NATIONAL BUREAU OF STANDARDS REPORT

6522

WIND RESISTANCE OF FREE-TAB ASPHALT SHINGLES

by

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and

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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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Floor, Roof and Wall Coverings Section
Building Technology Division

Sponsored by

Office of the Chief of Engineers
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U. S. DEPARTMENT OF COMMERCE

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1. INTRODUCTION

The most frequent cause of premature failure of free-tab asphalt shingles is damage by wind. The usual mechanism of failure is that winds of moderate intensity weaken the tabs by continued flexing so that they become vulnerable to gusts of more than 50 miles per hour that are not unusual. The wind resistance of a shingle therefore depends on its ability to remain in its natural position without distortion or bending. Initial distortion and bending of shingles are influenced by the following:

1. Temperature
2. Age
3. Slope of roof
4. Number and placement of fasteners
5. Weight per unit area.

As defined, the wind resistance of shingles at low temperatures, and of older shingles, is greater than that of new shingles and of shingles at higher temperatures, because shingles tend to become more brittle with age and with exposure to low temperatures. Of course, with winds strong enough to distore brittle shingles, the immediate damage for the same amount of distortion will be greater for the more brittle shingles.

Wind resistance decreases as the slope of the roof decreases, and as the number of fasteners is decreased. Placing fasteners too high has the effect of increasing the exposure of the shingles to wind effects and greatly reduces the wind resistance.

In regard to the shingle weight and its influence on the wind resistance, it is generally felt that the heavier the shingle (weight per unit area), other factors being equal, the better should be the wind resistance. The object of this program was to study this relationship.

The weight per unit area of shingles may be increased by increasing the weight of the base felt or the coating, or both of these. The weight per unit roof area of shingles may be increased either by using heavier shingles or by decreasing the exposure of the shingles.

This report gives the results of a study of the above variables insofar as they influence the wind resistance of the shingles.

The criterion was the ability of the respective shingle to resist distortion and bending under various wind loads.

Section 2 states the conclusions drawn from the study and the details of the wind resistance tests are described in the appendix.

2. CONCLUSIONS

1. Generally, the heavier asphalt shingles indicated the better wind resistance. Figure 1 shows the relative performance of three uniform thickness shingles, each of a different weight. The weight of the shingle is plotted against the wind resistance index, which is the reciprocal of the rise of the target tab under a wind stress of 30 miles per hour for a 15 min. period as applied by the method described in the appendix.[1/]

2. The thick butt shingles indicated better wind resistance than the uniform thickness shingles. This conclusion holds true for the conventional 210-lb. shingles as well as for the heavy weight shingles. The bar graph in Figure 2 illustrates this conclusion.

3. The conventional 210-lb. shingle exposed 4 in. to the weather indicated wind resistance superior to that of the same shingle exposed 5 in. to the weather, as illustrated in bar graph in Figure 3.

4. The 210-lb. shingle exposed 4 in. to the weather was approximately equal in regard to wind resistance to a 250-lb. shingle exposed 5 in. to the weather.

5. Shingles prepared on No. 60 felt performed better in regard to wind resistance than similar shingles prepared on No. 48 felt.

3. ACKNOWLEDGMENT

The authors acknowledge the assistance of the manufacturers of asphalt shingles for providing samples used in these tests.

1/ This should not be construed to mean that shingles of this type are normally disturbed by 30-mile winds.

