

An ACI Standard

Specification for Crack Repair by Epoxy Injection

Reported by ACI Committee 548

ACI 548.15-20



Specification for Crack Repair by Epoxy Injection

Copyright by the American Concrete Institute, Farmington Hills, MI. All rights reserved. This material may not be reproduced or copied, in whole or part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of ACI.

The technical committees responsible for ACI committee reports and standards strive to avoid ambiguities, omissions, and errors in these documents. In spite of these efforts, the users of ACI documents occasionally find information or requirements that may be subject to more than one interpretation or may be incomplete or incorrect. Users who have suggestions for the improvement of ACI documents are requested to contact ACI via the errata website at <http://concrete.org/Publications/DocumentErrata.aspx>. Proper use of this document includes periodically checking for errata for the most up-to-date revisions.

ACI committee documents are intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. Individuals who use this publication in any way assume all risk and accept total responsibility for the application and use of this information.

All information in this publication is provided “as is” without warranty of any kind, either express or implied, including but not limited to, the implied warranties of merchantability, fitness for a particular purpose or non-infringement.

ACI and its members disclaim liability for damages of any kind, including any special, indirect, incidental, or consequential damages, including without limitation, lost revenues or lost profits, which may result from the use of this publication.

It is the responsibility of the user of this document to establish health and safety practices appropriate to the specific circumstances involved with its use. ACI does not make any representations with regard to health and safety issues and the use of this document. The user must determine the applicability of all regulatory limitations before applying the document and must comply with all applicable laws and regulations, including but not limited to, United States Occupational Safety and Health Administration (OSHA) health and safety standards.

Participation by governmental representatives in the work of the American Concrete Institute and in the development of Institute standards does not constitute governmental endorsement of ACI or the standards that it develops.

Order information: ACI documents are available in print, by download, through electronic subscription, or reprint, and may be obtained by contacting ACI.

ACI codes, specifications, and practices are made available in the ACI Collection of Concrete Codes, Specifications, and Practices. The online subscription to the ACI Collection is always updated, and includes current and historical versions of ACI’s codes and specifications (in both inch-pound and SI units) plus new titles as they are published. The ACI Collection is also available as an eight-volume set of books and a USB drive.

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331
Phone: +1.248.848.3700
Fax: +1.248.848.3701

Specification for Crack Repair by Epoxy Injection

An ACI Standard

Reported by ACI Committee 548

Mahmoud M. Reda Taha, Chair

Ashraf I. Ahmed
Mohammad A. Alhassan
Jacques A. Bertrand
Constantin Bodea
Chris Davis
Don Edwards

David W. Fowler
Quentin L. Hibben
Albert O. Kaeding
Jay Lee
John R. Milliron
Bradley Nemunaitis

Joseph A. Nuciforo Jr.
John R. Robinson
Michael L. Schmidt
Joseph R. Solomon
Michael M. Sprinkel
Michael S. Stenko

Donald P. Tragianese
Wafeek S. Wahby
David White

CONSULTING MEMBERS

Milton D. Anderson
Lu Anqi
Craig A. Ballinger
John J. Bartholomew
Shashi P. Bhatnagar
Jerry D. Byrne
Zhi-Yuan Chen

Lech Czarnecki
Harold (Dan) R. Edwards
Larry J. Farrell
George Horeczko
David P. Hu
Bert Paul Kriekemans
Deon Kruger

William Lee
Troy D. Madeley
Henry N. Marsh Jr.
Peter Mendis
Peter J. Moss
Yoshihiko Ohama
Kelly M. Page

Hamid Saadatmanesh
Donald A. Schmidt
Meyer Steinberg
Harold H. Weber Jr.

This Specification gives requirements for repairing cracks in concrete by injection of two-component epoxy-resin adhesive.

Keywords: adhesive; crack; epoxy; repair injection; sealer.

