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National Voluntary Laboratory Accreditation Program Proficiency Testing for Thermal Insulation Materials Laboratory Accreditation Program Round 9 - August 1983

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Office of Product Standards Policy
Gaithersburg, Maryland 20899

May 1984

U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM PROFICIENCY TESTING FOR THERMAL INSULATION MATERIALS LABORATORY ACCREDITATION PROGRAM ROUND 9 - AUGUST 1983

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U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, ***Secretary***
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, ***Director***

NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM PROFICIENCY TESTING FOR THERMAL INSULATION MATERIALS LABORATORY ACCREDITATION PROGRAM ROUND 9 - AUGUST 1983

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Abstract

The National Voluntary Laboratory Accreditation Program (NVLAP) is a federal program which accredits testing laboratories satisfying published criteria. One Laboratory Accreditation Program (LAP) accredits laboratories for thermal insulation materials test methods. Participation in proficiency testing is required for certain test methods including: settled density, smoldering combustion, surface flammability, and thermal conductivity.

Analyses and summaries of the test data returned by 30 laboratories for these methods for Insulation LAP Proficiency Testing Round 9 are reported.

A description of NVLAP proficiency testing and how it fits into the laboratory evaluation process is given.

Key words: accreditation; fire tests; laboratory evaluation; laboratory performance; proficiency testing; settled density; smoldering combustion; surface flammability; thermal conductivity; thermal insulation

1. INTRODUCTION

The National Voluntary Laboratory Accreditation Program (NVLAP) provides a proficiency testing program for laboratories accredited under the Thermal Insulation Materials Laboratory Accreditation Program (Insulation LAP). Participation in the proficiency testing program is required for thermal conductivity, settled density, surface flammability, and smoldering combustion test methods.

This report presents the analyses of test data returned by 30 laboratories for Round 9 of Insulation LAP proficiency testing. The details and results of Rounds 1 through 8 have been presented in previous reports [1]*. A description of how proficiency testing fits into the NVLAP accreditation process is given in Appendix A. Additional information about NVLAP proficiency testing can be found in references [2] and [3].

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* Numbers in brackets refer to the literature references listed at the end of this report.

Three different materials were used for testing in Round 9. These sample materials are described in Table 1.

Table 2 is a description of statistical terms used in the presentation of the results of Round 9 analyses presented in Table 3. At the end of Table 3 are specific notes, where applicable, concerning each test method. Outlying laboratory results were identified using methods in American Society for Testing and Materials (ASTM) E178, Standard Practice for Dealing with Outlying Observations. Outliers are not included in the Group Mean and other statistical calculations shown in the Table. These outliers may also be missing from some of the diagrams because they are beyond the scale selected for displaying the data. Participants are urged to locate their results on the individual diagrams for the test methods in which they report data.

2. ANALYSES OF PROFICIENCY TEST DATA

2.1 Apparent Thermal Conductivity

Proficiency testing was conducted using two different test methods for apparent thermal conductivity; ASTM C177 (Guarded Hot Plate) [4] and ASTM C518 (Heat Flow Meter) [5].

In Round 9, each test specimen consisted of the 4 pound per cubic foot (64 kg/cubic meter), foil-faced, 1-inch (2.54 cm) thick fiberglass boards, previously used by participants for testing in Round 6 and Round 8, stacked in pairs to form a 2-inch (5.08 cm) thickness. These materials were to be retained by each laboratory. The foil faces were on the outside of the stack facing the cold plate, hot plate, and metering device(s). Laboratories cut thermal breaks in those foil faces in contact with the metering device(s) when appropriate. The thermal break is created by removing a small section of foil around the perimeter defined by the apparatus meter area.

The group results, shown in Table 3, were very uniform as can be seen by the small percent coefficients of variation (% C.V.). The range of the laboratory results was 4.1% of the group mean for the ASTM C177 test and 5.3% of the group mean for the ASTM C518 test. The spread of results is due to a combination of laboratory effects and variability of the test material. Since there is no data for the variability of the individual test specimens, no attempt was made to separate the effects.

Table 4 gives a summary of the test data for Rounds 6, 8, and 9. An analysis was made using the data for all three rounds from laboratories that 1) participated in all three rounds, and 2) used the original material for all three rounds. The second condition was set because some of the laboratories did not retain one or both sets of material and were sent replacements. The laboratory data meeting the conditions were put through the same computer program as the individual rounds and outliers were removed from the Group Means. The results are called "combined" in Table 4.

