NATIONAL BUREAU OF STANDARDS REPORT

8131

EXPERIMENTAL FIRES IN ENCLOSURES
C.I.B. TEST RESULTS

by

D. Gross

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

U. S. DEPARTMENT OF COMMERCE
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Abstract

The results of a series of model fire experiments performed under an international cooperative program are reported.

1. Introduction

Following the original suggestion by the British Joint Fire Research Organization (J.F.R.O.) in 1959, for a systematic investigation of the growth of fires in rooms using small-scale models [1], a preliminary series of tests under the sponsorship of the Working Party on Fire Research of the Conseil International du Batiment (C.I.B.) was undertaken by eight laboratories in six countries including the U. S. National Bureau of Standards [2]. The results from that series of eight tests were analyzed by J.F.R.O., who concluded that too great a variation existed between laboratories to permit the start of a larger program without more detailed specification of experimental techniques. More specific test procedures were subsequently suggested in both report form [3] and through a series of letters.

Ten laboratories in eight countries are participating in the current program and this report is the summary record of tests performed at N.B.S.

2. Experimental Procedures

2.1 Test Schedule

The testing scheme outlined in reference [3] provides for examining the effect of six parameters on the rate of burning, temperature and radiation in a compartment containing a wooden crib and a single window opening. The parameters, with the number of combinations in parentheses, were: Shape (5), Scale Size (3), Window Opening (3), Fire Load, or Quantity of Fuel (3), Fuel Dispersion (3) and Fuel Dimension (4). In addition, one laboratory was to examine the effect of wind speed in three directions.

The tests assigned to each laboratory were divided into two series. Series 1 comprised eight tests each repeated so as to provide an estimate of experimental variation and to establish a common base between laboratories. The Series 2 program assigned to NBS was considerably larger than could reasonably be handled and was deferred.

2.2 Test Compartment

The compartment was constructed according to detailed drawings provided by a cooperating laboratory, Brandveiligheidsinstituut T.N.O., Holland. It consisted of an angle steel framework and asbestos-cement sheets held together with screws (see Figure 1). An asbestos-cement board partition was used for those tests requiring a compartment only one-half the overall length of 2 meters. The width and height were 2 meters and 1 meter, respectively. A removable window assembly was constructed as a single member rather than in two halves.

The prescribed properties of the asbestos sheets were as follows:

Thickness:	0.95 cm (3/8 in.)
Density:	1.5 g/cc
Thermal Conductivity:	0.00085 cal/sec cm °C

Although an asbestos-cement board of these properties was obtained and used in the initial program in 1959, it was found to be no longer available on this continent. Therefore, and because of the severe fire exposure to which the compartment walls were to be subjected, it was considered necessary to purchase and use the currently available "Superbestos," rated by its manufacturer, Atlas Asbestos Co., Ltd., Montreal, to possess a higher degree of thermal stability during fire exposure. It had the following properties:

Thickness:	0.95 cm
Density:	0.67 g/cc
Thermal Conductivity:	0.00029 cal/sec cm °C

Severe cracking was experienced nonetheless during the first preliminary test, so that a means of patching was required. The method which proved most satisfactory and was used several times during the program, involved a light spray application of a fire-resistant gypsum plaster with perlite aggregate (avg. applied density 0.43 g/cc, thermal conductivity .00028 cal/sec cm °C.) The same plaster was also applied by trowel to fill in large cracks.

Tests were conducted only after preheating and drying of the compartment to remove moisture absorbed by the asbestos-cement sheets and the plaster. This was done by burning a minimum of 40 kg of scrap wood at the start of each day's testing and, where possible, by consecutive testing. All tests were conducted in the prescribed sequence during the period October 18 to November 4, 1963.

After the first few tests, a noticeable distortion of the window opening was observed and which remained fairly constant throughout the series. Whereas the original design opening was 48 cm, the opening became barrel-shaped and varied from approximately 48.0 cm at the top and bottom to approximately 49.5 cm near the center.

2.3 Wood Cribs

The fuel consisted of wood sticks of nominally square section arranged in cribs with a lattice-type construction. The type of wood prescribed was spruce with a density of 0.39 g/cc ± 10 percent when oven dry. The wood used was select grade Engelmann spruce (Picea engelmannii) which was smooth-sawed to size and preassembled into cribs using a thermosetting urea resin adhesive and a small quantity of nails. Details of the construction, composition and average density of each crib are given in Table 1. Cribs were conditioned to constant weight in an atmosphere controlled at 73 ± 2 F and 50 ± 5 percent rh. Prior to test, each crib was adjusted to its prescribed weight by the addition or removal of wood. The average moisture content of each crib at the time of test is also listed in Table 1. In each case, the crib weight comprised the spruce crib, the glue and the fiberboard wicks, but excluded the weight of nails and kerosene.

2.4 Weight Measurements

The tests were performed with one side of the compartment approximately 1.5 meters from the wall of a very large and essentially draft-free room. The compartment was suspended in a steel cradle so that its floor was approximately 1 meter above the building floor. The entire cradle and compartment was suspended and weighed by means of a commercial load cell of the strain gage type. In order to prevent load cell erros due to thermal effects, a cooling water jacket was placed around it. The temperature of the load cell case was monitored in all tests and never exceeded 46°C, the permissible temperature limit for complete conformance to specifications. The load cell output was adjusted to 0.0662 mv/kg (0.0300 mv/lb) and checked out perfectly before and after the test program using known weights. The millivolt output signal was digitally recorded at one minute intervals.

The compartment was levelled prior to each test and required slight relevelling (by means of sliding weights) during a few tests. No account was taken of the buoyancy effect, the magnitude of which might possibly be 4 kg for the scale 1, shape 221 compartment with 160 kg lead.

It was found in a typical test that the weight of the compartment and crib would decrease to a minimum value, corresponding to approximately 1 to 10 kg negative, and regain approximately 5 kg upon cooling to room temperature. The weight of ashes was usually between 0.2 and 0.7 kg.

2.5 Temperature Measurements

Thermocouples for indicating "ceiling" and "floor" temperatures were of 0.0508 cm (0.020 in.) diameter (B & S 24 gauge) chromel and alumel wires with asbestos and glass, silicone impregnated insulation. The beads were bare and unshielded. The thermocouples were inserted through a small hole in the top of the compartment and new thermocouples were used for each test. Temperatures were recorded directly and automatically in digital form at one minute intervals.

2.6 Radiation Measurements

Window (opening) radiation was monitored by Radiometer "H/14" for all tests and the calibration provided by J.F.R.O. (and checked at NBS) was used for conversion of millivolt output readings to intensity values in cal/sec cm^2. This radiometer was mounted on an outrigger frame attached to the compartment and at a distance of 2 meters from the compartment face for all tests. Except for the first test (NBS No.1, C.I.B. No. 1), all succeeding tests were conducted using a sheet metal screen immediately in front of the radiometer so as to minimize the contribution of radiation from flames above the window opening [4].