CONTENTS

PART 1—GENERAL, p. 2

- 1.1—Scope, p. 2
- 1.2—Interpretation, p. 2
- 1.3—Definitions, p. 2
- 1.4—Reference standards, p. 3
- 1.5—Submittals, p. 3
- 1.6—Delivery, storage, and handling, p. 3
- 1.7—Quality assurance and quality control acceptance of work, p. 3

PART 2—PRODUCTS, p. 5

- 2.1—Surface seal, p. 5
- 2.2—Injection adhesives, p. 5

PART 3—EXECUTION, p. 5

- 3.1—Evaluation and preparation, p. 5

ACI Committee Reports, Guides, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

Reference to this document shall not be made in contract documents. If items found in this document are desired by the Architect/Engineer to be a part of the contract documents, they shall be restated in mandatory language for incorporation by the Architect/Engineer.

@seismicisolation

ACI 548.15-20 supercedes ACI 503.7-07, was adopted on June 19, 2020, and was published November 2020.

Copyright © 2020, American Concrete Institute.

All rights reserved including rights of reproduction and use in any form or by any means, including the making of copies by any photo process, or by electronic or mechanical device, printed, written, or oral, or recording for sound or visual reproduction or for use in any knowledge or retrieval system or device, unless permission in writing is obtained from the copyright proprietors.

- 3.2—Test injection, p. 5
- 3.3—Injection, p. 5
- 3.4—Cleanup, p. 6
- 3.5—Safety, p. 6

NOTES TO SPECIFIER (NONMANDATORY), p. 6

- General notes, p. 6
- Foreword to Checklists, p. 6

PART 1—GENERAL

1.1—Scope

1.1.1 This Specification covers the repair of cracks in concrete by pressure-injecting epoxy into cracks that intersect at least one accessible surface of the concrete member. It does not cover the repair of delaminations where the intersection of the cracked concrete with the surface of the concrete member is not accessible nor can be made accessible.

1.1.2 This Specification is incorporated by Contract Documents and provides requirements for the Contractor.

1.1.3 This Specification governs for construction within its scope, except project-specific Contract Documents govern if there is a conflict.

1.1.4 This Specification governs if there is a conflict with reference material and testing standards.

1.1.5 Ignore provisions of this Specification that are not applicable to the Work.

1.1.6 Values in this Specification are stated in inch-pound units. A companion specification in SI units is also available.

1.1.7 The Notes to Specifier are not part of this Specification.

1.2—Interpretation

1.2.1 Unless otherwise explicitly stated, this Specification shall be interpreted using the following principles.

1.2.1.1 Interpret this Specification consistent with the plain meaning of the words and terms used.

1.2.1.2 Definitions provided in this Specification govern over the definitions of the same or similar words or terms found elsewhere.

1.2.1.3 Whenever possible, interpret this Specification so that its provisions are in harmony and do not conflict.

1.2.1.4 Headings are part of this Specification and are intended to identify the scope of the provisions or sections that follow. If there is a difference in meaning or implication between the text of a provision and a heading, the meaning in the text governs.

1.2.1.5 Where a provision of this Specification involves two or more items, conditions, requirements, or events connected by the conjunctions “and” or “or,” interpret the conjunction as follows:

“and” indicates that all the connected items, conditions, requirements, or events apply.

“or” indicates that the connected items, conditions, requirements, or events apply singularly.

1.2.1.6 The use of the verbs “may” or “will” indicates that the Specification provision is for information to the Contractor.

1.2.1.7 The phrase “as indicated in Contract Documents” means the specifier included the provision requirements in the Contract Documents.

1.2.1.8 The phrase “unless otherwise specified” means the specifier may have included an alternative to the default requirement in the Contract Documents.

1.2.1.9 The phrase “if specified” means the specifier may have included a requirement in the Contract Documents for which there is no default requirement in this Specification.

1.3—Definitions

accepted—determined by the Architect/Engineer to be in compliance with Contract Documents.

Architect/Engineer—the architect, engineer, architectural firm, or engineering firm issuing Contract Documents or administering the Work under Contract Documents, or both.

bond interface—the plane formed by an adhesive between two adjacent materials.

continuous metering and mixing—the process in which two adhesive components are continuously metered into and discharged from a mixing chamber.

Contract Documents—set of documents that form the basis of a contractual relationship between an Owner and constructor or design-builder. These documents are defined by the contractual agreement, and can contain contract forms, contract conditions, specifications, drawings, addenda, and contract changes.

