T 309

TEMPERATURE OF FRESHLY MIXED PORTLAND CEMENT CONCRETE

FOP FOR AASHTO

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01

Significance

Concrete temperature is one of the most important factors influencing the quality, time of set and strength of concrete. Without control of concrete temperature, predicting the concrete's performance is very difficult, if not impossible. Concrete with a high initial temperature will probably have higher than normal early strength and lower than normal ultimate strength. Overall quality of the concrete will also probably be lowered. Conversely, concrete placed and cured at low temperatures will develop strength at a slower rate, but ultimately will have higher strength and be of a higher quality.

02

The temperatures of concrete and of the air are used to determine the type of curing and protection that will be needed, as well as the length of time curing and protection should be maintained. Ideally, concrete temperature will be between 50 and 90°F during placement, and agency specifications may prohibit placement when air temperature is low, say below 36°F or high, say above 90°F. Controlling concrete temperature and limiting placement to certain air temperatures will reduce or eliminate many problems, including those associated with strength development and durability.

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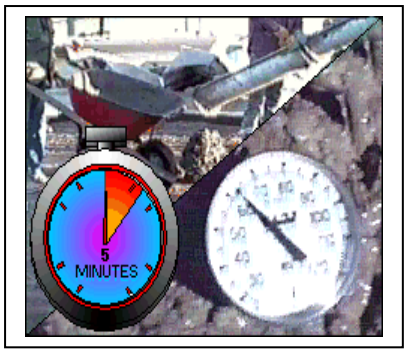
Scope

This procedure covers the determination of the temperature of freshly mixed portland cement concrete in accordance with AASHTO T 309.

Warning—Fresh Hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.



Temperature apparatus

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Apparatus

- Container — The container shall be made of nonabsorptive material and large enough to provide at least 3 in. of concrete in all directions around the sensor; concrete cover must also be at least three times the nominal maximum size of the coarse aggregate.
- Temperature Measuring Device — The temperature-measuring device shall be calibrated and capable of measuring the temperature of the freshly mixed concrete to ±1°F throughout the temperature range likely to be encountered. Partial immersion liquid-in-glass thermometers (and possibly other types) shall have a permanent mark to which the device must be immersed without applying a correction factor.
- Reference Temperature Measuring Device — The reference temperature measuring device shall be a liquid-in-glass thermometer readable to 0.5°F that has been verified and calibrated. The calibration certificate or report indicating conformance to the requirements of ASTM E 77 shall be available for inspection.

Calibration of Temperature Measuring Device

Each temperature measuring device shall be verified for accuracy annually and whenever there is a question of accuracy. Calibration shall be performed by comparing readings on the temperature measuring device with another calibrated instrument at two temperatures at least 27°F apart.

5 Minutes!

Sample Locations and Times

06 The temperature of freshly mixed concrete may be measured in the transporting equipment, in forms, or in sample containers, provided the sensor of the temperature measuring device has at least 3 in. of concrete cover in all directions around it.

07 Complete the temperature measurement of the freshly mixed concrete within 5 minutes of obtaining the sample.

Concrete containing aggregate of a nominal maximum size greater than 3 in. may require up to 20 minutes for the transfer of heat from the aggregate to the mortar after batching.

Procedure

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1. Dampen the sample container.
2. Obtain the sample in accordance with the FOP for WAQTC TM 2.

   Note: If temperature is measured in the forms or transporting equipment, sampling according to TM 2 may not be required unless other tests are to be performed.

Pressing concrete around sensing device

09

3. Place sensor of the temperature measuring device in the freshly mixed concrete so that it has at least 3 in. of concrete cover in all directions around it.
4. Gently press the concrete in around the sensor of the temperature measuring device at the surface of the concrete so that air cannot reach the sensor.
5. Leave the sensor of the temperature measuring device in the freshly mixed concrete for a minimum of two minutes, or until the temperature reading stabilizes.
6. Complete the temperature measurement of the freshly mixed concrete within 5 minutes of obtaining the sample.
7. Read and record the temperature to the nearest 1°F.

10

Report

Results shall be reported on standard forms approved for use by the agency. Record the measured temperature of the freshly mixed concrete to the nearest 1°F.

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Tips!

- Complete within 5 minutes of obtaining sample.
- Use calibrated temperature measuring device.
- Ensure that the sensor is surrounded by concrete, not air.
- Allow time for temperature to stabilize.

REVIEW QUESTIONS

1. Why is the temperature of concrete generally taken?

2. Summarize the specifications for the temperature measuring device.

3. The temperature measuring device shall be calibrated _____, or whenever there is a question of _____.

4. What special procedures are required when taking the temperature of concrete containing coarse aggregate over 3”?

5. After the temperature of the concrete is read, what is then required?

PERFORMANCE EXAM CHECKLIST

TEMPERATURE OF FRESHLY MIXED CONCRETE
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Participant Name _____ Exam Date _____

Record the symbols "P" for passing or "F" for failing on each step of the checklist.

Procedure Element	Trial 1	Trial 2
1. Obtain sample of concrete large enough to provide a minimum of 3" of concrete cover around sensor in all directions?	_____	_____
2. Place temperature measuring device in sample with a minimum of 3" cover around sensor?	_____	_____
3. Gently press concrete around thermometer?	_____	_____
4. Read temperature after a minimum of 2 minutes or when temperature reading stabilizes?	_____	_____
5. Complete temperature measurement within 5 minutes of obtaining sample?	_____	_____
6. Record temperature to nearest 1°F?	_____	_____

Comments: First attempt: Pass ☐ Fail ☐ Second attempt: Pass ☐ Fail ☐

_____
_____
_____
_____
_____
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Examiner Signature _____WAQTC #:_____

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