Flame radiation was monitored by a similar radiometer placed centrally 10 cm above the top of the compartment and in the plane of the opening. It was fabricated at NBS according to the published description [5], and its cone was blackened to reduce reflections [4]. Radiometer "R 1" was used for all tests with the exception of Test Nos. 7, 15 and 16 (NBS chronological designation), where Radiometer "R 2" was used.

Calibration curves for the three radiometers used are shown in Figure 2.

2.7 Data Recording

Data were automatically recorded in digital form by means of a scanning and recording system [6] programmed to provide a complete set of readings at one minute intervals. Since the measuring potentiometer contained two balancing slidewires, it was possible to obtain both direct temperature readings (with the use of chromel-alumel thermocouples) in the range 0 to 1400°C (±4°C accuracy) and millivolt readings in the range 0 to 14.00 mv (±0.04 mv accuracy). For those cases in which the output from the flame radiometer exceeded 14 mv, a 10 mv bucking signal was used to extend the range of the potentiometer to 24 mv.

For the scanning sequence used, the actual measuring times for each one minute cycle were as follows:

Quantity	Channel	Time min:sec
Enclosure Weight, mv	0	0:00(and each succeeding minute)
Window Radiation, mv	31	0:08 "
Flame Radiation, mv	32	0:09 "
Ceiling Temperature, °C	33	0:10 "
Floor Temperature, °C	34	0:11 "

In the listing and analysis of data, however, it was assumed that all readings were made at the time corresponding to the weight reading.

3. Results

The results of the sixteen tests performed in the prescribed sequence are listed in the standard form at the end of this report. Statistical averages were computed as requested for the time periods corresponding to 80 and 55 percent of the initial weight (80/55) and to 55 and 30 percent of the initial weight (55/30). The radiation and temperature averages were based upon the appropriate measured values at one-minute intervals, with no attempt at curve-fitting or interpolation. However, the rate of weight loss averages were based upon the interpolated 30, 55 and 80 percent times from a smooth curve drawn through the one-minute readings. Table 2 presents a summary list of all average values for the test series.

4. Observations

The following additional observations were visually noted during the test series:

The entire crib was not involved in flaming simultaneously, but rather burning proceeded from the front third, where the kerosene-soaked wicks were ignited, toward the rear. After burning had involved the front face of the crib, the increasingly taller flames were bent backwards by the inrush of air.

The normal pattern of air inflow at and near the floor level, then up and around at the rear of the compartment, and the exhaust of hot gases and flames at the ceiling level was then always obvious. However, for those tests with only 1/4 window opening, strong fire whirls were observed in the front corners of the compartment near the start of the test. These flaming vortices, which rose directly toward the ceiling and were drawn out of the window opening, lasted only until the burning had increased sufficiently to establish the normal pattern.

It was observed that with the 1/4 window opening the exiting flames and gases filled a larger portion (up to two-thirds) of the window opening than with the full open window (up to one-third). In addition, the flames extended to a greater height outside the compartment (up to 3 meters) in those tests with the 1/4 window opening.

During the major portion of those tests with the full window opening, a definite pattern of flame pulsations with accompanying "swoosh" sounds was noticed. These pulsations occurred with a frequency of approximately one per second. In both instances of a test with a 1/4 window opening (C.I.B. 3), a single rapid burst or mild explosion followed by momentarily increased flaming was observed.

The crib retained its lattice structure until almost the entire weight loss had occurred and then gradually crumbled, this again proceeding from front to rear as the charcoal glowing took place. The weight of the remaining ashes never amounted to more than one percent of the initial crib weight.

Dark, dense smoke was common to all tests, and for those tests with 80 and 160 kg cribs, the entire building of over 3000 m^3 became completely smoke-logged with visibility at eye level reduced to as little as 25 cm.

5. Acknowledgments

I am pleased to acknowledge the aid of John Klein and James Turner in the assembly of the cribs and of David Newman in the efficient performance of the tests and in the summary of the data. Edward Bender, Garnett Robinson and Melvin Womble assembled the compartment and attended to its repair and maintenance throughout.

6. References

[1] Lawson, D. I., "International Co-operation in Modelling Fires, A Suggested Programme," F.R.W.P./G.T.F. No. 59/11 (U.K.), June 1959.

[2] Gross, D., Ward, D. and Shoub, H. "Fires in Model Rooms, Results of Preliminary Experiments Under an International Cooperative Program," NBS Technical Report No. 6888, July 1960.

[3] Thomas, P. H., and Mather, J. "Proposals for Next Stage of C.I.B. Programme on Fires in Compartments," C.I.B./C.T.F. No. 61/49 (U.K.), September 1961.

[4] Letter from P. H. Thomas, dated April 2, 1962.

[5] McGuire, J. H. and Wraight, H. "A Radiometer for Field Use," J. Sci. Inst. 37, p. 128, April 1960.

[6] Gross, D., Bailey, W. H., Bender, E. W. and Robertson, A. F. "Central Furnace Control and Recording Facility," NBS Technical Report No. 7015, November 1960.

