SECTION 215

KEYHOLE POTHOLE EXCAVATION AND BACKFILL

DESCRIPTION

215.01.01 GENERAL

A. This specification covers the requirements for keyhole coring, vacuum excavation, backfilling, and reinstatement of the keyhole core in asphalt or concrete pavements to allow for underground utility repairs and underground potholing.

B. Quality control field inspection and testing requirements including frequency shall be in accordance with Contracting Agency requirements.

215.01.02 DEFINITIONS

A. **Keyhole coring:** The operation of coring a circular hole through the roadway pavement using diamond core drilling equipment,

MATERIALS

215.02.01 GENERAL

A. The material and placement requirements in the pipe zone and final backfill area shall be in accordance with Section 208,"Trench Excavation and Backfill".

B. Pavement keyhole cores removed shall either be removed from the work site or stored in a safe and secure on-site location. The cores shall be made readily available for restoring the pavement after backfilling is complete and approved.

C. **Bonding Agent:** The bonding agent shall be a single component cementitious, rapid hardening, high strength waterproof bonding agent conforming to the physical properties shown in Table 1.

1. The bonding material shall be impervious to water penetration at the joint after application.
2. The bonding materials shall securely bond the undamaged keyhole core to the pavement and shall completely fill the annular space at the joint.
3. The bonding materials shall within 30 minutes at an ambient temperature of 70 degrees Fahrenheit allow the core to support an equivalent traffic load condition of at least three (3) times the AASHTO H-25 standard.
4. The bonding material shall be Utilibond, manufactured by Utilicor Technologies Inc., or and Engineer approved equal.

NOTE: The report of the Regional Transportation Committee for Southern Nevada suggests that they would like to have at least two products that meet the specification. But subsequent inquiry by Officials indicated that only Utilibond met the requirements of overall strength and the strength gain time frame. The Standard provides for the substitution of an Engineer approved equivalent.

"Mr. Paul Judd, Regional Transportation Commission of Southern Nevada (RTC), explained that this item was a follow up to the prior agenda item. He went on to say that this particular item concerned the criteria for the materials and methods. He shared that the Utility Coordination Committee had made their approval conditional upon RTC staff members' attempts to find two sources of Utilibond to bond the keyhole back into the holes. He related that the RTC had conducted an industry-wide search and could not find a product with sheer strength equal to that of

Utilibond. He further noted that certain other products could achieve compressive strength equal to Utilibond, but not in the same time as Utilibond. Mr. Judd concluded his statement by stating that the RTC had listed Utilibond as the sole source and noting that the California Department of Transportation had a sole source for this particular keyhole application." RTC Report dated: 9/12/2010

Table 1

Bonding Material Properties

Property	ASTM Test Method	Requirements
Bond Strength (Slant Shear), **psi** (70 degrees F., 30 minute cure)	C882	200 min
Compressive Strength, psi (70 degrees F., 60 minute cure)	C109	1500 min

NOTE: The City of Toronto specification provides that In testing, the bonding material shall, within 30 minutes at 21ºC, reach an equivalent traffic loadable condition that is at a minimum two (2) times greater than the AASHTO H-25 standard (i.e. 30,000 lbs) on simulated loading slabs prepared to yield a standard mix with a 28 day compressive strength of 35 MPa using 19 mm minus aggregates. (This is similar to the MAG Standard but not as specific as the Nevada Standard.

CONSTRUCTION

215.03.01 POTHOLE EXCAVATION, GENERAL

A. The vertical alignment of the keyhole coring shall be perpendicular to the horizon, and the cutting shall extend to the full depth of the existing pavement section.

NOTE: This is important because the normal alignment of paved roads is not horizontal but varies up and down in a longitudinal direction according to the design Grade. Transversely, most roads are crowned or cambered from side to side to allow ground water to roll off. If the core is cut with a coring unit that is flat on the road surface, rather than plumb to the horizon, the Effect of Gravity can cause the core to bind up in the drum or, on reinstatement, can cause the bonding compound to migrate to the lowest side of the core and result in an imperfect bond. For this reason all standards require the use of coring equipment that can be adjusted to be perpendicular in both planes to the horizon.

B. Unless otherwise approved by the Engineer, keyhole cores shall not be greater than 24-inches in diameter. Adjacent cores shall not be closer than 3 feet from each other (edge to edge), shall not contain a joint or any pavement cracks greater than 1/8-inch wide, and shall not be performed in pavements where the section is less than 4-inches thick.

NOTE: Most jurisdictions allow overlapping cores to be cut if additional room or workspace is required to execute the underground task. This procedure results in the same perfect bond on reinstatement and avoids the need to bell out of the hole during vacuum excavation. The overlapping core also allows for better and more direct compaction and is supportive of the requirement that the zone of soil removal be in a vertical plane extending below the edges of the removed pavement.

