

An ACI Standard

Sightness Testing of Environmental Engineering Concrete Structures— Specification

Reported by ACI Committee 350

ACI SPEC-350.1-22



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Tightness Testing of Environmental Engineering Concrete Structures—Specification

An ACI Standard

Reported by ACI Committee 350

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The committee would like to thank M. Mitchell, D. Poole, P. Hedli, and J. Zanotti for their contributions to this Specification.

These test methods give procedures and criteria for tightness testing of environmental engineering concrete structures. They are applicable to liquid and gas containment structures constructed with concrete or a combination of concrete and other materials. This Specification includes hydrostatic, surcharged hydrostatic, and pneumatic tests.

These test methods may involve hazardous materials, operations, and equipment. This document does not purport to address all the safety problems associated with its use. It is the responsibility of the user of this Specification to establish appropriate safety and health practices and determine the applicability of regulatory limitations before use.

Keywords: containment structures; hydrostatic; leakage; pneumatic; reservoirs; tests; tightness; tightness criteria.

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ACI SPEC-350.1-22 supersedes ACI 350.1-10 and was adopted and published in October 2022.

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SECTION 1—GENERAL REQUIREMENTS

1.1—Scope

1.1.1 Work specified—This Specification covers tightness testing of liquid and gaseous environments for containment structures that are designed to resist liquid or gaseous loads and to meet the provisions of ACI 350. Unless otherwise specified, test containment structures after the structure is complete and concrete has attained its specified compressive strength. Provisions of this Specification govern except where other provisions are specified in Contract Documents.

1.1.1.1 Tests specified herein include:

- (a) Hydrostatic tightness test for open or covered containment structures
- (b) Surcharged hydrostatic tightness test for closed containment structures
- (c) Pneumatic tightness test for closed containment structures
- (d) Combination hydrostatic-pneumatic tightness test for closed containment structures

Do not substitute one type of test for another type of test without acceptance of the Architect/Engineer.

1.1.1.2 Unless otherwise specified, tightness testing procedures and requirements contained herein are applicable to reservoirs, basins, tanks, and open liquid transmission structures such as cast-in-place channels and conduits.

1.1.1.3 Unless otherwise specified, consider each cell of multi-cell containment structures as a single containment structure, and tested individually.

1.1.1.4 Unless otherwise specified, preparatory items indicated in 2.3.1 are required but waiving such items does not change the test acceptance criteria.

1.1.1.5 If specified, hydrostatically tightness test concrete paved structures, channels, and impoundments.

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 referenced material and testing standards.

1.1.5 Contractor is permitted to submit written alternatives to any provision in this Specification for consideration.

1.1.6 Unless otherwise specified, do not use this Specification in conjunction with ACI 350.5.

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

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

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

1.1.10 Work not specified—These provisions are not intended for structures such as hazardous material primary containment structures, cryogenic storage structures, high-pressure gas tanks, or miscellaneous precast concrete structures.



tures such as culverts, pipes, and manholes designed to meet requirements of other standards.

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 of the text governs.

1.2.1.5 Footnotes are part of this Specification. The meaning of the provision text governs in the event of a difference in meaning or implication between the provision text and a footnote to that provision.

1.2.1.6 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.

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

1.2.1.8 The phrase “as indicated in Contract Documents” means the Specifier included the provision requirements in Contract Documents.

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

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

1.2.1.11 If an ACI specification refers to combined ASTM standards, include the following provision in the interpretation article: “Unless otherwise stated, the inch-pound system [or metric, whichever is applicable] of units is applicable to combined standards referenced in this Specification.” Provisions should include the complete designation of a combined standard.

1.3—Definitions

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

Architect/Engineer—Architect, Engineer, architectural firm, or engineering firm, developing Contract Documents, or administering Work under Contract Documents, or both.

closed containment structure—a containment structure where the roof or cover is used to prevent escape of

contents, including gases emanating from those contents, to the outside atmosphere.

containment structure—a basin, reservoir, channel, or conduit to be tightness tested regardless of whether it has a closed or open top or is constructed partially or entirely of concrete.

Contract Documents—set of documents that form the basis of a contractual relationship between an Owner and Contractor 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 the Work.

covered containment structure—a containment structure where the contents are protected from exterior contamination by the presence of a cover or roof over the top of the containment structure.

day—with respect to testing, one day equals a 24-hour period.

embedded waterstop—a continuous ribbon, cast into both sides of a joint to form an internal dam across the joint.

environmental engineering concrete structures—concrete structures intended for conveying, storing, or treating water, wastewater, or other nonhazardous liquids.

fitting—an object that passes through the concrete or is embedded in the concrete to facilitate a connection to the containment structure.

open containment structure—a containment structure where the top surface of the containment structure’s contents is exposed to the weather.

Owner—the corporation, association, partnership, individual, public body, or authority for whom the Work is constructed.