Contractor—the person, firm, or entity under contract for construction of Work.

crack face—the exposed intersection of a crack and the surface of the concrete member.

crack repair—the work performed to permit the transfer of stress across the crack and provide a barrier to prevent the infiltration of aggressive solutions.

injection adhesive—the material that is injected into a crack for the purpose of repair.

injection port—a device or passageway in the surface seal through which the injection adhesive is introduced into a crack.

permitted—accepted by or acceptable to Architect/Engineer, usually pertaining to a request by Contractor, or when specified in Contract Documents.

specification—the written document that details requirements for the Work.

specifier—person or entity preparing specifications for a material, product, system, or service.

submit—provide to Architect/Engineer for review.

submittal—document or material provided to Architect/Engineer for review and acceptance.

surface seal—the material that is applied to the crack face to contain the injection adhesive during the injection process.

Work—the entire construction or separately identifiable parts thereof required to be furnished under Contract Documents.

1.4—Reference standards

1.4.1 *ASTM International*

ASTM C42/C42M-16—Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

ASTM C496/C496M-17—Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

ASTM C881/C881M-15—Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

1.5—Submittals

1.5.1 Injection adhesives—For each injection adhesive used, provide the following:

1.5.1.1 Qualification testing—Unless otherwise specified, submit an independent laboratory test report, including all test results, certifying that the injection adhesive meets all the requirements specified in 2.2.1 or 2.2.2 as appropriate.

1.5.1.2 Manufacturer's certification—Submit the manufacturer's certification verifying conformance to the requirements of 1.5.1.1 of each lot of injection adhesive to be used in the Work.

1.5.1.3 Manufacturer's safety data sheet—Submit the manufacturer's safety data sheet.

1.5.1.4 Additional testing—Submit additional test results if specified.

1.5.2 Accessories—Provide the following as appropriate:

1.5.2.1 Injection ports—Submit description of ports to be used.

1.5.2.2 Surface seal—Submit description of surface seal to be used. If a chemical product, submit manufacturer's safety data sheet and technical data sheet.

1.6—Delivery, storage, and handling

1.6.1 Delivery of materials—Deliver all materials in sealed containers with labels legible and intact.

1.6.2 Labeling—Only use materials that are marked with the following information:

- Name of manufacturer
- Manufacturer's product identification
- Manufacturer's instructions for mixing
- Warning for handling and toxicity
- Expiration date and lot number

1.6.3 Storage of materials—Store all materials in a clean and dry area at temperatures between 40 and 90°F, unless otherwise recommended by manufacturer.

1.6.4 Handling of materials—Handle all materials to avoid breaking container seals and in accordance with the manufacturer's safety data sheet and manufacturer's recommendations.

1.7—Quality assurance and quality control acceptance of work

1.7.1 Metering accuracy—Use equipment or tools for continuous (metering) or batch proportioning for the two components of the injection adhesive that are able to establish and maintain a ratio of the components within the tolerance specified by the manufacturer of the injection adhesive over the full range of operating pressures and @ seismic isolation

If the manufacturer of the injection adhesive does not specify a tolerance for the mixture ratio, maintain a mixture ratio within ± 5 percent of the nominal mixture ratio specified by the manufacturer of the adhesive.

1.7.2 *Qualification test for metering accuracy*

1.7.2.1 When a continuous metering and mixing pump is required, test the metering accuracy of equipment before the start of the Work to demonstrate that the pump is capable of maintaining the ratio within the tolerances required in 1.7.1.

1.7.2.1.1 The device used to measure metering accuracy shall be capable of controlling the discharge pressure of each of the components separately as they are simultaneously discharged into separate containers.

1.7.2.1.2 Conduct one test by discharging both adhesive components simultaneously into separate containers while maintaining a discharge pressure on both components equal to the lowest operating discharge pressure. Conduct a second test at the highest operating discharge pressure.

1.7.2.1.3 Measure injection pressure with a gauge mounted upstream of and within 12 in. of the mixing chamber.

1.7.2.1.4 Discharge each component into separate graduated containers or into containers that can be weighed. A minimum of 7 fl oz. of the larger volume component is required for an adequate ratio determination. If the ratio determination is made by mass, the volumetric ratio may be determined by calculation using the specific gravity of each component. The volumetric ratio is determined by multiplying the mass ratio by the inverse of the ratio of the specific gravities of the components.