C. Coring shall be performed with a keyhole coring saw.

D. The Contractor shall place a temporary mark on the keyhole core prior to cutting to insure that the removed section is replaced in the same orientation as originally found in the pavement.

E. Soils within potholes shall be removed by air/vacuum extraction methods to expose

utilities. The zone of soil removal shall remain essentially within a vertical plane extending below the edges of the removed pavement.

F. The contractor shall remove all materials excavated from the site.

215.03.02 POTHOLE BACKFILL AND COMPACTION

A. The backfilling of each zone shall be completed in accordance with Section 208, "Trench Excavation and Backfill." Unless otherwise approved by the Engineer, the backfill material shall be placed in maximum 10-inch loose lifts.

B. Backfill compaction quality shall be determined by use of a compression wave amplitude monitoring device manufactured specifically for the purpose of measuring soil compaction. This device shall measure the compression wave amplitude as compaction progresses using below-grade disposable piezoelectric transducer wave sensors and an above-grade electronic monitor. The device shall signal the operator of successful compaction when the compaction wave amplitude becomes asymptotic to continued compaction effort for each lift.

C. Backfill soil shall be placed with a moisture content within three percent of optimum moisture content. Moisture content shall be determined in accordance with AASHTO T217.

D. Place a disposable compaction sensor at the bottom of the first loose lift. A new sensor shall be placed for every 48-inches of compacted fill depth. Remove backfill soil and sensor if the disposable sensor fails during compaction and repeat repairs with a new sensor.

E. Mechanical compaction on each lift shall be continued until the electronic monitor signals that compaction is complete. A new lift shall not be placed until a positive signal has been received. Remove backfill soil and sensor if the monitor does not give a positive compaction signal after repeated compaction work.

215.03.03 PAVEMENT RESTORATION

A. The surface cut by keyhole coring restored to its original condition with the reinstated core flush with and in the original orientation as the existing surface matching existing pavement surface appearance,

B. Excess bonding material shall be removed from the restored surface. A patched appearance shall be avoided in surface restoration wherever possible.

C. Unless otherwise approved by the Engineer, the Contractor shall reinstate the bonded keyhole core within 24 hours of cutting the pavement. Openings allowed to be left open greater than 24 hours shall be covered with an approved steel road plate capable of supporting traffic loads, and in accordance with Subsection 208.03.21, "Cutting and Restoring Street Surfacing."

NOTE: One of the advantages of keyhole coring is its small size and uniform shape which allows an open core to be safely plated with a circular road plate that weighs less that 40 lbs. rather than the conventional rectangular road plate that can weigh more than 1000 lbs. Both the Toronto and MAG standards prescribe that if 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.

D. **Surface Tolerances:** The reinstated core shall be flush and level with the adjacent pavement. Gaps attributable to the positioning of the core shall be less than 1/16-inch

between the bottom of a minimum 3-foot long straightedge and the surface of the pavement in any direction of the surface of the keyhole core.

215.08.04 DEFICIENCIES

A. Where the keyhole core is found to be fractured or defective upon removal, or becomes damaged after removal and prior to reinstatement, the core shall not be used to restore the pavement. The pavement at damaged keyhole core locations shall be cut and a permanent patch shall be installed in accordance with Subsection 208.03.21, "Cutting and Restoring Street Surfacing."

NOTE: Both the MAG and Toronto Standards take advantage of the uniform diameter of the keyhole core to allow for the replacement of a defective core with another equivalent core of sound condition that matches the existing pavement in the same diameter, depth and composition as the defective core. This replacement or spare core can be sourced from a stockpile of cores cut and not reinstated or from spare cores specifically cut from other larger excavation sites before they are excavated. It results in a better performing restoration and pavement match than a conventional permanent pavement patch of new asphalt.

B. A keyhole core shall be considered unacceptable when one of the following conditions exist:

   1. The keyhole core contains any vertical cracks wider than 1/8-inch extending full depth through the core; or

   2. Any deteriorated piece of the keyhole core is larger than ten percent of the overall area of the core; or

   3. Two or more successive layers of pavement in the keyhole core become horizontally delaminated and cannot be re-bonded to each other with the bonding material.

C. All keyhole cores that are damaged or do not meet the surface tolerances shall be removed, and the Contractor shall cut and install a permanent patch in accordance with Subsection 208.03.21, "Cutting and Restoring Street Surfacing."

METHOD OF MEASUREMENT

215.04.01 MEASUREMENT

A. Unless otherwise specified, the quantity of Keyhole Core repair will not be measured for payment but shall be considered incidental to other items of work.

BASIS OF PAYMENT

215.05.01 PAYMENT

A. Payment for Keyhole Core Repair will be made only when required in the Special Provisions.