



REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
MANILA

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DEPARTMENT ORDER)

NO. **106**)
Series of 2015)

**SUBJECT: DPWH Standard Specification for
Item 740 - Structural Concrete
Injection and Crack Repair**

In line with the mandate of the Department in providing effective standard specifications in the implementation of various infrastructure projects and in view of the need of setting a standard specification for Structural Concrete Injection and Crack Repair, the attached **DPWH Standard Specification for Item 740 - Structural Concrete Injection and Crack Repair** is hereby prescribed, for the guidance and compliance of all concerned.

This specification shall form part of the revised edition of the DPWH Standard Specifications for Highways, Bridges and Airports, (Volume II).

This Order shall take effect immediately.


ROGELIO L. SINGSON
Secretary

Department of Public Works and Highways
Office of the Secretary

5.5.2 FET/JFS



**DPWH STANDARD SPECIFICATIONS FOR
ITEM 740 – STRUCTURAL CONCRETE INJECTION AND CRACK REPAIR**

740.01 Description

This item shall consist of repairing cracks in concrete structures by pressurized injection of epoxy into the cracks in accordance with these Specifications and as indicated on the Plans.

740.02 Material Requirements

740.02.1 Epoxy Resin Adhesives

Epoxy resin adhesives shall conform to the requirements of AASHTO M 235 as to type, grade, class and color.

740.02.2 Polymer Concrete and Mortar

Polymer binder and fine aggregate shall be in the proportions to meet a minimum compressive strength of 25 MPa in 4 hours.

a. Epoxy Mortar

Epoxy mortar shall conform to the requirements of ACI 503.4.

b. Other Polymer Concrete or Mortar

Other polymer concrete or mortar shall conform to the requirements of ASTM C1438, Type II- For general use.

740.03 Construction Requirements

740.03.1 Crack Preparation prior to repair

The Engineer shall be notified at least 10 days prior to crack preparation. The Engineer shall identify work areas and shall mark the cracks to be repaired.

The following shall be submitted for approval three (3) days before the work commences:

- (a) Personnel qualifications;
- (b) Description of the material to be used including the properties of each material and the specifications to which the material comply.

Dirt, laitance, and other debris from the exterior and interior of the crack shall be removed. Prior to the application of the epoxy material, cracks should therefore be thoroughly cleaned and dried by either high-pressure air blasting or hot air blasting using heated lance, when warranted, to eliminate the presence of contaminants (silt, water, oil,

dirt, etc.) that would be detrimental to the strength of the bond. Use of acids and other corrosive agents should not be used in cleaning cracks. Surfaces adjacent to the cracks shall likewise be cleaned. A temporary surface seal material with sufficient strength and adhesion

be applied to the face of the crack to confine the injected epoxy and to keep the epoxy from leaking out before it has gelled. After the injected epoxy has cured, the temporary seal material should be removed by grinding or other appropriate means.

Openings (entry ports) shall be provided in the surface seal along the crack. The distance between entry ports shall be at least the thickness of the concrete member being repaired.

740.03.2 Injection Procedure

Epoxy Injection is used on horizontal, vertical and overhead cracks where conventional methods of repair cannot penetrate and deliver the specific repair product onto the crack. When structural repair is required, the cause/s of the cracks should be determined and corrected prior to proceeding with epoxy injection. Cracks cause by corroding reinforcing steel should not be repaired by epoxy injection since continuing corrosion will cause new cracks to appear.

The epoxy resin adhesive component mix ratio shall be maintained within five percent (5%) by volume or as prescribed by the Engineer. Solvents shall not be used to thin the epoxy.

Positive inline displacement type equipment shall be used to measure, mix, and inject the epoxy at pressures not to exceed 1,380 KPa. Epoxy injection shall begin at the lowest entry port. Injection at the first port shall be continued until epoxy flows from the next highest port. The first port shall then be plugged and then inject epoxy into the second port until epoxy flows from the next highest port. This sequence shall be continued until the entire crack is filled.

The following tests shall be performed for each injection unit at the beginning and at the end of each day the unit is used.

a. Ratio Check Test

Disconnect the mixing head of the injection equipment. Pump the two adhesive components through a ratio check device having two independent valved nozzles capable of controlling the flow rate and back pressure by opening or closing the valves. Use a pressure gauge capable of sensing back pressure behind each valve. Adjust the discharge pressure to 1,380 KPa for both epoxy components. Simultaneously discharge both epoxy components into separate calibrated containers. Compare the discharged quantities to determine the mix ratio.