1.7.2.2 Demonstrate that the injection equipment does not have more than a 5 psi drop in pressure in either of the two components over 3 minutes, while the injection adhesive flow is turned off and the pump is set to 80 percent or more of the typical operating pressure.

1.7.3 Qualification tests for mixing effectiveness of equipment—Before the start of the test injection specified in 1.7.4, conduct the following tests on the specified injection adhesive processed with the equipment and tools to be used to meter, and mix the injection adhesive in the Work.

1.7.3.1 Bond strength for bonding hardened concrete to hardened concrete, 2-day cure, as specified in **ASTM C881/C881M**.

1.7.3.2 Compressive yield and compressive modulus tests as specified in ASTM C881/C881M.

1.7.3.3 If the test results do not meet the requirements of ASTM C881/C881M, modify or replace the equipment.

1.7.4 *Qualification of injection procedures*

1.7.4.1 Test injection—As the first item of Work, repair a test crack selected by the Architect/Engineer not less than 10 ft in total length. If there are no cracks at least 10 ft in length, the Architect/Engineer will select a number of shorter cracks whose total length will approximately equal 10 ft. Inject the test crack(s) using the specified injection adhesive. Use the same surface seal, equipment, and application methods that are to be used in executing the Work. Meet the requirements of 1.7.7. Do not begin the remaining injection work until the equipment and application methods are accepted by Architect/Engineer or specifier.

1.7.5 *Quality control*

1.7.5.1 *Metering accuracy tests for continuous mixing*—

The first time any piece of two-component continuous metering and mixing equipment is used in the Work and any time each piece of equipment is used after a 4-hour or longer shutdown period, test two-component continuous metering and mixing equipment to demonstrate that the equipment is operating as required in 1.7.1 and 1.7.2. If the ratio of the two components is not within the specified tolerance, stop injection work until the equipment is brought into compliance with 1.7.1. Maintain a record of all such tests, including date, time, results of the tests required in 1.7.5.1, temperature of each adhesive component, and location of the last crack injected before the test performed to comply with this section. Submit the record to the Architect/Engineer at the end of each workday.

1.7.5.2 *Metering accuracy test for batch mixing*—For every batch of adhesive mixed, record the amount of each component and the total amount of mixed adhesive within ± 5 percent either by weight or by volume. The determination may be converted between mass and volume by calculation using the specific gravity of the component. Maintain a record of all batches, including date, time, and mixture ratio.

1.7.6 *Daily log*—Maintain a written daily log for each day of injection work that includes:

- Substrate temperatures at the start and end of the workday
- Weather conditions, such as rain, snow, and wind, including changes during the shift
- Crack cleaning methods, if any, including locations
- Record of injection adhesive, including manufacturer, product and batch number, and amount used each day
- Signature and printed name of person responsible for record keeping

Submit the log to the Architect/Engineer each workday.

1.7.7 *Acceptance*

1.7.7.1 *Core testing*—Obtain core samples to evaluate injection repair in accordance with **ASTM C42/C42M** at the following frequency, unless otherwise specified:

| Inspection test | Frequency |
|--|--|
| Visual inspection for depth of penetration | Three cores from first 100 ft, and one core for each 100 ft thereafter |
| Splitting tensile strength per ASTM C496/C496M | One core for first 100 ft, and one core for each 250 ft thereafter |

It is permitted to use a core sample for both splitting tensile strength and visual inspection, provided the core sample meets the requirements for both listed in 1.7.7.1.1. It is recommended that nondestructive testing methods such as pachometer or surface-penetrating radar be used to locate existing reinforcing steel prior to coring. If cores would adversely affect reinforcing steel or other embedded items, do not core, and notify the Architect/Engineer so that an alternative location can be chosen.

1.7.7.1.1 *Requirements for acceptable core samples*—Obtain cores to evaluate injection repair in a manner that

includes as much of the bond interface of the repaired concrete as possible, unless otherwise accepted by the Architect/Engineer. Examine core samples to evaluate the degree of injection adhesive penetration; acceptable cores shall intersect the crack for at least 75 percent of the core length. Obtain cores, with a minimum diameter of 3.70 in., for splitting tensile tests. Control cores for the splitting tensile test must be of the same diameter and taken from an uncracked area within 12 in. from the repaired crack. It is permitted to obtain core samples with a minimum diameter of 2 in. to visually verify adhesive penetration. Acceptable cores for visual inspection shall intersect the crack for at least 75 percent of the core length.

