ndard Specifications for Fire Tests

of

Building Materials and Construction

Report of

Committee on Fire-resistive Construction

1918

NATIONAL FIRE PROTECTION ASSOCIATION
FRANKLIN H. WENTWORTH, Secretary
87 MILK STREET, BOSTON, MASS.

National Fire Protection Association

Executive Office, 87 Milk Street, Boston, Mass.

Franklin H. Wentworth, Secretary

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Members.

American Institute of Architects.
American Institute of Consulting Engineers.
American Institute of Electrical Engineers.
American Institute of Mining Engineers.
American Ceramic Society.
American Gas Institute.
American Electric Railway Association.
Arkansas Actuarial Bureau.
Associated Factory Mutual Fire Insurance Co's. Inspection Bureau.
Associated Manufacturers of Electrical Supplies.
Associated Metal Lath Manufacturers.
Association of Edison Illuminating Companies.
Association of Fire Underwriters of Baltimore City.
Board of Fire Underwriters of Allegheny County.
Board of Fire Underwriters of the Pacific.
Board of Fire Underwriters of the Territory of Hawaii.
Boston Board of Fire Underwriters.
Buffalo Association of Fire Underwriters.
Bureau of Explosives.
Canadian Fire Underwriters' Association.
Canadian Manufacturers' Association.
Chicago Board of Underwriters of Chicago.
Clay Products Association.
Committee of Manufacturers on Standardization of Fittings and Valves.
Compressed Gas Manufacturers' Association.
Cotton Insurance Association.
Electrical Supply Jobbers' Association.
Factory Insurance Association.
Factory Mutual Laboratories.
Fire Prevention Bureau of the Pacific.
Fire Underwriters' Electrical Bureau.
Florida Fire Prevention Society.
Gas Products Association.
Gypsum Industries Association.
Illinois Inspection Bureau.
Illinois State Fire Prevention Association.
Indiana Inspection Bureau.
Indiana State Fire Prevention Association.
Institute of Makers of Explosives.
Insurance Association of Providence.
International Acetylene Association.
International Association of Fire Engineers.
International Association of Municipal Electricians.
Iowa Insurance Service Bureau.
Iowa State Fire Prevention Association.
Kansas Inspection Bureau.
Kentucky Actuarial Bureau.
Kentucky State Insurance Board.
Louisiana Fire Prevention Bureau.
Louisiana State Society for the Reduction of Fire Waste.
Mainland Fire Underwriters' Association of British Columbia.
Massachusetts Mutual Farm Inspection Bureau.
Massachusetts Mutual Fire Insurance Union.
Michigan Inspection Bureau.
Michigan State Fire Prevention Association.
Millers' National Federation.
Mississippi Inspection and Advisory Rating Company.
Mississippi Society for the Prevention of Fires.
Missouri Inspection Bureau.
Mutual Fire Prevention Bureau.
National Association of Building Owners and Managers.
National Association of Credit Men.
National Association of Electrical Contractors and Dealers.
National Association of Electrical Inspectors.
National Association of Insurance Agents, The
National Association of Manufacturers of Approved Hollow Metal Window Frames and Sash.
National Association of Manufacturers of United States.
National Association of Master Gravel and Slag Roofers of America.
National Association of the Motion Picture Industry, Inc.
National Association of Sheet Metal Contractors of United States.
National Automatic Sprinkler Association.
National Board of Fire Underwriters.
National Commercial Gas Association.
National Convention of Insurance Commissioners.
National Electric Light Association.
National Implement and Vehicle Association.
National Lumber Manufacturers' Association.
National Paint, Oil and Varnish Association.
National Warm Air Heating and Ventilating Association.
National Wholesale Druggists' Association.
National Wholesale Grocers' Association.
Nebraska Inspection Bureau.
New Brunswick Board of Fire Underwriters.
New England Bureau of United Inspection.
New England Insurance Exchange.
New Hampshire Board of Underwriters.
New Jersey Schedule Rating Office.
New York Board of Fire Underwriters.
New York Fire Insurance Exchange.
Newfoundland Board of Fire Underwriters.
North Carolina Fire Prevention Association.
Nova Scotia Board of Fire Underwriters.
Ohio Inspection Bureau.
Ohio State Fire Prevention Association.
Oklahoma Inspection Bureau.
Philadelphia Fire Underwriters' Association.
Philadelphia Suburban Underwriters' Association.
Portland Cement Association.
Rocky Mountain Fire Underwriters' Association.
Society Advocating Fire Elimination.
Society of Motion Picture Engineers.
South Dakota State Fire Prevention Association.
Southern Cypress Manufacturers' Association.
South-Eastern Underwriters' Association.
St. Louis Fire Prevention Bureau.
Suburban Fire Insurance Exchange.
Tennessee Fire Prevention Association.
Tennessee Inspection Bureau.
Texas State Fire Insurance Commission.
The Union.
Underwriters' Association of the District of Columbia.
Underwriters' Association of the Middle Department.
Underwriters' Association of New York State.
Underwriters' Bureau of Middle and Southern States.
Underwriters' Bureau of New England.
Underwriters' Laboratories.
Underwriters' Service Association.
Vancouver Island Fire Underwriters' Association.
Water Works Manufacturers' Association.
Western Actuarial Bureau (Fire).
Western Canada Fire Underwriters' Association.
Western Canada Grain Association.
Western Factory Insurance Association.
Western Insurance Bureau.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.
Wisconsin State Fire Prevention Association.

