolts, nuts, couplings, rubber rings, and connecting pieces shall be cleaned thoroughly before installation.

Pipe shall be aligned on centreline to previously laid pipe.

Pipe shall be pulled or pushed only by a hand-operated winch. A backhoe shall not be used for pushing pipe.

Joints shall be prevented from opening after the pipe has been laid.

441.07.15.02 Ductile Iron Pipe

Mechanical Joints:

The gland shall be positioned on the pipe with the lip extension toward the joint. The gasket shall be slipped on the pipe with the thick edge towards the gland. The spigot end shall be pushed to its seat in the bell. The gasket shall be pressed to seat it evenly around the joint.

The gland shall be positioned for bolting and the bolts shall be inserted. All nuts shall be hand tightened.

The nuts shall be tightened half a turn at a time with a calibrated torque wrench. All nuts shall be tightened uniformly to the torque specified in AWWA C111/A21.11.

Bell and Spigot Joints:

The gasket shall be placed in the groove of the bell making certain it is properly seated.

The gasket shall be lubricated.

Pipe to be joined shall be aligned and the spigot shall be carefully entered into the bell until the spigot end just makes contact with the gasket.

The entry of the spigot into the bell shall be completed by hand or by the use of a hand operated winch until the second reference mark is flush with the face of the bell.

441.07.15.03 Concrete Pressure Pipe

Bell and Spigot Joints:

A cotton or burlap diaper shall be placed around the bell end of the pipe already in place.

A rubber gasket shall be placed on the spigot end of the pipe to be laid ensuring that the stretch and volume of the gasket is equalized around the entire circumference of the pipe. The gasket and spigot shall be lubricated prior to the spigot end being inserted home into the bell end.

The pipe shall be aligned and the spigot end shall be inserted into the bell of the pipe already in place.

Steel inserts shall be placed in the joints to prevent the spigot from entering the full depth of the bell. The location of the rubber gasket shall be checked around the entire circumference of the joint. The steel insert shall be removed and the pipe pushed until the spigot enters the full depth of the socket and is retained in position.

Ensure that the diaper is carefully placed around the joint recess. Cement mortar shall be poured around the assembled joint.
441.07.15.04  Polyvinyl Chloride Pressure Pipe - PVC and PVCO

Joints shall be bell and spigot with rubber gaskets. If gaskets are supplied separately, they shall be inserted in the groove of the bell end of the pipe.

The spigot shall be lubricated. The spigot end shall be inserted and pushed into the bell up to but not beyond the depth of the stop reference mark.

441.07.15.05  Polyethylene Pressure Pipe

Polyethylene pipe 100 mm diameter and larger shall be joined by the thermal butt fusion process. Procedures recommended by the pipe manufacturer shall be followed.

Polyethylene pipe 75 mm diameter and smaller shall be joined with heat fusion or insert or compression type fittings that are recommended by the pipe manufacturer and that prevent pull-out and resist creep deformation at full test pressure.

Connections to non-polyethylene fittings and appurtenances 50 mm diameter and larger shall be made with flanged joints according to the manufacturer's recommendations. Bolts shall be tightened to the torque specified by the manufacturer for the particular size and type of stub end.

441.07.15.06  Steel Pipe

Steel pipe shall be jointed according to AWWA C200. Field welding for joints shall be according to AWWA C206.

441.07.15.07  Service Connection Pipe

Service connection pipe shall be jointed as recommended by the manufacturer.

441.07.16  Cutting of Pipe

Whenever cutting of pipe is required, the pipe shall be cut according to the recommendations of the pipe manufacturer. After cutting the pipe, the interior of the pipe shall be cleaned and the end cover replaced until the pipe is installed.

441.07.17  Change in Line and Grade

441.07.17.01  Ductile Iron Pipe

Fabricated bends shall be provided for changes in line and grade of 11.25% or more.

Deflections of less than 11.25% may be made using a series of pipe joint deflections. The manufacturer's recommendation in deflecting any single pipe joint shall not be exceeded.

441.07.17.02  Concrete Pressure Pipe

Fabricated bends, bevel adaptors, or elbows shall be used for changes in line or grade greater than 5%. Changes in line or grade less than 5% shall be made using a manufactured joint or bevel connection or may be made over several joints. The manufacturer's joint deflection recommendations shall not be exceeded.

441.07.17.03  Polyvinyl Chloride Pipe - PVC and PVCO

Polyvinyl chloride pipe joints may be deflected but shall not exceed the manufacturer's recommendations. Otherwise, fabricated bends shall be used.
441.07.17.04 Polyethylene Pipe

Use of pipe flexibility may be allowed but shall not exceed the manufacturer's recommendations.

441.07.17.05 Steel Pipe

Fabricated bends shall be used at all changes in line or grade, unless the change can be accomplished by deflections at pipe joints without exceeding the manufacturer's recommendation for deflection at pipe joints.

441.07.18 Installation of Valves and Fittings

441.07.18.01 General

The work for the installation of valves and fittings shall include the valves and couplings and valve boxes, when valve boxes are specified in the Contract Documents. Valves and fittings shall be installed in locations and be of the type specified in the Contract Documents. Valves and connecting pipe shall be aligned accurately and supported as specified in the Contract Documents. Valves and fittings do not require end covers but shall be field cleaned prior to installation.

441.07.18.02 Air Release and Air/Vacuum Valves

Air release and air/vacuum valves shall be installed at locations specified in the Contract Documents.

Each air release and air/vacuum valve shall be provided with an isolating valve.

441.07.19 Installation of Hydrant Sets

The work for the installation of hydrant sets shall include the placing of hydrants, hydrant isolating valves, hydrant leads, restraining devices, and support devices.

Hydrant sets shall be installed at locations specified in the Contract Documents.

The hydrant shall be plumb with the nozzles parallel to the edge of pavement or curb line and the pumper connection facing the roadway.

441.07.20 Installation of Service Connections

A service connection shall consist of a service connection pipe and a service connection appurtenance set and shall be installed at locations and be of the size specified in the Contract Documents.

Service connection pipe shall be installed by pressure tap connection or saddles. Service connections on plastic watermains shall be installed using service saddles or tapped couplings.

Curb stop valve boxes shall be installed vertically and flush with the final grade elevation.

441.07.21 Shutting Down or Charging Mains

At no time shall watermains be shut down or charged or valves operated without permission from the Contract Administrator.

441.07.22 Connections to Existing Watermains

The work of connecting to existing watermains shall include the removal of all plugs, caps, blow offs, and thrust blocks from an existing watermain or fitting, and the installation of the connection.
All connections to existing watermains shall be made under the supervision of the Contract Administrator.

441.07.23  Thrust Restraints

All connections, caps, and bends shall be restrained by concrete blocking and/or restrained joints as specified in the Contract Documents. Concrete for thrust blocks shall be placed against undisturbed ground. Joints and couplings shall remain free from concrete. Only restrained joint products specifically designed for use with the pipe material shall be used.

441.07.24  Hydrostatic Testing

441.07.24.01  General

Hydrostatic testing shall be conducted under the supervision of the Contract Administrator upon completion of the watermain, including services and backfilling.

A test section shall be either a section between valves or the completed watermain.

Test pressure shall be 1,035 kPa.

The test section shall be filled slowly with water and all air shall be removed from the pipeline. A 24-hour absorption period may be allowed before starting the test. The test section shall be subjected to the specified continuous test pressure for 2 hours.

441.07.24.02  Polyethylene Pipe

The test procedure shall consist of initial expansion and test phases.

During the initial expansion phase, the test section shall be pressurized to the test pressure and sufficient make-up water added each hour for 3 hours to return to test pressure. The test phase begins after the initial expansion phase.

The test phase shall be 2 hours after which a measured amount of make-up water is added to return the test pressure. If the amount of make-up water added does not exceed the value in Table 1, leakage is not indicated.

If the amount of make-up water exceeds the Table 1 value, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

The test duration should not exceed 8 hours. If the pressure test is not completed, the test section shall be de-pressurized and allowed to relax for at least 8 hours before bringing the test section up to pressure again.

441.07.24.03  Other Pipe

A period of 24 hours shall be allowed before starting the test.

The test section shall be subject to the specified continuous test pressure for 2 hours.

The leakage is the amount of water added to the test section to maintain the specified test pressure for the test duration. The measured leakage shall be compared with the allowable leakage as calculated for the test section. The allowable leakage is 0.082 litres per millimetre of pipe diameter per kilometre of pipe for the 2-hour test period.

If the measured leakage exceeds the allowable leakage, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.
Flushing and disinfecting operations shall be conducted under the supervision of the Contract Administrator. The watermain shall be flushed to achieve a minimum velocity of 0.76 m/sec otherwise the watermain shall be swabbed. The Contract Administrator shall be notified at least 2 Business Days in advance of the proposed date on which flushing and disinfecting operations are to commence.

Watermains shall be flushed in a sequence approved by the Contract Administrator. The Contract Administrator may permit or require the flushing to be carried out in stages as sections of the system are completed. Flushed sections shall be protected from contamination.

After flushing is completed, water from the existing distribution system shall be allowed to flow at a controlled rate into the new pipeline. Liquid chlorine solution shall be introduced so that the chlorine is distributed throughout the section being disinfected. The chlorine shall be applied so that the chlorine concentration is 50 mg/litre minimum throughout the section. The system shall be left charged with the chlorine solution for 24 hours.

Sampling and testing for chlorine residual shall be carried out by the Contract Administrator. The chlorine residual shall be tested in the section after 24 hours. If tests indicate a chlorine residual of 25 mg/litre minimum, the section shall be flushed completely and recharged with water normal to the operation of the system. If the test does not meet the requirements, the chlorination procedure shall be repeated until satisfactory results are obtained.

Twenty-four hours after the system has been recharged, the Contract Administrator shall take samples for bacteriological tests. Samples shall be collected from every 350 m of the new watermain plus one sample from the end of each of the line and at least one sample from each branch. If there is indication of contamination, the disinfection procedure shall be repeated.

The system shall not be put into operation until approval has been given by the Contract Administrator.

Site restoration shall be according to OPSS 492.

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

All chlorinated water used for testing, flushing, or disinfecting watermains shall be disposed of safely.

The method of disposal of chlorinated water is subject to the approval of the Contract Administrator.

Measurement of watermains shall be by length in metres along the horizontal centreline of the pipe from the point of connection to a chamber, water treatment plant, or existing watermain to a point vertically above the end of the new watermain.
441.09.01.02 Valves
For measurement purposes, a count shall be made of the number of valves installed, regardless of the type and size.

441.09.01.03 Hydrant Sets
For measurement purposes, a count shall be made of the number of hydrant sets installed, regardless of the type.

441.09.01.04 Service Connection Pipe
Measurement of service connection pipe shall be by length in metres along the horizontal centreline of the pipe from the point of connection at the watermain to a point vertically above the end of the service connection.

441.09.01.05 Service Connection Appurtenance Sets
For measurement purposes, a count shall be made of the number of service connection appurtenance sets installed.

441.09.01.06 Connections to Existing Watermains
For measurement purposes, a count shall be made of the number of connections made to existing watermains.

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

441.10 BASIS OF PAYMENT

441.10.01 Watermains - Item
Valves - Item
Hydrant Sets - Item
Service Connection Pipe - Item
Service Connection Appurtenance Sets - Item
Connections to Existing Watermains - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.
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Appendix 441-A, November 2012
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 may consider including soil boring data, a geotechnical report, a subsurface report, or a soils report in the Tender Documents.

The designer should include the following in the Contract Documents:

- Pipe size, type, and class. (441.05.01)
- Service line valve type, pressure class, and end connections. (441.05.09.02)
- Gate valve end configuration. (441.05.09.03)
- Type of hydrants. (441.05.10)
- Alignment and grade tolerances for the pipe installation. (441.07.14)
- Valve type and location. (441.07.18.01)
- Air release and air/vacuum valve locations. (441.07.18.02)
- Location of hydrant sets. (441.07.19)
- Location and size of service connections. (441.07.20)
- Thrust restraints. (441.07.23)

The designer should determine if valve boxes are needed and, if so, they should be specified in the Contract Documents. (441.07.18.01)

Corrosion protection system provisions should be specified, if appropriate.

Tracer wire or tracer tape should be specified, if appropriate.

Under conditions of high ground water, external fluids may enter via air release and air/vacuum release valves; therefore, appropriate measures should be taken.

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.
Related Ontario Provincial Standard Drawings

OPSD 1101.012 Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1800 x 2400 mm, Components
OPSD 1101.013 Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1800 x 2400 mm, Riser and Base
OPSD 1101.014 Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1800 x 2400 mm, Thrust Blocks
OPSD 1101.015 Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 1800 x 2400 mm, Chimney and Cap
OPSD 1101.016 Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2400 x 3000 mm, Components
OPSD 1101.017 Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2400 x 3000 mm, Riser and Base
OPSD 1101.018 Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2400 x 3000 mm, Thrust Blocks
OPSD 1101.019 Precast Concrete Valve Chamber with Poured-In-Place Thrust Blocks, 2400 x 3000 mm, Chimney and Cap
OPSD 1101.020 Valve Operator
OPSD 1103.010 Concrete Thrust Blocks for Tees, Plugs, and Horizontal Bends
OPSD 1103.020 Concrete Thrust Blocks for Vertical Bends
OPSD 1104.010 Water Service Connection, 19 and 25 mm Diameter Sizes
OPSD 1104.020 Water Service Connection, 32, 38, and 50 mm Diameter Sizes
OPSD 1104.030 25 mm Blow Off Installation
OPSD 1105.010 Hydrant Installation
OPSD 1107.010 Piping Layout for Water Meters 50 mm and Smaller in Chambers
OPSD 1107.020 Piping Layout for Water Meters 75 to 250 mm in Chambers with By-Pass
OPSD 1107.030 Piping Layout for Water Meters in Building with By-Pass
OPSD 1108.010 Cast-In-Place Water Meter Chamber for 75 to 250 mm Meters
OPSD 1109.010 Cathodic Protection for Metallic Watermain Systems
OPSD 1109.011 Cathodic Protection for PVC Watermain Systems
OPSD 1109.012 Cathodic Protection off Existing Metallic Watermains, Exposed Service or Pipe Method
OPSD 1109.013 Anode Installation Over Pipe Method for Existing Metallic Watermains
OPSD 1109.014 Horizontal Anode Bank at Service
OPSD 1109.015 Vertical Anode Bank at Service
OPSD 1109.025 Waterproofing of Splices
Amendment to OPSS 510 (Apr 2010) – Construction Specification for Removal

OPSS 510.05  MATERIAL

OPSS 510.05.02  Concrete

Subsection 510.05.02 of OPSS 510 is amended by the deletion of the following:

Concrete for filling abandoned pipes shall be according to OPSS 1350 with minimum specified 28-Day compressive strength of 15 MPa.

OPSS 510.07  CONSTRUCTION

OPSS 510.07.01.02  Removal

Clause 510.07.01.02 of OPSS 510 is amended by the addition of the following paragraph:

Removed items may contain materials that may be subject to specific handling and disposal requirements, for example, asbestos and slug.

OPSS 510.07.01.03  Salvage

Clause 510.07.01.03 of OPSS 510 is amended by deleting the second paragraph in its entirety and replacing it with the following:

When specified in the contract document, catch basin and maintenance hole frames and covers shall be salvaged for reuse at the construction site.

OPSS 510.07.03.01  General

Clause 510.07.03.01 of OPSS 510 is amended by the deletion of the following:

Frames and grates or covers and watermain appurtenances, within valve chambers that are to be removed, shall be salvaged.

OPSS 510.07.03.06  Abandonment of Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

Clause 510.07.03.06 of OPSS 510 is amended by deleting the second sentence in the first paragraph in its entirety and replacing it with the following:
Such partial removal shall always be to a minimum of one metre below subgrade.

**OPSS 510.07.03.09 Abandonment of Pipes and Culverts**

Clause 510.07.03.09 of OPSS 510 is deleted in its entirety and replaced with the following:

All pipes which are abandoned as a result of removal or partial removal of maintenance hole, catch basin, ditch inlet or valve chamber shall be sealed/plugged/cupped.

When abandoning pipes that enter into a concrete culvert, maintenance hole, catch basin, ditch inlet, or valve chamber and the structure is to remain in service, the openings in the structure shall be sealed according to the *Removal of Pipes and Culverts* clause.

All abandoned corrugated metal pipes larger than 600 mm shall be filled with grout or concrete. Access points shall be provided to allow for confirmation that the pipe has been completely filled.

**OPSS 510.07.03.11 Removal of Hydrants, Valves, and other Watermain Appurtenances**

Clause 510.07.03.11 of OPSS 510 is deleted in its entirety and replaced with the following:

The work shall include the removal or abandonment of hydrants, valves, and other watermain appurtenances.

When the mainline is to remain in service after a removal, the tee must be removed and fill piece installed.

When a mainline valve is to be abandoned and the valve is not in a valve chamber, the valve box shall be removed. Valve shall be removed and fill piece installed.

When a water service connection is abandoned, small services shall be disconnected from the main either by shutting off service at the main stop and disconnecting service pipe from the main stop, or by removing main stop and inserting plug. Large services shall be disconnected by removing the tapping sleeve and valve or tee and valve or both from main and the fill piece shall be installed.
CONSTRUCTION SPECIFICATION FOR REMOVAL

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APPENDICES

510-A Commentary

510.01 SCOPE

This specification covers the requirements for demolition, salvage, removal, and in-place abandonment, either completely or partially, of those materials and structures so designated, including the requirements for backfilling resulting excavations, trenches, holes, and pits.

510.01.01 Specification Significance and Use

This specification has been developed for use in provincial- and municipal-oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities and the Ontario Ministry of Transportation.

Use of this specification or any other specification shall be according to the Contract Documents.
510.01.02 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.

510.02 REFERENCES

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

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 301  Restoring Unpaved Roadway Surfaces
OPSS 410  Pipe Sewer Installation in Open Cut
OPSS 421  Pipe Culvert Installation in Open Cut
OPSS 422  Precast Reinforced Concrete Box Culverts and Box Sewers in Open Cut
OPSS 501  Compacting

Ontario Provincial Standard Specifications, Materials

OPSS 1004  Aggregates - Miscellaneous
OPSS 1150  Hot Mix Asphalt
OPSS 1151  Superpave and Stone Mastic Asphalt Mixtures
OPSS 1301  Cementing Materials
OPSS 1302  Water
OPSS 1350  Concrete - Materials and Production
510.03 DEFINITIONS

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

**Bridge Structure** means that portion of a bridge and associated wing and retaining walls above the bridge footing, excluding modular bridges.

**CIR** means cold in-place recycling.

**CIREAM** means cold in-place recycling with expanded asphalt.

**Concrete Appurtenances** mean as defined in OPSS 410, 421, and 422.

**Culvert** means a single or multiple cell structure designed to provide an opening under a roadway, pedestrian way, railway, or side entrance for the passage of surface water, livestock, or pedestrians.

**Curb and Gutter** means any combination of curb, gutter, curb with gutter, gutter setbacks, bullnoses, gutter outlets, and spillways.