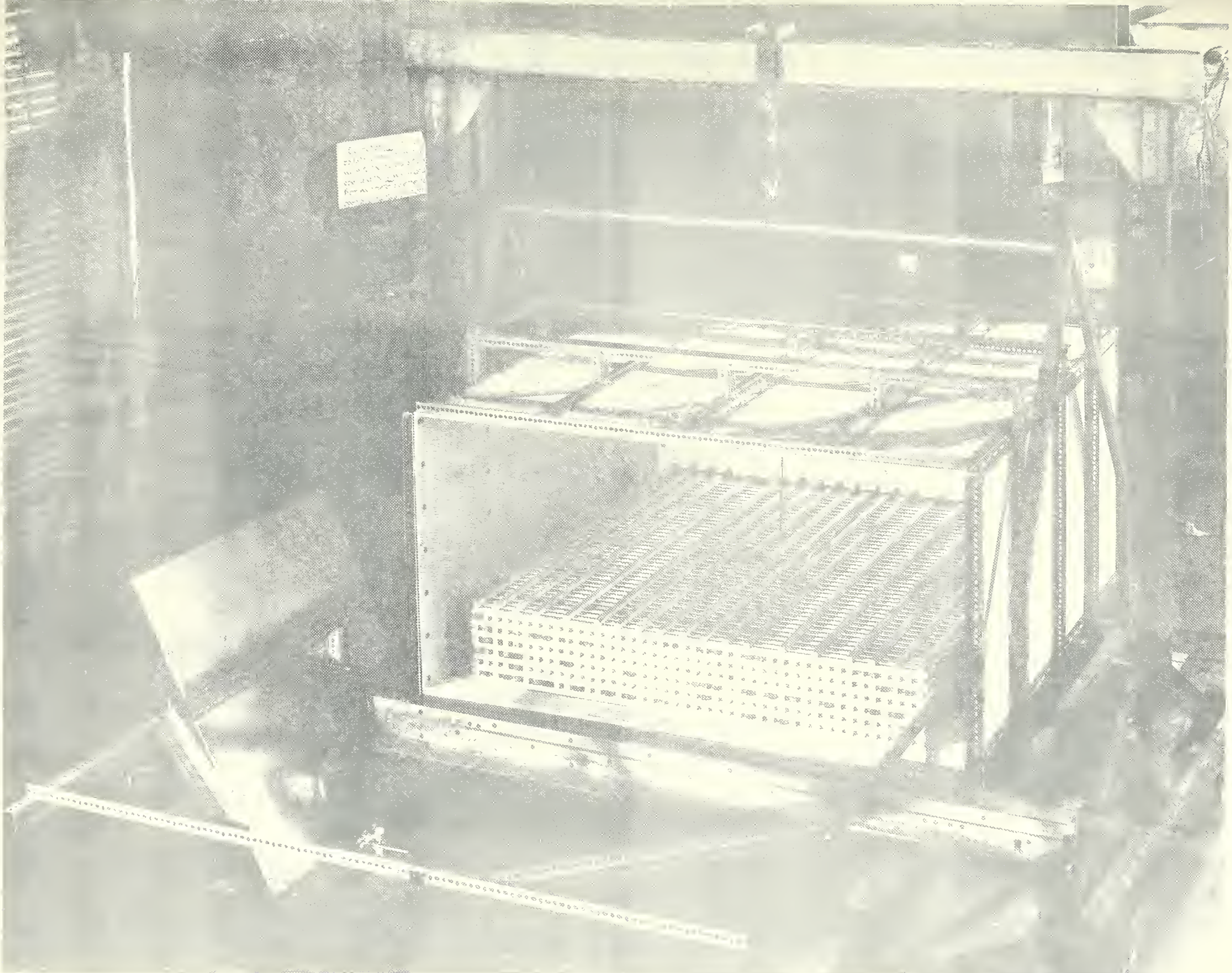

Fig. 1 C.I.B. Test Compartment

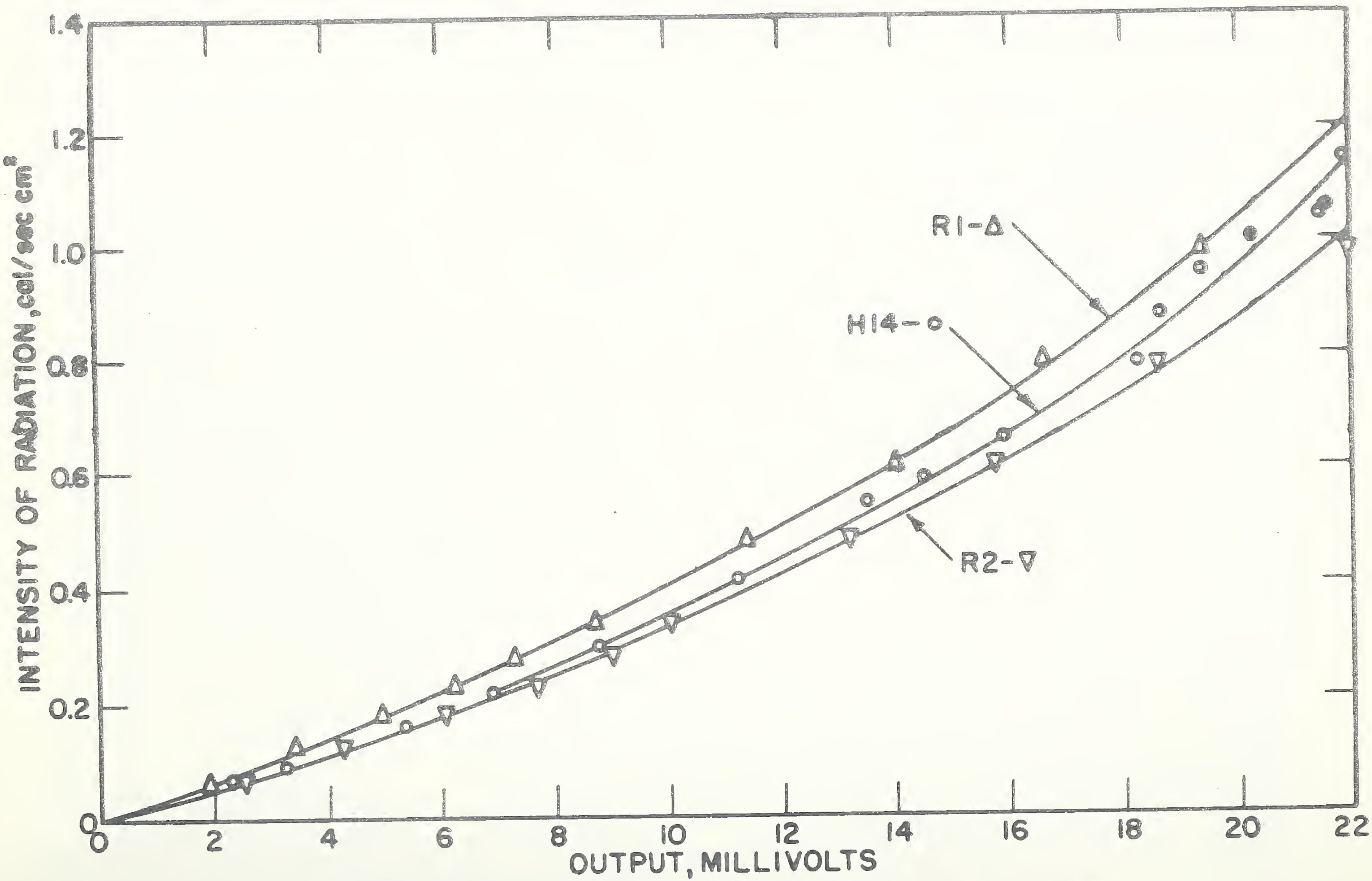

FIG.2—RADIOMETER CALIBRATION CURVES

Table 1. Properties of Test Cribs

Date 1963	NBS No.	CIB No.	Designation	Crib No.	Stick Size[a] Height	Stick Size[a] Width	Packing Density	Weight Nails	Weight Glue (wet)	Test Weight[b]	Mean Density As Condi.	Mean Density Dry Basis	Moisture Content[c] Dry Basis
					cm	cm		kg	kg	kg	g/cm^3	g/cm^3	%
10-18	1	1	221-20-1/4	8	1.99	2.09	0.91	0.73	0.58	79.3	.416	-	-
10-21	2	7	221-20-1	3	1.98	1.95	1.05	0.22	0.83	79.8	.421	.391	7.6
10-22	3	4	221-40-1/4	16	1.98	2.09	0.91	0.53	1.64	160.0	.395	.366	7.8
10-23	4	0	221-40-1	7	1.99	2.00	1.00	0.38	1.67	160.0	.409	.377	8.4
10-24	5	6	211-40-1/4	14	1.98	2.09	0.91	0.18	1.16	80.0	.402	.369	8.9
10-25	6	3	211-20-1/4	15	1.98	2.09	0.91	0.12	0.36	40.0	.408	.385	6.0
10-28	7	Y	211-40-1	11	1.99	2.13	0.88	0.16	0.81	80.0	.407	.367	10.9
10-29	8	9	211-20-1	12	1.99	2.13	0.88	0.12	0.41	40.0	.405	.373	8.5
10-29	9	Y	211-40-1	9	1.99	2.13	0.88	0.14	0.90	80.0	.398	.367	8.4
10-30	10	1	221-20-1/4	1	1.98	1.93	1.07	0.29	0.96	80.0	.408	.376	8.5
10-31	11	0	221-40-1	4	1.99	2.00	1.00	0.87	1.44	160.0	.406	.374	8.5
11-1	12	9	211-20-1	10	1.99	2.13	0.88	0.07	0.32	40.0	.434	.396	9.6
11-1	13	6	211-40-1/4	5	1.99	2.00	1.00	0.19	-	80.0	.407	.371	9.7
11-1	14	3	211-20-1/4	6	1.99	2.00	1.00	0.08	0.31	40.0	.465	.422	10.1
11-4	15	7	221-20-1	2	1.98	1.93	1.07	0.10	1.01	80.0	.414	.378	9.6
11-4	16	4	221-40-1/4	13	1.99	2.13	0.88	0.49	1.68	160.0	.391	.358	9.3

a. Uniformity within a single crib varied from ±2% to ±10%. Length = 83 cm or 167 cm nominal.

b Total weight after conditioning includes fiberboard wicks and dry glue, but excludes nails or kerosene.

c. Based on drying at 105°C of a portion of a stick removed from individual crib just prior to test.

Table 2. Summary Sheet

Date 1963	NBS No.	CIB No.	Designation	Time min.	Rate of Weight Loss kg/min		Mean Window Radiation cal/sec cm^2		Mean Flame Radiation cal/sec cm^2		Ceiling Temperature °C		Mean Floor Temperature °C	
				t_{80}	80/55	55/30	80/55	55/30	80/55	55/30	80/55	55/30	80/55	55/30
10-18	1	1	221-20-1/4	6.1	3.54	2.87	.181	.161	-	-	919	1090	906	1048
10-21	10	1	221-20-1/4	8.0	3.56	2.93	.164	.156	.250	.216	902	1028	895	1009
10-31	6	3	211-20-1/4	5.4	3.45	2.22	.140	.169	.694	.482	1027	1078	1016	1031
11-1	14	3	211-20-1/4	5.6	3.45	2.22	.173	.176	.628	.417	1074	1093	1055	1023
10-24	3	4	221-40-1/4	14.5	3.31	2.44	.148	.143	.729	.624	870	995	872	985
10-25	16	4	221-40-1/4	13.7	3.31	2.44	.146	.141	.562	.438	857	952	857	952