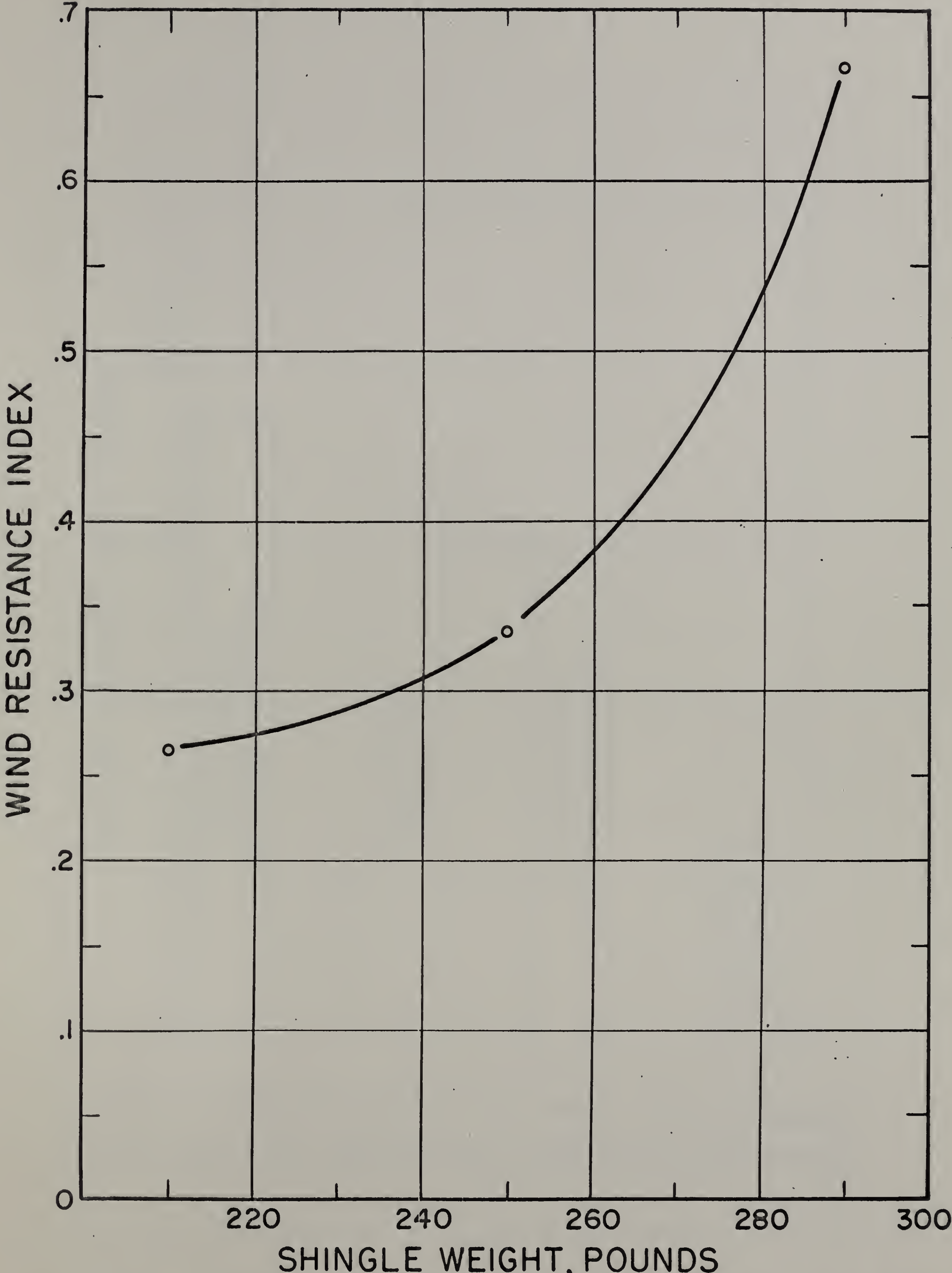

FIG. I – RELATIONSHIP OF WIND RESISTANCE TO WEIGHT OF UNIFORM THICKNESS ASPHALT SHINGLES

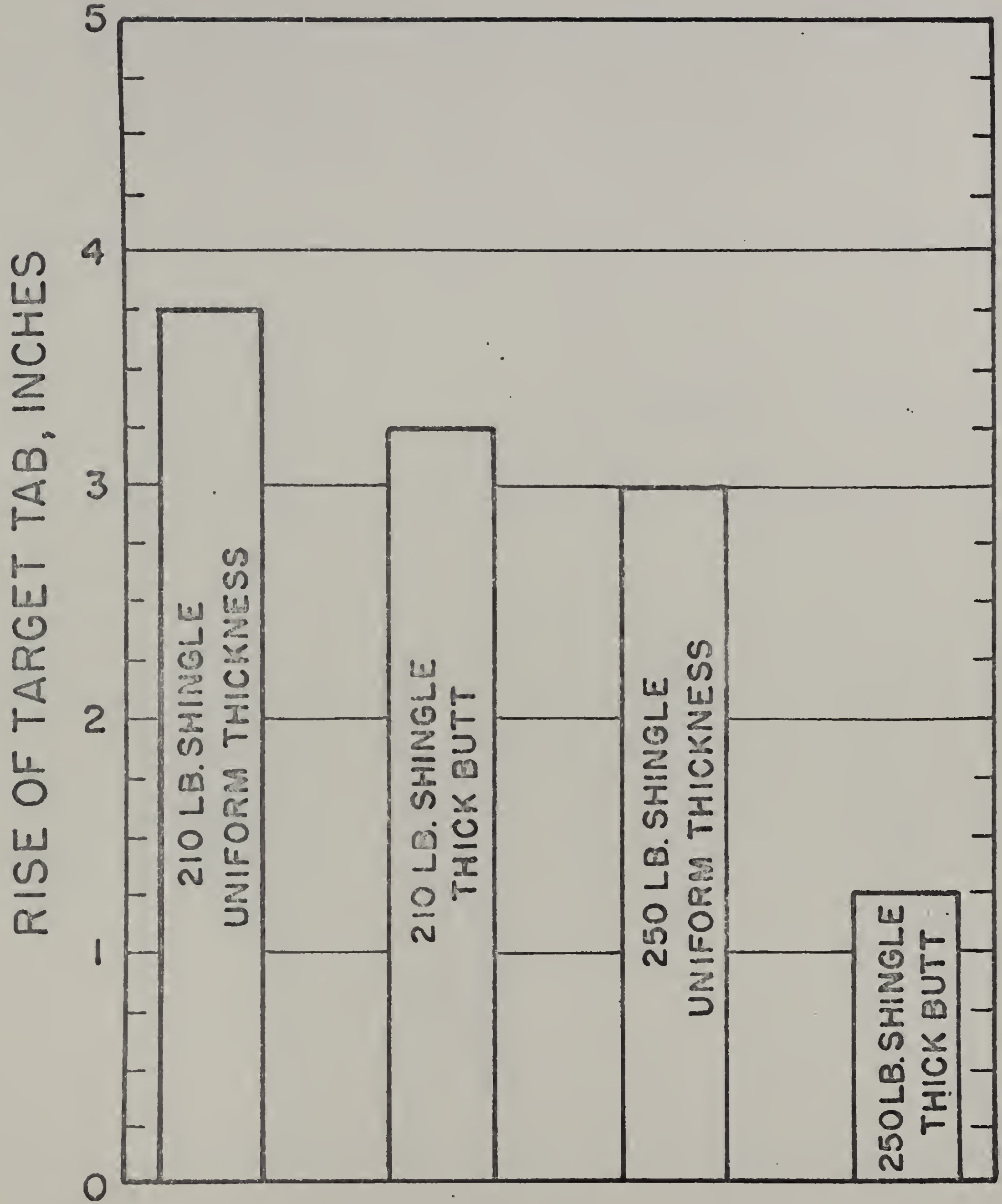

FIG. 2 - RELATIONSHIP OF WIND RESISTANCE TO THE TYPE OF ASPHALT SHINGLE ROOFING

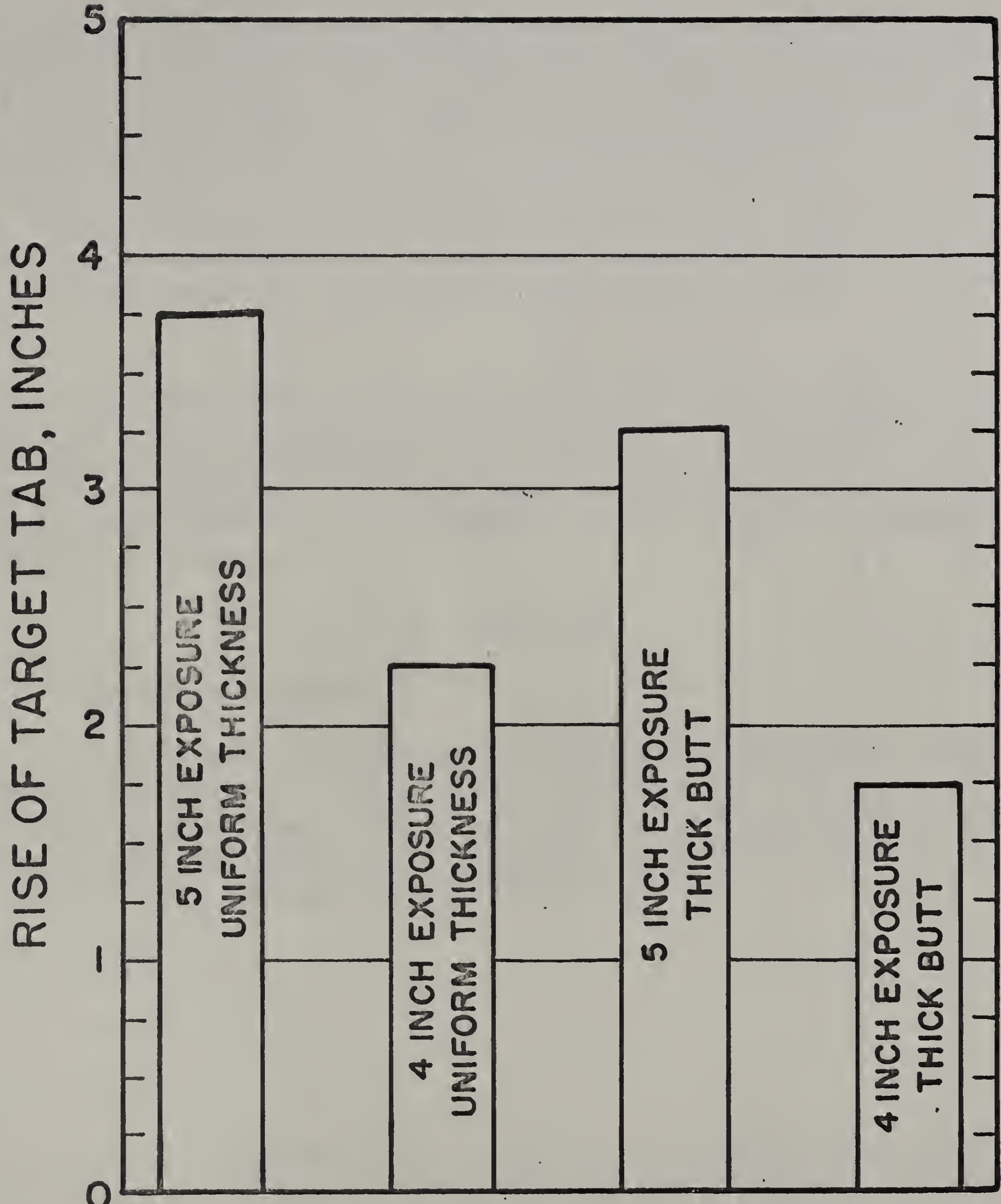

FIG. 3 - RELATIONSHIP OF WIND RESISTANCE TO EXPOSURE AREA OF ASPHALT SHINGLE ROOFING

APPENDIX - WIND-RESISTANCE TESTS.

1. Introduction

Wind tests have been used for a number of years by roofing manufacturers, Universities, and research laboratories to study the effects of winds on asphalt shingle roofings. Recently a method of wind testing has been proposed by the Asphalt Roofing Industry Bureau to determine the leak resistance of asphalt shingles when applied, using special precautions, on roof decks of low slope. Wind tests, like many laboratory tools, are limited insofar as they simulate actual conditions produced by winds during outdoor exposure. However, these same tests may become very useful tools when they are used to compare the performance of similar materials in regard to a common property.

With the limitations of the wind tests in mind, a series of tests was conducted to study the relationship between the weight per unit area of a shingle and its wind resistance. The storm test machine used in the tests was one of several types that have been used and was selected because it was readily available. No doubt similar results could be obtained with other types of equipment.

2. Apparatus

2.1 Storm Test Machine.

A storm test machine capable of delivering a horizontal stream of air through a rectangular opening at an average velocity of at least 60 miles per hour was employed. The apparatus was equipped with an adjustable stand to receive a test panel. An assembly drawing of the storm test machine is presented in Figure 4.

2.2 Clock.

2.3 Camera.

2.4 Oven.

A forced circulation air oven capable of receiving a 4- by 3-ft. panel on a slope of 2 in. per foot rise and maintaining a uniform temperature of 120°F. $\pm$3°F. when measured with a thermocouple at the four corners and the center of the test panel.