1.7.7.1.2 *Core markings*—Mark each core with a unique number and provide a list identifying the location where each numbered core was taken. Mark each of the cores with a T for top or B for bottom for cores taken vertically, or H for cores taken horizontally. Mark the respective end of the core with the letters IS (injection side) to indicate the side from which the injection was performed. If adjustment of core length is required, transfer identification marks on the core ends as necessary to maintain their identity up to the time of test.

1.7.7.1.3 *Splitting tensile test*—Cores used for evaluation of splitting tensile strength shall be tested in accordance with **ASTM C496/C496M**. Allow 24 hours after injection before coring and 72 hours after injection before beginning splitting tensile tests unless longer cure times are required for low installation temperatures. Core length-to-diameter ratio must be between 1.0 and 2.1 for splitting tensile tests. If required to adjust the length of cores for testing to meet the ratio of core length to diameter, the portion of the core furthest from injection surface shall be included in the length of core to be tested. When testing, align the core so that the crack is in a plane as close to vertical as possible.

1.7.7.1.4 *Core repair*—Fill core holes as indicated in Contract Documents.

1.7.7.1.5 *Alternatives to core testing*—No standards exist for using nondestructive evaluation (NDE) to determine the quality of crack repair by epoxy injection. NDE methods such as pulse velocity and impact-echo give indication the crack is filled by an injection epoxy but cannot provide information on cure of the epoxy or bond to the substrate. If permitted, side-by-side coring and NDE tests are required to demonstrate that NDE results correlate with coring results. If the NDE test method is known to the specifier or confidence in the test method is established, the requirements for destructive core testing may be reduced as permitted.

1.7.7.2 *Acceptance criteria*—Injection work is acceptable if core testing, as specified in 1.7.7.1, demonstrates adequate penetration and splitting tensile strength:

1.7.7.2.1 *Penetration*—Visual inspection demonstrates at least 90 percent of the depth of the crack in each core is filled with adhesive.

1.7.7.2.2 *Splitting tensile strength*—The splitting tensile strength of the core taken from that location must be at least 90 percent of the splitting tensile strength of the control core

taken for that splitting tensile core sample, unless otherwise specified.

1.7.7.2.3 Failure plane—If the requirements of 1.7.7.2.2 cannot be met, inspect the failure area of the splitting tensile test specimen. The splitting tensile test result of the cored specimen is acceptable if the fracture plane of the test specimen is predominantly in the parent concrete and the exposed injection epoxy does not exceed 10 percent of the failed area.

1.7.7.3 Inadequate penetration—When the results of visual inspection do not meet the requirements in 1.7.7.2.1, stop injection work until the areas represented by the testing are accepted, and changes in procedures or materials for continued injection work have been accepted. Reinject adhesive in the locations where injection has not been acceptable. If partial injection has blocked all access to the cracks on accessible surfaces, drill injection holes into the concrete to intersect the crack in their void areas.

1.7.7.4 Verification of injection adhesive—When the results of splitting tensile core testing, as specified in 1.7.7.1, do not meet the requirements of 1.7.7.2.2 or 1.7.7.2.3, stop injection work and repeat testing in 1.7.3.2 to verify that the adhesive and injection equipment meet the requirements of this Specification. Use an accelerated cure schedule provided by the manufacturer to cure the specimens. If the manufacturer does not provide an accelerated cure schedule, cure the specimens for 24 ± 1 hour at $125 \pm 2^\circ\text{F}$. Tests results shall meet the compressive strength requirement of **ASTM C881/C881M**.

If the compressive strength requirement is not met, stop injection work until the equipment and materials comply with this Specification. If the tests indicate the adhesive and equipment do not comply with the specification, stop work and notify the Architect/Engineer.

PART 2—PRODUCTS

2.1—Surface seal

Use the materials to seal the crack faces and set injection ports that have the strength and adhesion to contain the injection adhesive in the crack during the injection process and while the injection adhesive cures. If surface seal removal is required, the surface seal material shall not leave a residue or damage the surfaces.

2.2—Injection adhesives

2.2.1 Injection adhesives for cracks that can be sealed on all faces—Use an adhesive that conforms to the requirements of ASTM C881/C881M, Type IV, Grade 1, and any additional requirements if specified in the specification.