**Engineer** means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

**HIR** means hot in-place recycling.

**Pipe** means any closed conduit originally designed to convey liquid or gas.

**Sundry Asphalt Pavements** means paved islands, medians, boulevards, and walkways.

510.04 DESIGN AND SUBMISSION REQUIREMENTS

510.04.01 Design Requirements

Caps for capping maintenance holes, catch basins, ditch inlets, and valve chambers shall be designed according to CAN/CSA S6 and the Structural Manual.

510.04.02 Submission Requirements

510.04.02.01 Removal of Bridge Structures

Two weeks prior to commencement of the work, a work plan shall be submitted to the Contract Administrator outlining the equipment to be used, dust and debris control, and the sequence of removals for bridge demolition.
Where any portion of the bridge structure is to support traffic or equipment loading during demolition, the entire structure shall be evaluated for load carrying capacity according to the CAN/CSA S6 and the Structural Manual.

All submissions shall bear the seal and signature of the design Engineer and design check Engineer.

510.05 MATERIAL

510.05.01 Mortar

Mortar shall consist of a mixture of one part Portland cement according to OPSS 1301 and three parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302.

510.05.02 Concrete

Concrete for concrete seals shall be according to OPSS 1350 with minimum specified 28-Day compressive strength of 30 MPa.

Concrete for filling abandoned pipes shall be according to OPSS 1350 with minimum specified 28-Day compressive strength of 15 MPa.

510.05.03 Grout

Grout shall consist of a mixture of one part Portland cement according to OPSS 1301 and two parts mortar sand according to OPSS 1004, wetted with sufficient water to make the mixture plastic. Water shall be according to OPSS 1302.

510.07 CONSTRUCTION

510.07.01 General

Removal, abandonment, demolition, or salvage of a particular item shall be as specified in the Contract Documents.

The work shall include all associated excavation, backfill, compaction, trimming, plugging, capping, filling, sealing, and right-of-way preparation.

If provided, existing drawings from the Owner pertaining to bridge structures, modular bridges, culverts, and noise barriers designated for removal shall be reviewed prior to commencement of any activities.

Stockpiling requirements shall be as specified in the Contract Documents.

Where work is done in waterbodies and on waterbody banks, the work shall be according to the Contract Documents.

510.07.01.01 Excavation

Excavation required for the removal work to be carried out shall be part of the removal operation and shall be performed in such a manner as to leave undisturbed any portions not designated for removal.
510.07.01.02 Removal

Removal shall be performed in such a manner and with such equipment as to leave undisturbed and undamaged any portion not designated for removal or salvage. All damaged or disturbed portions shall be corrected expeditiously and repaired to the satisfaction of the Contract Administrator. The broken edges of portions to be left in place that are visible after construction shall be squared and neatly trimmed.

510.07.01.03 Salvage

Any material designated for salvage shall remain the property of the Owner and shall be maintained in a reasonable condition and stockpiled in a manner acceptable to the Contract Administrator.

Salvaged materials that are surplus to the Contract requirements shall be delivered to the location specified in the Contract Documents. When designated for salvage and surplus to the Contract requirements, salvaged frames and related grates or covers shall be kept together as a unit for delivery and stockpiling.

Any material designated for salvage damaged by the Contractor's operations or lost by the Contractor at any time prior to re-use or stockpiling shall be replaced with new material.

510.07.01.04 Backfilling, Compacting, and Trimming

Where a removal or partial removal requires the filling of a resulting trench, hole, or pit, backfilling shall be to the required grade using either suitable excavated material or imported material as required or as specified in the Contract Documents, and shall include levelling and trimming of the site to match required contours and provide adequate drainage. Backfill material shall be placed in layers not exceeding 300 mm and compacted according to OPSS 501.

510.07.01.05 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

510.07.02 Bridge Work

510.07.02.01 Removal of Bridge Structures and Bridge Footings

The work of bridge structure removal shall include the complete removal of bridge structure components above the top of the bridge footings to the lines and grades specified in the Contract Documents.

The work of bridge footings removal shall include cutting the piles to the underside of the footing and the complete removal of the bridge footings.

510.07.02.02 Removal of Modular Bridges

The work of modular bridge removal shall include the dismantling and removal and salvage of the modular bridge components, all timber in the deck, curbs, running strips, and steel beam guide rail system attached to the bridge. The work shall include the unloading and erection of the launching nose and subsequent dismantling.

Modular bridge components that are the property of the Owner, including the dismantled launching nose, shall be loaded onto transport vehicles, supported on 100 x 100 mm timber to allow forklift access, securely fastened, and then transported to the location specified in the Contract Documents.

All components shall be delivered in good condition during normal working hours and neatly stockpiled. All small parts shall be crated to prevent loss.
The approximate weight of the modular bridge, as specified in the Contract Documents, includes the weight of the steel components of the bridge, the ramps, and the launching nose, but excludes the weight of the wooden deck, construction tools, and rollers.

Vehicles required to transport the launching nose and the modular bridge components and parts shall be provided by the Contractor and of sufficient size to fully support the modular bridge components.

510.07.02.02.02 Removal of Modular Bridge Substructures

The work shall include the removal of modular bridge substructures, bank seats, cribs, and timber or steel bents, and any rock in the cribs.

Modular bridge substructure materials shall be removed from the right-of-way or managed as specified in the Contract Documents.

Rocks from cribs shall not be placed in any waterbody.

510.07.03 Drainage Work

510.07.03.01 General

Any sediment or deposited material required to be removed shall not be allowed to enter any waterbody.

Frames with grates or covers and watermain appurtenances, within valve chambers that are to be removed, shall be salvaged.

510.07.03.02 Removal of Curb and Gutter

The work shall include the removal of asphalt, concrete, and cut stone curb and gutter. Cut stone curb shall be salvaged.

510.07.03.03 Removal of Asphalt Curb and Gutter

The work shall include the removal of asphalt curb and gutter.

510.07.03.04 Removal of Concrete Curb and Gutter

The work shall include the removal of concrete curb and gutter.

510.07.03.05 Removal of Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

The work shall consist of the removal of maintenance holes, catch basins, ditch inlets, and valve chambers.
510.07.03.06 Abandonment of Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

The work shall include the partial removal of maintenance holes, catch basins, ditch inlets, and valve chambers where structures and the Utility systems therein are abandoned. Such partial removal, when within the roadway, shall be to a minimum of 1.0 m below subgrade.

Prior to backfilling, the bottom of each structure designated for partial removal shall be broken to allow for the free movement of groundwater.

As an alternative to partial removal, maintenance holes, catch basins, ditch inlets, or valve chambers may be removed in their entirety.

510.07.03.07 Capping Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

The work shall include the capping of maintenance holes, catch basins, ditch inlets, and valve chambers where the Utility systems therein are to remain in service. Such capping shall include the removal of all adjustment units. Where the structure exists within the roadbed, the upper portion of the structure shall be removed to a minimum of 1.0 m below subgrade and the walls of the structure shall be saw cut or similarly finished to produce a neat horizontal cut suitable for placing a concrete cap.

510.07.03.08 Removal of Pipes and Culverts

The work shall include the removal of pipes and culverts of 200 mm diameter and greater, including multiple cell timber culverts.

Concrete, clay, and plastic pipes may be removed by rupturing or collapsing the pipe with suitable equipment and leaving the debris in place in a manner as to eliminate all voids and so as not to be detrimental to the work.

When removing pipes that enter into a concrete culvert, maintenance hole, catch basin, ditch inlet, or valve chamber and the structure is to remain in service, the openings left in the structures from the pipe shall be sealed with concrete or brick suitable for outdoor use and mortar. Brick seals shall be a minimum thickness of one brick length. The contact surface of each brick shall be coated with mortar to provide a watertight seal. Concrete seals shall be the minimum thickness of the structure wall.

510.07.03.09 Abandonment of Pipes and Culverts

The work shall include the filling of all pipes and culverts when the Contract Documents specify abandonment.

Abandoned sections of pipes and culverts up to 1200 mm in diameter shall be filled with grout or concrete.

Access points shall be provided to allow for confirmation that the pipe has been completely filled.

When abandoning pipes that enter into a concrete culvert, maintenance hole, catch basin, ditch inlet, or valve chamber and the structure is to remain in service, the openings in the structure shall be sealed according to the Removal of Pipes and Culverts clause.

510.07.03.10 Removal of Pipe Subdrains

The work shall include the removal of pipe subdrains smaller than 200 mm in diameter.

Excavate, as required, to remove existing pipe subdrains, backfill the resulting trenches with native material, and compact.
510.07.03.11 Removal of Hydrants, Valves, and Watermain Appurtenances

The work shall include the removal or abandonment of hydrants, valves, and watermain appurtenances.

When a hydrant is removed, the hydrant shall be removed with its boot intact and salvaged.

When the mainline is to remain in service after a removal, the work shall include capping at the tee at the mainline.

When a mainline valve is to be abandoned and the valve is not in a valve chamber, the valve box shall be removed.

When a water service connection is abandoned, the work shall include shutting off the service at the mainline.

510.07.04 Fence and Noise Barrier Work

510.07.04.01 Removal of Fence

The work shall include the removal of all fences, regardless of type.

The work shall consist of the dismantling and removal of the fence, including all posts, fence fabric, footings, gates, components, and fittings forming part of the fence designated for removal.

Where the means of egress and ingress between the right-of-way and adjacent property is being controlled by an existing fence designated for removal, that control shall be maintained for the duration of the Contract.

When only part of an existing fence is removed, repairs to match the existing fence shall be made to the ends remaining.

510.07.04.02 Removal of Noise Barriers

The work shall include the dismantling of the noise barrier including posts, panels, framing, doors, fire access openings, and the removal of concrete footings to a depth of 1.3 m.

510.07.05 Delineators, Traffic Barriers, and Energy Attenuator Work

510.07.05.01 Removal of Delineator Posts

The work shall include the removal of delineator and guide posts, including wooden, metal, and flexible posts, and associated hardware.

510.07.05.02 Removal of Guide Rail Systems

The work shall include the removal of cable guide rail, steel beam guide rail, and box beam guide rail systems, including cables, steel beams, box beams, channels, hardware, posts, anchor blocks, and anchoring systems to the limits specified in the Contract Documents.

510.07.05.03 Removal of Concrete Barriers

The work shall include the removal of cast-in-place concrete barriers; the removal and salvage of precast concrete barriers; the removal of back to back installed concrete barriers, concrete or granular fill between the back to back concrete barriers, barrier transition sections; and the removal of associated pads and hardware as specified in the Contract Documents.
510.07.05.04  Removal of Energy Attenuators

The work shall include the removal of energy attenuators, including pads and anchoring devices. At specified locations, the energy attenuators shall be dismantled and salvaged as a complete system, including all hardware.

510.07.05.05  Removal of Ramp Closure Gates

The work shall include removal of ramp closure gate concrete footings, gates, signs, and all associated hardware.

The gates and associated hardware shall be salvaged and delivered to the location specified in the Contract Documents.

510.07.06  Pavement Work

510.07.06.01  General

During pavement removal operations, care shall be taken to prevent contamination with granular and other foreign materials.

Removal shall be performed in such a manner as to leave adjacent pavement and structures remaining in place undisturbed.

When the roadway is to be opened to traffic after the daily shut down and full width pavement removal is required, the following shall apply:

a) For two-lane highways, removal shall be done to the same station for the full pavement width prior to shutdown at the end of the day.

b) For multi-lane highways, removal shall be done to essentially the same station for the full pavement width for a specific direction prior to shutdown at the end of the day.

c) Prior to opening the lanes to traffic, temporary ramping shall be provided as specified in the Contract Documents.

Asphalt pavement material from removal operations that is to be used on this Contract or stockpiled for future use by the Owner shall be weighed according to the Contract Documents then processed prior to stockpiling so 100% of the resultant material passes the 26.5 mm sieve. RAP shall be stockpiled according to the requirements of OPSS 1150 or OPSS 1151, as applicable to the Contract.

Removed asphalt pavement materials that are different due to the removal equipment used or pavement type shall be stockpiled separately.

510.07.06.02  Cutting Existing Pavement

Pavement shall be cut for neat removal to the depth specified in the Contract Documents.

Suitable mechanical sawing equipment or pavement milling equipment capable of producing a straight clean vertical face shall be used for cutting the pavement. The existing pavement type, thickness, and, if any, size of reinforcement shall be as specified in the Contract Documents.
510.07.06.03  Removal of Pavement, Treated Base, and Concrete Base

The work shall include the full-depth removal of asphalt pavement, concrete pavement, asphalt pavement from concrete surfaces and concrete base, cement-treated base, and asphalt-treated base. All materials shall be managed as specified in the Contract Documents.

When removed material is to remain temporarily on site due to construction operations, the removed material shall be placed on an asphalt or concrete surface until final disposition.

When the operation for full-depth asphalt removal from concrete base or concrete surfaces other than structures causes thickness reductions or surface variations exceeding 10 mm, the removal operations shall be corrected expeditiously and the damaged concrete areas repaired.

As part of the work of full-depth pavement removal, where public traffic is to be maintained throughout the work without the use of a temporary bypass, temporary granular ramping shall be constructed and maintained to convey public traffic through the area. The ramping shall be at 20H:1V. Temporary ramps shall be removed to accommodate subsequent construction after traffic has been routed off the temporary ramp.

Following pavement removal, the existing roadway granular shall be restored according to OPSS 301, when such roadway is not designated for abandonment.

Prime, surface treatments, and mulch pavements greater than 50 mm in depth are considered to be asphalt pavement.

This work shall not include removal of materials for jointing done as part of a paving operation.

510.07.06.04  Removal of Asphalt Pavement, Partial-Depth

The work shall include the partial-depth removal of asphalt pavement. Such material shall be managed as specified in the Contract Documents.

The asphalt pavement shall be removed to the average depth specified in the Contract Documents.

Before commencing removal operations, all debris, deleterious material, and existing windrows shall be removed from the roadway surface, including material beyond the theoretical roadway width, to provide positive drainage.

If the remaining asphalt pavement does not require further processing or if the remaining asphalt pavement is to be recycled using CIR or CIREAM or HIR processes, then the equipment used for partial depth removal shall be automatically controlled for grade and slope during removal. The surface remaining after removal shall have a constant and continuous crossfall matching the intended surface course crossfall. The surface remaining after removal shall have an even texture and be free of significantly different grooves and ridges in all directions.

Removed asphalt pavement material shall not remain on the roadway after completion of the day's operation. Placing of the material on grade other than a bituminous surface prior to hauling to a stockpile shall not be permitted.

Temporary transverse ramping shall be as specified in the Contract Documents. If due to unforeseen circumstances, removal cannot be done full width prior to shut down at the end of the day, then temporary, longitudinal ramping shall also be provided as specified in the Contract Documents. All ramping shall be removed prior to placing adjacent hot mix asphalt pavement.

Partial-depth asphalt pavement removal operations and the resulting surfaces from partial-depth asphalt removal operations shall not be permitted between November 16th and June 1st, unless approved by the Contract Administrator.
510.07.06.05 Removal of Asphalt Pavement from Concrete Surfaces on Structures

The work shall include the removal of asphalt pavement and waterproofing from the concrete surfaces on structures. All materials shall be managed as specified in the Contract Documents.

When pavement-milling equipment is used, the weight of milling equipment shall be limited to:

a) 43 tonnes maximum weight for post-tensioned decks and rigid frame decks,

b) 26 tonnes maximum weight for thin slab concrete bridge deck on girders. For thin slab concrete bridge deck on girders, the equipment shall not travel laterally beyond 1.0 m from the centreline of the exterior girder.

When the method of asphalt removal results in impact damage or excessive vibration is observed, operations shall be modified to eliminate these effects.

Unless the Contract Documents specify a concrete or latex-modified concrete overlay is to be placed on the existing concrete deck, the milling operation shall be controlled such that the milling teeth do not come in contact with the concrete deck surface and bridge joints. Any remaining asphalt pavement and waterproofing not removed by rotary milling equipment shall be removed by other methods.

If the milling operation damages the surface of the concrete deck, causing surface variations or concrete thickness reductions exceeding 2 mm, the milling operation shall be corrected expeditiously and the damaged concrete areas repaired. The proposed repair method shall be submitted in writing to the Contract Administrator, prior to commencing repairs. Surface preparation, placement, and curing of the repair materials shall be according to the repair material manufacturer's instructions.

510.07.06.06 Removal of Concrete Pavement, Partial-Depth

The concrete pavement shall be removed to the depths indicated in the Contract Documents.

The equipment used for partial-depth concrete pavement removal shall be automatically controlled for grade and slope during removal. The surface remaining after removal shall have a constant and continuous cross fall matching the intended surface cross fall. The surface remaining after removal shall have an even texture free of significantly different grooves and ridges in all directions.

The removed concrete pavement material shall not remain on the roadway after completion of the day's operation.

After partial-depth removal of existing concrete pavement, the Contractor shall reshape and compact the existing shoulder material to ensure proper drainage of the remaining surface and adjoining shoulders.

Removal operations and resulting surfaces from removal operations shall not be permitted during the winter months on highways with posted speeds of 80 km/h or higher.

510.07 Concrete Work

510.07.07 Removal of Concrete

The work shall include the removal of retaining walls; footings; foundations; concrete culverts, including associated wingwalls and retaining walls; concrete appurtenances; and similar concrete structures specified in the Contract Documents.
Right-of-Way Work

Preparing Right-of-Way

When preparing the right-of-way is specified in the Contract Documents, all objects and materials within the specified road allowance that interfere with the execution of the work and are not covered under separate removal items, shall be removed under this work. The work includes, but is not limited to the removal of trees less than 150 mm diameter, tree roots and stumps, brush and hedges, culverts, wooden and steel posts, signs, sidewalks, precast or poured driveway curbs, asphalt curbs, boulders, stone walls and retaining walls, and other surface materials that require removal in order to complete all parts of the Contract.

Any precast concrete slabs, bricks and stones, cut stone curbs, timbers, or similar landscaping elements that are removed shall remain the property of the adjacent property owner and shall be piled neatly on such adjacent property.

Removal of Driveways, Sidewalks, and Sundry Asphalt Pavements

When collective work to remove driveways and sidewalks needs to be done, work shall include the removal of asphalt, concrete, stone or brick driveways and sidewalks, and sundry asphalt pavements.

Removal of Concrete Sidewalk

The work shall include the removal of concrete sidewalk.

Removal of Gabions

The work shall include the removal of gabions, including rock and wire.

Overhead Signs and Sign Support Structure Work

Overhead signs and sign support structures shall be salvaged.

Sign support structure footings shall be removed to a minimum of 1.3 m below subgrade.

MEASUREMENT FOR PAYMENT

Actual Measurement

Removal of Bridge Footings

Measurement of removal of bridge footings shall be the volume in cubic metres of the concrete removed.

