



COLORADO READY MIXED
CONCRETE ASSOCIATION

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Concrete in Colorado

Making Concrete Cylinders in the Field

*Technical information prepared by:
Colorado Ready Mixed Concrete Association (CRMCA)*

CONCRETE TEST CYLINDERS

Compressive strength is the most critical performance standard applied to concrete on a construction project. Therefore, it is very important for the tests to accurately represent the concrete delivered, placed, and initially cured on the project.



Test cylinders are used to measure the compressive strength of fresh concrete and to ensure the concrete meets job specifications. Either 6x12-inch or 4x8-inch test specimens are cast, stored, and initially cured in accordance with ASTM C31, **Standard Practices for Making and Curing Test Specimens in the Field**.

ASTM C31 requires:

- A certified ACI Field Testing Grade I technician or equivalent shall make test specimens in the field.
- The technician must test for temperature, unit weight, air content, and slump.

As required by ACI 301 and 318, the compressive strength result shall be the average of at least two specimens (three for 4x8 cylinders), from the same sample tested at 28 days.

Compressive strength reports shall be provided to the general contractor, architect, engineer, and ready mixed concrete supplier in a timely manner.

Use of Concrete Test Cylinders



ASTM C31 states the results of **standard-cured** cylinders are used for:

- Acceptance testing for specified strength.
- Adequacy of mixture proportions for strength.
- Quality control.

ASTM C31 states the results of **field-cured** cylinders are used for:

- Determination of whether a structure can be put into service or form/shoring removal.

- Comparison with test results of standard-cured specimens or from various in-place test methods.
- Adequacy of curing and protection of concrete in the structure.
- Form or shoring removal time requirements.

MAKING AND CURING CYLINDERS

Necessary equipment

- A wheelbarrow or other large sample container.
- Watertight molds. Plastic molds are typically used.
- Tamping rod with a round hemispherical tip.
 - 5/8-inch in diameter for 6x12-inch cylinders.
 - 3/8-inch diameter for 4x8-inch cylinders.
- Rubber mallet.
- Safety equipment for handling fresh concrete.
- Shovel, scoop, and float or trowel.
- Curing environment per ASTM C31, section 10.1.2.



Sampling Concrete

The sample used must be representative of the concrete being placed. All sampling must be in accordance with ASTM C172, **Standard Practice for Sampling Freshly Mixed Concrete** as follows:

- Taken from the middle of the load; after first 10% and before 90% is discharged.
- Sampled by diverting the mixer truck chute or by passing the sampling container through entire flow.
- A minimum of two portions for a composite sample; within 15 minutes of each other.
- Sample size of at least 1 cubic foot (28 liters).

Prior to Making Cylinders

- Protect the sample from evaporation, moisture and jobsite debris.
- Move the sample to where the tests are to be conducted, which should be close to where the cylinders will be cast and stored for initial curing.
- Combine and remix the concrete prior to testing.

- Begin the slump, temperature, and air content tests within 5 minutes and cast cylinders within 15 minutes from when the sample was obtained.

Casting Cylinders

- Select the proper size mold based on the maximum nominal size coarse aggregate or as specified.
- Place the molds on a flat, level, rigid surface, free of vibration and other disturbances, at a place near to the initial cure location.
- Label the outside of the mold with pertinent identification information. Do not label the lids or tops. Lids often get lost or misplaced.
- Use the appropriate consolidation method:
 - For concrete with a slump of less than 1-inch, a vibrator should be used.
 - For concrete with a slump greater than or equal to 1-inch, either rodding or vibrating may be used.
- Place the concrete in the molds using the appropriate number of layers. For 6x12-inch cylinders, use 3 equal layers. For 4x8-inch cylinders, use 2 equal layers.
 - If vibrated, 2 equal layers is required.



- Scoop the concrete in the mold.
- Consolidate each layer by rodding 25 times evenly distributed around the mold, penetrating through the entire layer.
- Using a mallet, tap the sides of the mold 10-15 times after each layer has been rodded or vibrated.

- Strike off the top with the rod, a float, or a trowel to insure a flat and level surface and cover with the lid.

Storing and Transporting Cylinders

- Carefully move cylinder molds by supporting the bottom.

REFERENCES:

ACI 301-16, Specifications for Structural Concrete, American Concrete Institute, Farmington Hills, MI, 2016, www.concrete.org/store/301-16

ACI 318-19, Building Code Requirements for Structural Concrete and Commentary, American Concrete Institute, Farmington Hills, MI, 2019, <https://www.concrete.org/store/318-19>

ASTM C31/C31M-18b Standard Practice for Making and Curing Concrete Test Specimens in the Field, ASTM International, West Conshohocken, PA, 2018, www.astm.org/C31

ASTM C172/C172M-17 Standard Practice for Sampling Freshly Mixed Concrete, ASTM International, West Conshohocken, PA, 2017, www.astm.org/C172

CIP 34 Making Concrete Cylinders in the Field, CIP Series, Concrete In Practice, NRMCA, Silver Spring, MD, www.nrmca.org/.../cip/

- Cylinders must be placed on a flat, level surface, and in a controlled environment. The temperature must be between 60-80°F, unless specifications require strengths greater than 6,000 psi. Then the cylinders must be between 68-78°F.
- Specimens must not lose moisture. Submerging cylinders completely in water is the preferred method to ensure reliable test results. Temperature in storage, regardless of the storage environment, must be maintained using heating and cooling methods as necessary. A min/max thermometer or other accepted temperature monitoring device shall be used, and results reported.



Cylinders must be protected from direct sunlight, excessive heat, freezing temperatures and moisture loss.

- Cylinders should not be moved or transported for at least 8 hours after final set or 16 hours after casting. Cylinders must be transported to the testing laboratory within 48 hours of casting unless otherwise specified.
- During transportation:
 - Keep specimens from jarring.
 - Keep in an upright position.
 - Protect the specimens
 - Transportation time must not exceed 4 hours.

DISCLAIMER

Contact with wet (unhardened) concrete, mortar, cement, or cement mixtures can cause SKIN IRRITATION, SEVERE CHEMICAL BURNS (THIRD-DEGREE), or SERIOUS EYE DAMAGE. Frequent exposure may be associated with irritant and/or allergic contact dermatitis. Wear waterproof gloves, a long-sleeved shirt, full-length trousers, and proper eye protection when working with these materials. If you have to stand in wet concrete, use waterproof boots that are high enough to keep concrete from flowing into them. Wash wet concrete, mortar, cement, or cement mixtures from your skin immediately. Flush eyes with clean water immediately after contact. Indirect contact through clothing can be as serious as direct contact, so promptly rinse out wet concrete, mortar, cement, or cement mixtures from clothing. Seek immediate medical attention if you have persistent or severe discomfort.



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