

FINAL

# Construction Specifications for Keyhole Pavement Coring and Reinstatement



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## Table of Contents

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	Page
Table of Contents .....	iii
1. Scope .....	1
2. Definitions.....	1
3. References .....	2
4. Material.....	2
4.1 Supply of Materials .....	2
4.2 Bonding Material for Keyhole Cores: .....	2
4.3 Laboratory Testing of Bonding: .....	3
4.4 Performance Requirements for Bonding Material .....	3
4.5 Backfill Material.....	4
5. Construction .....	4
5.1 General .....	4
5.2 Keyhole Coring .....	4
5.3 Backfilling.....	5
5.4 Reinstatement of Keyhole Cores .....	5
5.5 Quality Control .....	5

## 1. Scope

Keyhole pavement coring procedure involves cutting a core in paved surfaces, removing it, vacuum excavating to expose the underground utilities, performing any necessary operation and maintenance activities, backfilling and reinstating the pavement core.

These specifications cover the requirements for coring and reinstatement of the keyhole cores in pavements, sidewalks and other paved surfaces as a permanent repair of pavement within the jurisdiction of the municipality or highway agency.

## 2. Definitions

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

- **Bonding Material:** cementitious, rapid hardening, high strength, asphalt (asphalt/concrete (AC)) and/or concrete repair material, used to bond the keyhole core to the pavement from which it was removed.
- **Composite Pavement:** A rigid pavement having an asphalt concrete (AC) surfacing layer over Portland Cement Concrete (PCC) base (with or without granular base/subbase). See also Rigid Pavement.
- **Controlled-Low Strength Material (CLSM) (Flowable fill):** A mixture of aggregates, cement, and water, with or without fly ash or air entrained agents. The mix self flows, compacts and hardens into a material with higher strength than soil but able to be excavated with hand tools after 28 days.
- **Flexible Pavement:** A roadway pavement consisting of a layer(s) of asphalt concrete (AC) placed over granular base and subbase.
- **Granular Backfill:** Acceptable fine and coarse aggregate for construction of base and subbase soil as per DOT specifications.
- **Keyhole Pavement Coring:** means the operation of cutting a small (typically 18 - 24-inches in diameter or less) circular hole through roadway pavement, sidewalk or other paved surface, using a coring device that is capable of adjustment to ensure that the core is cut in an alignment that is perpendicular in both planes to the horizon and not the paved surface, using a diamond tipped core saw, to allow the intact core of pavement to be removed so that the underlying base and subbase materials can be removed by water or air assisted vacuum excavation, to expose the buried infrastructure..
- **Keyhole Pavement Core Reinstatement:** means the permanent repair process whereby the AC or PCC sections, base, and subbase materials, which were removed during keyhole excavation, are reinstated or replaced to condition acceptable by the municipality or highway agency.

- **Rigid Pavement:** means a pavement having a Portland Cement Concrete (PCC) surface or composite structure (AC layer over PCC base) over granular base and/or granular subbase.
- **Roadway:** means the portion of the street designed, improved and ordinarily used by vehicle traffic.
- **Sidewalk:** means the part of a public street that is improved for the exclusive use of pedestrians.
- **Street:** means an open way that is improved for the use of vehicles, persons, or animals on land.
- **Utility:** means the underground facility owner/operator or their contractor(s).

### 3. References

*[Note: This section includes references of the City, State and Highway specifications relevant to this standard.]*

### 4. Material

#### 4.1 Supply of Materials

Unless otherwise specified, the Utility shall supply all materials necessary for the execution and completion of the work.

#### 4.2 Bonding Material for Keyhole Cores:

Bonding material when mixed with the appropriate quantity of water should flow easily up and around the reinserted core and, with no voids, completely fill the annular space around the core to achieve a waterproof, mechanical joint between the keyhole pavement core and the original slab of pavement from which it was originally extracted."

Bonding material shall be a packaged dry mix, non-shrinkable, and impervious to water penetration at the joint after application.