Removal of Curb and Gutter

Removal of Asphalt Curb and Gutter

Removal of Concrete Curb and Gutter

Measurement of removal of curb and gutter shall be the length in metres horizontally along the flow lines of the curb and gutter removed, whether straight or circular, without separation into types. When the slope of the curb and gutter is 4H:1V or steeper, then the above measurement is of the slope length.

No deduction shall be made from the measured length for the spaces occupied by maintenance hole and catch basin castings. Where the removal includes runs of curb and gutter that converge to form bullnoses, each run shall be measured for payment and such measurement shall be deemed to include the concrete fillet within the bullnose.
510.09.01.03 Removal of Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

For measurement purposes, a count shall be made of the number of maintenance holes, catch basins, ditch inlets, and valve chambers removed regardless of type, depth, or size.

510.09.01.04 Abandonment of Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers, Partial-Depth

For measurement purposes, a count shall be made of the number of maintenance holes, catch basins, ditch inlets, and valve chambers abandoned regardless of type or size.

510.09.01.05 Capping of Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

For measurement purposes, a count shall be made of the number of maintenance holes, catch basins, ditch inlets, and valve chambers capped regardless of type or size.

510.09.01.06 Removal of Pipes and Culverts

Measurement of removal of pipes and culverts shall be the length in metres horizontally along the pipe or culvert, from one end or end section to the other end or the other end section. Where the grade of the pipe or culvert is 10% or greater, then the above measurement is of the slope length. Pipes and culverts smaller than 200 mm diameter shall be treated as part of the excavation work.

No deduction shall be made from the measured length for the spaces occupied by intermediate maintenance holes, catch basins, ditch inlets, and valve chambers.

510.09.01.07 Abandonment of Pipes and Culverts

Measurement of abandonment of pipes and culverts shall be by length in metres horizontally along the pipe or culvert, from one end or end section to the other end or the other end section. Where the grade of the pipe or culvert is 10% or greater, then the above measurement is of the slope length.

510.09.01.08 Removal of Pipe Subdrains

Measurement of removal of pipe subdrains shall be by length in metres horizontally along the centerline of the pipe subdrains, including outlets.

510.09.01.09 Removal of Hydrants
Removal of Valves
Removal of Watermain Appurtenances

For measurement purposes, a count shall be made of the number of hydrants, valves, and watermain appurtenances removed.

510.09.01.10 Removal of Fence
Removal of Noise Barrier

Measurement of removal of fence and noise barrier shall be the length in metres, horizontally along each fence or noise barrier removed.

510.09.01.11 Removal of Delineator Posts

For measurement purposes, a count shall be made of the number of delineator and guide posts removed.
510.09.01.12 Removal of Cable Guide Rail
Removal of Concrete Barrier
Removal of Steel Beam Guide Rail
Removal of Steel Box Beam Barrier

Measurement of removal of traffic barrier shall be the length in metres horizontally along each type of traffic barrier removed, excluding energy attenuators.

Where cable guide rail and steel box beam barrier are anchored to concrete anchor blocks, measurement shall be made between the end anchor points with no additional measurement made of the overlapping sections at intermediate anchorages.

510.09.01.13 Removal of Anchor Blocks

For measurement purposes, a count shall be made of the number of anchor blocks removed.

510.09.01.14 Removal of Energy Attenuators

For measurement purposes, a count shall be made of the number of complete energy attenuators systems removed.

510.09.01.15 Removal of Ramp Closure Gates

For measurement purposes, a count shall be made of the number of ramp closure gates removed.

510.09.01.16 Cutting Existing Pavement

Measurement of cutting of existing pavement shall be by length in metres along each cut.

510.09.01.17 Removal of Asphalt Pavement
Removal of Asphalt Pavement from Concrete Surfaces
Removal of Concrete Pavement
Removal of Asphalt-Treated Base
Removal of Cement-Treated Base
Removal of Concrete Base

Measurement of removal of asphalt pavement, asphalt pavement from concrete surfaces, concrete pavement, asphalt-treated base, cement-treated base, and concrete base shall be by area in square metres.

No deductions shall be made from the area for the space occupied by maintenance holes, catch basins, and valve chambers.

The full-depth removal of asphalt pavement, asphalt pavement from concrete surfaces, concrete pavement, asphalt-treated base, cement-treated base, and concrete base shall be measured for payment whether on the roadway surface or within an excavation, where such pavement or base has remained in place since its construction.

510.09.01.18 Removal of Asphalt Pavement, Partial-Depth
Removal of Concrete Pavement, Partial-Depth

Measurement of removal of partial-depth asphalt or concrete pavement shall be by area in square metres or by mass in tonnes as specified in the Contract Documents.
510.09.01.19  Removal of Asphalt Pavement from Concrete Surfaces on Structures
Measurement of removal of asphalt pavement from concrete surfaces on structures shall be by area in square metres.

510.09.01.20  Removal of Concrete
Measurement of removal of concrete shall be by volume in cubic metres.
When broken concrete or masonry is used as rip-rap or rock protection, deductions shall not be made from the concrete removal item.

510.09.01.21  Removal of Driveways, Sidewalks, and Sundry Asphalt Pavements
Measurement of removal of driveways, sidewalks, and sundry asphalt pavements shall be by horizontal area in square metres.

510.09.01.22  Removal of Concrete Sidewalk
Measurement of removal of concrete sidewalks shall be by horizontal area in square metres.

510.09.01.23  Removal of Gabions
Measurement of removal of gabions shall be by volume in cubic metres.

510.09.01.24  Removal of Sign Support Structure
Removal of Sign Support Structure Footings
For measurement purposes, a count shall be made of the number of sign supports and sign support footings removed.

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

510.10  BASIS OF PAYMENT

510.10.01  Removal of Bridge Structure - Item
Removal of Bridge Footings - Item
Removal of Modular Bridge - Item
Removal of Modular Bridge Substructure - Item
Removal of Curb and Gutter - Item
Removal of Asphalt Curb and Gutter - Item
Removal of Concrete Curb and Gutter - Item
Removal of Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers - Item
Abandonment of Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers Partial-Depth - Item
Capping of Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers - Item
Removal of Pipe and Culverts - Item
Abandonment of Pipes and Culverts - Item
Removal of Pipe Subdrains - Item
Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Imported backfill shall be paid for separately according to the tender item of the material specified in the Contract Documents.

Payment at the Contract price for the appropriate removal tender item shall be full compensation for all labour and Equipment for earth excavation required in the course of the removal operations.

Material designated for salvage but damaged by Contractor operations or lost by the Contractor shall be replaced with new material at no extra cost to the Owner.

If the Contractor elects to remove maintenance holes, catch basins, ditch inlets, and valve chambers in their entirety rather than as a partial removal, the removal shall be at no extra cost to the Owner.

When the Contract does not contain a separate item for the removal of pipe subdrain, the contract price for the items directly associated with the removal of pipe subdrain shall include full compensation for all labour, Equipment, and Materials required to do the work described in this specification.

Disturbed or damaged portions not designated for removal or salvage that result from the Contractor's operations shall be corrected or repaired at no extra cost to the Owner.
510.10.02  Excavation for Underpavement Objects

When the Contract contains separate items for the removal of concrete pavement, asphalt pavement, concrete base, cement-treated base, sidewalk, and curb and gutter, such items removed because of the removal of under-pavement objects such as sewers, culverts, Utilities, and watermains, payment shall be at the Contract prices and according to the specifications for the removal of concrete pavement, asphalt pavement, concrete base, cement-treated base, sidewalk, or curb and gutter, respectively.

510.10.03  Excavation for Removal

When excavation for removal overlaps the excavation required for other work under the Contract, the overlapping excavation for the removal shall be paid for in accordance with the specification for other work.

No deductions shall be made to the quantities of concrete base, cement-treated base, sidewalk, curb and gutter, and any other structure or portion of structure where these items removed are included within the established lines of an excavation item measured for separate payment.
Appendix 510-A, April 2010
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 specify the following in the Contract Documents:

- Items that are to be removed, abandoned, demolished, or salvaged. (510.07.01)
- Stockpiling requirements. (510.07.01)
- Requirements for work that is to be carried out in waterbodies or on waterbody banks. (510.07.01)
- For removal items,
  - Delivery locations for salvaged materials in excess to Contract requirements (510.07.01.03)
  - For bridge structures, specify the line and grade to which the structure is to be removed. (510.07.02.01)
  - Destination of modular bridge components. (510.07.02.02)
  - Approximate weight of the modular bridge to be removed. (510.07.02.02)
  - Management of modular bridge substructure materials. (510.07.02.02.01)
  - Delivery requirements for ramp closure gates. (510.07.05.05)
  - Temporary ramping requirements. (510.07.06.01)
  - For pavement, specify the depth of sawcut and identify the pavement type; thickness; size of reinforcement, if any; and management of materials. (510.07.06.02 and 510.07.06.03)
  - For partial-depth pavement, identify the average depth of the removal and management of materials. (510.07.06.05)
- Method of measurement for the partial-depth removal of asphalt or concrete pavement. (510.09.01.18)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Imported backfill. (510.07.01.04)

The designer should list in the Contract Documents existing drawings available, if any, for structures to be removed. (510.07.01)

The designer should determine if special restrictions or permits apply where work under the specification is required in waterbodies or on waterbody banks.

For the demolition of bridges, OPSS 510 does not place any restrictions on the Contractor in terms of methods or equipment to be used. Therefore, when it is foreseen that a demolition will require special requirements or safety precautions, the designer should include these requirements in the Contract Documents.

The designer should determine which removals are included under Earth Excavation and Grading. (510.10.03)

The designer should ensure that the removal of asphalt from bridge decks is to be paid separately, when the entire bridge deck is removed and the asphalt cannot be mixed with concrete.

The designer should ensure that all items to be left in place are in accordance with environmental constraints and requirements.
Appendix 510-A

Removed items may contain materials that may be subject to specific handling and disposal requirements (e.g., asbestos and slag). The designer should ensure that these requirements are included where such materials are known to exist.

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

Related Ontario Provincial Standard Drawings

OPSD 102.010  Removals, Legend
OPSD 710.010  Capping Existing Structures, Maximum 4.0 m Cover
Amendment to OPSS.MUNI 1010 (Apr 2013) – Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material

OPSS 1010.03 DEFINITIONS

Section 1010.03 of OPSS.MUNI 1010 is amended by the addition of the following:

**Granular A** means a set of requirements for dense graded aggregates intended for use as granular base within the pavement structure, granular shouldering and backfill. Granular A is also intended for use as embedment material for flexible pipes, bedding material and cover material for rigid pipes, and backfill material for rigid and flexible pipes.

**Granular A RCM** means a set of requirements for dense graded recycled concrete material intended for use as bedding, embedment material and trench backfill around underground infrastructure.

**Granular A RAP** means a set of requirements for dense graded recycled asphaltic material intended for use as granular base within the pavement structure and/or related work within the road allowance.

**50 mm Crushed Aggregate** means a set of requirements for dense graded recycled material intended for use as granular base within the pavement structure.

OPSS 1010.04 SUBMISSION AND DESIGN REQUIREMENTS

OPSS 1010.04.01 Submission of Test Data

Subsection 1010.04.01 of OPSS.MUNI 1010 is amended by deleting the first paragraph in its entirety and replacing it with the following:

The Contractor shall have test results available for the aggregates to be used in the work. The QC testing records shall be made available to Contract Administrator at least five Working Days before the delivery of the material. Test results shall be submitted by either the stockpile/pit-run method or control chart method. All test data forms shall be legible.
OPSS.MUNI 1010 is amended by the addition of the following subsection:

**OPSS 1010.04.02 Submission of RCM Test Data**

The Quality Control plan shall form part of the submission requirements to the City, along with test results for recent and current production confirming that the production process is according to LS-624 providing consistent RCM material meeting specification requirements. Physical properties shall be confirmed by an independent, CCIL Type C (Aggregate Quality Control) and Type D (Aggregate Physical Property Laboratory) certified laboratory.

**OPSS 1010.05 MATERIALS**

**OPSS 1010.05.02 Granular A, Granular M, and Granular S**

Subsection 1010.05.02 of OPSS.MUNI 1010 is amended by deleting the entire section and replacing with the following:

Granular A shall meet the specifications of Granular A RCM, Granular A RAP or shall be produced by crushing one or more of the following:

1) Quarried bedrock.

2) Naturally formed deposits of sand, gravel and cobbles.

Subsection 1010.05.02 of OPSS.MUNI 1010 is amended by the addition of the following clause:

**OPSS 1010.05.02.01 Granular A RCM**

Granular A RCM produced from reclaimed concrete material and intended primarily for pipe bedding shall:

1) contain up to 100 per cent by mass of crushed RCM only;

2) not contain glass or ceramic material; and

3) not contain more than a combined total of 0.5 per cent by mass of deleterious material. Gypsum, gypsum plaster and wall board mix shall not be allowed in the mix.

Subsection 1010.05.02 of OPSS.MUNI 1010 is amended by the addition of the following clause:

**OPSS 1010.05.02.02 Granular A RAP**

Granular A RAP produced from reclaimed asphalt pavement material:

1) may contain up to 100 per cent by mass of crushed RCM but shall not contain more than 30 per cent of RAP by mass;
2) shall not contain glass or ceramic material; and

3) shall not contain more than a combined total of 0.5 per cent by mass of deleterious material. Gypsum, gypsum plaster and wall board mix shall not be allowed in the mix.

Subsection 1010.05.03 of OPSS.MUNI 1010 is amended by the addition of the following clause:

OPSS 1010.05.03.06 50 mm Crushed Aggregate

50 mm crushed aggregate:

1) may contain up to 100 per cent by mass of crushed RCM but shall not contain more than 30 per cent of RAP by mass;

2) shall not contain glass or ceramic material; and

3) shall not contain more than a combined total of 0.5 per cent by mass of deleterious material. Gypsum, gypsum plaster and wall board mix shall not be allowed in the mix.

50 mm crushed aggregate shall meet the physical requirements shown in Table 1 and gradation requirements shown in Table 2.

OPSS 1010.07 PRODUCTION

OPSS 1010.07.02.01 General

Clause 1010.07.02.01 of OPSS.MUNI 1010 is amended by the addition of the following paragraphs:

All Contractors or suppliers producing RCM for City construction projects shall provide a detailed Quality Control plan covering RCM production and placement as part of their materials submissions. The QC plan shall describe the Contractor's or suppliers processes for the control, acceptance and documentation of sources of old concrete and identify how the sources of old concrete are controlled during delivery to ensure they are from a suitable source.

Describe the production and physical properties testing (tests and frequency) that are conducted by the Contractor or supplier to ensure that the RCM meets the City's requirements; including the absence of gypsum, gypsum plaster and wall board mix; and including a process to control excessive fine particles, RAP and building demolition wastes.

The Contractor or supplier shall provide a written certificate to the Contract Administrator expressly stating that no building demolition wastes have been used in the production of the RCM granular base and subbase. The certificate shall state that the RCM supplied contains sulphate concentrations less than or equal to 5000 µg/g. The sampling and testing frequency from the stockpile would commence with the first testing to be performed based on one test for every 1000 tonnes of production. Ten (10) samples/tests, based on one for every 1000 tonnes, are required to establish that material is considered to be under control meeting all specification requirements. The subsequence testing and sampling can be performed less frequently at one test for every 5000 tonnes.
Contractors or suppliers shall obtain and submit samples to a Canadian Association for Environmental Analytical Laboratories (CAEAL) certified third party external analytical laboratory for sulphate concentration testing as part of their ongoing QC/process control program, and submit the test results to the City as part of its approval submission.

OPSS 1010.08 QUALITY ASSURANCE

OPSS 1010.08.04 Acceptance

Subsection 1010.08.04 of OPSS.MUNI 1010 is amended by deleting the fourth paragraph in its entirety and replacing it with the following:

The Contractor shall cease using the non-complying materials and at the discretion of the Contract Administrator, remove the unacceptable materials, including the unacceptable materials that has already been placed and compacted. No payment shall be made for unacceptable materials.

OPSS 1010.08.05 Referee Testing

Subsection 1010.08.05 of OPSS.MUNI 1010 is amended by deleting the first sentence in the second paragraph in its entirety and replacing it with the following:

The Contract Administrator shall select a referee laboratory within three business days following the Contractor's notification to invoke referee testing.
**TABLE 1**  
Physical Property Requirements

Table 1 of OPSS.MUNI 1010 is amended by the addition of column *50 mm Crushed Aggregate* as follows:

**Table 1: Physical property requirements**

<table>
<thead>
<tr>
<th>Laboratory test</th>
<th>MTO test number</th>
<th>Granular O</th>
<th>Granular A</th>
<th>Granular S</th>
<th>Granular B Type I and Type II</th>
<th>Granular B</th>
<th>50 mm crushed aggregate</th>
<th>Select sub grade material</th>
</tr>
</thead>
<tbody>
<tr>
<td>coarse aggregate petrographic requirement</td>
<td>LS-609</td>
<td>Note a</td>
<td>Note a</td>
<td>Note a</td>
<td>Note a</td>
<td>Note a</td>
<td>Note b</td>
<td>Note b</td>
</tr>
<tr>
<td>freeze-thaw loss, % maximum</td>
<td>LS-614</td>
<td>15</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>fine aggregate petrographic requirement</td>
<td>LS-616</td>
<td>LS-709</td>
<td>Note c</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>micro-deval abrasion coarse aggregate loss, % maximum</td>
<td>LS-618</td>
<td>21</td>
<td>25</td>
<td>25</td>
<td>30 (^d)</td>
<td>25</td>
<td>25</td>
<td>30 (^d)</td>
</tr>
<tr>
<td>micro-deval abrasion fine aggregate loss, % maximum</td>
<td>LS-619</td>
<td>25</td>
<td>30</td>
<td>30</td>
<td>35</td>
<td>30</td>
<td>30</td>
<td>n/a</td>
</tr>
<tr>
<td>plasticity index</td>
<td>LS-704</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>percent crushed, minimum</td>
<td>LS-607</td>
<td>100</td>
<td>50</td>
<td>50</td>
<td>n/a</td>
<td>50</td>
<td>50</td>
<td>n/a</td>
</tr>
<tr>
<td>2 or more crushed faces, % minimum</td>
<td>LS-617</td>
<td>85</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Asphalt Coated Particles, % maximum</td>
<td>LS-621</td>
<td>n/a</td>
<td>30 (^f)</td>
<td>30 (^d)</td>
<td>Note e</td>
<td>30</td>
<td>30</td>
<td>n/a</td>
</tr>
</tbody>
</table>
Note a: Granular A, B Type I, or M may contain up to 15% by mass of crushed glass and ceramic material combined.

Note b: Granular A, B Type I, M, and S shall not contain more than 1% by mass of deleterious material. Granular O, Granular B Type II and SSM shall not contain more than 0.1% by mass of wood. Petrographic classification of rock type need not be reported. This requirement is only to be reported when such material is present.