After the test is completed at 1,380 KPa discharge pressure, repeat the procedures for 0 KPa discharge pressure.

b. Pressure Check test

Disconnect the mixing head of the injection equipment. Attach the two adhesive component delivery lines to a pressure check device having two independent valved nozzles capable of controlling the flow rate and pressure by opening or closing the valves. Use a pressure gauge capable of sensing the pressure build-up behind each valve. Close the valves on the pressure-check device and operate the equipment until the gauge pressure on each line reads 1,380 KPa. Stop the pumps and check that the gauge pressure does not drop below 1,310 KPa within 3 minutes.

c. Records

Complete and accurate records of the ratio and pressure check tests shall be maintained and made available. Additional ratio and pressure check tests may be required.

740.03.3 Coring

One 50 mm diameter test core shall be taken according to AASHTO T 24 for every 15 m of repaired crack at designated locations. Crack repair shall be acceptable when the epoxy bonding has penetrated at least ninety percent (90%) of the crack volume within the core sample.

When a test core is unacceptable, redo the 15 m crack segment or the segment that the core represents and resample. This procedure shall be repeated until acceptable crack repair is achieved.

740.03.4 Finishing

The surface seal shall be removed and sample core holes shall be filled with polymer concrete and mortar. The face of the crack, the entry ports, and the core holes flush with the adjacent surface shall be finished to match the adjacent concrete, of which the surface shall also be finished

740.03.5 Traffic Control

Traffic control shall be provided to slow the traffic to a maximum speed of 25 kilometers per hour.

Traffic control shall be provided prior to the application of epoxy paste surface seal. The traffic control shall not be removed within 6 hrs from the completion of the crack injection work or until the injected epoxy resin adhesive has reached a compressive strength of at least 10 Mpa.

For bridge deck repairs, traffic shall be staged so that the edge of the nearest travel lane is no closer than the center of the adjacent girder, unless specified in the contract.

740.03.6 Acceptance

Sampling, testing and acceptance of the epoxy resin adhesives shall conform to Table 740.

Material for structural concrete injection and crack repair shall be evaluated by visual inspection and certification from a manufacturer or an effective testing and inspection system. Structural concrete injection and crack repair works shall be evaluated by visual inspection and coring.

Table 740 - Sampling, Testing, and Acceptance Requirements

Material or Product (Subsection)	Characteristic	Test Methods Specifications	Sampling Frequency	Point of Sampling	Reporting Time
Daily Start –Up and Shutdown Testing					
Epoxy resin adhesive	Ratio check	Subsection 740.03.2(a)	Daily before starting work and after ending work	Injection unit	Subsection 740.03.2(c)
Epoxy resin adhesive	Pressure check	Subsection 740.03.2(b)	Daily before starting work and after ending work	Injection unit	Subsection 740.03.2(c)
Production					
Epoxy resin adhesive	Penetration of material into crack	Coring	1 core for every 15 meters of repaired crack length	In-place after epoxy resin injection completed	Upon completion of test

740.04 Method of Measurement

The quantity to be paid for shall be based on the number of liters of epoxy resin adhesive component in prescribed proportion of 5% per volume, estimated to be used, including other materials. Although the unit of measurement is in lump sum, it is mandatory to show the derivation of the lump sum cost.

740.05 Basis of Payment

The accepted works, as prescribed in Section 740.04, Method of Measurement, shall be paid for at the contract unit price for Structural Concrete Injection and Crack Repair, which payment shall be the full compensation for crack preparation, furnishing all materials, pressure injection machine, finishing, facilitating and controlling traffic, and for furnishing all labor, equipment, tools and incidentals necessary to complete the work item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
740	Structural Concrete Injection and Crack Repair	Lump sum

References:

1. *Standard Specifications for Construction of Roads and Bridges on Federal Highways Projects (Federal Project 2014)*, U.S. Department of Transportation, Federal Highway Administration
2. *American Society for Testing and Materials (ASTM)*
3. *American Association of State Highway and Transportation Officials (AASHTO)*
4. *Structural Crack Repair by Epoxy Injection, ACI RAP Bulletin 1*, American Concrete Institute
5. *Sika Injection Systems for Concrete Structures*
6. *Chemicals for Concrete Construction, Unitex*
7. *Epoxy Injection of Concrete and Wood, Epoxy.com*
8. *Methods of Concrete Crack Repair, The Constructor, Civil Engineering Home*