10-29	5	6	211-40-1/4	8.4	3.23	2.56	.154	.164	.808	.672	964	1056	947	974
10-30	13	6	211-40-1/4	8.6	3.28	2.50	.151	.163	.805	.684	936	1027	927	958
10-22	2	7	221-20-1	6.2	6.06	4.00	.406	.317	.554	.291	977	1002	959	980
10-23	15	7	221-20-1	5.5	5.26	4.00	.440	.378	.618	.370	959	1028	949	998
11-4	8	9	211-20-1	7.1	2.33	1.47	.174	.146	.080	.041	598	500	639	542
11-4	12	9	211-20-1	5.8	2.56	1.96	.194	.181	.102	.054	660	556	737	709
10-28	4	0	221-40-1	9.8	4.88	3.20	.396	.291	.778	.405	982	1049	980	984
10-29	11	0	221-40-1	8.8	5.88	4.12	.421	.359	.738	.359	946	1027	943	995
11-1	7	Y	211-40-1	8.7	3.64	2.53	.360	.308	.407	.225	969	934	981	949
11-1	9	Y	211-40-1	8.1	3.70	2.67	.374	.312	.534	.318	991	961	1006	990

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 1 (NBS 1)

Shape:	221	Amount of Fuel :	20 kg/m^2
Scale:	1 meter	Dispersion of Fuel:	1 spacing
Window Opening:	1/4	Dimension of Fuel :	2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	79.3	76.3	71.6	64.5	57.5	50.7	43.6	37.7	31.7	26.1	20.6	15.9	11.2	7.3	3.4	.8					
Temp. Ceiling, °C	42	422	733	821	882	946	1036	1097	1098	1118	1150	1164	1141	1108	1097	1047					
Temp. Floor, °C	30	292	653	809	875	939	1006	1056	1069	1051	1069	1023	995	1006	1012	1003					
Window Radiation, $cal/sec\ cm^2$	.000	.015	.085	.155	.185	.190	.185	.175	.160	.135	.150	.125	.145	.115	.110	.100					
Flame Radiation, $cal/sec\ cm^2$	.005	.030	.250	.570	>.61	>.61	>.61	>.61	>.61	>.61	.550	.440	.330	.205	.155	.085					

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, $cal/sec\ cm^2$																				
Flame Radiation, $cal/sec\ cm^2$																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	$\theta_c 80/55$	$\theta_c 55/30$	$\theta_b 80/55$	$\theta_b 55/30$	$I_o 80/55$	$I_o 55/30$	$I_f 80/55$	$I_f 55/30$	t_{80}
3.54	2.87	919	1090	906	1048	.181	.161	-	-	6.1

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 7 (NBS 2)

Shape: 221
Scale: 1 meter
Window Opening: 1

Amount of Fuel : 20 kg/m^2
Dispersion of Fuel: 1 spacing
Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	79.8	78.9	74.3	63.8	52.1	41.3	32.4	25.3	19.8	14.8	10.2	6.8	3.9	1.3	-.4						
Temp. Ceiling, °C	35	170	620	903	986	1034	1005	1001	899	856	820	699	651	537	499						
Temp. Floor, °C	32	88	616	897	957	1014	983	971	878	854	829	755	697	631	566						
Window Radiation, cal/sec cm^2	.000	.010	.080	.340	.440	.395	.330	.270	.210	.180	.155	.135	.110	.100	.085						
Flame Radiation, cal/sec cm^2	.000	.005	.055	.430	.605	.625	.250	.180	.100	.080	.055	.040	.025	.010	.010						