Report of Committee on Fire-resistive Construction.

Fire Tests.

The Committee, realizing the importance of having standards established as nearly as possible in harmony with the ideas of all investigators in the same line of work, undertook the assembly of a joint conference of technical societies interested in the subject. This effort was eminently successful, and the specifications herewith presented as a part of this Committee's Report were drafted by the Joint Conference composed of representatives from the following national technical organizations:—

National Fire Protection Association.
American Society for Testing Materials.
U. S. Bureau of Standards.
National Board of Fire Underwriters.
Underwriters' Laboratories.
Associated Factory Mutual Fire Insurance Companies.
American Institute of Architects.
American Concrete Institute.
American Society of Mechanical Engineers.
American Society of Civil Engineers.
Canadian Society of Civil Engineers.

These Specifications were presented for consideration in tentative form in 1917, and were finally adopted by the Association in their present form in 1918.

The Specifications are in official use in the control of fire tests at the Underwriters' Laboratories and by the U. S. Bureau of Standards. They have also been formally endorsed by the American Society for Testing Materials, American Society of Mechanical Engineers, American Concrete Institute, National Board of Fire Underwriters, and the Associated Factory Mutual Fire Insurance Companies, and will be presented for letter ballot, or other final action, in due course of procedure in those organizations. They will be presented to the other co-operating societies at their next regular meeting.

The value of having these Specifications issued with such endorsements can hardly be over-estimated. It means that henceforth official fire tests in any part of the country in order to receive recognition by any or all of the above named technical organizations, must be conducted in accordance with these Standard Specifications. It is, therefore, apparent that they must eventually become the measure of performance for tests made to demonstrate the merits of a particular building material or form of construction for a municipality. That would remove much of the confusion and uncertainty which has frequently resulted from such tests. Incidentally, it will be of financial advantage to the person or company having a test made, for a test conducted under these Specifications by any competent disinterested experts, properly reported and attested, should be authoritative and acceptable everywhere.

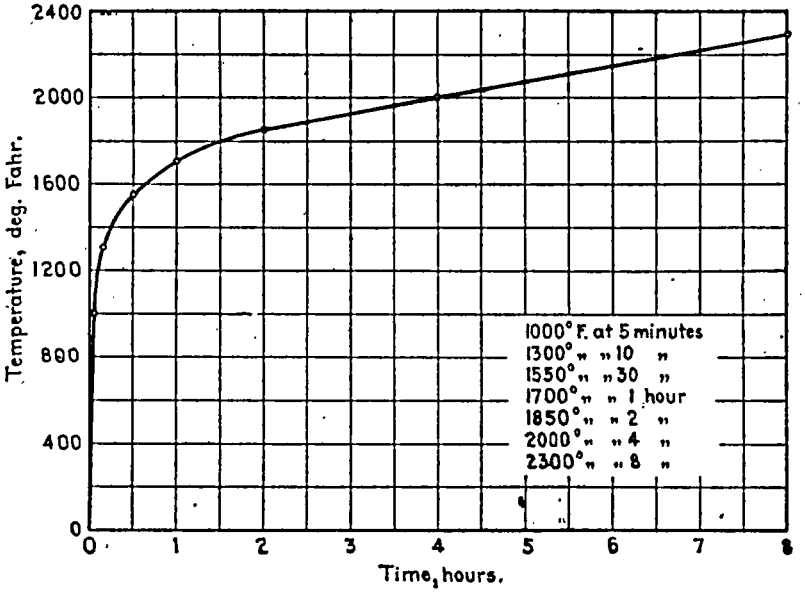

Fig. 1. Standard Time Temperature Control Curve for Fire Tests.

Control of Fire Tests.

Time-Temperature Curve.

1. The conduct of fire tests of materials and construction shall be controlled by the standard time-temperature control curve shown in Fig. 1. The points on the curve which determine its character are,

1000° F. at 5 minutes,
1300° F. at 10 minutes,
1550° F. at 30 minutes,
1700° F. at 1 hour,
1850° F. at 2 hours,
2000° F. at 4 hours,
2300° F. at 8 hours.

Determination of Temperatures.