2.2.2 Injection adhesives for cracks that cannot be sealed on all faces—If all faces of the crack cannot be reached to apply a surface seal, use an injection adhesive that conforms to the requirements of ASTM C881/C881M, Type IV, Grades 1, 2, or 3, and has a viscosity that will allow it to achieve and maintain the penetration requirements specified in 1.7.7.2.

PART 3—EXECUTION

3.1—Evaluation and preparation

3.1.1 Crack width—Inspect all cracks to determine if they are within the scope as indicated in Contract Documents. If specified, measure the width of the crack to make this determination, and make the measurement at the time of day when the cracks are at their widest as measured at the surface of the concrete member. Cracks larger than 0.005 in. in width are repairable using the liquid adhesives specified in 2.2.1. Do not repair any crack that is less than 0.005 in. at its widest point unless otherwise specified.

3.1.2 Crack movement—If the width of a crack changes because of daily temperature cycles or other external loading of the structure, inject the crack when it is at its widest.

3.1.3 Preparation

3.1.3.1 Remove foreign material, such as dirt, oil, grease, or other chemicals, from the cracks before application of surface seal or injection adhesive by oil-free compressed air, unless otherwise specified.

3.1.3.2 Unless the crack is in submerged concrete, remove any water that can be seen by visual inspection from the cracks before application of the surface seal or injection, and remove water that appears during the injection process. Unless otherwise specified, remove water by blasting the crack with compressed air.

3.1.3.3 Unless otherwise specified, install ports in accordance with manufacturer's instruction spaced at a distance equal to the measured depth of the crack. If the depth of the crack is not known, space the ports at a distance equal to the thickness of the concrete member. Apply a surface seal around the ports and over all exterior faces of the crack that can be reached to contain the injection adhesive in the crack.

3.1.3.4 Do not inject adhesive if the temperature of the concrete is not within the range of application temperatures recommended by the manufacturer of the adhesive.

3.2—Test injection

After the test crack has been prepared, conduct the test injection specified in 1.7.4.1. Unless otherwise specified, if results do not meet the requirements of 1.7.7.2, modify crack preparation and injection procedures, as permitted, until satisfactory results can be obtained.

3.3—Injection

3.3.1 Procedure—Unless otherwise specified, use the port-to-port flow method described in the following text as appropriate.

3.3.1.1 For cracks generally in an inclined or vertical plane, start injecting into the port at the lowest elevation of the crack until it will no longer accept the injection epoxy. If injection epoxy shows at the next higher port and the first port still accepts material, close the second port and continue injecting into the lower port. Continue closing higher ports as the injection epoxy appears until the lower port no longer accepts material. Seal the lower injection port, shift to the last port epoxy appeared and continue epoxy injection. If the epoxy has gelled in the port, move to the next higher clean

port to continue epoxy injection. Repeat the process until the entire crack has been injected and will not accept material. After initial injection has been completed at the highest elevation port, wait at least 10 minutes and reinject at that port until no additional adhesive can be injected.

3.3.1.2 For cracks generally in a horizontal plane, start injecting at the lowest end of the crack until it will no longer accept the injection epoxy. If injection epoxy shows at the next port and the first port still accepts material, close the second port and continue injecting into the first port. Continue closing successive ports as the injection epoxy appears until the first port no longer accepts material. Seal the first injection port, shift to the last port epoxy appeared, and continue epoxy injection. If the epoxy has gelled in the port, move to the next successive clean port to continue epoxy injection. Repeat the process until the entire crack has been injected and will not accept material. After initial injection has been completed, wait at least 10 minutes and reinject all ports. Repeat injection procedure until all ports refuse injection adhesive.

3.3.1.3 If flow from port to successive ports cannot be achieved, report to the Architect/Engineer.

3.3.2 *Degree of filling*—Inject cracks so that the requirements of **1.7.7.2** are met.

3.4—Cleanup

3.4.1 Protect concrete surfaces against spillage.

3.4.2 Remove any injection adhesive applied, leaked, or spilled beyond desired areas, unless otherwise specified. Perform cleanup with material designated by epoxy resin system manufacturer. Avoid contamination of work area.