Note c: Test required for materials north of the French and Mattawa Rivers only. For materials with greater than 5.0% passing the 75µm sieve, the amount of mica passing the 150µm sieve and retained on the 75µm sieve, shall not exceed 10% of the material in that sieve fraction unless either testing according to LS-709 determines permeability values to be greater than $1.0 \times 10^{-4}$ cm/s or field experience show satisfactory performance. Prior data demonstrating compliance with this requirement will be acceptable provided such testing has been done within the past five years and that field performance of these materials has been satisfactory.

Note d: The coarse aggregate Micro-Deval abrasion loss test requirements will be waived if the material has more than 80% passing the 4.75 mm sieve.

Note e: Granular B Type I may contain up to 30% asphalt coated particles. Granular B Type II shall not contain RAP or asphalt coated products.

Note f: RAP up to 30% by mass not applicable to Granular A and Granular A RCM.
### Table 2: Gradation requirements – percent passing

<table>
<thead>
<tr>
<th>MTO test number</th>
<th>Sieve</th>
<th>Granular</th>
<th>B&lt;sup&gt;a&lt;/sup&gt;</th>
<th>50 mm crushed aggregate</th>
<th>Select subgrade material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Type I&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Type II</td>
<td>M</td>
<td></td>
</tr>
<tr>
<td>150 mm</td>
<td>n/a</td>
<td>n/a</td>
<td>100</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>106 mm</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>100</td>
<td>n/a</td>
</tr>
<tr>
<td>37.5 mm</td>
<td>100</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>26.5 mm</td>
<td>95-100</td>
<td>100</td>
<td>100</td>
<td>50-100</td>
<td>50-100</td>
</tr>
<tr>
<td>19 mm</td>
<td>80-95 85-100&lt;sup&gt;(87-100*)&lt;/sup&gt;</td>
<td>90-100</td>
<td>n/a</td>
<td>n/a</td>
<td>100</td>
</tr>
<tr>
<td>16 mm</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>13.2 mm</td>
<td>60-80 65-90&lt;sup&gt;(75-95*)&lt;/sup&gt;</td>
<td>75-100</td>
<td>n/a</td>
<td>n/a</td>
<td>75-95</td>
</tr>
<tr>
<td>9.5 mm</td>
<td>50-70 50-73&lt;sup&gt;(60-83*)&lt;/sup&gt;</td>
<td>60-85</td>
<td>n/a</td>
<td>n/a</td>
<td>55-80</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>20-45 35-55&lt;sup&gt;(40-60*)&lt;/sup&gt;</td>
<td>40-60</td>
<td>20-100</td>
<td>20-55</td>
<td>35-55</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>0-15 15-40</td>
<td>20-40</td>
<td>10-100</td>
<td>10-40</td>
<td>15-40</td>
</tr>
<tr>
<td>300 µm</td>
<td>n/a</td>
<td>5-22</td>
<td>11-25</td>
<td>2-65</td>
<td>5-22</td>
</tr>
<tr>
<td>150 µm</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>75 µm</td>
<td>0-0.5 2.0-8.0&lt;sup&gt;(2.0-10.0**)&lt;/sup&gt;</td>
<td>9.0-15.0</td>
<td>0-8.0</td>
<td>0-10.0</td>
<td>2.0-8.0</td>
</tr>
</tbody>
</table>

Note a: Where Granular B is used for granular backfill for pipe sub drains, 100% of the material shall pass the 37.5mm sieve.

Note b: Where RAP is included in Granular B Type I, 100% of the RAP shall pass the 75mm sieve. Conditions in Note 1 supersede this requirement.

* Where the aggregate is obtained from an air-cooled blast furnace slag source.

** Where the aggregate is obtained from a quarry or an air-cooled blast furnace slag or nickel slag source.
TABLE 3  Minimum Sampling and Testing Frequency for Control Chart Use

Table 3 of OPSS.MUNI 1010 is amended by the addition of row 50 mm Crushed Aggregate as follows:

Table 3: Minimum sampling and testing frequency for control chart use

<table>
<thead>
<tr>
<th>Material</th>
<th>Frequency for Type 1 control chart t</th>
<th>Frequency for Type 2 control chart t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granular A, M and S</td>
<td>2500</td>
<td>5000</td>
</tr>
<tr>
<td>Granular B and SSM</td>
<td>5000</td>
<td>10,000</td>
</tr>
<tr>
<td>Granular O</td>
<td>2000</td>
<td>4000</td>
</tr>
<tr>
<td>50 mm Crushed Aggregate</td>
<td>5000</td>
<td>10,000</td>
</tr>
</tbody>
</table>

TABLE 4  Sample Size

Table 4 of OPSS.MUNI 1010 is amended by the addition of row 50 mm Crushed Aggregate as follows:

Table 4: Sample size

<table>
<thead>
<tr>
<th>Material</th>
<th>Minimum mass of individual field samples kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granular A, S, M, and O</td>
<td>25</td>
</tr>
<tr>
<td>Granular B and SSM</td>
<td>50</td>
</tr>
<tr>
<td>Granular B and SSM 100% passing 26.5 mm sieve</td>
<td>25</td>
</tr>
<tr>
<td>50 mm Crushed Aggregate</td>
<td>50</td>
</tr>
</tbody>
</table>

Note: Each sample container shall hold no more than 25 kg of material.
1010.01 SCOPE

This specification covers the material requirements for aggregates for use in base, subbase, select subgrade, granular surface, shouldering, and backfill material. Procedures for QC and QA and referee testing protocols are incorporated.

1010.01.01 Specification Significance and Use

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 according to the Contract Documents.
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.

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 Specification, Material

OPSS 1001  Aggregates - General

Ministry of Transportation, Ontario, Publications

MTO Laboratory Testing Manual

| LS-602 | Sieve Analysis of Aggregates |
| LS-607 | Percent Crushed Particles in Processed Coarse Aggregate |
| LS-609 | Petrographic Analysis of Coarse Aggregate |
| LS-614 | Freezing and Thawing of Coarse Aggregate |
| LS-616 | Petrographic Analysis of Fine Aggregate |
| LS-617 | Percent Particles with Two or More Crushed Faces and Uncrushed Particles in Processed Coarse Aggregate |
| LS-618 | The Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus |
| LS-619 | Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus |
| LS-621 | Determination of Amount of Asphalt Coated Particles in Coarse Aggregate |
| LS-624 | The Use of Control Charts for Construction Aggregates |
| LS-625 | Sampling of Granular Materials |
| LS-702 | Determination of Particle Size Analysis of Soils |
| LS-703/704 | Liquid Limit, Plastic Limit and Plasticity Index of Soils |
| LS-709 | Determination of Permeability of Granular Soils |
For the purpose of this specification, the following definitions apply:

**Air-Cooled Blast-Furnace Slag** means the material resulting from solidification of molten blast-furnace slag under atmospheric conditions. Subsequent cooling may be accelerated by application of water to the solidified surface.

**Bench** means a ledge parallel to stratigraphic bedding that in quarries forms a single level of operation above which rock is excavated from a contiguous face.

**Business Day** means any Day except Saturdays, Sundays, and statutory holidays.

**Control Chart** means a graphical chart used to monitor the central tendency and variability of a material characteristic in order to control production.

**Ceramic** means porcelain, china, and whiteware, e.g., sinks, toilets, and bidets made from clay and silica fired at a high temperature, excluding clay brick and tile, free of organic materials, metal, and plastic.

**Deleterious Material** means materials from the recycling stream other than glass, ceramic, reclaimed asphalt pavement, and reclaimed concrete materials that includes but is not limited to the following: wood, clay brick, clay tile, plastic, gypsum, gypsum plaster, and wallboard.

**Free of Clay** means the amount of material with a particle diameter less than 2 \( \mu \text{m} \) shall not be greater than 1% of the total sample when tested according to LS-702.

**Glass** means processed glass obtained from the recycling stream that is free of organic materials, metal, and plastic.

**Granular A** means a set of requirements for dense graded aggregates intended for use as granular base within the pavement structure, granular shouldering, and backfill.

**Granular B** means a set of requirements for well-graded aggregates intended for use as granular subbase within the pavement structure and granular backfill. Granular B may be either Type I or Type II.

**Granular M** means a set of requirements for dense graded aggregates intended for use on unpaved road surfaces and for the maintenance of unpaved shoulders.

**Granular O** means a set of requirements for open graded aggregates intended only for use as a free draining granular base within the pavement structure.

**Granular S** means a set of requirements for dense graded aggregates intended only for use as surface dressing of low volume unpaved roads with an AADT less than 200.

**Nickel Slag** means the non-metallic co-product resulting from the production of nickel.

**Physical Property** means an inherent attribute or feature of an aggregate or soil material. Tests are carried out to determine a materials resistance to weathering or degradation or both.

**Pit-Run Material** means material excavated directly from an existing bank in a pit and delivered to the job site without further processing, e.g., crushing, screening, washing, and classifying.

**Production Characteristic** means an attribute or feature of an aggregate or soil material, including gradation, that is introduced into the material through the manufacturing process, e.g., crushing, screening, and blending.

**Quality Assurance (QA)** means a system or series of activities carried out by the Owner to ensure that materials received meet the specified requirements.
Quality Control (QC) means a system or a series of activities performed by the Contractor to ensure that materials supplied meet the specified requirements.

Random Numbers means numbers generated by chance and recorded in random number tables.

Reclaimed Asphalt Pavement (RAP) means processed hot mix asphalt material that is recovered by partial or full depth removal.

Reclaimed Concrete Material (RCM) means removed or processed old Portland cement concrete.

Referee Testing means testing by an independent laboratory selected by the Contract Administrator and acceptable to the Contractor, the results of which are used for resolving differences between QC and QA testing.

Select Subgrade Material (SSM) means a set of requirements for well-graded non-plastic aggregates used to replace poor subgrade materials and as swamp backfill.

Statistical Control means when all sources of assignable variation have been removed, that is when the variability of the process is confined to chance variation alone.

Steel Slag means the non-metallic co-product resulting from the production of steel in a basic oxygen or electric arc furnace.

1010.04 DESIGN AND SUBMISSION REQUIREMENTS

1010.04.01 Submission Requirements

1010.04.01.01 Submission of Test Data

The Contractor shall have test results available for the aggregates to be used in the work. At the request of the Contract Administrator, the Contractor shall make available or submit QC test results prior to the delivery of the material. Test results shall be submitted by either the stockpile/pit-run method or control chart method. All test data forms shall be legible.

Test data for each aggregate product shall be managed independently. When more than one source is used for supplying materials, test data from each source and product shall be managed independently.

1010.05 MATERIALS

1010.05.01 General

The requirements of OPSS 1001 shall apply to this specification. Materials shall conform to this specification when tested according to the MTO Laboratory Testing Manual.

All aggregate source materials shall be clean hard durable particles free of earth, humus, and clay, e.g., coatings, lumps, and fragments. When reclaimed materials are permitted, they shall be homogeneously blended. When RCM is permitted, RCM shall not contain loose reinforcing materials.

When air-cooled blast furnace slag, nickel slag, and RAP containing steel slag aggregates are used, site-specific notification shall be given by the Contractor to the Ontario Ministry of the Environment (MOE). Glass and ceramic material shall be processed to remove all deleterious organic materials.

One hundred percent of the processed glass and ceramic material shall pass the 13.2 mm sieve.

Steel slag shall not be used.
Granular A, Granular M, and Granular S may be produced by crushing one or more of the following:

a) Quarried bedrock.
b) Naturally formed deposits of sand, gravel, and cobbles.
c) RAP up to 30% by mass.
d) RCM.
e) Air-cooled blast-furnace slag or nickel slag.
f) Glass or ceramic materials up to 15% by mass combined.

Granular A and Granular M may contain up to 100% RCM but shall not contain more than 30% by mass of asphalt coated particles and not more than a combined total of 15% by mass of glass and ceramic material. The combined amount of deleterious material shall not exceed a total of 1% by mass. Granular A and Granular M containing RAP with steel slag aggregates shall be acceptable for unpaved gravel shoulders only.

Granular B may be either Type I or Type II as described below.

Granular B Type I may be produced from naturally formed deposits of sand, gravel, and cobbles or by crushing one or more of the following:

a) Quarried bedrock.
b) Air-cooled blast-furnace slag or nickel slag.
c) RCM.
d) RAP up to 30% by mass.
e) Glass or ceramic materials up to 15% by mass combined.

Granular B Type I may contain up to 100% RCM but shall not contain more than 30% by mass of asphalt coated particles. Granular B Type I may not contain more than a combined total of 15% by mass of glass and ceramic material. The combined amount of deleterious material shall not exceed 1% by mass.

RAP containing steel slag aggregates shall not be allowed.

Granular B Type II shall only be obtained from crushing quarried bedrock, air-cooled blast furnace slag, or nickel slag. Steel slag and reclaimed materials shall not be used in the production of Granular B Type II.
Granular O shall only be produced by crushing quarried bedrock, or by crushing cobbles or boulders retained on the 50 mm sieve.

Select subgrade material shall only be non-plastic granular or sandy type soil produced from naturally formed deposits.

Aggregates that have become mixed with foreign matter of any description, or aggregates that have become mixed with each other shall not be used and shall be removed from the stockpile immediately. When a change in the character of the materials occurs or when the performance of materials that meet the requirements of this specification is found to be unsatisfactory, the use of the materials shall be discontinued until the Contractor, with the approval of the Contract Administrator, proves the source to be satisfactory.

Once a stockpile has been produced, sampled, and tested for QC under the procedure for stockpile/pit-run method, no further materials shall be added to the stockpile. Stockpiles produced, sampled, and tested under the procedure for control chart method may continue to have materials added provided that sampling and testing show that materials in the stockpile conform to this specification and that the process remains in statistical control.

The Contractor shall be responsible for all QC sampling and testing required to show conformance of the aggregates with this specification. Either the stockpile/pit-run method or control chart method shall be used. These records shall be made available to the Contract Administrator upon request.

When the stockpile/pit-run method has been selected, test data shall be obtained from samples taken from stockpiled or pit-run material to be used in the work.

When the control chart method has been selected, control charts shall be prepared in accordance with LS-624 or similar method. Each control chart shall contain information regarding control limits, specification limits, target values, testing frequencies, sampling locations, and time period over which the testing has taken place. Each control chart shall include individual test data of the most recent sample indicated on the chart.

The Contractor shall select all QC laboratories and shall be responsible for all costs associated with the testing for QC requirements.

An acceptable laboratory conducting tests for physical properties shall be one that holds a current certificate from Canadian Council of Independent Laboratories (CCIL) as Type D for the applicable test methods and also participates in the Annual MTO Proficiency Sample Testing Program for the specific tests, except LS-616 and LS-709.

An acceptable laboratory to conduct tests for gradation according to LS-602 and percent crushed particles according to LS-607 shall be one who holds a current certificate from CCIL as Type C.

Testing shall be conducted by qualified laboratory staff that hold a valid aggregate testing certificate from CCIL.
Equivalent alternate laboratory and technician certifications or laboratory proficiency testing programs may be used to demonstrate similar requirements provided they are acceptable to the Contract Administrator.

1010.07.03 Physical Properties

1010.07.03.01 Stockpile/Pit-Run Method

Testing demonstrating conformance of the aggregates shown in Table 1 shall be completed for each quantity of material produced according to the following schedule:

a) For the first 25,000 tonnes of aggregate produced.

b) For the next 50,000 tonnes of aggregate produced.

c) For each 100,000 tonnes of aggregate produced thereafter.

Further testing is required whenever material is produced from a new source or a new bench in a quarry or whenever a significant change in aggregate production or material occurs that may affect the quality of material.

1010.07.03.02 Control Chart Method

The Contractor shall use a Type 1 control chart as defined in LS-624 or similar method for each physical property requirement shown in Table 1. When the control chart has been established, the minimum frequency of sampling and further testing shall be as follows:

a) Annually, i.e., obtained within the past 12 months, when the mean value of the physical property is less than 75% of the limit shown in Table 1 and the Type 1 control chart demonstrates the process to be in statistical control; or

b) Three times per year, spaced evenly throughout the aggregate production season, when the mean value of the physical property is greater than 75% of the limit shown in Table 1 or the Type 1 control chart demonstrates the process to be out of statistical control.

1010.07.04 Production Characteristics

1010.07.04.01 Stockpile/Pit-Run Method

Testing demonstrating conformance of the aggregates shown in Table 2 shall be completed for each 1,000 tonnes of material produced.

1010.07.04.02 Control Chart Method

A Type 1 or Type 2 control chart according to LS-624 or similar method for each applicable requirement shown in Table 2 may be used.

Type 1 control charts shall cover production of at least 20,000 tonnes of material. Type 2 control charts shall cover production of at least 80,000 tonnes of material. New or revised control charts shall be required for each successive production and delivery quantity of material, as applicable.

a) When a Type 1 chart is used, the minimum number of test results shall be twenty (n=20). When this control chart has been established, the frequency of sampling and further testing shall be as follows:

i. When the mean value (n=20) of the test results is within the limit and the process is shown to be in statistical control, the frequency of sampling and testing may be decreased to meet the quantities shown in Table 3; otherwise,

ii. The minimum frequency shall be every 1,000 tonnes of material produced.
b) When a Type 2 chart is used, the minimum number of subgroups shall be twenty (k=20). When this control chart has been established, the frequency of sampling and further testing shall be as follows:

i. When the process is shown to be in statistical control, frequency of sampling and testing may be decreased to meet the quantities shown in Table 3; otherwise,

ii. The minimum frequency shall be every 1,000 tonnes of material produced.

1010.08 QUALITY ASSURANCE

1010.08.01 General

The Contract Administrator shall be allowed access to all sampling locations and reserves the right to take a QA sample at any time with notice to the Contractor. The Contract Administrator may elect to carry out testing at the QA laboratory to ensure that materials used in the work conform to the requirements of this specification.

Test data for each aggregate type shall be managed independently. When more than one source is used for supplying materials, test data from each source, and product shall be managed independently.

1010.08.02 Sampling

Sampling shall be according to LS-625 taken at a time and location determined by the Contract Administrator.

Duplicate samples shall be obtained and sealed by the Contractor in the presence of the Contract Administrator. In the event that the Contractor is unavailable to take the sample, no further materials shall be placed in the work until the QA sample has been taken. Samples shall be of sufficient mass of the material to conduct the necessary gradation and physical property tests.

Each QA sample shall meet the requirements shown in Table 4 and shall be clearly identified both inside and outside of the container.

When materials contain blended or reclaimed aggregates or both, QA sampling shall be performed on the final blended product.

1010.08.03 QA Laboratory Requirements

The Owner shall designate the QA laboratories and shall be responsible for all costs associated with QA testing.

An acceptable laboratory conducting tests for physical properties shall be one that holds a current certificate from CCIL as Type D for the applicable test methods and also participates in the Annual MTO Proficiency Sample Testing Program for the specific tests, except for LS-616 and LS-709.

An acceptable laboratory to conduct tests for gradation according to LS-602 and percent crushed particles according to LS-607 shall be one that holds a current certificate from CCIL as Type C.

Testing shall be conducted by qualified laboratory staff that holds a valid aggregate testing certificate from CCIL.