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, cal/sec cm^2																				
Flame Radiation, cal/sec cm^2																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_e80/55	θ_e55/30	θ_b80/55	θ_b55/30	I_o80/55	I_o55/30	I_f80/55	I_f55/30	t_{80}
6.06	4.00	977	1002	959	980	.406	.317	.554	.291	6.2

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 4 (NBS 3)

Shape: 221	Amount of Fuel : 40 kg/m^2
Scale: 1 meter	Dispersion of Fuel: 1 spacing
Window Opening: 1/4	Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	160.0	159.1	156.5	154.3	149.7	143.6	136.9	130.1	123.4	116.5	109.4	103.0	96.4	90.5	84.4	78.5	73.4	68.3	63.5	58.7	54.5
Temp. Ceiling, °C	25	54	327	511	717	753	773	808	824	854	879	893	891	926	926	944	960	959	978	1032	1059
Temp. Floor, °C	21	26	59	118	299	600	760	814	829	858	884	892	889	923	922	937	953	952	973	1023	1045
Window Radiation, cal/sec cm^2	.005	.005	.010	.020	.065	.095	.120	.130	.135	.140	.150	.155	.155	.155	.155	.155	.150	.140	.140	.140	.130
Flame Radiation, cal/sec cm^2	.000	.000	.030	.050	.200	.385	.500	.615	.690	.710	.755	.765	.730	.745	.770	.735	.685	.620	.600	.575	.520

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg	49.7	45.7	42.2	38.9	36.1	33.2	30.2	27.1	24.1	21.5	19.4	17.0	14.7	12.5	10.5	8.7	6.6	5.2	4.4	3.5
Temp. Ceiling, °C	1079	1081	1109	1087	1106	1103	1088	1076	1079	1068	1076	1084	1082	1077	1061	1034	1021	994	952	907
Temp. Floor, °C	1055	1052	1048	1018	1007	1021	1015	1019	1067	1046	1081	1015	1033	1018	978	947	922	902	871	827
Window Radiation, cal/sec cm^2	.125	.125	.120	.120	.115	.115	.115	.115	.110	.105	.110	.110	.115	.115	.115	.110	.105	.100	.085	.070
Flame Radiation, cal/sec cm^2	.480	.425	.385	.355	.255	.235	.245	.190	.180	.135	.170	.175	.150	.135	.110	.100	.080	.045	.040	.030

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	$\theta_c 80/55$	$\theta_c 55/30$	$\theta_b 80/55$	$\theta_b 55/30$	$I_o 80/55$	$I_o 55/30$	$I_f 80/55$	$I_f 55/30$	t_{80}
3.31	2.44	870	995	872	985	.148	.143	.729	.624	14.5

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 0 (NBS 4)

Shape:	221	Amount of Fuel :	40 kg/m^2
Scale:	1 meter	Dispersion of Fuel:	1 spacing
Window Opening:	1	Dimension of Fuel :	2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	160.0	159.1	155.8	149.1	138.8	126.8	116.2	105.6	96.8	88.4	80.5	73.4	66.3	60.1	54.2	48.9	44.0	39.8	36.2	32.4	29.5
Temp. Ceiling, °C	22	53	351	814	880	927	941	992	1005	1023	1029	1052	1068	1057	1062	1054	1008	984	937	884	803
Temp. Floor, °C	22	26	41	477	882	928	949	993	1005	1003	989	991	994	987	963	986	976	964	934	904	938
Window Radiation, cal/sec cm^2	.005	.010	.040	.200	.330	.390	.405	.405	.380	.350	.330	.310	.295	.285	.255	.250	.230	.210	.190	.160	.140
Flame Radiation, cal/sec cm^2	.005	.005	.030	.260	.560	.910	.770	.865	.745	.610	.515	.480	.405	.355	.375	.205	.125	.105	.075	.045	.035

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg	26.5	23.6	20.6	18.2	15.8	13.4	11.2	9.0	7.2	5.9	4.4	2.9	2.3	1.4		.0				
Temp. Ceiling, °C	844	721	676	669	645	656	586	566	539	486	437	435	381	359		315				
Temp. Floor, °C	901	866	797	749	735	688	668	654	623	569	516	474	438	406		349				
Window Radiation, cal/sec cm^2	.140	.130	.120	.120	.115	.110	.095	.090	.080	.070	.060	.050	.045	.040		.030				
Flame Radiation, cal/sec cm^2	.050	.030	.030	.030	.035	.030	.020	.020	.015	.010	.010	.005	.005	.000		.000				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_c80/55	θ_c55/30	θ_b80/55	θ_b55/30	I_o80/55	I_o55/30	I_f80/55	I_f55/30	t_{80}
4.88	3.20	982	1049	980	984	.396	.291	.778	.405	9.8

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 6 (NBS 5)

Shape: 211
Scale: 1 meter
Window Opening: 1/4

Amount of Fuel : 40 kg/m^2
Dispersion of Fuel: 1 spacing
Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	80.0	78.9	77.0	72.0	65.2	58.5	51.9	45.9	40.0	35.0	29.8	25.1	20.6	16.8	12.9	9.7	6.7	3.9	1.2	-.9	
Temp. Ceiling, °C	58	169	768	826	885	945	985	998	1029	1065	1067	1087	1097	1103	1089	1092	1068	1050	1013	991	
Temp. Floor, °C	25	40	225	828	889	951	975	954	955	975	979	988	986	1001	988	1001	979	971	956	936	
Window Radiation, cal/sec cm^2	.005	.010	.030	.080	.120	.150	.160	.170	.170	.165	.160	.155	.150	.140	.140	.130	.115	.120	.115	.100	
Flame Radiation, cal/sec cm^2	.000	.005	.060	.415	.685	.835	.840	.820	.770	.690	.610	.560	.490	.430	.375	.310	.245	.230	.185	.150	

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, cal/sec cm^2																				
Flame Radiation, cal/sec cm^2																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	$\theta_e 80/55$	$\theta_e 55/30$	$\theta_B 80/55$	$\theta_b 55/30$	$I_o 80/55$	$I_o 55/30$	$I_f 80/55$	$I_f 55/30$	t_{80}
3.23	2.56	964	1056	947	974	.154	.164	.808	.672	8.4

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 3 (NBS 6)

Shape: 211	Amount of Fuel : 20 kg/m^2
Scale: 1 meter	Dispersion of Fuel: 1 spacing
Window Opening: 1/4	Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	40.0	38.6	35.9	29.6	22.9	17.5	13.4	10.1	7.5	5.4	3.1	2.4	1.1	.0							
Temp. Ceiling, °C	53	308	844	1023	1086	1098	1073	994	901	844	803	765	743	718							
Temp. Floor, °C	29	59	746	1021	1050	1068	1038	852	730	674	616	597	628	642							
Window Radiation, cal/sec cm^2	.005	.010	.040	.130	.175	.190	.160	.120	.085	.070	.060	.055	.050	.045							
Flame Radiation, cal/sec cm^2	.000	.005	.130	.725	.780	.540	.295	.135	.090	.075	.065	.050	.045	.035							