The percent coefficients of variation for the combined data for both test methods are approximately 1.1%. The range of the laboratory results was 2.8% for the C177 test and 4.3% for the C518 test.

The units for apparent thermal conductivity (k_{app}) can be expressed as $Btu/(h \cdot ft^2 \cdot (^oF/in))$ or $W/(m^2 \cdot (K/m))$. The latter term may be abbreviated as $W/(m \cdot K)$ as noted in ASTM E380 [6]. The reason for expressing the units the first way is that it is indicative of the property being measured. Thermal conductivity is the heat flow rate (Btu/h or W) through a unit area (ft^2 or m^2) when the temperature gradient is unity ($^oF/in$ or K/m).

2.2 Settled Density

The settled density test is contained in the Interim Safety Standard for Cellulose Insulation [7]. This test method replaces the earlier Federal Specification HH-I-515D [8].

The group results for the settled density test are shown in Table 3. Table 5 gives a summary of the results for settled density for Rounds 3 through 9. The percent coefficient of variation has remained relatively stable since Round 5.

Table 6 gives the percent deviation of each laboratory's results for the seven rounds. Some of the laboratories reported making changes in their procedures and equipment following Round 7.

It has been suggested that differences in sample container height is a source of between-laboratory bias. This was seen with one of the NVLAP laboratories. Short containers tend to give high results. In the next round of proficiency testing, laboratories will be asked to report the size, shape, and material of their containers.

Another possible source of between-laboratory bias may be the age and condition of the shaker. It has been suggested that the shake pattern and intensity may change with age (machine use time). A simple method for looking at the shaker patterns is as follows: Fasten a pen firmly to the shaker table. Place a sheet of paper in a clipboard. While the shaker is operating, draw the paper past the pen, making firm contact with it and note the period of time that the pen is touching the paper. By noting the distances from + peak to - peak vertically, an average amplitude can be calculated. The frequency or rate can be calculated by counting the number of cycles drawn and dividing by the time that the pen touched the paper.

Other variables include voltage settings to the blower and condition of the cellulosic material as it is being fed into the inlet tube.

2.3 Surface Burning Characteristics

2.3.1 Critical Radiant Flux Test

The critical radiant flux test method (radiant panel) is contained in the Interim Safety Standard for Cellulose Insulation [9] which replaces the earlier Federal Specification HH-I-515D [8].

The group results for this test are given in Table 3. The percent coefficient of variation for this round was 14%. Some of the laboratories reported that the test material burned to the limit of their test specimen container. The group statistics therefore, must be compared with caution to other rounds. Three laboratories reported that one or more specimens burned to the limit.

Original photographs of the burned specimens were requested from the laboratories. These photographs were reviewed as part of the evaluation of the data. No unusual burn-front patterns were seen. It was noted however, that the specimen surfaces for the outlying laboratory were unusually smooth. The photographs have been very useful in evaluating the laboratory data.

A comparison of the radiant energy flux profiles reported by participants has been made. The results of this comparison make it possible to identify flux profiles which differ from the expected curve shape. Differences in curve shape seem to come from two very different sources; the measurement of the flux at the dummy specimen and the drawing of the curve through the points on the profile chart. Although the differences are small, they may be significant because the critical radiant flux for a specimen is determined from the profile curve.

A computer curve fitting method [10] has been used to draw the flux profile curve for each laboratory. The fitting algorithm forces a smooth curve to go through all of the data points.

Figure 1 shows the Standard Radiant Heat Energy Flux Profile curve produced by the computer program. The data points are the same as those that were used to produce the curve shown in Figure 8 of the Interim Safety Standard for Cellulose Insulation, 16 CFR Part 1209. The x's above and below the curve mark the limits on the flux profile as specified in paragraph 1209.6 section (e)(3).

Figure 2 shows the flux profiles reported by three participating laboratories. Curve A, has the expected shape for a good flux profile. Curve B, from a second laboratory, is close to the expected shape. The left end of the curve may be too straight and there is a small wave in the middle. Curve C, from the third laboratory, has an unexpected shape. The extra waviness indicates that something is different about the flux profile. This may be due to errors in measurement, non-uniformity of the gas panel, or some other effect. This laboratory should determine the causes of the different shape. It should be noted that each of the three flux profiles meets the test method requirement at 20, 40, and 60 centimeters.