Specifications for the bonding material shall follow the performance requirement listed in this specification.

The material shall be placed in accordance to the manufacturers' recommendations. All mixing, handling and curing practices recommended by the manufacturer shall be followed and will be considered a part of these specifications.

4.3 Laboratory Testing of Bonding:

- 4.3.1 Specifications for Packaged, Dry, Rapid-Hardening Cementations Materials for Concrete Repairs- ASTM C928
- 4.3.2 Compression- ASTM C109 or C39
- 4.3.3 Freeze/Thaw - ASTM C666 Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
- 4.3.4 Set Time - ASTM C266 Standard Test Method for Setting a Hydraulic-Cement Paste by Gilmore Needles
- 4.3.5 Shear Strength (Slant Shear) - ASTM C882
- 4.3.6 Thermal Expansion and Shrinkage - ASTM C531

4.4 Performance Requirements for Bonding Material

- 4.4.1 The bonding material shall comply with the requirements of ASTM C928. In addition, the bonding material shall have the following bond strength characteristics of Table 1.

**Table-1 Minimum 1-day and 7-day bond strength**

	1 day	7 days
Bond Strength, Minimum (psi)	1500	2000

- 4.4.2 In addition, the bonding material shall, at a maximum of one hour at 50°F (10°C) carry an equivalent traffic loadable condition that is at a minimum greater than 2 times the half-axle load of the AASHTO standard 18-Kip Equivalent Single Axle Load (EASL) or AASHTO H-25 truck load.

For the AASHTO H-25 truck load, the minimum acceptable shear stress of the bonding material after one hour for an 18-inch diameter core is as shown in Table 2.

**Table-2 Minimum 1-hour bond strength for various core thicknesses**

Truck Type: H-25  
 Max Wheel Load: 10,000 lb  
 Core Diameter: 18 inches

Core Thickness (inch)	Shear Stress on 18-inch core (psi)
6	45
8	33
10	27
12	23
14	20

4.4.3 For pavement coring installations at temperatures below 50°F (10°C), extended curing time, or the use of additives or core heating procedures may be used to accelerate core setting duration. Contact bonding material manufacturers for recommendations on installations below 50°F (10°C).

#### 4.5 Backfill Material

The type and gradation of the granular backfill should be according to the construction specifications and provisions of the municipality or highway agency.

### **5. Construction**

#### 5.1 General

All work performed by the Utility using keyhole methods shall be carried out in such a manner that the pavement or sidewalk surfaces worked upon are restored and matched as close as possible to the original condition of the surface.

#### 5.2 Keyhole Pavement Coring

Cutting of existing pavements shall be performed with an appropriate 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 pavement structure.

Coring operator shall place a temporary mark (paint) on the pavement core and adjacent pavement prior to cutting to insure that the pavement core, when replaced, will have the same orientation as when it was first cut and removed.

Pavement cores shall be either removed from the work site or stored in a safe and secure on-site location until it is reused.

### 5.3 Backfilling

Proper backfilling and compaction is necessary in order to properly reinstate the pavement core and eliminate any future settlement. Backfilling and compaction shall be performed per the requirements of the municipality or highway agency where the work is being performed.

### 5.4 Reinstatement of Keyhole Pavement Cores

The pavement surface shall be restored to its original condition by setting the reinstated pavement core flush with and in its original orientation.

Bonding material meeting the requirements of Section 4 (Materials) shall be used for pavement core reinstatement. Excess bonding material shall be removed from the restored pavement surfaces.

A pavement 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 similar 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 pavement core is limited to the horizontal delimitation of two or more successive layers of pavement, that core may not be considered to be defective if the layers are capable of being re-bonded to each other with the bonding material during reinstatement.

In flexible pavements, where the pavement layer is less than 4 inch (100 mm) thick, bonding material may be used in filling of the keyhole to a depth equal to the thickness of the pavement layer, in lieu of reinstating the excavated core if the core is cracked, damaged, or deformed such that it is not practical to reinstate it. In this circumstance, the bonding material should satisfy the structural requirements of the original structure and match the color of the pavement.