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, cal/sec cm^2																				
Flame Radiation, cal/sec cm^2																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_e80/55	θ_e55/30	θ_b80/55	θ_b55/30	I_o80/55	I_o55/30	I_f80/55	I_f55/30	t_{80}
3.45	2.22	1027	1078	1016	1031	.140	.169	.694	.482	5.4

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation Y (NBS 7)

Shape: 211
Scale: 1 meter
Window Opening: 1

Amount of Fuel : 40 kg/m^2
Dispersion of Fuel: 1 spacing
Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	80.0	79.7	77.9	73.8	66.6	58.4	51.0	44.8	38.9	33.4	28.6	24.2	20.7	17.9	15.0	12.4	11.1	8.8	7.1	5.3	3.9
Temp. Ceiling, °C	22	37	191	715	957	987	950	962	999	977	895	751	724	625	560	463	440	429	387	349	356
Temp. Floor, °C	20	25	65	331	969	997	978	978	981	977	931	863	849	829	841	827	827	682	667	461	418
Window Radiation, cal/sec cm^2	.005	.010	.020	.100	.315	.380	.365	.345	.345	.315	.290	.230	.210	.170	.155	.130	.115	.105	.090	.085	.075
Flame Radiation, cal/sec cm^2	.005	.005	.010	.080	.470	.525	.370	.285	.280	.255	.170	.085	.075	.050	.040	.030	.020	.020	.015	.010	.010

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg	2.9	2.0	1.0	.0																
Temp. Ceiling, °C	359	322	325	273																
Temp. Floor, °C	383	363	358	324																
Window Radiation, cal/sec cm^2	.070	.065	.060	.050																
Flame Radiation, cal/sec cm^2	.010	.010	.010	.000																

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_e80/55	θ_e55/30	θ_b80/55	θ_b55/30	I_o80/55	I_o55/30	I_f80/55	I_f55/30	t_{80}
3.64	2.53	969	934	981	949	.360	.308	.407	.225	8.7

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 9 (NBS 8)

Shape: 211	Amount of Fuel : $20\ kg/m^2$
Scale: 1 meter	Dispersion of Fuel: 1 spacing
Window Opening: 1	Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	40.0	39.2	38.1	34.4	29.9	24.9	20.8	17.8	14.9	12.2	9.9	8.1	6.0	4.6	3.6	2.4	1.6	.7	.1	-.2	
Temp. Ceiling, °C	27	76	259	451	691	594	519	529	491	455	456	429	400	397	364	346	327	289	273	249	
Temp. Floor, °C	26	115	266	501	719	646	555	552	596	482	532	398	406	398	328	321	292	262	248	237	
Window Radiation, $cal/sec\ cm^2$	.000	.010	.035	.080	.195	.190	.165	.150	.130	.120	.110	.100	.080	.075	.070	.065	.060	.050	.040	.040	
Flame Radiation, $cal/sec\ cm^2$	.000	.000	.005	.030	.115	.085	.055	.040	.030	.030	.030	.025	.020	.015	.010	.010	.010	.010	.005	.005	

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, $cal/sec\ cm^2$																				
Flame Radiation, $cal/sec\ cm^2$																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	$\theta_e 80/55$	$\theta_e 55/30$	$\theta_b 80/55$	$\theta_b 55/30$	$I_o 80/55$	$I_o 55/30$	$I_f 80/55$	$I_f 55/30$	t_{80}
2.33	1.47	598	500	639	542	.174	.146	.080	.041	7.1

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation Y (NBS 9)

Shape: 211
Scale: 1 meter
Window Opening: 1

Amount of Fuel : 40 kg/m^2
Dispersion of Fuel: 1 spacing
Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	80.0	79.6	77.0	72.0	64.0	55.7	48.3	41.9	35.9	30.5	25.4	21.8	18.2	15.2	12.7	10.8	8.5	7.0	5.9	4.7	3.5
Temp. Ceiling, °C	26	42	447	918	973	1003	1006	1014	1018	931	938	727	695	584	558	507	449	410	401	388	335
Temp. Floor, °C	23	28	59	895	984	1024	1023	1008	1031	991	946	861	818	699	630	559	501	443	413	389	351
Window Radiation, cal/sec cm^2	.000	.010	.035	.245	.350	.390	.380	.360	.340	.310	.260	.215	.190	.165	.140	.120	.110	.095	.085	.075	.070
Flame Radiation, cal/sec cm^2	.000	.000	.050	.490	.585	.570	.495	.475	.465	.270	.145	.090	.090	.050	.030	.020	.010	.010	.005	.000	.000

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg	2.8	2.4	1.7	1.1	.8	.5	.2													
Temp. Ceiling, °C	311	286	267	255	235	220	211													
Temp. Floor, °C	324	301	289	255	242	221	211													
Window Radiation, cal/sec cm^2	.060	.050	.045	.040	.040	.030	.030													
Flame Radiation, cal/sec cm^2	-.005	-.005	-.005	-.005	-.005	-.005	-.005													

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_e80/55	θ_e55/30	θ_b80/55	θ_b55/30	I_o80/55	I_o55/30	I_f80/55	I_f55/30	t_{80}
3.70	2.67	991	961	1006	990	.374	.312	.534	.318	8.1

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 1 (NBS 10)

Shape:	221	Amount of Fuel :	20 kg/m^2
Scale:	1 meter	Dispersion of Fuel:	1 spacing
Window Opening:	1/4	Dimension of Fuel :	2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	80.0	78.1	75.9	70.2	63.4	56.6	49.3	42.7	36.3	30.6	25.1	20.1	15.7	12.0	8.8	6.1	4.1	2.4	1.1	.2	-.3
Temp. Ceiling, °C	42	314	495	764	842	874	921	967	1011	1036	1106	1112	1105	1117	1098	1052	1001	910	817	736	697
Temp. Floor, °C	20	189	396	741	838	873	917	937	994	1024	1077	1088	1082	1094	1021	945	913	833	728	633	551
Window Radiation, $cal/sec\ cm^2$	.000	.010	.030	.105	.140	.160	.175	.175	.170	.150	.130	.125	.120	.110	.105	.100	.095	.075	.055	.045	.040
Flame Radiation, $cal/sec\ cm^2$	.000	.010	.050	.385	.145	.250	.285	.275	.245	.215	.135	.465	.370	.230	.130	.055	.025	.000	-.020	-.030	-.030