Small variations in the measurement of the flux at each point may lead to slight irregularities in the computer-plotted curve. It has not yet been determined at what level these irregularities indicate a laboratory problem that requires attention.

2.3.2 Flame Spread Index Test

The flame spread index is measured using ASTM E84 tunnel test method [11]. The group results for this test are given in Table 3.

The test was conducted using a urethane foam board material. All eight reporting laboratories were included in the Group Mean with a percent coefficient of variation of 13%. This % C.V. was the lowest of Rounds 3 through 9. The flame spread classification for each of the 6 rounds (there was no testing in Round 8) was in the range 20 to 30.

2.4 Smoldering Combustion

The smoldering combustion test method is contained in the Interim Safety Standard for Cellulose Insulation [12] which replaces the earlier Federal Specification HH-I-515D [8].

A specially prepared loose fill type material was used for Round 9 testing. The group results are given in Table 3. The weight loss due to smoldering combustion was approximately 53%. The percent coefficient of variation was 20%.

The Interim Safety Standard established a maximum weight loss of 15 percent for material with acceptable smoldering resistance [12, 13]. Due to the nature of the test, a cellulosic loose fill material which passes the standard typically exhibits a weight loss of about 1 or 2 percent. Materials that fail typically exhibit a weight loss in excess of 30 percent.

3. COMMENTS

NVLAP will continue to highlight test methods in future rounds. The goal is to identify areas for improvement in laboratory practices as well as in test methods. This effort depends on the availability of customized materials for testing and the continued excellent cooperation of the participants.

4. REFERENCES

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Rounds 5 & 6, September 1982
Round 7, March 1983
Round 8, May 1983

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[3] Kirkpatrick, D., and Horlick, J., "Proficiency Testing: An Essential Element of Laboratory Performance Evaluation and Accreditation"; American Society for Testing and Materials Special Technical Publication 814, 128-140 (1983).

[4] American Society for Testing and Materials C177-76, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Guarded Hot Plate, 1916 Race Street, Philadelphia, PA 19103.

[5] American Society for Testing and Materials C518-76, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter, Race Street, Philadelphia, PA 19103.

[6] American Society for Testing and Materials E380-82, Standard for Metric Practice, 1916 Race Street, Philadelphia, PA 19103.

[7] Federal Register, 16 CFR Part 1209 - Interim Safety Standard for Cellulose Insulation, Vol. 44, No. 131, July 6, 1979, pp. 39966-39968, Sec. 1209.4, Test procedures for determining settled density.

[8] Federal Specification HH-I-515D, Insulation Thermal (Loose Fill for Pneumatic or Poured Application): Cellulosic or Wood Fiber, June 15, 1978, Amendment 1, October 11, 1979.

[9] Federal Register, 16 CFR Part 1209 - Interim Safety Standard for Cellulose Insulation, Vol. 44, No. 131, July 6, 1979, pp. 39969-39971, Sec. 1209.6, Test procedures for critical radiant flux.

[10] Kahaner, D., Horlick, J., and Wyman W., "Mathematical Software in BASIC -- DINT: Data Integration", to be published in IEEE Micro.

[11] American Society for Testing and Materials E84-81a, Surface Burning Characteristics of Building Materials, Race Street, Philadelphia, PA 19103.

[12] Federal Register, 16 CFR Part 1209 - Interim Safety Standard for Cellulose Insulation, Vol. 44, No. 131, July 6, 1979, pp. 39972-39972, Sec. 1209.7, Test procedures for smoldering combustion.

[13] Lawson, J.R., Technical Support for the Consumer Product Safety Commission 1979 Interim Standards for Cellulose Insulation, NBSIR 81-2213, March 1981.

Table 1. Proficiency sample materials

Round 9 - August 1983

Apparent Thermal Conductivity, ASTM C177
ASTM C518

The test specimens consisted of 4 pound per cubic foot (64 kg/cubic meter), foil-faced, 1-inch (2.54 cm) thick fiberglass boards stacked in pairs to form a 2-inch (5.08 cm) thickness.

Settled density, 16 CFR Part 1209 (formerly HH-I-515D)
Radiant panel, 16 CFR Part 1209 (formerly HH-I-515D)
Smoldering combustion, 16 CFR Part 1209 (formerly HH-I-515D)

The test material was a batch of specially formulated cellulosic loose-fill insulation. The level of fire retardancy was chosen to give smoldering combustion results at the 50% weight loss level.