Equivalent alternate laboratory and technician certifications or laboratory proficiency testing programs may be used to demonstrate similar requirements provided they are acceptable to the Contract Administrator.

1010.08.04 Acceptance

When QA testing has not been carried out, the material shall be deemed acceptable. Otherwise, QA test results or referee test results shall be used for acceptance purposes as indicated below.
When QA test results show that the materials meet the applicable requirements shown in Table 1 and Table 2, the material shall be accepted.

When QA test results show that the material does not meet the applicable requirements shown in Table 1 and Table 2, the Contract Administrator shall notify the Contractor that materials represented by the test results shall not be accepted. This notification shall take place in writing within 3 business days of receipt of the non-conforming data.

At the discretion of the Contract Administrator, irrespective of non-compliance with the requirements shown in Table 1 and Table 2, aggregates may be accepted on the basis of satisfactory field performance.

1010.08.05 Referee Testing

When QA test results do not meet the requirements of this specification, the Contractor has the option of invoking referee testing of the test result that fails to meet the requirements. The Contractor shall notify the Contract Administrator of the selected option within 2 business days following notification of unacceptable material.

The Contract Administrator shall select a referee laboratory acceptable to the Contractor within 3 business days following the Contractor's notification to invoke referee testing. Referee samples shall be delivered to the referee laboratory from the QA laboratory by the Contract Administrator. The sealed sample shall be opened in the presence of the Contractor and the Contract Administrator. If referee materials are not available, the Contractor shall be responsible for obtaining and submitting new samples to the referee laboratory from a location to be decided by the Contract Administrator. The Contract Administrator shall be present to witness the sampling.

Referee testing shall be carried out in the presence of the Contract Administrator. When applicable, the referee laboratory shall also test a control aggregate sample for each test method required. The Contractor may observe the testing at no cost to the Owner. Comments on the nonconformity of the test methods must be made and corrected at the time of testing. If the testing cannot be corrected or if agreement on the procedure cannot be reached, the testing shall be postponed until the procedure is corrected or agreement between the parties is reached. Referee test results shall be binding on both the Owner and the Contractor.

When a referee test result shows that the aggregates do not meet the requirements of this specification, the material represented by the test result, including materials in existing stockpiles or in the work shall not be accepted. The Contractor shall remove the material from the work at no cost to the Owner.

When a referee test result shows that the aggregates are in complete conformance with the requirements of this specification, the material represented by the sample shall be accepted.

The Owner shall be responsible for the cost of referee testing provided that the referee test results show that the aggregates meet the applicable specifications. Otherwise, the Contractor shall be responsible for the costs.
TABLE 1
Physical Property Requirements

<table>
<thead>
<tr>
<th>Laboratory Test</th>
<th>MTO Test Number</th>
<th>Granular O</th>
<th>Granular A</th>
<th>Granular S</th>
<th>Granular B Type I and Type II</th>
<th>Granular M</th>
<th>Select Subgrade Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Aggregate Petrographic Requirement</td>
<td>LS-609 (Note 2)</td>
<td>(Note 1)</td>
<td>(Note 2)</td>
<td>(Note 2)</td>
<td>(Note 1)</td>
<td>(Note 2)</td>
<td>(Note 2)</td>
</tr>
<tr>
<td>Freeze-Thaw Loss, % maximum</td>
<td>LS-614</td>
<td>15</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Fine Aggregate Petrographic Requirement</td>
<td>LS-616</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(Note 3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LS-709</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Micro-Deval Abrasion Coarse Aggregate loss, % maximum</td>
<td>LS-618</td>
<td>21</td>
<td>25</td>
<td>25</td>
<td>30 (Note 4)</td>
<td>25</td>
<td>30 (Note 4)</td>
</tr>
<tr>
<td>Micro-Deval Abrasion Fine Aggregate loss, % maximum</td>
<td>LS-619</td>
<td>25</td>
<td>30</td>
<td>30</td>
<td>35</td>
<td>30</td>
<td>N/A</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>LS-704</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Percent crushed, minimum</td>
<td>LS-607</td>
<td>100</td>
<td>50</td>
<td>50</td>
<td>N/A</td>
<td>50</td>
<td>N/A</td>
</tr>
<tr>
<td>2 or more crushed faces, % minimum</td>
<td>LS-617</td>
<td>85</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Asphalt Coated Particles, % maximum</td>
<td>LS-621</td>
<td>N/A</td>
<td>30</td>
<td>30</td>
<td>(Note 5)</td>
<td>30</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Notes:

1. Granular A, B Type I, or M may contain up to 15% by mass of crushed glass and ceramic material combined.

2. Granular A, B Type I, M, and S shall not contain more than 1% by mass of deleterious material. Granular O, Granular B Type II, and SSM shall not contain more than 0.1% by mass of wood. Petrographic classification of rock type need not be reported. This requirement is only to be reported when such material is present.

3. Test required for materials north of the French and Mattawa Rivers only. For materials with greater than 5.0% passing the 75 μm sieve, the amount of mica passing the 150 μm sieve and retained on the 75 μm sieve, shall not exceed 10% of the material in that sieve fraction unless either testing according to LS-709 determines permeability values to be greater than 1.0 x 10^-4 cm/s or field experience show satisfactory performance. Prior data demonstrating compliance with this requirement shall be acceptable provided such testing has been done within the past five years and that field performance of these materials has been satisfactory.

4. The coarse aggregate Micro-Deval abrasion loss test requirements shall be waived if the material has more than 80% passing the 4.75 mm sieve.

5. Granular B Type I may contain up to 30% asphalt coated particles. Granular B Type II shall not contain RAP or asphalt coated products.
<table>
<thead>
<tr>
<th>MTO Test Number</th>
<th>Sieve</th>
<th>Granular</th>
<th>Select Subgrade Material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>O</td>
<td>A</td>
</tr>
<tr>
<td>LS-602</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>150 mm</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>106 mm</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>37.5 mm</td>
<td>100</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>26.5 mm</td>
<td>95-100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>19.0 mm</td>
<td>80-95</td>
<td>85-100</td>
</tr>
<tr>
<td></td>
<td>13.2 mm</td>
<td>60-80</td>
<td>65-90</td>
</tr>
<tr>
<td></td>
<td>9.5 mm</td>
<td>50-70</td>
<td>50-73</td>
</tr>
<tr>
<td></td>
<td>4.75 mm</td>
<td>20-45</td>
<td>35-55</td>
</tr>
<tr>
<td></td>
<td>1.18 mm</td>
<td>0-15</td>
<td>15-40</td>
</tr>
<tr>
<td></td>
<td>300 μm</td>
<td>N/A</td>
<td>5-22</td>
</tr>
<tr>
<td></td>
<td>150 μm</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>75 μm</td>
<td>0-5.0</td>
<td>2.0-8.0</td>
</tr>
</tbody>
</table>

Notes:

1. When Granular B is used for granular backfill for pipe subdrains, 100% of the material shall pass the 37.5 mm sieve.

2. When RAP is included in Granular B Type I, 100% of the RAP shall pass the 75 mm sieve. Conditions in Note 1 supersede this requirement.

* When the aggregate is obtained from an air-cooled blast furnace slag source.

** When the aggregate is obtained from a quarry or an air-cooled blast furnace slag or nickel slag source.
### TABLE 3
Minimum Sampling and Testing Frequency for Control Chart Use

<table>
<thead>
<tr>
<th>Material</th>
<th>Frequency for Type 1 Control Chart t</th>
<th>Frequency for Type 2 Control Chart t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granular A, M, and S</td>
<td>2,500</td>
<td>5,000</td>
</tr>
<tr>
<td>Granular B and SSM</td>
<td>5,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Granular O</td>
<td>2,000</td>
<td>4,000</td>
</tr>
</tbody>
</table>

### TABLE 4
Sample Size

<table>
<thead>
<tr>
<th>Material</th>
<th>Minimum Mass of Individual Field Samples kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granular A, S, M, and O</td>
<td>25</td>
</tr>
<tr>
<td>Granular B and SSM</td>
<td>50</td>
</tr>
<tr>
<td>Granular B and SSM 100% passing 26.5 mm sieve</td>
<td>25</td>
</tr>
</tbody>
</table>

Note: Each sample container shall hold no more than 25 kg of material.
Appendix 1010-A, April 2013
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 determine if the forms in Appendices 1010-B and 1010-C are to be used for submission purposes. If so, they need to be invoked by reference in the Contract Documents.

The use of steel slag aggregate is prohibited.

The designer should be aware that air-cooled blast furnace slag, nickel slag, and RAP containing steel slag aggregates may require specific placement guidelines based on local municipal and MOE requirements.

Prior to tendering, when Owner supplied or specified air-cooled blast furnace slag, nickel slag, or RAP containing steel slag aggregates are to be used, the designer should obtain site notification from MOE and ensure all environmental guidelines and requirements are met.

RAP content is determined by LS-623, percent Asphalt Coated Particles. However, this test is limited to identifying RAP content in the coarse aggregate portion only. When RAP in fine aggregate is a concern a Petrographic Examination of the material passing the 4.75 mm sieve is recommended. (1010.05.02)

The Contract Documents should specify the QA testing to be performed in the Contract. If QA testing is not specified, the material shall be deemed acceptable.

The designer may specify a higher percent crushed requirement to improve performance in higher traffic areas.

Related Ontario Provincial Standard Drawings

No information provided here.
Note: This appendix is not a mandatory part of the standard specification. However, it is written in mandatory language to permit invoking it by reference in the Contract Documents.

### OPSS 1010 - FINE AGGREGATE TEST DATA

Granular A, B, M, O, S, and Select Subgrade Material (SSM)

<table>
<thead>
<tr>
<th>Material Type (check one)</th>
<th>Granular</th>
<th>SSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ] A</td>
<td>[ ] B Type I</td>
<td>[ ] B Type II</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laboratory Test Number</th>
<th>Acceptance Requirements</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Granular</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B Type I</td>
</tr>
<tr>
<td>Petrographic Requirement, LS-616</td>
<td>For materials north of the French and Mattawa Rivers: maximum 10% mica (retained on the 75 μm sieve).</td>
<td>N/A</td>
</tr>
<tr>
<td>Micro-Deval Abrasion Loss, % maximum, LS-619</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>Plasticity Index, % maximum, LS-704</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Issued by Testing Laboratory Representative:

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>SIGNATURE</th>
<th>DATE</th>
</tr>
</thead>
</table>

Received By Contract Administrator Representative:

<table>
<thead>
<tr>
<th>PRINT NAME</th>
<th>SIGNATURE</th>
<th>DATE</th>
</tr>
</thead>
</table>
**OPSS 1010 - COARSE AGGREGATE TEST DATA**

Granular A, B, M, O, S, and Select Subgrade Material (SSM)

<table>
<thead>
<tr>
<th>Laboratory Test Number</th>
<th>Acceptance Requirements</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Granular</td>
<td>SSM</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>B Type I</td>
</tr>
<tr>
<td>Crushed Particles, % minimum, LS-607</td>
<td>50</td>
<td>N/A</td>
</tr>
<tr>
<td>Petrographic Requirement, LS-609</td>
<td>(Note 1)</td>
<td>N/A</td>
</tr>
<tr>
<td>Freeze-Thaw Loss, % maximum, LS-614</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>2 Faces Crushed, % minimum, LS-617</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Micro-Deval Abrasion Loss, % maximum, LS-618</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>Asphalt Coated Particles, % maximum, LS-621</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Notes:

1. Maximum of 15% by mass of crushed glass or ceramic material or both, and maximum of 1% by mass of deleterious materials (wood, clay brick, clay tile, gypsum, gypsum plaster, and wallboard).

2. The coarse aggregate Micro-Deval abrasion loss test requirement shall be waived if the material has more than 80% passing the 4.75 mm sieve.

Issued by Testing Laboratory Representative:

```
PRINT NAME SIGNATURE DATE
```

Received By Contract Administrator Representative:

```
PRINT NAME SIGNATURE DATE
```
Amendment to OPSS.MUNI 1350 (Nov 2014) – Material Specification for Concrete – Materials and Production

This specification shall be read in conjunction with OPSS.MUNI 1350 (Nov 2014). OPSS.MUNI 1350 (Nov 2014) shall form a normative part of this specification as a completed document. All requirements of OPSS.MUNI 1350 (Nov 2014) Appendix 1350-A shall apply in this specification.

TS 1350.01 SCOPE

Section 1350.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

This specification also covers the requirements for acceptance of concrete material for the construction of road base, curb and gutter, sidewalk, crosswalk, streetcar track and other concrete items.

TS 1350.02 REFERENCES

Section 1350.02 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

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

City of Toronto Standard Specifications
TS 3.40 Construction Specification for Concrete Road Base
TS 3.45 Construction Specification for the Repair of Concrete Pavement and Base
TS 3.50 Construction Specification for Concrete Curb and Concrete Curb and Gutter
TS 3.65 Construction Specification for Concrete Crosswalk
TS 3.70 Construction Specification for Concrete Sidewalk and Concrete Raised Median
TS 3.75 Construction Specification for Streetcar Track Pavement and Foundation Slab

Ontario Provincial Standard Specifications
OPSS 904 Construction Specification for Structural Concrete
OPSS 1306 Material Specification for Burlap
OPSS 1315 Material Specification for White Pigmented Curing Compounds
OPSS 1440 Material Specification for Steel Reinforcement for Concrete
OPSS 1860 Material Specification for Geotextiles

Canadian Standards Association
A3000 Cementitious Materials Compendium
A23.1 Concrete Materials and Methods of Concrete Construction
A23.2 Test Methods and Standard Practices for Concrete
A23.2-1C Sampling Plastic Concrete
A23.2-4C Air Content of Plastic Concrete by the Pressure Method
A23.2-5C  Slump of Concrete  
A23.2-17C  Temperature of Freshly Mixed Hydraulic Cement Concrete

American Society of Testing and Materials
C 171    Standard Specification for Sheet Materials for Curing Concrete  
C 174    Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores  
C 309    Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete  
C457    Standard Test Method for Microscopical Determination of Parameters of the Air Void System in Hardened Concrete  
C 666    Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing  
D 1751    Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction

Transportation Research Report  
NCHRP  Concrete Sealers for Protection of Bridge Structures  
Report 244

TS 1350.03 DEFINITIONS

Section 1350.03 of OPSS.MUNI 1350 is amended by the addition of the following sentences:

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

Admixtures means a material other water, aggregate, cementing material, and fibre reinforcement used as an ingredient in concrete, mortar, or neat cement grout and added to the batch immediately before or during its mixing in order to purposely modify its usual characteristics and behavior.

Alkali-Aggregate Reactivity means a chemical reaction between the cementing material and certain minerals in the aggregates which cause expansive cracking in the hardened concrete.

Cold Weather means those conditions when the air temperature is at or below 5°C. It is also considered to exist when the air temperature is at or is likely to fall below 5°C within 96 hours after concrete placement. Temperature refers to shade temperature.

Crushed Material means aggregate particles having at least one well-defined face resulting from fracture. Particles with smooth faces and rounded edges or with only small chips removed are not considered crushed.

Epoxy means a multi-component resin grout.

Falsework means a temporary structure erected to support work in the process of construction, composed of shoring or vertical posting, formwork for beams and slabs, and lateral bracing.

Form A means a complete City of Toronto concrete mix design submission form for performance specification alternative. OPSS.MUNI 1350 (Nov 2014) OPSF 1350-1 is replaced by Form A.
**Form B** means a complete City of Toronto concrete mix design submission form to be submitted by the concrete supplier after executing a confidentially agreement. OPSS.MUNI 1350 (Nov 2014) OPSF 1350-2 is replaced by Form B.

**Formwork** means a total system of support for freshly placed concrete including moulds or sheathing as well as all supporting membranes, hardware and bracing.

**Grout** means a mixture of cementing materials, with or without admixtures, and water. The consistency varies from stiff to fluid.

**Mortar** means a mixture of cementing materials, sand and water, with a butter-like consistency.

**Non-Structural Concrete** means concrete used for the construction of catch basins, maintenance holes, valve chambers, pipe support, road base, curb and gutter, crosswalk, sidewalk, streetcar track and all other concrete that does not classify as structural concrete.

**Slurry** means a pourable mixture of cementing materials, sand and water.

**Superplastizied (Flowing) Concrete** means normal slump concrete to which a high-range water reducing admixture has been added to produce a high-slump flowing concrete.

**Structural Concrete** means any concrete used in the construction of bridges, culverts, tunnels, retaining walls, wharfs or guideways.

**TS 1350.04 DESIGN AND SUBMISSION REQUIREMENTS**

Subsection 1350.04.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

**TS 1350.04.01 Design Requirements**

Concrete mix design shall be one of the following alternatives chosen by the City:

- performance specification alternative; or
- prescriptive specification alternative.

The Contractor shall submit a mix design for each type of concrete specified in the Contract Documents. A complete mix design should consist of the following:

1) Either a completed City concrete mix design submission Form A; or
2) A completed City concrete mix design submission Form B; and
3) Supporting documentation including all material quality test data for the mix design and component materials required by the contract.

Concrete mix design submission Forms A or B shall identify all materials to be used in the concrete. No material shall be used in the concrete without the knowledge of the Contract Administrator.
Under the performance specification alternative, the Contractor shall provide a complete mix design submission on Form A to the Contract Administrator for each specific concrete mix.

At the sole discretion of the City, the City and the concrete supplier may enter to execute a confidentiality agreement to cover the protection of proprietary mix proportion information which is to be released as part of the mix design submission process on Form B.

**TS 1350.04.02 Submission Requirements**

Subsection 1350.04.02 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

A complete mix design submission shall be provided for concrete of each specified compressive strength according to CSA A23.1. A separate mix design submission is also required within each strength level for:

- Mixes where material proportions vary outside the tolerance identified below in this clause.
- Cast-in-place and slip-formed concrete.
- Mixes with different sources of materials.
- Mixes with different admixtures.
- Special purpose or unique mixes.

Submission of separate mix designs and separate supporting documentation is not required if concrete with the same mix design is to be supplied by multiple plants with the same sources of materials in the same proportions, however it must be supported in writing prior to use.

A new, complete mix design submission shall be provided prior to:

- Changing sources of materials used in the concrete.
- Substituting a material or product for another from the same source.
- Adding a material to the concrete that was not on the original mix design (except retarder).
- Adjusting the quantities of the stated materials in the concrete, outside of the following tolerances stated on Form B:

  a) Cement: ± 5% of quantity  
  b) Supplementary cementing materials: 95% to 100% of quantity  
  c) Admixtures: Dosage or range of dosage  
  d) Water: Range

Material quantities may be varied within the tolerances identified above, without submission of a new mix design.

Removal of a material from the mix requires submission of a new mix design, but does not require submission of supporting test data.

The submission process for new or modified mix designs is the same as for the original mix design.
**TS 1350.04.02.01.01 Performance Based Concrete Mix Data**

Clause 1350.04.02.01.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

**Form A**

Form A shall be completed by the concrete supplier based on the requirements of the Contract. The Contractor shall confirm with the concrete supplier and the Contract Administrator the performance characteristics of the concrete through the submission of Form A for each type of concrete as specified in the Contract Documents. The form shall be signed by the Contractor to certify that performance characteristics of the concrete have met their respective requirements under the contract.