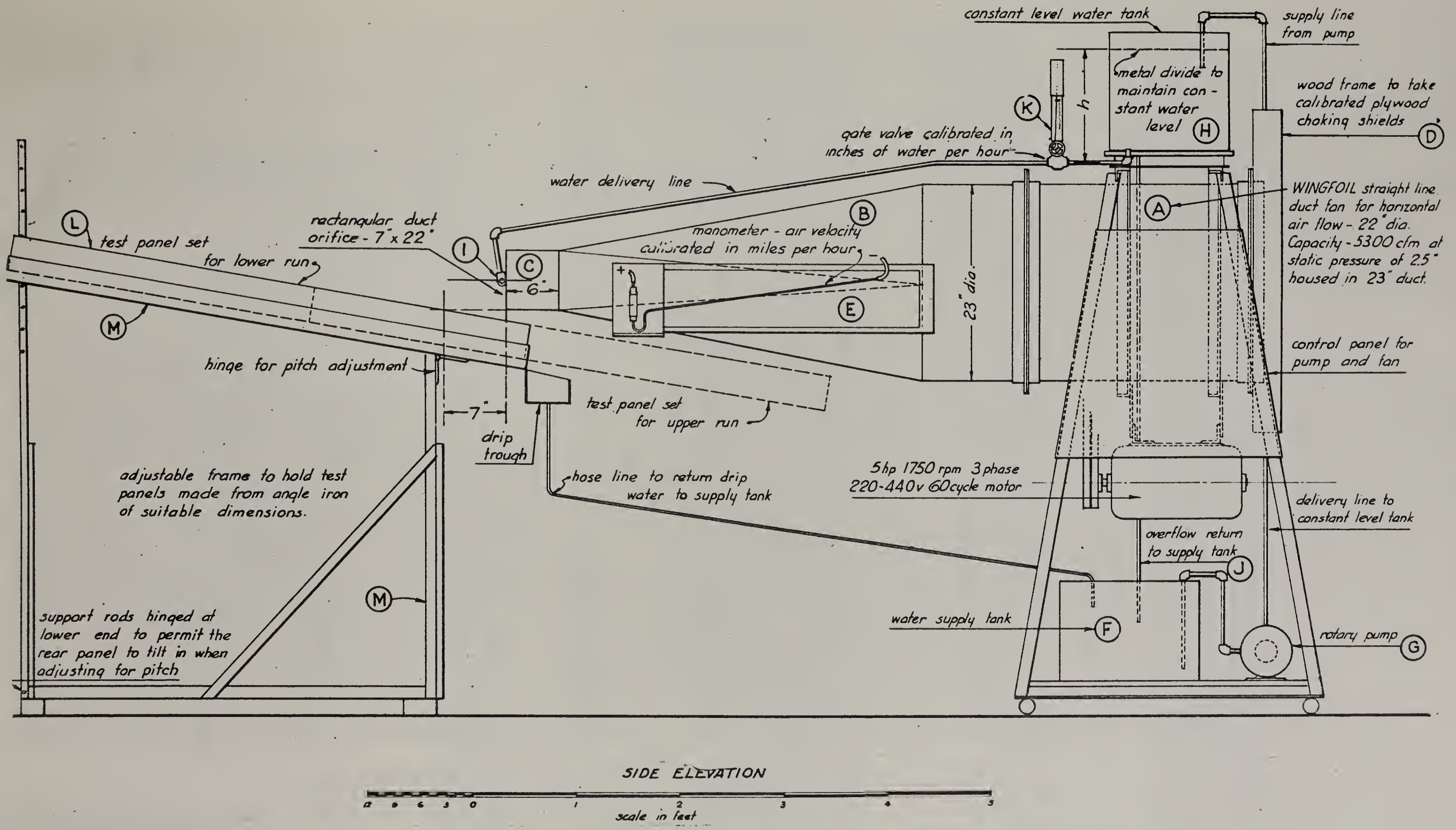

FIG. 4—STORM TEST MACHINE.

3. Test Panels

The test deck consisted of a 4-ft. by 3-ft. by 3/4-in. plywood panel on which asphalt shingles were applied in the conventional manner, parallel to the short dimension of the panel, as recommended for service conditions by the manufacturer. Four nails, properly positioned, were used to fasten each shingle, and no mechanical method was used to seal the shingle tabs.

4. Conditioning of Test Specimens

After the shingles were applied, the test panel was placed in the conditioning oven, which was maintained at 120°F., on a slope of 2 in. per foot rise, for 16 hr. The test specimen was then removed from the chamber and allowed to remain at room temperature (75 ±5°F.) for 24 hr. before the wind tests were made.

5. Test Procedure

The conditioned test panel was secured in place on the deck of the storm test machine in such a position that the exposed edge of the target tab was on the same level and 7 ±1/16 in., measured horizontally, from the lower edge of the duct orifice. The slope of the test machine deck was maintained at 2 in. per ft. rise. When the specimen was in position, the fan was started and adjusted to produce a wind velocity of 30 miles per hour. This velocity was maintained for a 15-min. period. The amount of rise of the target tab was noted and recorded.

6. Results

The results of the wind tests are presented in Figure 5.