Surface Burning Characteristics, ASTM E84

Each laboratory received twelve pieces of rigid urethane foam 24 by 24 inches (61 by 61 cm) by two inches (5.08 cm) thick yielding 48 square feet (4.5 square meter).

Table 2. Statistical terms and diagrams used in Table 3

TERMS:

GROUP MEAN - the arithmetic average of all of the laboratory results, except those that were determined to be outliers.

SD MEANS - the standard deviation among the laboratory results making up the Group Mean, the between laboratory standard deviation.

LABS - the number of laboratories reporting data.

LABS IN MEAN - the number of laboratories included in the Group Mean.

RANGE - the difference between the highest and lowest reported laboratory results included in the Group Mean.

% C.V. - The percent coefficient of variation, defined as (Sd Means/Group Mean) times 100, is a measure of the dispersion or scatter of the data.

UNITS - the unit of test in which the data is presented in the Table and on the horizontal axis of the diagrams.

DIAGRAMS:

A simple plot of the data accompanies each analysis when such a plot is possible. The horizontal axis for each plot is the test variable. The vertical axis is the frequency of occurrence. Each laboratory's reported value is represented by a dot (·) or an "X". An "X" indicates that the value was an outlier and is not included in calculating the Group Mean. The Group Mean is indicated on the plot by a small arrow above the proper place on the horizontal axis.

For display purposes, the plot covers a range of approximately ±3 standard deviations of the Group Mean. Laboratories whose data are outside this range may not appear on the plot.

Notes following Table 3 explain special cases and give the outlying test values that do not appear on the plots.

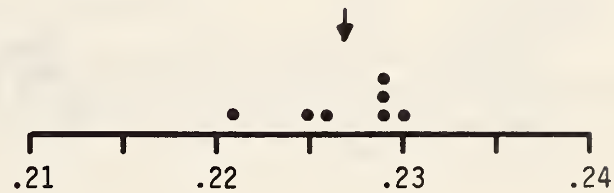
Table 3. Statistical Analyses of the Data

Round 9 - August 1983

(1) Apparent Thermal Conductivity, k_{app}

ASTM Method C177-76
Sample material: Foil-faced fiberglass (see Table 1)
Units: Btu / $hr \cdot ft^2 \cdot (^oF/in)$

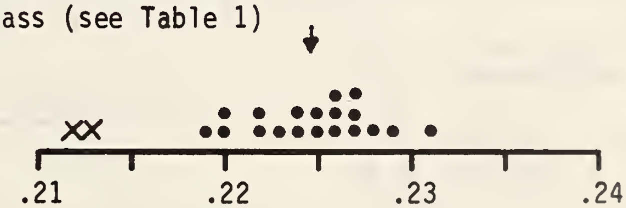
Group Mean = .2270
Sd Means = .0033
Labs = 8
Labs in Mean = 7
Range = .0094
% C.V. = 1.45



(2) Apparent Thermal Conductivity, k_{app}

ASTM Method C518-76
Sample material: Foil-faced fiberglass (see Table 1)
Units: Btu / $hr \cdot ft^2 \cdot (^oF/in)$

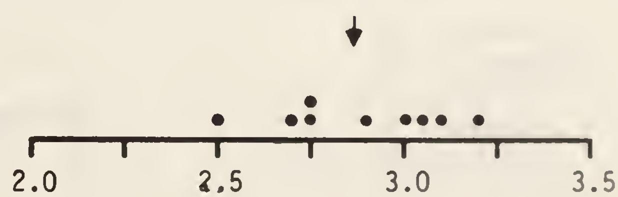
Group Mean = .2247
Sd Means = .0032
Labs = 22
Labs in Mean = 19
Range = .0120
% C.V. = 1.43



(3) Settled Density

16 CFR Part 1209 (formerly HH-I-515D)
Sample material: Loose fill (see Table 1)
Units: Pounds per cubic foot

Group Mean = 2.88
Sd Means = .23
Labs = 9
Labs in Mean = 9
Range = .72
% C.V. = 8.1



