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An American National Standard

Standard Practice for Conducting an Interlaboratory Study to Determine Precision Estimates for a Fire Test Method with Fewer Than Six Participating Laboratories[1]

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1. Scope

1.1 This practice describes the techniques for planning, conducting, analyzing, and treating results of an interlaboratory study (ILS) for estimating the precision of a fire test method when fewer than six laboratories are available to meet the recommended minimum requirements of Practice E691. Data obtained from an interlaboratory study are useful in identifying variables that require modifications for improving test method performance and precision.

1.2 Precision estimates developed using this practice will not be statistically equivalent to precision estimates produced by Practice E691 because a small number of laboratories are used. The smaller number of participating laboratories will seriously reduce the value of precision estimates reported by this practice. However, under circumstances where only a limited number of laboratories are available to participate in an ILS, precision estimates developed by this practice will provide the user with useful information concerning precision for a test method.

1.3 A minimum of three qualified laboratories is required for conducting an ILS using this practice. If six or more laboratories are available to participate in an ILS for a given fire test method, Practice E691 shall be used for conducting the ILS.

1.4 Since the primary purpose of this practice is the development of the information needed for a precision statement, the experimental design in this practice will not be optimum for evaluating all materials, test methods, or as a tool for individual laboratory analysis.

1.5 Because of the reduced number of participating laboratories a Laboratory Monitor shall be used in the ILS. See Standard Guide E2335.

1.6 *Field of Application*—This practice is concerned with test methods that yield numerical values or a series of numerical values for different fire-test response properties. The numerical values mentioned above are typically the result of calculations from a set of measurements.

1.7 This practice includes design information suitable for use with the development of interlaboratory studies for test methods that have categorization (go-no-go) allocation test results. However, it does not provide a recommended statistical practice for evaluating the go-no-go data.

1.8 This fire standard cannot be used to provide quantitative measures.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards*:[2]

E176 Terminology of Fire Standards

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E178 Practice for Dealing With Outlying Observations

[1] This practice is under the jurisdiction of ASTM Committee E05 on Fire Standards and is the direct responsibility of Subcommittee ~~E05.15~~E05.31 on ~~Furnishings and Contents~~Terminology and Services / Functions.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

E456 Terminology Relating to Quality and Statistics
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
E1169 Practice for Conducting Ruggedness Tests
E2335 Guide for Laboratory Monitors

3. Terminology

3.1 *Definitions*—For formal definitions of statistical terms, see Terminology E456. For formal definitions of fire terms, see Terminology E176.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 ~~*test*~~*protocol, ~~method~~ n—~~and protocol—~~in this practice*, ~~the term "test method" is used both for the actual measurement process and for the written description of the process, while the term "protocol" is used for the~~ directions given to the laboratories for conducting the ~~ILS.~~interlaboratory study (ILS).

3.2.2 *repeatability (of results and ~~reproducibility—~~measurements), n—*~~these terms deal with the variability of test results obtained under specified laboratory conditions. Repeatability concerns the variability between independent test results obtained within a single laboratory in the shortest practical period of time by a single operator with a specific set of test apparatus using test specimens (or test units) taken at random from a single quantity of homogeneous material obtained or prepared for the ILS. Reproducibility deals with the variability between single test results obtained in different laboratories, each of which has applied the test method to test specimens (or test units) taken at random from a single quantity of homogeneous material obtained or prepared for the ILS.~~quantitative expression of the random error associated with successive measurements of the same measurand carried out subject to all of the following conditions: the same measurement procedure, the same observer, the same measuring instrument, used under the same conditions, the same location, and repetition over a short period of time.

3.2.2.1 *Discussion—*

Repeatability deals with results in a single laboratory while reproducibility deals with results obtained in different laboratories.

3.2.3 *reproducibility (of results of measurements), n*—quantitative expression of the random error associated with successive measurements of the same measurand carried out by operators working in different laboratories, each obtaining single results on identical test material when applying the same method.

3.2.3.1 *Discussion—*

Repeatability deals with results in a single laboratory while reproducibility deals with results obtained in different laboratories.

3.2.4 *test method, n—in this practice*, description of the actual measurement process as well as written description of the process.

3.3 For further discussion of the terms discussed above, see Practice E177 and the formal definitions in Terminology E456.

4. Summary of Practice

4.1 The procedure presented in this practice consists of three basic steps: planning the interlaboratory study, guiding the testing phase of the study, and analyzing the test result data. The analysis evaluates the consistency of the data through the use of numerical estimates of precision of the test method pertaining to both within-laboratory repeatability and between-laboratory reproducibility.