7. Ratings

Based on the results of the wind tests, described in this report, the following ratings can be made. The lower numbers indicate the better performance in regard to wind resistance of the shingles tested:

1. 250-lb., thick butt, #60 felt.
2. 290-lb., uniform thickness.
3. 250-lb., thick butt, #48 felt.
4. 210-lb., thick butt, exposed 4 in. to weather.
5. 210-lb., uniform thickness, exposed 4 in. to weather.
6. 250-lb., uniform thickness, #60 felt.
7. 250-lb., uniform thickness, #48 felt.
8. 210-lb., thick butt, exposed 5 in. to weather.
9. 210-lb., uniform thickness, exposed 5 in. to weather.

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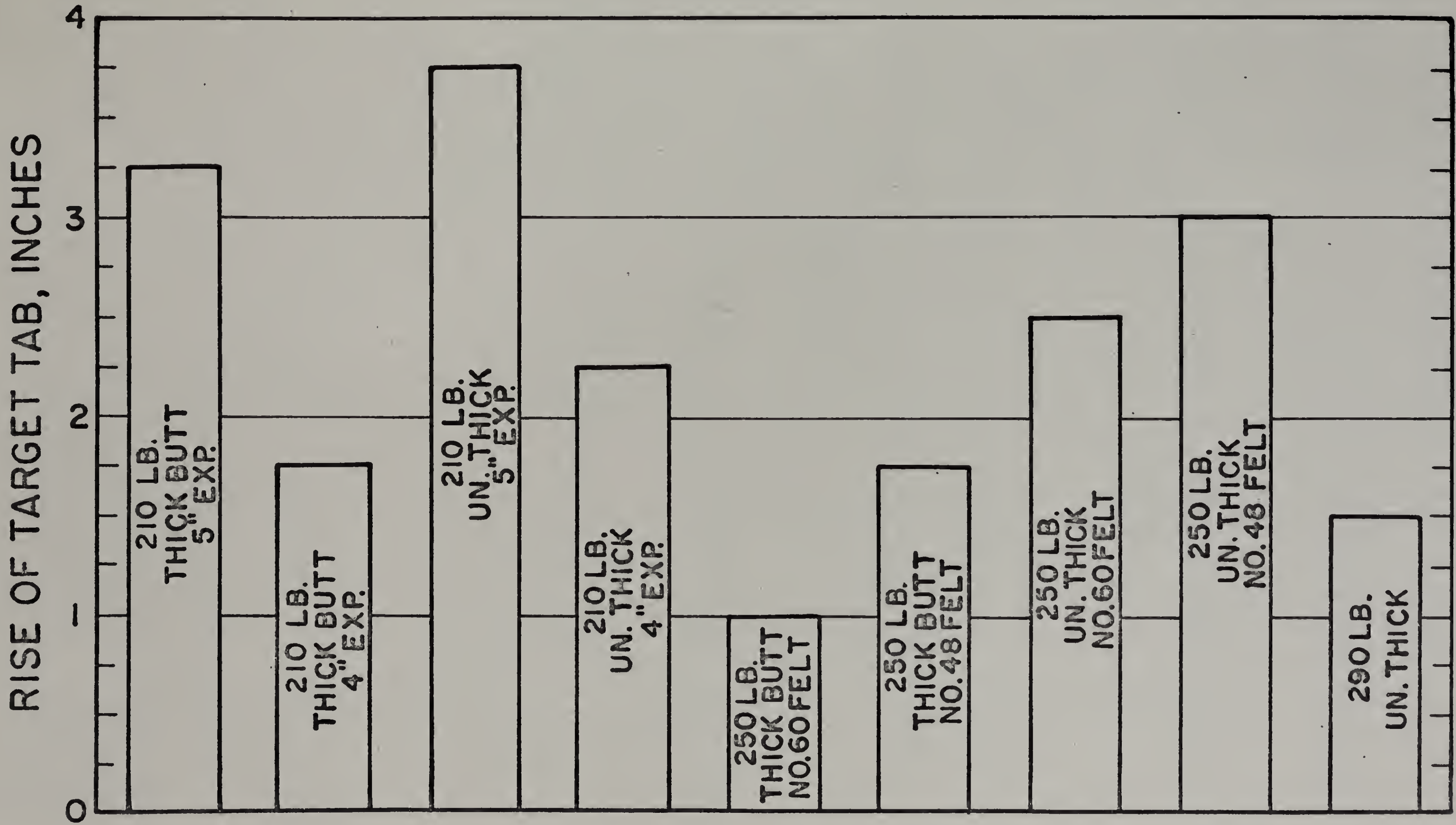

FIG. 5 - RESULTS OF WIND RESISTANCE TESTS

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Frederick H. Mueller, Secretary
NATIONAL BUREAU OF STANDARDS
A. V. Astin, *Director*

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