

Operator Qualifications for Determining F-Numbers

Q. *We are a large concrete contractor whose primary scope of work is to furnish and install (that is, pump, place, and finish) commercial and residential random-traffic floor slabs. Our concrete finishing scope is supervised and performed by ACI-certified Concrete Flatwork Finishers in accordance with ACI 301-20, Section 5.3.4.1.¹ A testing agency hired by the owner continuously evaluates our work for contract compliance by inspection and testing in accordance with appropriate ACI specifications and ASTM International standards. These ASTM International standard test methods cover everything from measuring slump (ASTM C143/C143M-20²) to determining flatness and levelness of random-traffic floor slabs (ASTM E1155-20³).*

ACI 301-20, Section 1.7.3.1, requires the owner's testing agencies performing specified tests of concrete materials to meet the requirements of ASTM C1077-17.⁴ These requirements include other ASTM International standards and ACI certification for field and laboratory testing but don't include ASTM E1155 or any certifications for that testing. Other ACI documents such as ACI 117-10,⁵ ACI 311.4R-05,⁶ and ACI 311.7-18⁷ are also silent on this topic.

On a recent project, we challenged the testing agency's floor flatness/levelness test results after performing companion testing by using our measuring device on the same sample measurement lines. Our device operator was trained and duly certified by the device manufacturer. As it turned out, the testing agency operator had been "legacy trained" by other inspectors, not trained or certified by the device manufacturer. The shortcomings of such on-the-job legacy training have been described in the literature: "Too often as one operator teaches another operator how to perform F-number measurements, some of the finer points shown in the manufacturer's operating manual are overlooked."⁸ In our case, the F-number test result differences were significant and potentially costly.

When challenged, the owner's testing agency told us that ASTM E329-21 allows legacy training because it constitutes the "on-the-job training" cited in Section 6.2.6 Inspector or

Technician: "This person shall have sufficient education and on-the-job training or trade school training to properly perform the inspection or test to which the person is assigned."⁹

Is the owner's testing agency's position correct regarding legacy training?

A. To answer this, we reviewed the industry standards, test methods, and specifications where one would reasonably expect to find requirements for mandatory device operator training or certification. All such documents are currently silent on training, qualifications, or certification for operators determining F-numbers.

Even though the owner's testing agency cited ASTM E329-21, Section 6.2.6, it didn't provide the entire paragraph. Two additional sentences add perspective: "This person must be able to demonstrate competence for the test or inspection that is being conducted either by oral or written examination, or both. Certification as appropriate for the services being performed, or certification by other qualified national authorities as appropriate to the service, shall be considered as one means of documenting competency."⁹

We don't believe the testing agency has met the full intent of this paragraph. First, the testing agency indicated only on-the-job training—no educational component was described. Second, on-the-job training does not "demonstrate competence" by "oral or written examination, or both." Third, while there are no national authorities providing third-party accreditation for this test, the device manufacturers do provide training and certification in the use of their devices in accordance with ASTM E1155.

Although testing of F-numbers is not a life safety or

Questions in this column were asked by users of ACI documents and have been answered by ACI staff or by a member or members of ACI technical committees. The answers do not represent the official position of an ACI committee. Comments should be sent to keith.tosolt@concrete.org.

building code issue, such testing is performed to determine and enforce specification compliance. For that reason, mandatory certification is a rational requirement that should be incorporated into appropriate industry standards such as ACI 301, ASTM C1077, and AIA MasterSpec, Section 033000 Cast-in-Place Concrete.¹⁰

Quality Assurance Specifications

Quality assurance specifications are procedures that assure that proposed materials, fabrication, and installation strategies meet contract requirements. Standards and tests are specified to ensure construction and testing meet specific requirements. Quality assurance specifications from 2021 AIA MasterSpec, Section 033000 Cast-in-Place Concrete, are provided in the following. The sentence in bold font is added to illustrate how to include a quality assurance specification for qualified operators performing F-number testing:

“1.6 Quality Assurance

D. Field Quality-Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1^[11] or an equivalent certification program.”¹⁰

2. Personnel conducting testing in accordance with ASTM E1155 to be certified by the device manufacturer.

Of course, an accompanying provision should be added to AIA MasterSpec, Section 1.5 Informational Submittals, to ensure submittal and verification of the manufacturer’s certification. One national floor consultant recommends a similar approach in project specifications.¹²

Contractor Bid Qualification

In the interim, we recommend contractors qualify their bid proposals to accept F-number testing for specification compliance only if the operator is certified by the device manufacturer. Such training and certification programs can be found at the following links:

- The Dipstick® at <https://dipstick.com/f-number-school-info/>;
- D-Meter and F-Meter at <https://allenface.com/f-number-technician-classes/>; and
- Axiom 1155 at www.axiom1155.com/training.

Employ Preconstruction Conference

Lastly, ASTM E1155, Section 6, Note 3, states “all project participants should agree on the exact test apparatus to be used prior to the application of this test method for contract

specification enforcement.”³ The preconstruction conference specified in ACI 301-20, Section 1.6.1, would be the appropriate time for all stakeholders to confirm all personnel (contractors and inspectors) are properly trained and certified to perform the work.

References

1. ACI Committee 301, “Specifications for Concrete Construction (ACI 301-20),” American Concrete Institute, Farmington Hills, MI, 2020, 69 pp.
2. ASTM C143/C143M-20, “Standard Test Method for Slump of Hydraulic-Cement Concrete,” ASTM International, West Conshohocken, PA, 2020, 4 pp.
3. ASTM E1155-20, “Standard Test Method for Determining F_f Floor Flatness and F_L Floor Levelness Numbers,” ASTM International, West Conshohocken, PA, 2020, 8 pp.
4. ASTM C1077-17, “Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation,” ASTM International, West Conshohocken, PA, 2017, 9 pp.
5. ACI Committee 117, “Specification for Tolerances for Concrete Construction and Materials and Commentary (ACI 117-10) (Reapproved 2015),” American Concrete Institute, Farmington Hills, MI, 2010, 81 pp.
6. ACI Committee 311, “Guide for Concrete Inspection (ACI 311.4R-05),” American Concrete Institute, Farmington Hills, MI, 2005, 13 pp.
7. ACI Committee 311, “Specification for Inspection of Concrete Construction (ACI 311.7-18),” American Concrete Institute, Farmington Hills, MI, 2018, 8 pp.
8. McCall, C.; Smith, R.; Suprenant, B.A.; and Tipping, E., “Common Problems with F-number Measurements,” *Concrete Construction*, Jan. 15, 2003, 4 pp.
9. ASTM E329-21, “Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection,” ASTM International, West Conshohocken, PA, 2021, 11 pp.
10. “AIA MasterSpec, Section 03 30 00 Cast-In-Place Concrete,” The American Institute of Architects (AIA), Washington, DC, 2021.
11. “ACI Certification Program Policy: Concrete Field Testing Technician - Grade I (ACI CPP 610.1-18),” American Concrete Institute, Farmington Hills, MI, 2018, 15 pp., www.concrete.org/Portals/0/Files/PDF/cpp_6101-18.pdf.
12. Walker, W.W.; Holland, J.A.; Bentley, C.L. Sr.; Tipping, E.G.; Smith, R.E.; and Birdwell, B.M., “Floor Flatness and Levelness Testing - The Complete Specification,” *Engineering Bulletin*, Structural Services, Inc., Oct. 11, 2018, 4 pp., www.ssiteam.com/uploads/collections/Floor_Flatness_and_Levelness_Testing_-_The_Complete_Specification2.pdf.

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