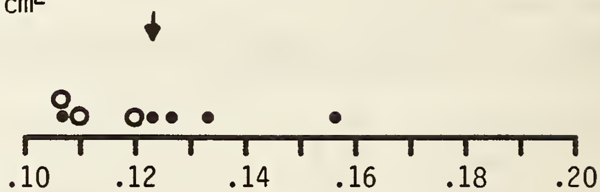
see NOTES following Table 3

Table 3 (continued)

(4) Critical Radiant Flux Test

16 CFR Part 1209 (formerly HH-I-515D)
Sample material: Loose fill (see Table 1)
Units: Critical radiant flux, watts/cm^2

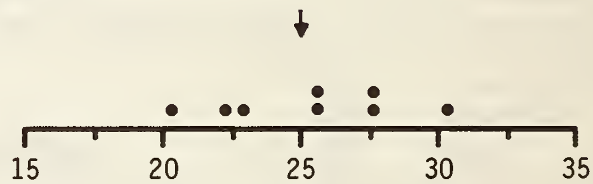
Group Mean = .12
Sd Means = .02
Labs = 9
Labs in Mean = 8
Range = .05
% C.V. = 14



(5) Flame Spread Index Test

ASTM Test Method E84-81a
Sample material: Foam board (see Table 1)
Units: Flame Spread Classification

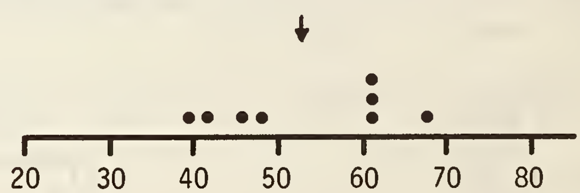
Group Mean = 25.2
Sd Means = 3.3
Labs = 8
Labs in Mean = 8
Range = 10.0
% C.V. = 13.



(6) Smoldering Combustion

16 CFR Part 1209 (formerly HH-I-515D)
Sample material: Loose fill (see Table 1)
Units: Weight loss, percent

Group Mean = 53.
Sd Means = 10.
Labs = 9
Labs in Mean = 8
Range = 28.
% C.V. = 20.



see NOTES following Table 3

Table 3 (continued). Notes

Note on (1) Apparent Thermal Conductivity, C177:

One laboratory value not included in the Group Mean is an outlier as determined by tests in ASTM E178. It is beyond the limits of the plot. The outlying value was 0.267.

Note on (2) Apparent Thermal Conductivity, C518:

Three laboratory values not included in the Group Mean are outliers as determined by tests in ASTM E178. The X's denote outliers. The outlying value off the plot was 0.254.

Note on (3) Settled Density:

See Tables 5 and 6.

Note on (4) Critical Radiant Flux Test

One laboratory value not included in the Group Mean is an outlier as determined by tests in ASTM E178. It is beyond the limits of the plot. The outlying value was 0.22.

Laboratory data indicated by an "o" contain one or more values that are at the limit of the flux curve.

Note on (6) Smoldering Combustion:

One laboratory value not included in the Group Mean is an outlier as determined by tests in ASTM E178. It is beyond the limits of the plot. The outlying value was 2%.

Table 4. Apparent thermal conductivity, summary of results for Rounds 6, 8, and 9

ASTM Method C177	Round 6	Round 8	Round 9
Group Mean	0.2245	0.2252	0.2270
Sd Means	0.0022	0.0044	0.0033
Labs in Mean	9	8	7

ASTM Method C177	Round 6, 8, and 9 Combined
Group Mean	0.2257
Sd Means	0.0024
Labs in Mean	6

ASTM Method C518	Round 6	Round 8	Round 9
Group Mean	0.2249	0.2242	0.2247
Sd Means	0.0042	0.0027	0.0032
Labs in Mean	22	22	19

ASTM Method C518	Round 6, 8, and 9 Combined
Group Mean	0.2241
Sd Means	0.0025
Labs in Mean	14

For the combined analyses, laboratories were included in the Group Mean only if; 1) they participated in all three rounds, 2) they used the original materials in all three rounds, and 3) they were not found to be outliers in the combined analyses.

