

**Construction Specification for  
Keyhole Excavation and Permanent Reinstatement of Keyhole Cores****SCOPE**

This specification covers the requirements for keyhole coring, vacuum excavation, backfilling, and reinstatement of the keyhole core in pavements, sidewalks and other improved surfaces as a permanent repair within the City of Mississauga road allowance.

**Bonding Material for Keyhole Cores**

Bonding material shall be impervious to water penetration at the joint after application. The bonding material is required to securely bond the undamaged keyhole core to the pavement or sidewalk and to fill the annular space at the joint.

Specifications for the bonding material shall be submitted, upon request from the City, for review and approval before a bonding material is used. The specifications will include results of laboratory and field testing.

**Laboratory Testing of Bonding Material**

Summary of Tests:	ASTM C109 or C39
Compression Freeze /	ASTM 666A and 666B
Thaw Set Time	ASTM C266
Bond Strength using Slant Shear	ASTM C882
Thermal	ASTM C531
Expansion and Shrinkage	

***Field Testing of Bonding Material***

In testing, the bonding material shall, within 30 minutes at 21°C, reach an equivalent traffic loadable condition that is at a minimum two times greater than the AASHTO H-25 standard on simulated loading slabs prepared to yield a standard mix with a 28 day compressive strength of 35 MPa using 19 mm minus aggregates.

**Unshrinkable Fill as Backfill Material**

The materials for and the production of unshrinkable fill shall be according to OPSS 1359. Prior to the use of unshrinkable fill, upon request from the City, the Contractor shall provide documentation of compliance with the above requirements.

The supplied unshrinkable fill shall be tested and material that does not meet OPSS 1359 requirements shall be removed and replaced at the Applicant or its contractor's expense. All costs associated with the removal and replacement of deficient unshrinkable fill shall be borne by the Applicant or its contractor, including the cost of administration and retesting.

**Imported Granular as Backfill Material**

Granular material shall not be used for keyhole backfill; however, granular A according to OPSS 1010 may be used in lieu of unshrinkable fill in boulevards only where an exemption on the use of unshrinkable fill has been granted by the City.

## **CONSTRUCTION**

### **General**

All construction and maintenance work performed by the Applicant or its contractor using keyhole excavation method shall be carried out in such a manner that the pavement or sidewalk surfaces worked upon are restored and colour matched as close as possible to, if not better than, the original condition of the surface. Excess bonding material shall be removed from the restored surface. A "patched" appearance is visually unacceptable to the abutting properties, and efforts should be made to avoid this in surface restoration wherever possible.

### **Keyhole Coring**

Pavement and sidewalk cuts for vacuum excavation in keyhole coring shall not be greater than 460 mm in diameter. The surface cut by keyhole coring shall be restored to its original condition with the reinstated core flush with the existing surface, and with the structure of the restored surface matching existing concrete surfaces and asphaltic concrete surfaces.

In the event larger cores, up to 610 mm in diameter, or overlapping cores, or cores closer than one metre from each other, a joint or any longitudinal or transverse crack greater than 3 mm width may be allowed only with the prior approval of the City. The finished surface shall meet the requirements and performance measures, herein.

Cutting of existing pavements shall be performed with an approved keyhole-coring saw. The vertical alignment of the keyhole-coring saw shall be perpendicular to the horizon, and the cutting shall be extended to the full depth of the existing structure.

### ***Flexible Pavements***

Keyhole cores will not be permitted in flexible pavements where the asphaltic concrete is less than 100 mm thick. The Applicant or its contractor must demonstrate to the satisfaction of the City staff through a program of coring of the existing pavement that the pavement has a minimum of 100 mm thickness of asphaltic concrete. In addition, Keyhole cores should not be closer than one metre from each other, a joint or any longitudinal or transverse crack greater than 3 mm width.

### ***Composite Pavements***

Keyhole cores should not be closer than one metre from each other, a joint or any longitudinal or transverse crack greater than 3 mm width.

### ***Sidewalks and Other Hard Surfaces on Boulevard***

Keyholes should not be closer than 100 mm from a crack greater than 3 mm width, an expansion joint or the edge of sidewalk.

### **Backfilling**

Materials used in backfilling keyhole excavation shall be according to reference materials, herein.

The City's Road Classification System forms the basis for determining the type of backfilling required in keyhole excavation. Unshrinkable fill shall be used within the pavement portion of the road allowance of expressways, major arterial roads, minor arterial roads, collector roads and local roads. With the written permission of the City, Granular A may be used in lieu of unshrinkable fill in boulevards. If the excavation is less than 1.2m, compacted granular A will be used in place of unshrinkable fill.

Unshrinkable fill shall be used as the backfilling material on streets, alleys, and sidewalks if prior approval of other backfill materials is not approved. Unshrinkable fill should also be required where the City inspector determines that mechanical compaction devices are impractical or ineffective to adequately compact the backfill materials. The Applicant or its contractor shall bring the unshrinkable fill or other backfill, approved by the City, to a level 50 mm below the base of the pavement structure or to the base of the sidewalk using a vibrator as necessary. A 50 mm thick leveling course of pea gravel (½ inch) shall be placed on the unshrinkable fill when the unshrinkable fill has set. The pea gravel leveling course can be tamped by hand.