3.4.3 Unused materials shall be disposed in accordance with manufacturer's recommendations and applicable regulations.

3.4.4 After injection material has cured, remove surface seal and any installed injection ports that protrude from the surface of the concrete, unless otherwise specified.

3.5—Safety

3.5.1 Advise applicators to avoid contacting injection adhesive or components with eyes and skin, inhalation of vapors, and ingestion. Make protective and safety equipment available on site. Refer to the manufacturer's safety data sheet and heed all label warnings by manufacturer.

NOTES TO SPECIFIER (NONMANDATORY)

General notes

G1. ACI Specification 548.15 is to be used by reference in the Project Specification. Do not copy individual sections, parts, articles, or paragraphs into the Project Specification because taking them out of context may change their meaning.

G2. If sections or parts of ACI Specification 548.15 are copied into the Project Specification or any other document, do not refer to them as an ACI Specification.

G3. A statement such as the following will serve to make ACI Specification 548.15 a part of the Project Specification:

"Work on (Project Title) shall conform to all requirements of ACI Specification 548.15, Specification for Crack Repair by Epoxy Injection, published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by these Contract Documents."

G4. Each technical section of ACI Specification 548.15 is written in the three-part section format of the Construction Specifications Institute, as adapted for ACI requirements. The language is imperative and terse.

G5. If ACI Specification 548.15 is used with another ACI specification that contains overlapping provision, identify which requirements are in conflict and state in the Contract Documents which requirements govern.

Foreword to Checklists

F1. This Foreword is included for explanatory purposes only; it does not form a part of ACI Specification 548.15.

F2. ACI Specification 548.15 may be referenced by the specifier in the Project Specification for any building project, together with supplementary requirements for the specific project. Responsibilities for project participants must be defined in the Project Specification. ACI Specification 548.15 cannot and does not address responsibilities for any project participant other than the Contractor.

F3. Checklists do not form a part of ACI Specification 548.15. Checklists assist the specifier in selecting and specifying project requirements in the Project Specification.

F4. The Mandatory Requirements Checklist indicates work requirements regarding specific qualities, procedures, materials, and performance criteria that are not defined in ACI Specification 548.15. The specifier must include these requirements in the Project Specification.

F5. The Optional Requirements Checklist identifies specifier alternatives and additions. The checklists identify the sections, parts, and articles of ACI Specification 548.15 and the action required or available to the specifier. The specifier should review each of the items in the checklist and make adjustments to the needs of a particular project by including those selected alternatives or additions as mandatory requirements in the Project Specification.

F6. *Cited references*—Documents and publications that are referenced in the Checklists of ACI Specification 548.15 are listed as follows. These references provide guidance to the specifier and are not considered to be part of ACI Specification 548.15.

American Concrete Institute

ACI 228.2R-13—Report on Nondestructive Test Methods for Evaluation of Concrete in Structures

International Concrete Repair Institute

ICRI 210.1R-2016—Guide for Verifying Field Performance of Epoxy Injection of Concrete Cracks

MANDATORY REQUIREMENTS CHECKLIST

| Section/Part/Article | Notes to Specifiers |
|----------------------|--|
| 1.1.1 | Specify specific scope of work. Specify any cracks that are not within the scope of the Work and who identifies those cracks: Contractor or Specifier. |
| 1.7.7.1.4 | Specify requirements for repairing core holes. |
| 1.7.7.1.5 | Specify if nondestructive evaluation (NDE) is permitted. Specify permitted NDE methods. Specify reduced coring requirements in conjunction with NDE requirements. Refer to ACI 228.2R and ICRI 210.1R. |