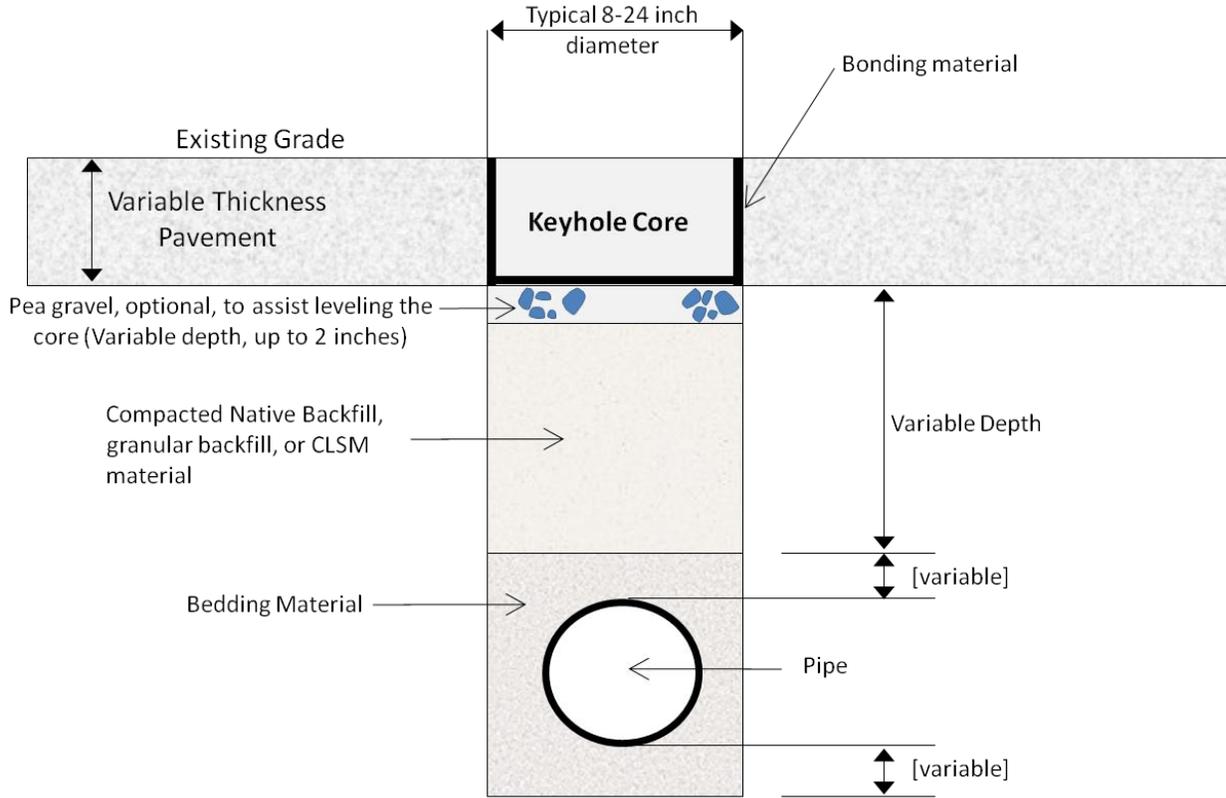
In the event that a keyhole cored pavement cannot be reinstated and will be left unattended, the opening shall be covered with an approved form of an appropriately-sized, circular steel road plate fitted with a collar that, when inserted into the keyhole, will prevent the hole cover from tipping, tilting, bouncing or spinning out of the hole in all types of the traffic conditions.

Figure 1 shows a view of the keyhole restoration scheme.

### 5.5 Quality Control

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 3 ft long straightedge is placed in

any direction on the surface of the keyhole pavement core, except across the crown or drainage gutters.



**Figure 1 - Schematic of the Keyhole restoration in pavement**

[End of Specifications]