The performance based mix design as detailed in Form A will be checked by the Contract Administrator to verify that the materials and sources are in compliance with the Contract Documents. Concrete placement cannot proceed until the Contract Administrator has verified that the form meets the project requirements. The form shall then form the basis of the detailed mix design.

The Contractor shall provide the following on submission of Form A:

1) Concrete exposure requirements shall be according to CSA A23.1, Table 2.

2) Primary concrete plant(s) supplying concrete.

3) Specified strength of concrete, for example 24-hour, 7-day, 28-day, or other specified ages.

4) Identification of all materials to be used in the concrete.

5) Concrete supplier and sources of all materials to be used.

6) Intended use and location of the concrete on the contract.

7) Target air content of the mix and slump range for quality control purposes.

8) Nominal maximum size of coarse aggregate and fine aggregate, and inventory numbers for the aggregates.

9) Declarations from the concrete supplier that the concrete they supply will meet all concrete requirements as specified in the Contract Documents.

10) The percentage of all supplementary cementing materials meet the contract requirements.

11) The dosage ranges of all chemical admixtures meet the requirements shown in subsection TS 1350.05.01, herein.

Form A shall be accompanied by all material quality test data of all materials used in the mix design, if requested.
Form B

Upon the execution of a confidentiality agreement between the City and the concrete supplier to cover the protection of proprietary mix proportion information which is to be released as part of the mix design submission process, the concrete supplier shall forward a completed Form B to the City.

The detailed mix design in Form B shall, in addition to material source information, contain the material quantities for cement, supplementary cementing materials, water and admixtures ranges, consistent with the specified Designated Sources for Materials List, and the requirements shown in TS 1350.05.01, herein.

The concrete supplier shall provide the following to the City on submission of Form B:

1) The information provided on Form A.

2) Quantity of cement and supplementary cementing materials to be used in the mix.

3) Dosage range of chemical admixtures to be used in the mix shall be according to subsection TS 1350.05.01, herein.

4) Quantity range of water to be used in the mix (total water).

Form B shall be signed by the concrete supplier to certify that performance characteristics of the concrete meet their respective requirements under the contract.

Form B shall be checked by the City to verify that the materials and sources are in compliance with the contract requirements. Concrete placement cannot proceed until the Contract Administrator has verified that the form meets the contract requirements.

TS 1350.05 MATERIALS

Section 1350.05 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

Concrete materials submission shall provide the following information:

1) The source of each material to be incorporated in the concrete and the name of the concrete supplier.

2) Certification that all materials to be incorporated into the concrete mix are compatible in the mix and meet or exceed the requirements given in subsection TS 1350.05.01, herein.

3) The proportions of materials for each class of concrete to be incorporated into the work as per the confidentiality agreement in a confidential manner by the City.

4) The results of slump, total air content and compressive strength testing at 7-day, 28-day, and other ages if required in the contract, for each class of concrete supplied.

5) If blended hydraulic cements or supplementary cementing materials are proposed, the Contract Administrator may request for documentation demonstrating satisfactory performance of similar concrete mixes incorporating the proposed cementing materials and proportions used in similar
applications such as bridge deck, sidewalk, and so on, and the current condition. The satisfactory performance may be shown through the documented visual assessment of at least five projects, each at least three years old, for each mix incorporating blended hydraulic cement or supplementary cementing materials.

6) If supplementary cementing materials are to be incorporated into the concrete mix, the Contract Administrator may request certification and documentation, stating that the quality and durability of the concrete with supplementary cementing materials will equal or exceed the quality and durability of the concrete without supplementary cementing materials. Specific documentation relating to de-icer chemical scaling resistance and rate of strength gain, if required, shall also be submitted.

7) At the request of the Contract Administrator, the results of testing of the quality of the air voids system of the hardened concrete mix(es) shall be incorporated into the Work, as determined by ASTM C 457, documenting conformance to CSA A23.1, clause 4.3.3.
Subsection 1350.05.01 of OPSS.MUNI 1350 is amended by the addition of the following Table A:

### Table A: Materials for concrete

<table>
<thead>
<tr>
<th>Specification</th>
<th>TS 3.40</th>
<th>TS 3.45</th>
<th>TS 3.50</th>
<th>TS 3.70</th>
<th>TS 3.75</th>
</tr>
</thead>
<tbody>
<tr>
<td>concrete for</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>road base</td>
<td></td>
<td></td>
<td>curb and gutter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sidewalk and median</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>streetcar track</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cement type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland and Portland</td>
<td></td>
<td></td>
<td>Portland and Portland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>limestone cement GU/GUL</td>
<td></td>
<td></td>
<td>limestone cement GU/GUL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>min 28-day compressive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>strength</td>
<td>32 MPa</td>
<td>32 MPa</td>
<td>32 MPa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>class of exposure</td>
<td>C-2</td>
<td>C-2</td>
<td>C-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>max size of aggregate</td>
<td>37.5 or 19 mm</td>
<td>19 mm</td>
<td>19 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>slump at plant</td>
<td>- -</td>
<td>- -</td>
<td>- -</td>
<td></td>
<td></td>
</tr>
<tr>
<td>slump at discharge no</td>
<td>80 ± 30 mm</td>
<td>80 ± 30 mm</td>
<td>max 20 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plasticizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>slump at discharge with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>plasticizer</td>
<td>- -</td>
<td>- -</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>air content for max size</td>
<td>5.5 ±1.5% (37.5 mm)</td>
<td>6.5 ±1.5%</td>
<td>6.5 ±1.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>of aggregate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>water/cementing</td>
<td>max 0.45</td>
<td>max 0.45</td>
<td>max 0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>materials ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lot size</td>
<td>per day or as directed by the City</td>
<td>per day or as directed by the City</td>
<td>per day or as directed by the City</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TS 1350.05.01.01 Cementing Materials**

Clause 1350.05.01.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

All cement shall be general use Portland cement (GU) and Portland-limestone cement (GUL) according to CSA A3000 or high-early-strength Portland cement (HE) and Portland-limestone cement (HEL) meeting the requirements of CSA A3000.

High-early-strength Portland cement (HE) and Portland-limestone cement (HEL) may be used only with the prior approval of the Contract Administrator.
Portland cement (GU) and Portland-limestone cement (GUL) may not be used as a means of obtaining high early strength in the concrete unless prior approval has been obtained from the Contract Administrator.

Blended hydraulic cements shall be according to CSA A3000. Blended hydraulic cements may be used only with the prior approval of the Contract Administrator.

Supplementary cementing materials such as fly ash, silica fume and/or slag cement may be used by meeting the requirements of this specification.

Except when the cementing materials are supplied blended, the supplementary cementing material shall be weighed separately from the cement. In the concrete materials weighing process the cement shall be weighed prior to the supplementary cementing material. Supplementary cementing materials may be weighed on the same scale with the cement.

**TS 1350.05.01.02   Aggregates**

Clause 1350.05.01.02 of OPSS.MUNI 1350 is amended by the deletion of the following:

The maximum nominal size of the aggregate shall not exceed 19.0 mm.

**TS 1350.05.02.04   Air Content**

Clause 1350.05.02.04 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

Air content on the job site shall be controlled according to CSA A23.1, clause 5.2.5.3.4.

**TS 1350.05.02.05   Slump or Slump Flow**

Clause 1350.05.02.05 of OPSS.MUNI 1350 is amended by the addition of the following paragraphs:

Under the performance specification alternative, addition of water on the job site according to CSA A23.1, clause 5.2.5.3.2 is at the discretion of the Contractor.

Under the prescriptive specification alternative, addition of water on the job site according to CSA A23.1, clause 5.2.5.3.2 is at the discretion of the City.

Section 1350.05 of OPSS.MUNI 1350 is amended by the addition of the following subsection:

**TS 1350.05.03   Other Materials**

**TS 1350.05.03.01   Steel Reinforcement for Concrete**

Steel reinforcement for concrete shall be according to OPSS 1440.

Submissions required by the Contract Administrator from the Contractor shall provide at least the following information:

1) The source of all reinforcing steel products and name of the reinforcing steel fabricator.
2) Three copies of the mill certificate and three copies of the stress-strain curves representative of each lot of material to be used for reinforcing steel.

**TS 1350.05.03.02 Curing Media**

Submissions required by the Contract Administrator from the Contractor shall provide at least the following information:

1) Curing plan requirements.

2) Allowable curing regimes according to CSA A23.1, Table 19.

3) Three copies of the manufacturer’s product installation and certification data.

All exposed concrete surfaces shall have the curing process commence as soon as possible and not more than 30 minutes after surface finishing or within one hour of form removal. Acceptable methods of curing include one or more of the following:

- Burlap cloth shall be made from jute or kenaf, and shall be according to OPSS 1306.

- Geotextile fabric shall be a synthetic, permeable textile shall be according to OPSS 1860. A minimum thickness of 0.9 mm is required geotextile fabric and water.

- White opaque polyethylene film shall be according to ASTM C 171. A minimum thickness of 6 mils is required.

- White pigmented curing compound shall be according to ASTM C 309 and OPSS 1315.

Each curing method may be used at ambient temperatures up to 28°C. At temperatures above 28°C, only the geotextile fabric and water procedure is recommended. At temperature below 5°C, curing compound is not recommended.

Concrete shall not be placed if rain is sufficiently intense to separate cement (paste) from the surface of the concrete mix or to hinder finishing operations. The surface of the concrete shall not be finished when water is present on the surface. Concrete already placed shall be protected against the effects of rain until the concrete has sufficiently hardened to resist damage.

The section of newly constructed concrete shall be closed to all vehicular traffic, including construction equipment, until such time as the concrete has attained at 20 MPa. Pedestrian traffic shall be kept off the newly constructed concrete for at least eight hours. The Contractor shall provide adequate measures to protect the newly constructed concrete section from damage by vehicular or pedestrian traffic.

**TS 1350.05.03.03 Joint Filler**

Expansion joint filler material shall be according to ASTM D 1751.

Submissions required from the Contractor shall provide at least the following information:
1) The source of the expansion filler material.

2) Three copies of the manufacturer’s product installation and certification data.

**TS 1350.05.03.04 Concrete Sealer**

The sealer shall be a two-coat colourless solution of methyl methacrylate copolymer resins, a penetrating agent and fast evaporating solvent with a minimum solids content of 20 per cent and containing no fillers. Application rates and solids content shall be according to certified test results on the NCHRP 244 test series to be submitted prior to construction for approval. Acceptable materials shall meet the following NCHRP 244 performance criteria:

1) Four Inch Cube Tests: 75 per cent effective in reducing water absorption when compared to an untreated control sample.

2) Southern Exposure Tests: 90 per cent effective in reducing chloride ion content when compared to an untreated control sample.

Submissions required from the Contractor shall provide at least the following information:

1) The source of the expansion concrete sealer.

2) Three copies of the manufacturer’s product installation and certification data.

3) Certification that the sealer meets or exceeds the requirements of NCHRP 244.

**TS 1350.07 PRODUCTION**

**TS 1350.07.02 Temperature Control**

Subsection 1350.07.02 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

When the air temperature is below 5°C or likely to fall below this limit within 24 hours of placing, or when the air temperature is at or above 27°C or is likely to rise above this limit during concrete placing, the Contractor shall comply with the requirements of OPSS 904.

**TS 1350.08 QUALITY ASSURANCE**

**TS 1350.08.02.01 General**

Clause 1350.08.02.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

Concrete compressive strength and proper curing, as specified in this specification, shall be the criteria for acceptance of non-structural concrete.

As requested by the City, the Contractor shall submit to the owner prior to the start of the project verification that the foreman, lead hand or the supervisor of the concrete placing crew has ACI Flatwork Certification or equivalent.
TS 1350.08.02.01.02 Quality Assurance Test Reporting

Sub-clause 1350.08.02.01.02 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

The concrete mix shall be sampled according to CSA A23.2–1C; the slump of the concrete shall be tested in accordance with CSA A23.2–5C; the air content of the concrete shall be tested according to CSA A23.2–4C; and the temperature of the concrete shall be tested in accordance with CSA A23.2-17C.

Concrete test reports shall be distributed immediately to the Owner, Contractor and concrete supplier by electronic files when available.

TS 1350.08.02.04.01 Compressive Strength

Sub-clause 1350.08.02.04.01 of OPSS.MUNI 1350 is amended by the addition of the following paragraph:

The compressive strength requirements for standard-cured cylinders shall be according to CSA A23.1 clause 4.4.6.6.1.2. The strength determination of test result shall be according to CSA A23.1 clause 4.4.6.4.1.

Section 1350.08 of OPSS.MUNI 1350 is amended by the addition of the following subsections:

TS 1350.08.03 Field Sampling and Testing of Concrete

Concrete field sampling for cylinders and testing of air, slump and temperature of plastic concrete shall be obtained directly from the load of concrete and tested according to CSA A23.2.

TS 1350.08.03.01 Frequency of Field Sampling and Testing

The concrete supplied shall be sampled for acceptance tests according to Table B and Table C.
Table B: Frequency of field sampling and testing of concrete

<table>
<thead>
<tr>
<th>Concrete for</th>
<th>Quantity m³</th>
<th>28-day cylinder</th>
<th>Field testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>abutments, catch basins, maintenance holes, columns, culverts, slabs, footings, foundations, piers, walls, curb and gutter, sidewalk, and forms</td>
<td>&lt; 100</td>
<td>3 sets /day</td>
<td>Air, slump and temperature tests shall be carried out when cylinders are cast, or as directed by the City.</td>
</tr>
<tr>
<td></td>
<td>100 - 500</td>
<td>2 sets/100 m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 500</td>
<td>1set/100 m³</td>
<td></td>
</tr>
<tr>
<td>decks</td>
<td>&lt; 100</td>
<td>3 sets /day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>100 - 500</td>
<td>2 sets/100 m³</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt; 500</td>
<td>1set/100 m³</td>
<td></td>
</tr>
<tr>
<td>decks overlay</td>
<td>- - -</td>
<td>3 sets /day</td>
<td></td>
</tr>
<tr>
<td>volume overlay</td>
<td>- - -</td>
<td>1 set /load</td>
<td></td>
</tr>
</tbody>
</table>

The following lot sizes for small quantity work relating to catch basins, maintenance holes, slabs, foundations, curb and gutter, sidewalk and fixed forms:

Table C: Small quantity lots frequency of field sampling and testing of concrete

<table>
<thead>
<tr>
<th>If quantity is . . .</th>
<th>Then sets per day required is . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 65 (m³)</td>
<td>2</td>
</tr>
<tr>
<td>less than 30 (m³)</td>
<td>1</td>
</tr>
</tbody>
</table>

OPSS.MUNI 1350 is amended by the addition of the following section:

**TS 1350.10 ACCEPTANCE**

**TS 1350.10.01 Compressive Strength Acceptance**

Acceptance of concrete strength for a lot shall be based on the compressive strength test results of a lot defined in subsection TS 1350.05.01 or as specified in the Contract Documents.

The Contract Administrator may determine the lot size after discussion with the Contractor before any concrete is placed, or according to the lot size as shown in subsection TS 1350.05.01, herein.

A concrete lot is deemed unacceptable if the concrete compressive strength does not meet all of the following:

1) The average of all groups of three consecutive compressive strength tests shall be equal to or greater than the specified strength.

2) No individual strength test shall be more than 3.5 MPa below the specified strength.
The Contractor is required to remove and replace all unacceptable lots at no extra cost to the City. All replacement lots shall be accepted on the same basis as the original lot.

**TS 1350.10.02 Small Lot Acceptance**

For the purpose of acceptance, the concrete within the track allowance shall be divided into lots of up to 100 linear metres or daily production, whichever is less.

Concrete used in this Contract shall be according to TS 1350, except that the acceptance requirements shall apply to all types of concrete and not just for 28-day strengths. For example, if 7-day concrete is requested, the acceptance of the appropriate item or Extra Work shall be based on amending TS 1350 and all other relative specifications to replace all instances of 28-day with 7-day.

A single cylinder test may be used to represent a sub lot under the following conditions:

- the second cylinder was damaged or determined to be unrepresentative; or
- the second cylinder was broken early or later; either in error or at the discretion of the Contract Administrator.
OPSS.MUNI 1350 is amended by the addition of the following section:

**TS 1350.11 PAYMENT AND WARRANTY**

**TS 1350.11.01 Small Lot Price Adjustment**

Price adjustments for 28-day concrete will be based on the following:

**Table D: Price adjustment for compressive strength 28-day concrete**

<table>
<thead>
<tr>
<th>Average tested compressive strength</th>
<th>Per cent payment of concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 3.5 MPa below specified compressive strength</td>
<td>(\frac{(Actual \Strength)^{2.5}}{(Specified \Strength)^{2.5}}\times100)</td>
</tr>
<tr>
<td>greater than 3.5 MPa below specified compressive strength</td>
<td>remove and replace at no extra cost to the City</td>
</tr>
</tbody>
</table>

Price adjustments for high early strength concrete will be non-payment for any and all premium costs or based on the following, whichever is greater:

**Table E: Price adjustment for high early strength concrete**

<table>
<thead>
<tr>
<th>Average tested high early compressive strength</th>
<th>Per cent payment of concrete</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 3.5 MPa below specified high early strength</td>
<td>(\frac{(Actual \Strength)^{2.5}}{(Specified \Strength)^{2.5}}\times100)</td>
</tr>
<tr>
<td>between 3.5 MPa and 7.0 MPa below specified high early strength</td>
<td>(\frac{(Actual \Strength)^{3}}{(Specified \Strength)^{3}}\times100)</td>
</tr>
<tr>
<td>greater than 7.0 MPa below specified high early strength</td>
<td>remove and replace at no extra cost to the City</td>
</tr>
</tbody>
</table>

Concrete that is to be removed and replaced at no extra cost to the City may be deemed usable if all of the following conditions are met:

- High early strength concrete meets the specified compressive strength within the next time constraint, for example 24 hour within 7 days, and 7 day within 28 days;
- The contract schedule did not incur any delays;
- The major interim schedules did not incur any delays, such as delays in opening the intersection to full operation;
- The public did not incur any delays, for instance delayed access to private property; and
- The concrete passes all other requirements.
In lieu of removing and replacing concrete that does not meet the compressive strength requirements, the Contract Administrator has the option to allow the usable concrete to be left in place. However, payment for the appropriate item or extra work related to the usable concrete shall be at 40 per cent of the bid cost for the entire contract item or no payment will be made for the concrete portion of the extra work performed, including all labour and Equipment that was used in the supply or placement of the concrete or both.