OPTIONAL REQUIREMENTS CHECKLIST

| Section/Part/Article | Notes to Specifiers |
|----------------------|---|
| 1.5.1.1 | If the adhesive is known to the Specifier to be suitable for the application, the requirement for independent test reports may be waived. |
| 1.5.1.3 | Identify additional required testing. |
| 1.7.5.1 | Indicate when records should be submitted. |
| 1.7.5.2 | Indicate when records should be submitted. |
| 1.7.7.1 | Specify locations where cores should not be taken because of the presence of reinforcing steel, other embedments, or other sensitive areas. |
| 1.7.7.2.2 | When contaminants are present in a crack, exploratory injection and core testing may demonstrate that the requirements of 1.7.7.2 cannot be achieved even after all reasonable efforts to remove contaminants have been exhausted. If project requirements allow a lower strength than the required 90 percent of splitting tensile strength, replace the 90 percent with the percent of splitting tensile strength that the project requirements will allow. |
| 3.1.1 | If the adhesive is known to the Specifier to be suitable for cracks smaller than 0.005 in., the minimum crack width requirement must be provided. |
| 3.1.3.1 | If the cracks contain concrete fines that have resulted from the grinding action of concrete movement or densely packed dirt, removal that would render the crack repairable may not be possible. In many cases, these contaminants can be successfully removed with compressed air, water injected under pressure, or a combination of both. If the contamination is only near the surface, it may be possible to drill holes to intersect the crack below the contamination. Injection can then be accomplished through these holes. Contamination with oil, grease, or other chemicals may also make achievement of a satisfactory bond impossible unless removal efforts are successful. If it is expected that any of these conditions exist after removal attempts, exploratory injection and core testing may be required to determine whether certain cracks should be excluded from the scope of work or whether the acceptance criteria should be modified. |
| 3.1.3.2 | Specify alternate procedures for water removal. |
| 3.1.3.3 | Specify alternate placement of injection ports. |
| 3.2 | Modification of crack injection procedures may include: alternate crack preparation such as increasing the abrasive blasting pressure, increasing injection pressure, altering port spacing, changing the time of day for injection to accommodate temperature and moisture differentials, and changing injection epoxy. If core testing and nondestructive evaluation are not possible, quality assurance is difficult. Method requirements can greatly increase the likelihood of adequate penetration. Liquid adhesives, when introduced into a crack, usually self-level by flowing or draining to the lowest elevation in the void. The injection of a liquid adhesive into a crack can be visualized as filling a void with a liquid from the bottom. Injecting from the lowest elevation to the highest provides the most assurance that the crack has been completely filled. |
| 3.3 | Specify alternate procedures for injection. |
| 3.4.2 | Specify if there is no requirement to remove spills and stains from the concrete. |
| 3.4.4 | Specify the removal of metal ports if there is a possibility of corrosion. Specify if there is no requirement to remove surface seals and ports. |





American Concrete Institute
Always advancing

As ACI begins its second century of advancing concrete knowledge, its original chartered purpose remains “to provide a comradeship in finding the best ways to do concrete work of all kinds and in spreading knowledge.” In keeping with this purpose, ACI supports the following activities:

- Technical committees that produce consensus reports, guides, specifications, and codes.
- Spring and fall conventions to facilitate the work of its committees.
- Educational seminars that disseminate reliable information on concrete.
- Certification programs for personnel employed within the concrete industry.
- Student programs such as scholarships, internships, and competitions.
- Sponsoring and co-sponsoring international conferences and symposia.
- Formal coordination with several international concrete related societies.
- Periodicals: the ACI Structural Journal, Materials Journal, and Concrete International.

Benefits of membership include a subscription to Concrete International and to an ACI Journal. ACI members receive discounts of up to 40% on all ACI products and services, including documents, seminars and convention registration fees.

As a member of ACI, you join thousands of practitioners and professionals worldwide who share a commitment to maintain the highest industry standards for concrete technology, construction, and practices. In addition, ACI chapters provide opportunities for interaction of professionals and practitioners at a local level to discuss and share concrete knowledge and fellowship.

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331
Phone: +1.248.848.3700
Fax: +1.248.848.3701

www.concrete.org



American Concrete Institute
Always advancing

38800 Country Club Drive
Farmington Hills, MI 48331 USA
+1.248.848.3700
www.concrete.org

The American Concrete Institute (ACI) is a leading authority and resource worldwide for the development and distribution of consensus-based standards and technical resources, educational programs, and certifications for individuals and organizations involved in concrete design, construction, and materials, who share a commitment to pursuing the best use of concrete.

Individuals interested in the activities of ACI are encouraged to explore the ACI website for membership opportunities, committee activities, and a wide variety of concrete resources. As a volunteer member-driven organization, ACI invites partnerships and welcomes all concrete professionals who wish to be part of a respected, connected, social group that provides an opportunity for professional growth, networking and enjoyment.