Table 5. Settled density, summary of statistics for Rounds 3 through 9

Statistic	Round 3 (May 80)	Round 4 (Jan 81)	Round 5 (Jul 81)	Round 6 (Nov 81)	Round 7 (Jun 82)	* Round 8 (Dec 82)	Round 9 (Aug 83)
Group Mean (in lb/ft^3)	2.63	2.74	2.64	2.14	3.04	3.13	2.88
Standard Deviation of the Means	0.32	0.32	0.22	0.18	0.25	0.21	0.23
Range	1.07	1.11	0.72	0.64	0.74	0.54	0.72
% Coefficient of Variation	12.3	11.6	8.2	8.4	8.3	6.7	8.1
Number of Labs Reporting	14	15	14	14	12	10	9
Number of Labs in Group Mean	14	15	14	13	11	9	9

* The portion of this table covering Rounds 3 through 7 was presented in a TECH BRIEF which was sent to each laboratory in October 1982.

Table 6. Settled density, percent deviation of laboratory results from group means for Rounds 3 through 9

LAB	PERCENT DEVIATION ROUND 3 (May 80)	ROUND 4 (Jan 81)	ROUND 5 (Jul 81)	ROUND 6 (Nov 81)	ROUND 7 (Jun 82)	AVERAGE PERCENT DEVIATION, ROUNDS 3-7	PERCENT DEVIATION ROUND 8 (Dec 82)	ROUND 9 (Aug 83)
A	7.6	10.6	8.3	27.6*	28.2*	16.5	26.2*	
B	12.2	23.0	11.7	10.3	11.1	13.7	-1.1	5.3
C	20.5	16.1	7.6	7.5	10.8	12.5	8.9	12.0
D		2.2	5.7	16.8	9.2	8.5	5.9	-6.2
E	-1.1	10.2	7.6			5.6		
F	19.0	6.2	-1.9	-0.9		5.6		
G	5.7	1.5	4.9	-0.5	-6.9	0.9		
H	-4.9	-3.3	1.1	3.3	-3.9	-1.6	-6.4	-5.0
I	0.4	-4.7	-3.4	-0.9	-4.3	-2.6		
J	-6.1	-11.7	-5.7	4.7	-4.3	-4.6	-1.7	0.2
K	-1.1	-13.1	-1.5	-5.1		-5.2	-4.9	-13.2
L	-4.9	-7.7		-3.3		-5.3		
M	-16.3	-2.6	-5.3	-3.3	-4.9	-6.5	-4.0	4.2
N	-12.9	-17.5	-15.5	-12.6	5.6	-10.6	10.3	8.0
O	-20.2	-10.6	-12.9	-13.1	-13.1	-14.0	-7.0	-5.2

$$\text{Percent Deviation} = \frac{\text{Lab test value} - \text{Group Mean}}{\text{Group Mean}} \times 100$$

* indicates laboratory used pouring method and was excluded from the Group Mean calculation

The portion of this table covering Rounds 3 through 7 was presented in a TECH BRIEF which was sent to each laboratory in October 1982. As a result of that TECH BRIEF, some of the laboratories reported that they modified their equipment or test method.

