

**ALBERTA TRANSPORTATION**  
**TECHNICAL STANDARDS BRANCH**

**BT006 – JANUARY 2013**

**TEST PROCEDURE FOR MEASURING LENGTH CHANGE OF  
BRIDGE CONCRETE PATCHING MATERIAL**

**SCOPE -** The test procedure outlines the steps required to evaluate the length change characteristics of materials used as patching materials in accordance with Alberta Transportation Specification [B391](#). The test procedure is based on the ASTM Test Method C157, which has been modified to evaluate specific Alberta Transportation criteria.

**1.0 GENERAL**

Patching materials are frequently used by Alberta Transportation to repair bridge concrete. Alberta Transportation has recognized that excessive shrinkage or expansion of the patching materials had an adverse influence on the expected service life of the patch. It has also been recognized that a significant proportion of the volume change occurs at a relatively early age, and that curing conditions have a significant impact on the amount of change. The test method was developed by Alberta Transportation to measure length changes at realistic ages and under curing conditions which reflect expected ambient conditions. Samples are restrained from expanding during the initial 24 hours prior to de-moulding. Samples are free to shrink while still in the moulds, but after set has occurred.

**1.1 REFERENCE DOCUMENTS**

- ASTM C157, "Standard Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete"
- ASTM C490, "Specification for Apparatus for Use in Measurement of Length change of Hardened Cement Paste, Mortar and Concrete"
- [B391](#) "Specification for Bridge Concrete Patching Materials"

**2.0 PROCEDURE FOR MEASURING LINEAR SHRINKAGE**

**2.1 MOULDS**

Moulds for casting the test specimen shall be rigid, non-yielding metal, which is not readily attacked by the patching material. The dimensions of the mould shall conform to those detailed in ASTM C490. The moulds shall be equipped to hold suitable gage studs in place during setting of the mortar specimen. The gage studs shall be stainless steel metal or other metal resistant to attack from the concrete. Both interior and exterior faces of the gage stud shall be suitable to make gage length determinations with the accuracy described in Section 2.2.

The stud shall be partially threaded into an end spacer and held in place by a gage stud spacer screw, which is threaded from the opposite side of the end spacer. The gage stud spacer screws shall extend through unthreaded holes in the end plates, which do not inhibit movement of the screws. A hex nut on the gage stud spacer screw shall tighten the attached spacer plate to the end plate. The moulds shall be constructed such that by releasing the gage stud spacer screws attaching the spacer to the end plate, the spacer and gage stud become free to move horizontally toward the centre.

## **2.2 DETERMINATION OF GAGE LENGTH**

Prior to casting, determine the gage length to an accuracy of 0.0025 mm. The gage length shall be the dimension between the interior faces of the gage studs and is referred to as "A" measurement in this document. The moulds shall have a gage length of 250 mm  $\pm$  2.5 mm. The gage length "A" shall be determined with a suitable measuring device capable of the required accuracy. Alternatively, the gage length can be established by use of a standardized reference bar as shown in the attached Figure 1. Using the threading action of the gage studs, the gage length is adjusted until the gage length contacts the ends of the reference bar. The gage length is now the length of the reference bar. The reference bar shall conform to the requirements of the reference bar specified in ASTM C490 for checking the comparator-measuring device with the exception that the length of the bar must correspond to the gage length. The length of the reference bar must be determined to the required accuracy.

Measurements of the hardened concrete specimens will involve measuring the length between the outer ends of the gage studs, which will be referenced to as "A" measurements in this document. To compare the measurements to gage length ("A" measurements) will require determining the length of the gage studs prior to casting the specimens. The length of the studs can be determined with a suitable micrometer with an accuracy of 0.0025 mm.

In the event that the 24 hour length exceeds the gage length, A, which indicates initial expansion, the length will be monitored to determine when expansion has terminated. This length will be considered a gauge length for the purpose of future shrinkage measurements.

## **2.3 PREPARATION OF MOULDS**

Prior to casting, the inside surfaces of the mould must be sealed to prevent loss of moisture and to aid in removal of the specimens. The sides should be sheathed with a thin polyethylene sheet or suitable sealant, which will not affect the dimensions or properties of the patching material.

## 2.4 MIX PROPORTIONS AND MIXING REQUIREMENTS

Patching materials shall be proportioned and mixed in strict accordance with manufacturer's recommendations. Unless specified otherwise by the manufacturer, mixing shall be performed in accordance with the procedures in Alberta Transportation Specification [B391](#) and ASTM C157.

## 2.5 MOULDING OF SPECIMEN

Mould the specimens in accordance with the procedures specified in ASTM C157. The test specimens shall be 75x75x285 mm regardless if the material is neat or extended with aggregate. As soon as practical after the final set has occurred in the test specimens, release the hex nuts holding the gage stud spacers. At an age of 24 hours, de-mould the specimens and remove the spacer plates from the gage studs.

## 2.6 CURING OF SPECIMENS

Curing of specimens shall be conducted under two regimes to evaluate length change.

1. Standard Curing - One set of three specimens shall be cast and cured at 50% Relative Humidity and 23°C ( $\pm 1^\circ\text{C}$ ). Neither the exposed surfaces nor the moulds holding the samples shall be covered during this period.
2. Manufacturer's Curing\* - A second set of three specimens shall be cured for the first 24 hours after casting at 23°C ( $\pm 1^\circ\text{C}$ ) using wet burlap, plastic covers, water spray in a moist room.

Alternatively, at the direction of the manufacturer, a curing compound meeting the requirements of ASTM C309 or C1315 may be applied after casting of specimens. OH-V products may only consist of application of a curing compound for the manufacturer's curing regime.

3. Moisture Expansion – A third set of three specimens shall be cured in saturated lime water after demoulding at 24 hrs ( $\pm 0.5$  hr).

\*The manufacturer's curing regime may be omitted when wet curing or application of a curing compound is not recommended by the manufacturer.

## 2.7 DETERMINING LENGTH CHANGE

After de-moulding, determine specimen length at ages of 1 day  $\pm 1$  hr, 3 days  $\pm 4$  hrs, 7 days  $\pm 8$  hrs, 28 days  $\pm 12$  hrs, 56 days  $\pm 12$  hrs, 90 days  $\pm 12$  hrs in accordance with procedures detailed in ASTM C157. Calculate the length change by subtracting the length of the gage studs from the specimen lengths, and referencing the length to the initial gage length as determined in Section 2.2.

For initially expansive products, reference all shrinkage measurements to the maximum expanded length.

Moisture expansion shall be recorded after demoulding at 1 day  $\pm$  1 hr, 3 days  $\pm$  4 hrs, 7 days  $\pm$  8 hrs, 28 days  $\pm$  12 hrs, 56 days  $\pm$  12 hrs, and 90 days  $\pm$  12 hrs.

## **2.8 TEST REPORT**

For each patching material mix, a report shall be prepared that summarizes the results of the tests. The report shall include the following information:

1. Product and Manufacturer's name
2. Identification as mortar or concrete specimens, number of specimens, and date moulded,
3. A summary of the manufacturer's recommendations for the use, mixing, placing and curing of the patching material
4. Size of specimens.
5. Flow or slump and mix temperature.
6. Description of consolidation of material, specifying whether external rodding or vibration was used.
7. Conditions and periods of curing, including temperature and humidity.
8. Conditions and periods of storage including temperature and humidity.
9. Percent length change of specimens at ages of 1, 3, 7, 28, 56, and 90 days, based on the gage length at time of casting or when expansion has terminated, whichever is larger.