**Attachments**

The following two concrete mix design submissions form part of this specification:

1) Concrete Mix Design Submission Form A for Performance Specification Alternative
2) Concrete Mix Design Submission Form B for Prescriptive Specification Alternative
## Concrete Mix Design Submission (Form A)

### Project: ____________________________  Date: ____________________________

#### Contract No.: ____________________________  Contractor: ____________________________

#### Location: ____________________________  Concrete Supplier: ____________________________

#### Primary Plant  Back-up Plant  Name & Address: ____________________________  Name & Address: ____________________________

<table>
<thead>
<tr>
<th>Mix Code</th>
<th>Application / Element / Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Specifications

#### Structural Requirements
- CSA Exposure Class
- Maximum W/C Ratio
- Minimum Specified Strength, Mpa @ Days
- Nominal Maximum Aggregate Size, mm
- HVSCM Type 1 or 2
- Maximum Slag Replacement, %
- Maximum Fly Ash Replacement, %
- Plastic Air Content, %
- Slump Range, mm

#### Durability Requirements
- Exposure to Sulphate Attack
- Alkali Aggregate Reactivity

#### Architectural Requirements
- Colour / Texture
- Other

#### Contractor Requirements

<table>
<thead>
<tr>
<th>Rate (m³/h)</th>
<th>Quantity (m³)</th>
<th>Strength @ Age (MPa)</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Specialty Information</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Concrete Set (Delayed, Normal, Accelerated)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Method of Placement</th>
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</table>

### Materials Section

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<th>Material</th>
<th>Quantity</th>
<th>Type / Name &amp; Source</th>
<th>Inventory No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td>(kg/m³)</td>
<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>SCM - Slag</td>
<td>(kg/m³)</td>
<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>SCM - Fly Ash</td>
<td>(kg/m³)</td>
<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Water</td>
<td>(l/m³)</td>
<td>----------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Fine Aggregate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse Aggregate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A.E.A.</td>
<td>(ml/100 kg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W.R.</td>
<td>(ml/100 kg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.P.</td>
<td>(ml/100 kg)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Contractor's Representative submitting Form A:

| Print Name: ____________________________  Signature: ____________________________  Date: ____________________________ |
|----------------------------------------|----------------------------------|-----------------|

### Concrete Supplier's declaration to meet the above contract requirements:

| Print Name: ____________________________  Signature: ____________________________  Date: ____________________________ |
|----------------------------------------|----------------------------------|-----------------|

### Form A Reviewed by Contract Administrator:

| Print Name: ____________________________  Signature: ____________________________  Date: ____________________________ |
|----------------------------------------|----------------------------------|-----------------|

### Notes:

1) The "Concrete Supplier" provides the contractor a valid "Certificate of Concrete Production Facilities as issued by the RMCAO (copy available upon request).
2) Check www.rmcao.org for an updated list of certified concrete plants
3) The "Concrete Supplier" certifies that all materials incorporated in the mix design meet current CSA A22.1 requirements.
4) Concrete tests done according to CSA Standards shall not be accepted for any basis of measurement.

December 2007
# CONFIDENTIAL

CONCRETE MIX DESIGN SUBMISSION (FORM B)

<table>
<thead>
<tr>
<th>Project:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract No.:</td>
<td>Contractor:</td>
</tr>
<tr>
<td>Location:</td>
<td>Concrete Supplier:</td>
</tr>
<tr>
<td>Primary Plant</td>
<td>Back-up Plant</td>
</tr>
<tr>
<td>Name &amp; Address:</td>
<td>Name &amp; Address:</td>
</tr>
</tbody>
</table>

## Mix Code

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</thead>
</table>

## Structural Requirements

- CSA Exposure Class
- Maximum W/C Ratio
- Minimum Specified Strength, MPa @ Days
- Nominal Maximum Aggregate Size, mm
- H/V/C/N Type 1 or 2
- Maximum Slag Replacement, %
- Maximum Fly Ash Replacement, %
- Plastic Air Content, %
- Slump Range, mm

## Durability Requirements

- Exposure to Sulfate Attack
- Alkali Aggregate Reactivity

## Architectural Requirements

- Colour / Texture
- Other

## SPECIFICATIONS

<table>
<thead>
<tr>
<th>Rate, m³/h</th>
<th>Quantity, m³</th>
<th>Slump Range, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strength @ Age, MPa @ Days</td>
<td></td>
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<tr>
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## CONTRACTOR REQUIREMENTS

<table>
<thead>
<tr>
<th>Material</th>
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</tr>
<tr>
<td>S.P.</td>
<td>(mL/100 kg)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Form B submitted by: ____________________________
Print Name: ____________________________
Signature: ____________________________
Date: ____________________________

Form Reviewed by Contract Administrator:
Print Name: ____________________________
Signature: ____________________________
Date: ____________________________

Notes:

1) The "Concrete Supplier" provides to the contractor a valid "Certificate of Concrete Production Facilities" as issued by the CCAOS (copy available upon request).
   Check www.ccaos.org for an updated list of certified concrete plants.
2) The "Concrete Supplier" certifies that all materials incorporated in the mix designs meet current CSA A23.1 requirements.
3) Concrete not done according to CSA Standards shall not be accepted for any basis of measurement.
4) The Owner shall be responsible for performances "off the shelf" if the owner specifies any material proportion(s).
ONTARIO
PROVINCIAL
STANDARD
SPECIFICATION

MATERIAL SPECIFICATION FOR
CONCRETE - MATERIALS AND PRODUCTION

TABLE OF CONTENTS

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1350.02 REFERENCES
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1350.07 PRODUCTION
1350.08 QUALITY ASSURANCE
1350.09 OWNER PURCHASE OF MATERIAL - Not Used

APPENDICES

1350-A Commentary

1350.01 SCOPE

This specification covers the requirements for Materials; product supply pre-qualification; and mixing, transporting, and delivering concrete.

1350.01.01 Specification Significance and Use

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 according to the Contract Documents.
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.

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 904 Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1001 Aggregates - General
OPSS 1002 Aggregates - Concrete
OPSS 1302 Water

CSA Standards

A23.1-09 Concrete Materials and Methods of Concrete Construction *
A23.2-3C Making and Curing Concrete Compression and Flexural Test Specimens *
A23.2-4C Air Content of Plastic Concrete by the Pressure Method *
A23.2-5C Slump and Slump Flow of Concrete *
A23.2-6C Density, Yield, and Cementing Materials Factor of Plastic Concrete *
A23.2-8C Flexural Strength of Concrete (Using a Simple Beam with Third-Point Loading) *
A23.2-9C Compressive Strength of Cylindrical Concrete Specimens *
A23.2-10C Accelerating the Curing of Concrete Cylinders and Determining Their Compressive Strength *
A23.2-13C Splitting Tensile Strength of Cylindrical Concrete Specimens *
A283-00 (R2004) Qualification Code for Concrete Testing Laboratories
A3000-08 Cementitious Materials Compendium

* [Part of A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]
ASTM International

C 260-01 Standard Specification for Air-Entraining Admixtures for Concrete
C 457-06 Standard Test Method for Microscopical Determination of Air Void Content and Parameters of the Air Void System in Hardened Concrete
C 494/C 494M-05a Standard Specification for Chemical Admixtures for Concrete
C 1017/C 1017M-03 Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
C 1202-05 Standard Test Method for Electrical Indication of Concretes Ability to Resist Chloride Ion Penetration

Ready Mixed Concrete Association of Ontario Publications (RMCAO)

R1025 Certificate of Ready Mixed Concrete Production Facilities
R1026 Certificate of Mobile Mix Concrete Production Facilities

1350.03 DEFINITIONS

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

Agitator Truck means a vehicle in which freshly mixed concrete can be conveyed from the mixing site to the Work Area while being agitated. The containment vessel can either be stationary with an agitator or it can be mobile with a drum rotated continuously so as to agitate the concrete.

Cementing Material means hydraulic cement with or without a supplementary cementing material.

Confidentiality and Indemnity Agreement means a legal agreement between an Owner and the concrete supplier as obtained from the Municipal Engineers Association (MEA) or the Ready Mixed Concrete Association of Ontario (RMCAO).

Curing means the maintenance of a satisfactory moisture content and temperature in concrete for a period of time immediately following placing and finishing so that the desired concrete properties may develop.

High Volume Supplementary Cementing Materials (HVSCM) Concrete means concrete that contains a level of supplementary cementing materials above that typically used in construction.

Hot Weather means those conditions when the air temperature is at or above 28 °C. It is also considered to exist when the air temperature is likely to rise above 28 °C within 24 hours. Temperature refers to shade temperature.

Inspector means a representative of the Owner to which the concrete is being supplied.

Mobile Mix Concrete means concrete that is completely batched and mixed by a mobile mixer truck at the site.

Performance Criteria means requirements to be met as specified in the Contract Documents and as shown in form OPSF 1350-1 or OPSF 1350-2.

Portland Cement means the product obtained by pulverizing clinker consisting essentially of hydraulic calcium silicates to which calcium sulphate, limestone, water, and processing additions may be added at the option of the cement manufacturer.
Pre-Qualification Performance Criteria means requirements to be met as specified in the Contract Documents and as shown in form OPSF 1350-1 or OPSF 1350-2 and have been demonstrated through trial batches or concrete test data from a similar class of concrete as specified in the Trail Batch clause.

Ready Mixed Concrete means concrete that is completely batched at the plant and completely mixed at the plant or while in transit.

Self-Consolidating Concrete (SCC) means a highly flowable, yet stable concrete that can spread readily into place, fill the formwork, and, if applicable, encapsulate the reinforcement without any mechanical consolidation and without undergoing any significant separation of material constituents.

Stationary Mixer means a non-mobile mixer installed at a plant for the purpose of mixing concrete.

Supplementary Cementing Material (SCM) means material that, when used in conjunction with hydraulic cement, contributes to the properties of the hardened concrete through hydraulic or pozzolanic activity or both.

Truck Mixer means a concrete mixer mounted on a truck or other vehicle used for the complete mixing of concrete materials after they have been batched at the plant.

Water-to-Cementing Materials Ratio (W/CM) means the ratio by mass of the amount of water to the total amount of cementing material in a freshly mixed batch of concrete or mortar, stated as a decimal. The amount of water does not include that absorbed by the aggregate.

1350.04 DESIGN AND SUBMISSION REQUIREMENTS

1350.04.01 Design Requirements

1350.04.01.01 Mix Design Alterations

The Contractor may make minor alternations to the stated mix proportions in order to maintain compliance with the overall performance requirements as specified in the Contract Documents. Such deviations shall be according to CSA A23.1.

A minimum of 24 hours notice of deviations in the mix design that alter the sources of supply or the fundamental characteristics of the mix shall be given to the Owner by the Contractor. Resubmission of form OPSF 1350-1 and, if applicable, form OPSF 1350-2, shall be made for such deviations.

1350.04.02 Submission Requirements

Submissions for the performance or prescriptive specification alternative requirements shall be made based on the specification alternative as specified in the Contract Documents.

1350.04.02.01 Performance Specification Alternative

In the case of the performance specification alternative, the Contractor shall be solely responsible for the design of the concrete and to ensure that the requirements of CSA A23.1 and this specification have been met.

At least 14 Days prior to placing any concrete, the Contractor, in concert with the concrete supplier, shall:

a) Establish the concrete mix properties to meet performance criteria for plastic and hardened concrete, after considering the Contractor’s criteria for construction and placement and the Owner’s performance criteria.
b) Submit documentation demonstrating the Owner’s pre-qualification performance criteria can be met.

c) Prepare, submit, and implement a quality control plan to ensure that the Owner’s performance criteria can be met. When specified in the Contract Documents, submit documentation demonstrating that the Owner’s performance requirements have been met.

d) Ensure that the concrete supplier submits the following to the Contractor to forward to the Owner.

   i. Certification that the plant, equipment, and all materials to be used in the concrete comply with the requirements of this specification.
   ii. Certification that the mix design satisfies the requirements of this specification.
   iii. Certification that the production and delivery of concrete will meet the requirements of this specification.
   iv. Certification that the concrete complies with the specified performance criteria.

e) Provide documentation verifying that the concrete supplier’s plant and equipment meet the plant certification requirements of the RMCAO Approved Quality Program.

1350.04.02.01.01 Performance Based Concrete Mix Data

At least 2 weeks prior to the delivery of concrete, the Contractor shall submit to the Owner the attached form OPSF 1350-1 detailing the material and sources of materials to be used for each class of concrete. The form shall be completed for all concrete supplied to the project.

The quantity of chemical admixtures shall be at least the minimum dose specified in the Contract Documents. The Contractor may deviate from the specified minimum dose due to weather conditions and changes in materials. However, written notification of this change shall be provided to the Contract Administrator at least 24 hours prior to the delivery of the concrete by the Contractor.

1350.04.02.01.02 Mix Design Confidentiality and Indemnity Agreement

The Contractor shall ensure that the concrete supplier submits a confidential concrete mix design for the Contract to the Owner on the attached form OPSF 1350-2, when requested by the Contract Administrator, and only after a confidentiality agreement has been signed between the Owner and the concrete supplier.

At least 2 weeks prior to the placing of any concrete, the Owner and the concrete supplier shall execute a confidentiality agreement to cover the protection of proprietary mix proportion information that is to be released as part of form OPSF 1350-2.

1350.04.02.02 Prescriptive Specification Alternative

In the case of the prescriptive specification alternative, the Owner shall be solely responsible for the concrete mix design and to ensure that the requirements of CSA A23.1 and this specification have been met.

The Contractor, in concert with the concrete supplier, shall:

a) Plan the construction methods based on the Owner’s mix proportions and parameters.

b) Obtain approval from the Owner for any deviations from the specified mix design or parameters.

c) Identify to the Owner any anticipated problems or deficiencies with the mix parameters related to construction.
d) Provide verification that the plant, equipment, and materials to be used in the concrete comply with
the requirements of this standard.

e) Demonstrate that the concrete complies with the prescriptive criteria as supplied by the Owner.

1350.04.02.03 Ready Mixed Concrete Operation or Mobile Mix Concrete Operation

At least 1 week prior to the delivery of concrete to the Work Area, the Contractor shall submit to the
Owner a current valid Certificate of Ready Mixed Concrete Production Facilities or a current valid
Certificate of Mobile Mix Concrete Production Facilities for the plant being used to produce ready mixed
concrete, issued under the Approved Quality Program as outlined in the publications, Certificate of Ready
Mixed Concrete Production Facilities and Certificate of Mobile Mix Concrete Production Facilities.

1350.04.02.04 Concrete Delivery Ticket

The concrete supplier shall provide 2 copies of the delivery ticket to the Contractor immediately following
unloading at the Work Area. The Contractor shall provide one copy of each delivery ticket to the Owner
within 1 Business Day of completion of the placement. The concrete delivery ticket shall include:

a) Name and location of plant.

b) Date and serial number of the ticket.

c) Name of Contractor.

d) Specific designation of the job by name and location.

e) Specified class or designation of the concrete.

f) Volume of concrete.

g) Truck number and cumulative total or load number.

h) Time stamped when mixing of cement and aggregates commences.

i) Ordered slump or slump flow.

j) Time that the discharge of load was completed.

k) Amount of water added after batching, authorization, and units used.

l) Amount and type of admixtures added after batching.

1350.05 MATERIALS

1350.05.01 Materials for Concrete

1350.05.01.01 Cementing Materials

Cementing materials shall be according to CAN/CSA A3000.

Portland cement shall be used; however, a portion of it may be replaced by SCM. The SCM shall be
ground granulated blast furnace slag, fly ash, or silica fume or any combination of two or all of the
materials.
The mass of Portland cement and all SCMs contained in a concrete mix shall be specified on form OPSS 1350-2, if applicable. Furthermore, the Contractor shall disclose on form OPSS 1350-1 and, if applicable, form OPSS 1350-2, when the mix design is classified as a HVSCM as specified in CSA A23.1.

HVSCM 1 concrete shall only be used with prior written approval of the Owner.

Neither slag nor fly ash shall be used for lean concrete base, unless trial mix tests are performed and the results show that the performance requirements of the Owner have been met.

1350.05.01.02 Aggregates

Aggregates shall be according to OPSS 1001 and OPSS 1002.

The maximum nominal size of the aggregate shall not exceed 19.0 mm.

1350.05.01.03 Water

Water for concrete shall be according to OPSS 1302 and CSA A23.1, clause 4.2.2.

1350.05.01.04 Air Entraining and Chemical Admixtures

Air entraining chemical admixtures shall be according to the ASTM C 260.

Chemical admixtures shall be according to ASTM C 494M or when flowing concrete is specified, it shall be according to ASTM C 1017M.

The Contractor shall ensure that the chemical admixtures to be used are compatible with each other and that the performance of the concrete will not be negatively affected.

The Contractor shall use only chemical admixtures specified in the Contract Documents. Specialty chemical admixtures may be used when approved by the Owner.

1350.05.02 Performance Requirements for Concrete

1350.05.02.01 General

In instances where there are conflicts between this specification and other standards, the most stringent performance requirements shall apply.

1350.05.02.02 Exposure Classes of Concrete

Concrete having various exposure classifications shall meet the most stringent requirements of CSA A23.1, Tables 1, 2, and 3.

Classification A exposures do not apply to this specification.

1350.05.02.03 Compressive Strength

The concrete compressive strength shall be according to CSA A23.1, Tables 1, 2, and 3, and as specified in the Contract Documents.
1350.05.02.04 Air Content

The total air content of the concrete, measured with an air meter immediately prior to placing, shall be as shown in CSA A23.1, Table 4. Nominal maximum sizes of coarse aggregate shall be according to CSA A23.1, Table 4 (i.e., 10 mm, 14-20 mm, and 28-40 mm shall be 9.5 mm, 13.2-19.0 mm, and 28-40 mm, respectively).

Air content in hardened concrete shall meet the requirements of CSA A23.1, clauses 4.3.3.2 and 4.3.3.3, and the requirements as shown in Table 3 of this specification.

1350.05.02.05 Slump or Slump Flow

Slump or slump flow shall be consistent with the placement and consolidation methods, equipment, and site conditions.

Slump requirements shall be identified and reviewed by the Contractor and concrete supplier prior to construction. The tolerances for concrete slump acceptance and rejection in the Work Area shall be as follows:

a) Slumps less than 80 mm - the maximum allowable variation shall be ± 20 mm.

b) Slumps between 80 to 180 mm - the maximum allowable variation shall be ± 30 mm.

c) Slumps greater than 180 mm - the maximum allowable variation shall be ± 40 mm.

d) For SCC, the maximum allowable variation shall be ± 70 mm from the slump specified in the mix design.

Slump or slump flow shall be measured according to CSA A23.2-5C. Maximum slump for non-self-consolidating concrete shall be 240 mm, provided no segregation of the concrete occurs.

1350.05.02.06 Within Batch Uniformity of Concrete

If, in the opinion of the Contract Administrator, there is evidence of non-uniformity of the mixed concrete from a particular mixer, tests shall be carried out by the Contractor on 3 samples of concrete obtained from widely separate portions of the batch while the mixer is being completely emptied at normal operating rate to evaluate the mixing equipment.

Samples shall not be taken prior to 10% or after 90% of the batch has been discharged.

The minimum size of sample shall be 30 litres.

Between samples, the mixer shall not be allowed to turn in the mixing direction. Water shall not be added to the batch at any time after sampling has started.