Project Specifications—the written documents that detail requirements for the Work in accordance with service parameters and other specific criteria.

reference standards—standards of a technical society, organization, or association, including the codes of local or state authorities, which are referenced in Contract Documents.

required—mandatory in this Specification or Contract Documents.

soap suds—water impregnated with soap or synthetic detergent used to indicate air passage through joints or defects by the formation of soap bubbles.

strip-applied waterstop—a continuous strip applied to one side of a reinforced construction joint and secured by adhesive to the surface of the hardened concrete substrate forming a seal within the joint.

submit—provide to Architect/Engineer for review.

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

tightness—resistance to leakage of liquids or gases from one face through the opposite face of an element.

vacuum box—a box with a transparent top, open bottom, and air-sealing bottom edges used in conjunction with an air pump capable of creating a vacuum within the box.

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

1.4—Referenced standards

International Organization for Standardization

ISO 8573-1:2010—Compressed Air—Part 1: Contaminants and Purity Classes

1.5—Submittals

1.5.1 General—Submit for review submittals required in this Specification.

1.5.2 Repair procedures—Submit for review repair methods, materials, and modifications proposed to meet tightness requirements of Contract Documents.

1.5.3 Test reports—Submit test reports of results of tightness testing performed during the course of the Work to Architect/Engineer. Include test locations in the containment structure, dates of testing, water level measurements, amounts of precipitation or evaporation (when applicable), measured temperatures and volume corrections (if any), retest results, and corrective actions taken, if any, and results. Submit final report within 7 days of successful test completion.

1.6—Quality control and quality assurance; acceptance of Work

1.6.1 Duties and responsibilities of Contractor—Unless otherwise specified, the following duties and responsibilities are required of the Contractor. Prepare and fill the containment structure and provide access and equipment and make the measurements and observations for the required testing. Provide Architect/Engineer with access to observe measurements and witness observations included in the test reports. Provide at least 24 hours' notice to Architect/Engineer to allow for scheduling of quality assurance tests, review of project requirements, and assignment of personnel.

SECTION 2—HYDROSTATIC TIGHTNESS TEST FOR OPEN OR COVERED CONTAINMENT STRUCTURES

2.1—General

2.1.1 Scope—This section covers the hydrostatic tightness test, which consists of two parts. Part 1 is a qualitative criterion. Part 2 is a quantitative criterion expressed as the maximum allowable percent volume loss per day.

2.1.1.1 Test containment structures for hydrostatic tightness as indicated in Contract Documents. The hydrostatic tightness test is the preliminary test for all other tightness tests as well as an individual test.

2.1.1.2 Unless otherwise specified, when hydrostatic tightness testing is specified, the quantitative criteria shall be in accordance with Table 2.1.1.2.

Table 2.1.1.2—Default hydrostatic tightness testing quantitative criteria

Type of containment structure	Default hydrostatic test quantitative criterion
Fully lined prior to hydrostatic test	No measurable loss*
Secondary containment structures	No measurable loss*
Structures with floors that are monolithically placed (without joints) and designed to be shrinkage crack free	0.0125% of volume per day
Other types	0.050% of volume per day
Concrete-paved reservoirs and channels	0.100% of volume per day

*"No measurable loss" of water means the decrease in the water surface elevation does not exceed 1/8 in. in 72 hours when adjusted for evaporation and precipitation.

2.2—Products

2.2.1 Materials

2.2.1.1 Water—Unless otherwise specified, use potable water.

2.3—Execution

2.3.1 Test preparation

2.3.1.1 Clean exposed concrete surfaces of the containment structure, including the floor, of foreign material and debris to permit examination of the concrete surfaces for areas of potential leakage. Remove standing water in or outside of the containment structure that would interfere with the examination of the exposed concrete surfaces of the containment structure. Visually examine concrete surfaces and concrete joints for potential leakage points. Repair areas of potential leakage before filling the containment structure with water. Unless otherwise specified, do not apply any coatings, inside or outside, until after the hydrostatic tightness testing has been completed.

2.3.1.2 Visually examine all openings, fittings, and pipe penetrations in the containment structure at both faces, if practical.

2.3.1.3 Install liners that are mechanically locked to the surface during the placement of the concrete before the hydrostatic tightness testing. Visually examine interior liners for pinholes, tears, and partially fused splines. Unless otherwise specified, perform integrity testing of interior liners in accordance with product manufacturer's written testing procedures prior to hydrostatic testing. Repair all deficiencies.

2.3.1.4 Securely seal all containment structure penetrations, including inlets and outlets, to prevent the addition or loss of water in the containment structure during the test. Repair seepage observed at these locations before Part 2 test measurements are taken. No allowance will be made in test measurements for uncorrected known points of seepage.

2.3.1.5 Monitor flow from any underdrain system, if a system is provided, during the same period and record any increase in flow and consider it for information as a part of the hydrostatic tightness testing. Submit information on changes in flow of any underdrain system.

2.3.1.6 Lower groundwater around containment structure to below top of base slab and keep at that elevation or lower during testing.