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, $cal/sec\ cm^2$																				
Flame Radiation, $cal/sec\ cm^2$																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	$\theta_e 80/55$	$\theta_e 55/30$	$\theta_b 80/55$	$\theta_b 55/30$	$I_o 80/55$	$I_o 55/30$	$I_f 80/55$	$I_f 55/30$	t_{80}
3.56	2.93	902	1028	895	1009	.164	.156	.250	.216	8.0

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 0 (NBS 11)

Shape: 221	Amount of Fuel : 40 kg/m^2
Scale: 1 meter	Dispersion of Fuel: 1 spacing
Window Opening: 1	Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	160.0	158.2	153.8	144.3	132.7	119.8	107.1	95.9	84.7	75.1	66.6	58.6	51.8	45.9	40.4	35.9	31.7	27.6	24.3	20.9	18.1
Temp. Ceiling, °C	25	135	579	773	851	914	941	969	999	-	1010	1035	1065	1061	1045	1018	995	932	843	793	716
Temp. Floor, °C	21	23	54	684	851	911	940	962	995	-	1009	999	991	972	972	952	952	947	935	925	829
Window Radiation, cal/sec cm^2	.000	.010	.090	.240	.340	.405	.425	.435	.425	-	.360	.340	.325	.285	.280	.245	.235	.225	.200	.170	.160
Flame Radiation, cal/sec cm^2	.000	.005	.140	.325	.665	.780	.885	.740	.565	-	.345	.280	.220	.095	.075	.025	.015	.000	-.010	-.010	-.010

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg	15.5	12.5	10.2	7.8	5.7	4.3	2.6	1.1	.0											
Temp. Ceiling, °C	679	637	614	568	530	491	475	470	444											
Temp. Floor, °C	818	797	787	777	744	713	705	638	527											
Window Radiation, cal/sec cm^2	.150	.140	.135	.120	.110	.095	.085	.075	.070											
Flame Radiation, cal/sec cm^2	-.010	-.010	-.010	-.010	-.010	-.010	-.010	-.015	-.015											

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_e80/55	θ_e55/30	θ_b80/55	θ_b55/30	I_o80/55	I_o55/30	I_f80/55	I_f55/30	t_{80}
5.88	4.12	946	1027	943	995	.421	.359	.738	.359	8.8

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 9 (NBS 12)

Shape: 211 | Amount of Fuel : 20 kg/m^2
Scale: 1 meter | Dispersion of Fuel: 1 spacing
Window Opening: 1 | Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	40.0	38.3	36.1	31.5	26.1	21.1	16.8	13.2	10.4	7.9	5.9	4.3	2.9	1.9	.5	.0					
Temp. Ceiling, °C	36	364	367	594	686	608	573	516	469	403	370	342	333	318	310	277					
Temp. Floor, °C	28	203	558	709	688	707	789	725	506	419	337	339	360	325	324	300					
Window Radiation, cal/sec cm^2	.005	.025	.060	.140	.200	.180	.180	.150	.130	.110	.090	.085	.080	.070	.060	.055					
Flame Radiation, cal/sec cm^2	.000	.005	.015	.075	.095	.070	.060	.045	.030	.020	.010	.010	.010	.010	.005	.005					

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, cal/sec cm^2																				
Flame Radiation, cal/sec cm^2																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_e80/55	θ_e55/30	θ_b80/55	θ_b55/30	I.80/55	I.55/30	I_f80/55	I_f55/30	t_{80}
2.56	1.96	660	556	737	709	.194	.181	.102	.054	5.8

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 6 (NBS 13)

Shape:	211	Amount of Fuel :	40 kg/m^2
Scale:	1 meter	Dispersion of Fuel:	1 spacing
Window Opening:	1/4	Dimension of Fuel :	2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	80.0	79.2	76.7	72.4	66.0	59.3	52.8	46.8	40.7	35.1	30.3	25.3	21.2	17.0	13.0	10.0	6.7	4.3	2.0	.2	
Temp. Ceiling, °C	47	114	760	845	881	913	935	968	967	1036	1048	1039	1057	1049	1058	1061	1047	1016	989	939	
Temp. Floor, °C	22	25	76	837	879	909	932	959	946	954	943	972	999	1012	1005	952	869	847	846	842	
Window Radiation, cal/sec cm^2	.000	.005	.020	.075	.110	.140	.155	.165	.165	.165	.165	.160	.155	.150	.145	.130	.120	.110	.100	.085	
Flame Radiation, cal/sec cm^2	.000	.000	.065	.320	.575	.745	.845	.840	.810	.700	.615	.730	.475	.425	.350	.275	.200	.140	.090	.050	

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, cal/sec cm^2																				
Flame Radiation, cal/sec cm^2																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	$\theta_c 80/55$	$\theta_c 55/30$	$\theta_b 80/55$	$\theta_b 55/30$	$I_o 80/55$	$I_o 55/30$	$I_f 80/55$	$I_f 55/30$	t_{80}
3.28	2.50	936	1027	927	958	.151	.163	.805	.684	8.6

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 3 (NBS 14)

Shape: 211
Scale: 1 meter
Window Opening: 1/4

Amount of Fuel : 20 kg/m^2
Dispersion of Fuel: 1 spacing
Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	40.0	38.6	36.7	29.7	24.1	18.1	13.8	10.7	7.9	5.2	3.4	1.9	.5								
Temp. Ceiling, °C	53	318	673	992	1074	1104	1071	1036	967	868	825	774	728								
Temp. Floor, °C	27	210	591	986	1068	1021	999	975	893	790	751	710	678								
Window Radiation, cal/sec cm^2	.000	.010	.025	.130	.175	.190	.170	.130	.110	.080	.070	.060	.050								
Flame Radiation, cal/sec cm^2	.000	.005	.040	.540	.630	.520	.315	.160	.185	.050	.035	.025	.010								

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, cal/sec cm^2																				
Flame Radiation, cal/sec cm^2																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_e80/55	θ_e55/30	θ_B80/55	θ_b55/30	I_o80/55	I_o55/30	I_f80/55	I_f55/30	t_{80}
3.45	2.22	1074	1093	1055	1023	.173	.176	.628	.417	5.6

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 7 (NBS 15)

Shape: 221 | Amount of Fuel : 20 kg/m^2
Scale: 1 meter | Dispersion of Fuel: 1 spacing
Window Opening: 1 | Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	80.0	76.8	72.0	61.9	50.5	40.7	32.5	25.3	20.6	15.3	11.4	8.2	5.3	3.4	1.7	-.1					
Temp. Ceiling, °C	29	245	864	900	983	1039	1031	999	955	871	764	713	627	555	502	428					
Temp. Floor, °C	25	110	834	899	975	973	1020	1002	972	907	856	818	797	777	697	650					
Window Radiation, cal/sec cm^2	.000	.025	.215	.395	.465	.445	.350	.285	.230	.185	.150	.130	.110	.095	.075	.060					
Flame Radiation, cal/sec cm^2	.000	.010	.210	.535	.770	.510	.280	.200	.090	.055	.030	.015	.005	.000	-.010	-.015					