2. (a) The temperature fixed by the curve shall be deemed to be the average true temperature of the furnace gases as obtained from the readings of several thermo-couples (not less than three) symmetrically disposed and distributed in such a manner as to show the temperatures of the gases near all parts of the sample.

(b) The temperatures shall be read at intervals not exceeding 5 minutes during the first hour, and thereafter the intervals may be increased to not more than 15 minutes.

Classification as Determined by Test.

3. Fire-resistive materials and construction shall be classified in accordance with the degree of protection they afford when measured by a fire test conducted in conformity with the standard time-temperature control curve as,

4 hour protection,
2 hour protection,
1 hour protection,
½ hour protection,
¼ hour protection.

Other classes may be interpolated or added as needed.

Test Structures.

4. (a) The test structure may be located at any place where all the necessary facilities for properly conducting the test are provided.

(b) Entire freedom is left to each investigator in the design of his test structure and the nature and use of fuel, so long as the test requirements are met.

Test Sample.

5. The material or construction constituting the test sample shall be truly representative of regular practice.

Conduct of Tests.

Fire Test.

6. The fire test on the sample with its applied load, if any, shall be continued until failure occurs or until it has withstood the test conditions for a period equal to one and one-fourth times that for which classification is desired.

Fire Stream Test.

7. A second test with duplicate sample shall be made to determine the effect of a hose stream on a sample under fire test, the water being applied at the end of a period equal to three-fourths of that for which classification is desired, but not later than one hour after the beginning of the test, except that for classification periods of one-half hour or less the fire stream test may be omitted.

Application of Water.

8. The size of nozzle, water pressure and time of water application shall be as indicated in Table I. The hose stream shall be first directed at the middle of the sample and then at all parts of the exposed faces, changes in direction being made slowly.

TABLE I.

Parts of Structure	Type of Protection	Size of Hose Nozzle in.	Water Pressure at Nozzle lb.	Time of Application min.
Floors and Roofs	4 hour	1⅛	50	10
	2 "	"	50	5
	1 "	"	50	2.5
	½ "	"	30	1
	¼ "	"	15	1
Walls, Columns and Partitions	4 "	"	50	5
	2 "	"	30	3
	1 "	"	30	2.5
	½ "	"	30	1
	¼ "	"	15	1

Loading.

9. For any material or construction intended to carry load other than its own weight, the full rated safe working load shall be applied during the entire fire test, also during the fire stream test. After completion of the fire stream test, the sample shall be subjected to excess loading as prescribed under specifications for the different structural parts.

Floor and Roof Tests.

Size of Sample. 10. For floor and roof tests the sample shall be of such a size that the minimum span of the supporting beams of the floor arch shall be twelve feet, and the supporting beams and girders shall have a clearance of at least eight inches from the walls of the test structure.

Time of Testing. 11. The floor may be tested as soon after construction as desired, but within forty days. Artificial drying will be allowed if desired.

Plastering. 12. If the construction is to be plastered in practice, the sample shall be plastered in the same manner.

Loading. 13. The floor shall be loaded in a manner to develop in each member of the construction stresses equal to the maximum safe working stress allowed in the material of the member.

Requirements. 14. The test shall not be regarded as successful unless the following conditions are met:—

(a) The floor or roof shall have sustained safely the full rated safe working load during the fire test without passage of flame, for a period equal to one and one-fourth times that for which classification is desired.

(b) The floor or roof shall have sustained safely the full rated safe working load during the fire stream test as prescribed by Sections 7 and 8 without passage of flame, and after its completion shall sustain a total load equal to the dead load plus two and one-half times the designed live load.

Non-Bearing Partition Tests.

Size of Sample. 15. For partition tests the area of the sample shall be not less than 100 square feet and no dimension less than 9 feet.

Determination of Temperatures. 16. Temperatures on the outer surface of the partition shall be read by thermometers, not less than five, symmetrically disposed and placed against the surface of the partition with their bulbs properly protected against radiation of heat.

Position of Nozzle. 17. The distance of the nozzle from the partition during the application of water shall be not more than twenty feet when the hose stream is applied approximately normal to the surface of the partition, which distance shall be reduced by one foot for each ten degrees of angle from the normal when the hose stream is applied at an angle to the surface of the partition.

Requirements. 18. The test shall not be regarded as successful unless the following conditions are met:—

(a) The partition shall have withstood safely the fire test for a period equal to one and one-fourth times that for which classification is desired.

(b) The partition shall have withstood the fire stream test as prescribed in Sections 7 and 8.

(c) No fire shall have passed through the partition during the prescribed fire periods.

(d) Transmission of heat through the partition during the prescribed fire period shall not have been such as to raise the temperature on its outer surface in excess of 300° Fahrenheit.

(e) Partition shall not have warped, bulged or disintegrated under action of fire or water to such an extent as to be unsafe.