4.2 Planning of the interlaboratory study will include a review of the test procedure to be used in the interlaboratory study. This review will identify portions of the test method that appear to contribute to a loss in precision. Special interlaboratory instructions or modifications to the test method wording are made as needed to clarify these sections and often result in a modification to the test method following the interlaboratory study.

4.3 A manager for the interlaboratory study and an interlaboratory test monitor shall be selected. The same person is allowed to conduct both functions.

4.4 Parties conducting an interlaboratory precision study of a test method will acquire participation agreements with as many laboratories as possible that are willing to take part in the interlaboratory study and have the capability to run the test method of interest. A minimum of three laboratories shall participate in the precision study. Precision results will increase in quality with a larger number of participating laboratories.

4.5 The types of materials and number of test specimens shall be selected for the interlaboratory study. No less than three test specimens shall be selected for the interlaboratory study, and they shall be selected to reflect the range of performance of test specimens normally evaluated by the test method. A minimum of three replicates shall be tested for each test material selected. If a standard reference material is available for the test method, the material shall be included as a specimen in the interlaboratory

study. If a standard reference material is not available, a test specimen that consistently produces low variability test results shall be selected as a reference material for the interlaboratory study.

5. Significance and Use

5.1 ASTM regulations require precision statements in all test methods in terms of repeatability and reproducibility. This practice is used when the number of participating laboratories or materials being tested, or both, in a precision study is less than the number specified by Practice E691. When possible, it is strongly recommended that a full E691 standard protocol be followed to determine test method precision. Precision results produced by the procedures presented in this standard will not have the same degree of accuracy as results generated by a full E691 protocol. This procedure will allow for the development of useful precision results when a full compliment of laboratories is not available for interlaboratory testing.

5.2 This practice is based on recommendations for interlaboratory studies and data analysis presented in Practice E691. This practice does not concern itself with the development of test methods but with a standard means for gathering information and treating the data needed for developing a precision statement for a fire test method when a complete E691 interlaboratory study and data analysis are not possible.

PLANNING THE ILS

6. Planning

6.1 *Task Group*—Either the task group that developed the test method or a special task group appointed for the purpose must have overall responsibility for the ILS, including funding where appropriate, staffing, the design of the ILS, and decision-making with regard to questionable data. The task group shall decide on the number of laboratories, materials, and test results for each material. In addition, it shall specify any special calibration procedures and the repeatability conditions to be specified in the protocol.

6.2 *ILS Coordinator*—The task group must appoint one individual to act as overall coordinator for conducting the ILS. The coordinator will supervise the distribution of materials and protocols to the laboratories and receive the test result reports from the laboratories. Scanning the reports for gross errors and checking with the laboratories, when such errors are found, will also be the responsibility of the coordinator. The coordinator will consult as needed with a statistician in questionable cases.

6.3 *Laboratory Monitor*—The task group must appoint one individual to act as a laboratory monitor for the ILS. The laboratory monitor will develop an ILS checklist specific to the test method, inspect the test laboratories for equipment conformity and operator training, verify compatibility of the data acquisition system, and based on the Checklist and inspection results report to the sponsoring ASTM Subcommittee. Complete details for the function of a laboratory monitor are located in Guide E2335.

6.4 *Statistician*—The task group shall obtain the assistance of a person skilled in the use of statistical procedures, the test method being studied, and with the materials being tested in order to ensure that the requirements in this practice are met in an efficient and effective manner. This person will conduct the data analysis using procedures given in this standard and will assist the task group in interpreting results from the data analysis.

7. Basic Design

7.1 Keep the ILS design simple in order to obtain estimates of within-and between-laboratory variability that are free of secondary effects. The basic design is represented by a two-way classification table in which the rows represent the laboratories, the columns represent the materials, and the cell (the intersection of a row and column) contains the test results made by a particular laboratory on a particular material (see Table 1).

TABLE 1 Example, ILS Test Result Data

Laboratory	A	B	C	D	E
1	35.3	31.2	38.9	34.0	27.2
	34.0	31.0	35.0	35.5	31.1
	35.5	35.1	50.8	63.1	27.3
2	10.7	12.9	20.6	19.9	15.0
	12.7	15.0	8.0	16.2	8.2
	13.3	12.2	16.2	8.1	12.3
3	36.0	28.0	32.1	32.1	25.1
	36.0	32.1	36.0	32.0	25.0
	29.0	28.0	32.2	32.0	21.2
4	40.9	36.8	32.8	36.7	24.5
	36.7	32.7	28.6	32.7	24.4
	28.6	32.7	32.6	32.7	28.5
5	41.6	37.6	33.2	41.6	29.0
	41.7	25.1	29.2	37.5	29.1
	46.0	29.3	29.0	37.3	29.2