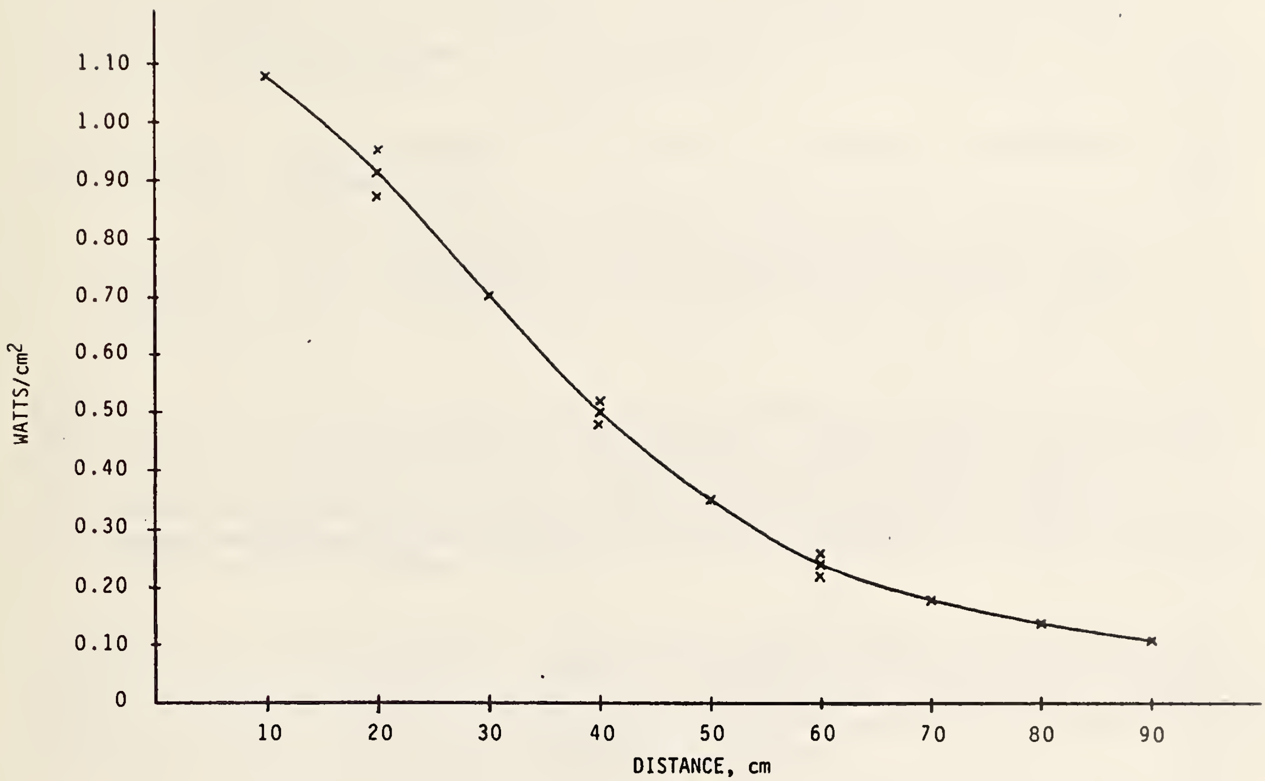
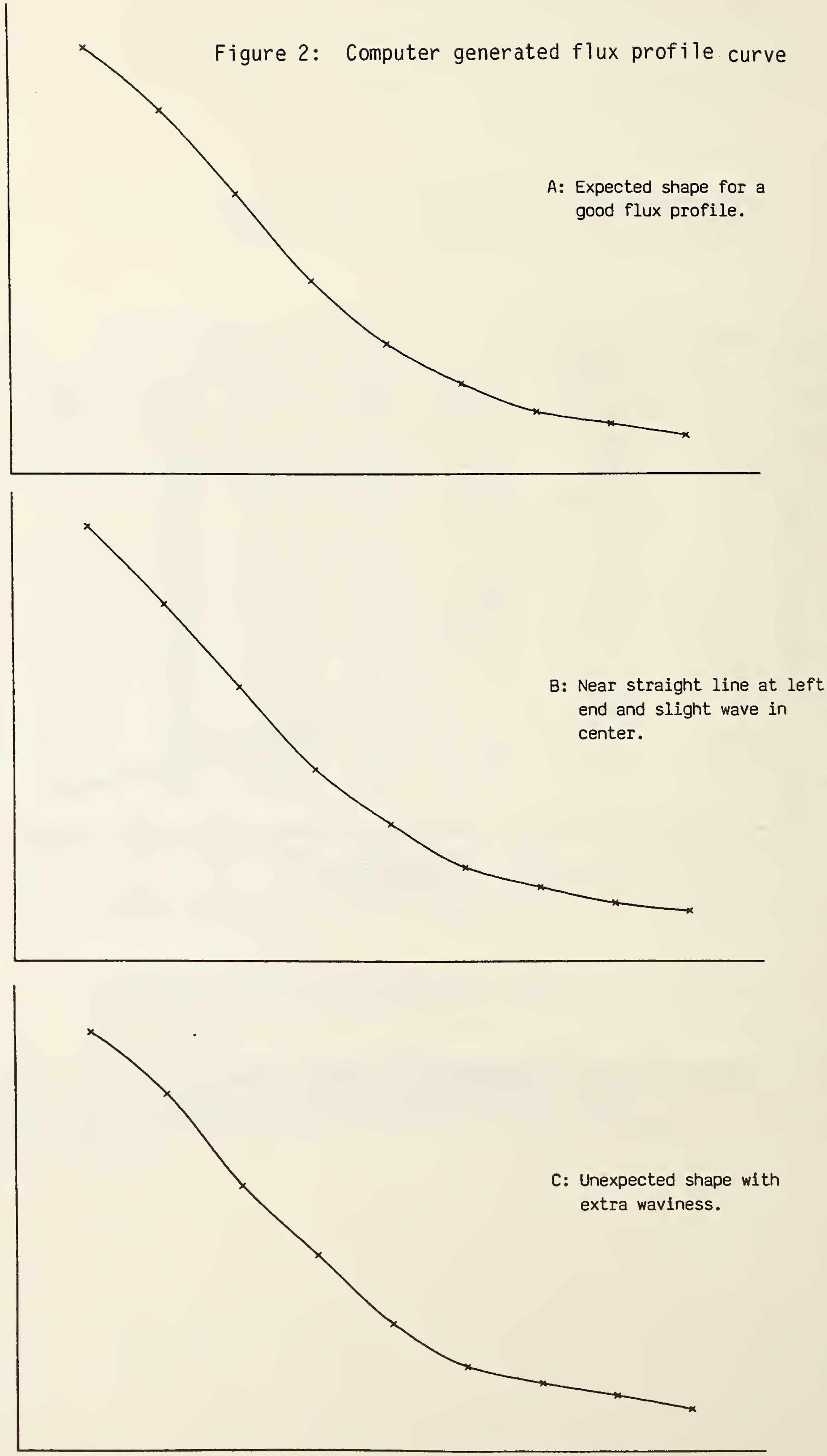