Unshrinkable fill shall be used in all cuts made on streets scheduled for reconstruction or resurfacing within the current construction season and when keyhole cores are defective or unusable.

#### **Permanent Surface Restoration with Keyhole Cores**

Where possible, the Applicant or its contractor must reinstate the keyhole core, complete with the bonding material immediately or within 24 hours of cutting the existing pavement unless special permission has been granted by the City inspector.

To ensure that the keyhole core is placed in the same orientation as originally constructed, the Contractor shall place a temporary mark such as paint or chalk to help align the keyhole core.

#### **Mitigation of Defective Keyhole Cores**

Where the keyhole core is found to be fractured or defective upon removal, or becomes damaged after removal and prior to reinstating the keyhole cuts, the defective or damaged core shall not be used to reinstate the pavement. A core that is fractured in the vertical plane is considered to be defective and shall not be used to reinstate the pavement. If another equivalent core of sound condition and matching existing pavement of the same diameter, depth and composition as the defective core is available, it may be reinstated in substitution of the defective core.

If the keyhole core is limited to the horizontal delamination of two or more successive layers of asphalt concrete, that core may not be considered to be defective if the layers are capable of being rebonded to each other with the bonding compound during reinstatement.

#### ***Temporary Reinstatement***

If the core is found to be defective, the pavement shall be temporary reinstated with

asphalt. Surface course should be placed and mechanically compacted in uniform lifts not exceeding 50 mm loose thickness with equipment suitable for such purpose.

Extra efforts will be required from the Applicant or its contractor to ensure a proper compaction at the joints between the existing pavement and new asphalt patch. The total thickness of the hot-mix asphalt shall match that of the existing roadway. All vertical and horizontal contact surfaces between the new and existing pavement shall be tack coated. Gaps between the existing and new asphalt must be sealed with hot rubberized asphalt.

### **Temporary Condition**

In the event when a keyhole cut cannot be reinstated within 24 hours of cutting, the opening shall be covered with an approved form of an appropriately-sized, circular steel road plate fitted with a collar that, when inserted into the keyhole, will prevent the hole cover from tipping, tilting, bouncing or spinning out of the hole in all kinds of the traffic conditions; or a counter-sunk steel plate set flush with the surface of the pavement and overlapping the cut by no less than 300 mm on all sides. The steel plate must have a non-skid surface and must provide a safe driving surface. This plate must be secured to the pavement and has sufficient thickness and strength to support the traffic without movement or bouncing. An asphalt mix shall be used to jam the plate into the pavement along all edges.

The use of steel plates will not be granted during the winter months, November 1 to April 30.

Permission must be sought from City staff before the cores are left on site. If the cores are left on site, they must be kept within the road allowance and away from the pavement and not obstructing pedestrian traffic. The cores must be stored in a safe and secure place on site for not more than 72 hours. After 72 hours, the cores must be removed and they should be stored elsewhere under the safe and secure custody of the Applicant or its contractor. The cores shall be made readily available for restoring the keyhole.

### **Management and Disposal of Excess Material**

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

The Applicant or its Contractor is required to remove all materials excavated by keyhole excavation off site at their expense.

### **Records**

The contractor shall maintain records containing the location and details of all keyhole core repairs. The records shall be made available to the City on request within 7 days.

The records shall be kept for submission to the City upon completion in a format that will allow the City to upload this information into a data base for future reference.

A location sketch of the keyhole core is required to illustrate the centre of the keyhole core referenced to two or more physical objects. The location sketch shall include ties of a horizontal distance taken from the curb line at right angles to the keyhole core, a horizontal distance measured from the centre of an identified manhole to the keyhole core, and/or a distance measured from the top of a hydrant (if in close proximity) to the keyhole core.

## **QUALITY ASSURANCE**

### **Surface Tolerance**

#### ***Pavements***

The reinstated core shall be flush and level with the adjacent pavement. No gap, attributable to the positioning of the core, should be found between the bottom of the straightedge and the surface of the pavement when a one metre long straightedge is placed in any direction on the surface of the keyhole cores, except across the crown or drainage gutters.

#### ***Sidewalks***

The reinstated core shall be flush and level with the adjacent pavement. No gap, attributable to the positioning of the core, shall be found between the bottom of the straightedge and the surface of the sidewalk when a one metre long straightedge is placed in any direction on the surface of the keyhole cores of the sidewalk.

### **Removal of Unacceptable Keyhole Cores**

All keyhole cores that are damaged or do not meet the surface tolerances shall be removed and reinstalled at the Applicant or its contractor's expense.

A keyhole core is considered unacceptable when one of the following conditions exist:

- a) The keyhole core contains any vertical cracks wider than 3 mm extending full depth or partial depth through the core; or
- b) Any deteriorated piece of the keyhole core is larger than 10 per cent of the overall area of the keyhole core

All unacceptable keyhole cores shall be removed, disposed of offsite, and a matching replacement core shall be installed or a temporary asphalt patch shall be constructed at the keyhole core location. The keyhole core repair work shall all be completed at the Applicant or its contractor's expense.

### **Warranty**

The Applicant will warrant the keyhole for 24 months and shall maintain a rigorous quality control and assurance programs such that each keyhole will be inspected and reported once every 12 months under contract warranty period.