The following criteria and that of CSA A23.1, Table 13, shall be used to judge whether or not the equipment under test is producing uniform concrete:

a) Where the result of each test is equal to or less than the acceptance limit, the concrete shall be considered uniform.

b) Where the result of any single test is greater than the rejection limit, the concrete shall be considered non-uniform.

c) If a test result falls between acceptance limit and rejection limit, additional tests shall be made on the next consecutive batch or load delivered by that unit.
If, after testing one additional batch or load, the test falls outside the acceptance limit, the equipment shall be rejected.

1350.06          EQUIPMENT

1350.06.01  Batching Plant

The batching plant and equipment shall be according to the certification requirements of the RMCAO.

The batching plant shall have direct communication with the placement operation.

1350.06.02  Mixing Equipment

All mixers shall be according to the certification requirements of RMCAO and shall be capable of discharging the concrete so that the uniformity requirements of CSA A23.1, Table 13, are met.

1350.06.03  Non-Agitating Delivery Equipment

The concrete containment area of non-agitating delivery equipment shall be a smooth watertight steel container equipped with gates that will permit control of the concrete discharge.

1350.07          PRODUCTION

1350.07.01  General

A manufacturer producing ready mixed concrete shall possess a current valid Certificate of Ready Mixed Concrete Production Facilities or a current valid Certificate of Mobile Mix Concrete Production Facilities for the plant being used to produce ready mixed concrete, issued under the Approved Quality Program as outlined in the publications, Certificate of Ready Mixed Concrete Production Facilities and Certificate of Mobile Mix Concrete Production Facilities.

The entire contents of the truck mixer shall be discharged prior to recharging. When any ingredient is added after initial batching, the volume of material in the drum shall not exceed the mixing capacity of the drum.

Proper facilities shall be provided to enable inspection of the quality of the materials used in the production of the concrete. The inspector shall be provided with all reasonable facilities for securing samples to determine whether the concrete and its materials are being supplied according to this specification. Owners wishing to obtain samples of the various raw materials from the concrete supplier shall provide advance notice to the concrete supplier and comply with all concrete supplier health and safety policies.

Where test results fail to meet the minimum requirements of this specification and the Owner and the concrete supplier have already executed a confidentially agreement, the Contractor shall ensure that the batch records retained by the concrete supplier under the Approved Quality Program shall be made available to the Owner within 5 Business Days of a written request. The Owner shall treat these records in the same manner as form OPSF 1350-2 and they shall remain the confidential information of the concrete supplier.

1350.07.02  Temperature Control

The concrete temperature at the time of discharge from the truck shall be between 10 and 28 °C.
1350.07.03  Records and Reporting

In addition to the batch records required to conform to the Approved Quality Program, the Contractor shall record the following information on the concrete delivery tickets, when applicable:

a) The method used to control the temperature of the concrete during hot weather conditions.

b) The method used to extend the discharge time of the concrete beyond 1.5 hours after introduction of the mix water during hot weather conditions.

c) The type and quantity of any materials added to the concrete after leaving the batch plan, and the time that each material was added.

1350.07.04  Concrete Strengths 35 MPa or Greater

1350.07.04.01  Trial Batch

The mix properties for concrete with strengths of 35 MPa or greater shall be confirmed by the performance of a trial batch. The trial batch shall confirm all the performance properties identified for a particular class of concrete in CSA A23.1, Table 2, through the following tests:

a) Slump.

b) Plastic air content.

c) Compressive strength.

d) Hardened Air Void System (AVS).

The testing of the field trial batch of concrete shall be the responsibility of the Contractor.

At least 30 Days prior to placing concrete with strengths of 35 MPa or greater, the Contractor shall mix a full size trial batch of concrete in the proportions stated in the mix design.

When the concrete is mixed within a truck mixer, the volume of the trial batch shall be the same as the volume of concrete normally mixed in the truck.

When the source of concrete is a ready mixed concrete plant, the trial batch of concrete shall originate from the primary plant to be used for the supply of the concrete and be delivered to the Work Area.

When the approved ready mixed concrete operation is currently supplying or has supplied a similar class of concrete within the last 6 months, permission may be given by the Owner to use concrete test data from that operation without the need for full size field trial batch, providing:

a) There is no change in the source of any material.

b) The performance characteristics of the aggregates have not changed significantly.

c) The concrete mix designated and previously used meets the specified performance requirements.

d) Documentation of this prior approval is submitted to the Owner.

1350.07.04.02  Early Compressive Strength Determination of Mix Design

When approved by the Owner, accelerated compressive strengths shown in Table 1 may be used to predict the 28-Day compressive strength of the proposed concrete mix.
The cylinders shall be tested according to CSA A23.2-10C using the autogenous curing test procedure.

1350.07.05  Ready Mixed Concrete

1350.07.05.01  Delivery of Ready Mixed Concrete

1350.07.05.01.01  General

The concrete shall be delivered to the Work Area without segregation in a thoroughly mixed and uniform mass and be discharged with the uniformity required in CSA A23.1, Table 13.

1350.07.05.01.02  Delivery by Non-Agitating Equipment

Concrete that is completely mixed in a stationary mixer may be transported in non-agitating equipment. Covers shall be used to provide protection to the concrete during inclement weather.

Discharge of concrete shall be completed within 30 minutes of the introduction of the mixing water to the cement and aggregates.

1350.07.05.01.03  Delivery by Agitator or Mixer Trucks

After completion of mixing, concrete shall be transported to the Work Area by means of agitator trucks or truck mixers. The equipment shall be operated at the agitation speed of rotation designated by the manufacturers of the truck.

Discharge of the concrete shall be completed within 90 minutes after the introduction of mixing water to the cement and aggregates. This time may be extended using a set retarder, provided the Owner approves such use.

1350.07.05.01.03.01  Site Addition of Materials

When a truck mixer is used at agitating capacity, no adjustment shall be made to the load of concrete.

In the case of the performance specification alternative, only the concrete supplier, in concert with the Contractor, shall undertake the site addition of materials to the mixer.

When the measured slump or slump flow of the concrete is less than that specified in the mix design, water may be added by the concrete supplier, in concert with the Contractor, to bring the concrete up to the designated slump or slump flow, provided the following criteria are met:

a)  The specified water-to-cementing materials ratio is not exceeded.

b)  No more than 60 minutes has elapsed from the time of batching.

c)  Addition of water is only at the start of discharge (i.e., not more than 10% of the concrete has been discharged).

d)  Not more than the lesser of 16 L/m^3 or 10% of the mixing water shall be added.

Air entraining admixture may be added to the load of concrete by the concrete supplier, in concert with the Contractor, prior to discharge, to increase the air content to that specified in the mix design. The use of detraining admixtures to lower the air content of concrete is prohibited.

When any material is added to the concrete, the concrete supplier shall thoroughly mix the load of concrete to meet the uniformity requirements of CSA A23.1, Table 13.
1350.08  QUALITY ASSURANCE

1350.08.01  General

The Owner shall be allowed access to all sampling locations and reserves the right to request a quality assurance (QA) sample at any time from the Contractor. The Contract Administrator may elect to carry out testing of the QA sample to ensure that material used in the Work is according to the requirements of this specification. Testing shall be carried out at a laboratory designated by the Owner. The Owner shall be responsible for all costs associated with QA testing.

Samples of aggregates, cementing materials, water, chemical admixtures, and air entraining admixtures representative of the materials to be used in the work shall be provided, when requested by the Owner.

1350.08.02  Sampling and Testing

1350.08.02.01  General

1350.08.02.01.01  Quality Assurance Testing Staff and Laboratory Requirements

Field sampling and testing of concrete shall be performed by a person holding either of the following certifications:

a) CSA Certified Concrete Testing Technician, Concrete Testing and Sampling Certificate, or

b) ACI Concrete Field Testing Technician - Grade 1.

This person shall have a valid original card issued by the certifying agency in his or her possession at all times.

Laboratory tests shall be completed by a laboratory certified according to CSA A283 for the category appropriate to the test required by CSA.

1350.08.02.02  Quality Assurance Test Reporting

Concrete test reports shall be immediately distributed electronically to the Owner, Contractor, and concrete supplier using CMATS™. The test results shall include the following information for each individual mix design:

a) Project identification.

b) A graphical representation of the specified and actual compressive strength data.

c) The average strength value for each age that the concrete is tested.

d) Average slump value for the mix design.

e) Average plastic air content for the mix design.

Testing shall be completed as shown in Table 2.

1350.08.02.02  Air Content in Hardened Concrete

The air void system in the hardened concrete may be performed on cast cylinder specimens. The air void system shall be tested according to ASTM C 457.
1350.08.02.03 Testing for Uniformity of Mixed Concrete

When required by the Owner, tests to determine the within-batch uniformity of mixed concrete shall be according to the Within Batch Uniformity of Concrete clause, except the acceptance and rejection limits for uniformity shall be according to CSA A23.1, Table 13.

1350.08.02.04 Strength Tests and Requirements

1350.08.02.04.01 Compressive Strength

For the purpose of concrete acceptance on the basis of concrete strength, cylinders shall be made and cured according to CSA A23.2-3C, under standard moisture and temperature conditions, and tested according to CSA A23.2-9C.

A compressive strength test result is the average strength of two standard 100 x 200 mm or 150 x 300 mm concrete cylinders that are representative of concrete taken from one batch of concrete.

To conform to the specified nominal minimum 28-Day compressive strength requirements:

a) The average of all groups of 3 consecutive strength tests shall be equal to or greater than the specified strength.

b) No individual strength test shall be more than 3.5 MPa below the specified strength.

1350.08.02.04.02 Flexural Strength

Concrete for pavement and base shall meet the requirements for compressive strength and also flexural strength as stated here. The minimum flexural strength shall be 3.8 MPa at 10 Days.

A flexural strength test is the average of 2 breaks on a standard beam test specimen that is representative of concrete taken from one batch of concrete.

Flexural strength test beams shall be made and cured according to CSA A23.2-3C, depending on the particular circumstances. The method of testing shall be according to CSA A23.2-8C.

Alternatively, a splitting tensile test may be carried out instead of the flexural strength test. One splitting tensile test shall be considered to be the average of 2 standard cylinders that are representative of concrete taken from one batch of concrete. The splitting tensile test cylinders shall be according to CSA A23.2-3C. The method of testing shall be according to CSA A23.2-13C. The minimum splitting tensile strength shall be 2.8 MPa at 10 Days.

To conform to the specified nominal minimum 10-Day strength requirements, the average of all sets of 3 consecutive strength tests shall be equal to or greater than the specified strength.
### TABLE 1
#### 2-Day Accelerated Compressive Strengths

<table>
<thead>
<tr>
<th>Minimum 28-Day Compressive Strengths MPa</th>
<th>Corresponding 2-Day Accelerated Compressive Strengths MPa</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>8.4</td>
</tr>
<tr>
<td>25</td>
<td>12.9</td>
</tr>
<tr>
<td>30</td>
<td>17.4</td>
</tr>
<tr>
<td>35</td>
<td>21.9</td>
</tr>
<tr>
<td>40</td>
<td>26.4</td>
</tr>
</tbody>
</table>

### TABLE 2
#### Quality Assurance Tests

<table>
<thead>
<tr>
<th>Required Test</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slump and Slump Flow of Concrete</td>
<td>CSA A23.2-5C</td>
</tr>
<tr>
<td>Air Content</td>
<td>CSA A23.2-4C</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>CSA A23.2-3C and CSA A23.2-9C</td>
</tr>
<tr>
<td>Accelerating the Cure of Concrete Cylinders and Determining Their Compressive Strength (Accelerated Cured)</td>
<td>CSA A23.2-10C</td>
</tr>
<tr>
<td>Yield</td>
<td>CSA A23.2-6C</td>
</tr>
<tr>
<td>Chloride Ion Penetrability Test</td>
<td>ASTM C 1202</td>
</tr>
<tr>
<td>Linear Shrinkage Test</td>
<td>ASTM C 157M (Note 1)</td>
</tr>
</tbody>
</table>

**Note:**
1. Drying shall commence after 7 Days of wet curing.

### TABLE 3
#### Hardened Concrete Air Void System Requirements

<table>
<thead>
<tr>
<th>Class of Exposure</th>
<th>Total Air Content %</th>
<th>Spacing Factor mm</th>
</tr>
</thead>
</table>
| C-XL, C1, C2, and F1 | 3.0 minimum | 0.230 maximum mean  
|                   |                     | 0.260 maximum individual |
| Concrete with water/cementing ratios of 0.36 or less | 3.0 minimum | 0.250 maximum mean  
|                   |                     | 0.300 maximum individual |
Concrete Mix Design Submission

Contract  ____________________________  Date Submitted  ____________________________
Location  ____________________________  Submitted To  ____________________________
Contractor  ____________________________  Contact  ____________________________
Batch Plants:  Primary  ____________________________  Secondary  ____________________________

Concrete Supplier:  Name  ____________________________
Address  ____________________________
City/Province  ____________________________
Telephone  ____________________________  Fax  ____________________________  Email  ____________________________

| MIX CODE |
| Application / Element / Location |
| Specification |
| Structural Requirements |
| - CSA Exposure Class |
| - Maximum W/CM |
| - Minimum Specified Strength, MPa @ Days |
| - Nominal Maximum Aggregate Size, mm |
| - HVSCM Type 1 or 2 |
| - Plastic Air Content, % |
| Durability Requirements |
| - Exposure to Sulphate Attack |
| - Alkali Aggregate Reactivity |
| Architectural Requirements |
| - Colour / Texture |
| - Other |

| Contractor Requirements |
| Rate, m³/h  | Quantity, m³  | Slump Range, mm  | Strength @ Age, MPa @ Days  | Other |
| Specialty Information |
| - Concrete Set, Delay, Normal, Accelerated |

| Materials Section |
| Material  | Source |
| Cement |
| SCM - Slag |
| SCM - _____ |
| Water |
| Fine Agg. |
| Coarse Agg. |
| A.E.A. |
| W.R. |
| S.P. |

Form Submitted By:
Print Name: ____________________________  Signature: ____________________________  Date: _____________

Contractor's Representative Receiving Form:
Print Name: ____________________________  Signature: ____________________________  Date: _____________

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CONFIDENTIAL - Concrete Mix Design Submission

Contract: ____________________________ Date Submitted: ____________________________
Location: ____________________________ Submitted To: ____________________________
Contractor: ____________________________ Contact: ____________________________
Batch Plants: Primary ____________________________ Secondary ____________________________
Concrete Supplier: Name: ____________________________
Address: ____________________________
City/Province: ____________________________
Telephone: ____________________________ Fax: ____________________________ Email: ____________________________

MIX CODE
Application / Element / Location

SPECIFICATION
Structural Requirements
- CSA Exposure Class
- Maximum W/CM
- Minimum Specified Strength, MPa @ Days
- Nominal Maximum Aggregate Size, mm
- HVSCM Type 1 or 2
- Plastic Air Content, %

Durability Requirements
- Exposure to Sulphate Attack
- Alkali Aggregate Reactivity

Architectural Requirements
- Colour / Texture
- Other

CONTRACTOR REQUIREMENTS
Rate, m³/h
Quantity, m³
Slump Range, mm
Strength @ Age, MPa @ Days
Other

Specialty Information
- Concrete Set, Delay, Normal, Accelerated

Method of Placement

MATERIALS SECTION
<table>
<thead>
<tr>
<th>Material</th>
<th>Source</th>
<th>Unit</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement</td>
<td></td>
<td>kg/m³</td>
<td></td>
</tr>
<tr>
<td>SCM - Slag</td>
<td></td>
<td>kg/m³</td>
<td></td>
</tr>
<tr>
<td>SCM - _____</td>
<td></td>
<td>kg/m³</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td>L/m³</td>
<td></td>
</tr>
<tr>
<td>Fine Agg.</td>
<td></td>
<td>mL/100 kg</td>
<td></td>
</tr>
<tr>
<td>Coarse Agg.</td>
<td></td>
<td>mL/100 kg</td>
<td></td>
</tr>
<tr>
<td>A.E.A.</td>
<td></td>
<td>mL/100 kg</td>
<td></td>
</tr>
<tr>
<td>W.R.</td>
<td></td>
<td>mL/100 kg</td>
<td></td>
</tr>
<tr>
<td>S.P.</td>
<td></td>
<td>mL/100 kg</td>
<td></td>
</tr>
</tbody>
</table>

Form Submitted By:
Print Name: ____________________________ Signature: ____________________________ Date: _____________

Municipal Representative Receiving Form:
Print Name: ____________________________ Signature: ____________________________ Date: _____________

OPSF 1350-2
Rev. Date: 11/2014 OPSS.MUNI 1350
Appendix 1350-A, November 2014
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

This specification is intended for use by municipalities requiring ready mixed concrete.

The designer should specify the following in the Contract Documents:

- The Owner’s choice of concrete specification alternatives, either Performance Specifications or Prescriptive Specifications. (1350.04.02)

- Minimum dose of chemical admixtures. (1350.04.02.01.01)

- Chemical admixtures. (1350.05.01.04)

The designer should determine if a quality control program is to be prepared and implemented. If so, the requirement for it should be specified in the Contract Documents. (1350.04.02.01)

The designer may consider the following and specify this requirement for air content in hardened concrete in the Contract Documents:

When the approved ready mixed concrete operation is currently supplying or has supplied a similar class of concrete within the last 6 months, permission may be given to waive this testing requirement, providing that:

a) There is no change in the source of any material.

b) The concrete mix designated and used previously meets the specified performance requirements.

c) Documentation of this prior approval is submitted to the Owner.

CSA A23.1, Table 5, lists the alternative methods for specifying concrete. The designer should review this table when determining which concrete specification alternative is to be used in the Contract. CSA A23.1, Annex J, discusses the selection of alternatives for specifying concrete requirements. These alternatives include:

**Performance** - When the Owner requires the concrete supplier to assume the responsibility for performance of the concrete as delivered and the Contractor to assume responsibility for the concrete in place.

For this alternative, the Owner should specify the following in the Contract Documents:

a) Required structural criteria including strength at age.

b) Required durability criteria including class of exposure.

c) Additional criteria for durability, volume stability, architectural requirements, sustainability, and any additional Owner performance, pre-qualification or verification criteria.
Appendix 1350-A

d) Quality management requirements.

e) Certification of the concrete supplier through the Approved Quality Program.

f) Any other properties that may be required to meet the Owner’s performance requirements.

**Prescriptive** - When the Owner assumes responsibility for the performance of the concrete.

For this alternative, the Owner should specify the following in the Contract Documents:

a) Mix proportions, including the quantities of any or all materials (admixtures, aggregates, cementing materials, and water) by mass per cubic metre of concrete;

b) The range of air content;

c) The slump range;

d) Use of a concrete quality plan, if required;

e) Other requirements.

CSA A23.1, Annex K, discusses concrete made with a high volume of supplementary concreting materials (HVSCM).

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

**Related Ontario Provincial Standards Drawings**

No information provided here.