Figure 1: Standard Radiant Heat Energy Flux Profile curve

Figure 2: Computer generated flux profile curve



APPENDIX A

PROFICIENCY TESTING - AN ESSENTIAL PART OF NVLAP

NVLAP is a voluntary program which accredits laboratories for specific test methods, not on a laboratory entity basis. Accredited laboratories participate in proficiency testing for those methods requiring it. The test results are used by both NVLAP and the participants to monitor laboratory performance. If proficiency testing data indicate poor laboratory performance, NVLAP may send additional material for follow-up testing or schedule on-site monitoring visits. Depending on the test method, the test results must be within statistical bounds compared to the group or must be within specified accuracy in order for the laboratory to be accredited.

NVLAP accredits and continues accreditation of individual laboratories based on a technical evaluation of:

- information provided by the laboratory in its annual application
- periodic on-site assessments of the laboratory by technical experts
- results of periodic proficiency testing in which the laboratory participates

NVLAP proficiency testing programs are interlaboratory testing programs in which specially chosen samples are periodically distributed to and tested by participating laboratories in accordance with specified test methods. Proficiency testing is an integral part of the NVLAP accreditation process. It is a means of assessing laboratory performance by analyzing results generated by the laboratory in actual testing.

In addition to fulfilling NVLAP requirements, the proficiency testing program provides the participants with a means of comparing their performance and results with those from a group of peer laboratories. NVLAP also provides the standards-writing community with statistical information and information about problems encountered by users of the test methods.

Proficiency testing requirements are based on the needs and limitations of each LAP and are described in a LAP Handbook provided to each laboratory. Not all test methods covered by a LAP have proficiency testing requirements. However, proficiency testing is required for test methods that are of significant importance to the industry or to users of the laboratory services. Proficiency testing may also be implemented in areas needing improvement in testing technology or laboratory performance.

A NVLAP project leader coordinates proficiency testing programs for each LAP and is responsible for:

- test sample selection and distribution
- experimental design based on the test method, number of laboratories, and types of samples available
- preparation of testing instructions and data sheets
- statistical analyses and tabulation of test data
- preparation and distribution of reports to participating laboratories and technical groups having direct interest in the test results.

Additional information about NVLAP is available from: National Voluntary Laboratory Accreditation Program, National Bureau of Standards, Washington, DC 20234, telephone (301) 921-3431.

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10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)*

The National Voluntary Laboratory Accreditation Program (NVLAP) is a federal program which accredits testing laboratories satisfying published criteria. One Laboratory Accreditation Program (LAP) accredits laboratories for thermal insulation materials test methods. Participation in proficiency testing is required for certain test methods including: settled density, smoldering combustion, surface flammability, and thermal conductivity.

Analyses and summaries of the test data returned by 30 laboratories for these methods for Insulation LAP Proficiency Testing Round 9 are reported.

A description of NVLAP proficiency testing and how it fits into the laboratory evaluation process is given.

12. KEY WORDS *(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)*

accreditation; fire tests; laboratory evaluation; laboratory performance; proficiency testing; settled density; smoldering combustion; surface flammability; thermal conductivity; thermal insulation

13. AVAILABILITY

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