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg																				
Temp. Ceiling, °C																				
Temp. Floor, °C																				
Window Rediation, cal/sec cm^2																				
Flame Radiation, cal/sec cm^2																				

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_e80/55	θ_e55/30	θ_B80/55	θ_b55/30	I_o80/55	I_o55/30	I_f80/55	I_f55/30	t_{80}
5.26	4.00	959	1028	949	998	.440	.378	.618	.370	5.5

INTERNATIONAL EXPERIMENTS ON FIRES IN SIMPLE COMPARTMENTS

Report Form

U. S. National Bureau of Standards, Washington, D. C.

C.I.B. Test Designation 4 (NBS 16)

Shape: 221 | Amount of Fuel : 40 kg/m^2
Scale: 1 meter | Dispersion of Fuel: 1 spacing
Window Opening: 1/4 | Dimension of Fuel : 2 cm. side

EXPERIMENTAL RESULTS

Time, min	0	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
Weight, kg	160.0	157.8	155.9	152.8	147.3	140.7	134.3	127.4	120.2	113.8	107.1	100.9	94.7	88.5	82.8	77.0	71.7	66.3	61.7	57.1	53.1
Temp. Ceiling, °C	35	293	421	693	735	756	792	817	836	849	854	859	881	899	910	922	945	956	964	975	993
Temp. Floor, °C	25	65	83	186	455	711	789	817	836	849	854	859	881	900	915	926	943	954	961	974	993
Window Radiation, cal/sec cm^2	.000	.010	.020	.050	.085	.105	.120	.140	.140	.145	.145	.150	.150	.155	.155	.150	.150	.140	.125	.125	.120
Flame Radiation, cal/sec cm^2	.000	.010	.020	.160	.285	.440	.530	.560	.555	.620	.570	.540	.560	.550	.530	.510	.470	.440	.400	.385	.350

Time, min	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Weight, kg	48.6	44.8	41.2	37.6	34.2	31.2	28.5	25.4	22.9	20.3	17.9	15.6	14.0	11.6	9.8	8.1	6.7	5.4	4.4	3.5
Temp. Ceiling, °C	1003	1019	1020	1019	1032	1029	1026	1011	1014	1004	1010	996	992	984	984	977	963	935	925	908
Temp. Floor, °C	1005	1021	1019	1019	1009	1002	998	994	992	991	1007	1019	1009	963	895	895	883	855	867	819
Window Radiation, cal/sec cm^2	.115	.110	.110	.105	.105	.100	.105	.105	.105	.100	.105	.105	.105	.100	.100	.100	.100	.090	.085	.075
Flame Radiation, cal/sec cm^2	.300	.240	.210	.215	.190	.190	.165	.160	.140	.100	.115	.090	.070	.070	.055	-	.030	.020	.010	.010

STATISTICS

Rate Wt. Loss $\frac{kg}{min}$		Ceiling Temp. °C		Floor Temp. °C		Window Rad. $\frac{cal}{sec\ cm^2}$		Flame Rad. $\frac{cal}{sec\ cm^2}$		Time to 80% orig. wt. min
R80/55	R55/30	θ_e80/55	θ_e55/30	θ_b80/55	θ_b55/30	I_o80/55	I_o55/30	I_f80/55	I_f55/30	t_{80}
3.31	2.44	857	952	857	952	.146	.141	.562	.438	13.7

THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its major laboratories in Washington, D.C., and Boulder, Colorado, is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant publications, appears on the inside of the front cover.

WASHINGTON, D. C.

Electricity. Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics. High Voltage. Absolute Electrical Measurements.

Metrology. Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Volume.

Heat. Temperature Physics. Heat Measurements. Cryogenic Physics. Equation of State. Statistical Physics.

Radiation Physics. X-ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

Analytical and Inorganic Chemistry. Pure Substances. Spectrochemistry. Solution Chemistry. Standard Reference Materials. Applied Analytical Research. Crystal Chemistry.

Mechanics. Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Rheology. Combustion Controls.

Polymers. Macromolecules: Synthesis and Structure. Polymer Chemistry. Polymer Physics. Polymer Characterization. Polymer Evaluation and Testing. Applied Polymer Standards and Research. Dental Research.

Metallurgy. Engineering Metallurgy. Metal Reactions. Metal Physics. Electrolysis and Metal Deposition.

Inorganic Solids. Engineering Ceramics. Glass. Solid State Chemistry. Crystal Growth. Physical Properties. Crystallography.

Building Research. Structural Engineering. Fire Research. Mechanical Systems. Organic Building Materials. Codes and Safety Standards. Heat Transfer. Inorganic Building Materials. Metallic Building Materials.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics. Operations Research.

Data Processing Systems. Components and Techniques. Computer Technology. Measurements Automation. Engineering Applications. Systems Analysis.

Atomic Physics. Spectroscopy. Infrared Spectroscopy. Far Ultraviolet Physics. Solid State Physics. Electron Physics. Atomic Physics. Plasma Spectroscopy.

Instrumentation. Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

Physical Chemistry. Thermochemistry. Surface Chemistry. Organic Chemistry. Molecular Spectroscopy. Elementary Processes. Mass Spectrometry. Photochemistry and Radiation Chemistry.

Office of Weights and Measures.

BOULDER, COLO.

CRYOGENIC ENGINEERING LABORATORY

Cryogenic Processes. Cryogenic Properties of Solids. Cryogenic Technical Services. Properties of Cryogenic Fluids.

CENTRAL RADIO PROPAGATION LABORATORY

Ionosphere Research and Propagation. Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services. Vertical Soundings Research.

Troposphere and Space Telecommunications. Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Spectrum Utilization Research. Radio-Meteorology. Lower Atmosphere Physics.

Radio Systems. Applied Electromagnetic Theory. High Frequency and Very High Frequency Research. Frequency Utilization. Modulation Research. Antenna Research. Radiodetermination.

Upper Atmosphere and Space Physics. Upper Atmosphere and Plasma Physics. High Latitude Ionosphere Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.

RADIO STANDARDS LABORATORY

Radio Standards Physics. Frequency and Time Disseminations. Radio and Microwave Materials. Atomic Frequency and Time-Interval Standards. Radio Plasma. Microwave Physics.

Radio Standards Engineering. High Frequency Electrical Standards. High Frequency Calibration Services. High Frequency Impedance Standards. Microwave Calibration Services. Microwave Circuit Standards. Low Frequency Calibration Services.

Joint Institute for Laboratory Astrophysics - NBS Group (Univ. of Colo.).

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