NATIONAL BUREAU OF STANDARDS REPORT

6448

PERFORMANCE TESTS OF TWO ONE-INCH
THROW-AWAY TYPE "DUST-STOP" AIR FILTERS

Manufactured by
Owens-Corning Fiberglas Corporation
Toledo, Ohio

by

Carl W. Coblentz
Paul R. Achenbach

Report to

Bureau of Yards and Docks
Office of the Chief of Engineers
Headquarters, U. S. Air Force
Washington, D. C.

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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Air Conditioning, Heating, and Refrigeration Section
Building Technology Division

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1. INTRODUCTION

The performance characteristics of a group of cleanable viscous impingement type air filters were determined to provide information for evaluating the relative economy of cleanable versus throw-away types of filters. This investigation was requested by the Defense Department through the Tri-Service program of research and development at the National Bureau of Standards to obtain required data for the preparation of new air filter specifications.

This report presents the results of the performance test of two nominally 1-in. thick throw-away filters of a type of which only the 2-in. thick model had been tested previously at this Bureau. The performance of a 2-in. thick specimen of this filter was presented in NBS Report No. 4972 dated January 18, 1957.

2. DESCRIPTION OF TEST SPECIMENS

The test specimens were manufactured by the Owens-Corning Fiberglas Corporation of Toledo, Ohio, and bore the trade name, "Dust-Stop". The specimens were obtained for testing from the NBS storeroom. The filter media consisted of a 1-in. thick pack of glass fibers and had been treated with an oily adhesive. The filter media were held in position on both faces by thin brass sheet retainers, perforated with 1 1/2 in. diameter cut-outs. The cardboard frames measured 19 7/8 in. square by 7/8 in. thickness on the outside, leaving an 18 in. square opening corresponding to 2.25 sq ft net face area. The weights of the clean filters were 387 grams and 378 grams, respectively (approximately 13 1/2 oz).

3. TEST METHOD AND PROCEDURE

The performance of the filters was determined at face velocities of 360 and 540 ft/min, i.e., air flow rates of 816 cfm and 1224 cfm, respectively. The arrestance measurements were conducted in accordance with the NBS "Dust Spot Method" as described in the paper, "A Test Method for Air Filters" by R. S. Dill, (ASHVE Transactions, Vol. 44, p. 379, 1938).

The aerosol used for the arrestance determination was Cottrell precipitate which had been sifted through a 100-mesh wire screen. In order to simulate actual operating conditions when loading the filters, four percent by weight of cotton linters, previously ground in a Wiley mill with a four-millimeter screen, was introduced simultaneously with the Cottrell precipitate. The pressure drop of the filters was recorded after each increment of 20 grams of dust had been introduced into the test apparatus. Whereas the arrestance determinations were made with 100 percent Cottrell precipitate, cotton linters were added to retain the ratio of four parts by weight to every 96 parts of Cottrell precipitate, including the amount used for arrestance measurements. Arrestance determinations were made at the beginning and at the end of the loading of each filter and also at several intermediate load conditions.

The filters were loaded with a dust concentration of approximately 1 gram of dust in 1000 cu ft of air until the pressure drop exceeded 0.5 in. W.G. at 360 ft/min face velocity and 0.8 in. W.G. at 540 ft/min face velocity.

At the conclusion of each test, the fallout of dust that occurred upstream of the filter was determined by sweeping out this part of the test apparatus. The ratio of fallout to the total amount of dust introduced into the test apparatus was then determined. In the evaluation of the test specimen the "Dust Load", then, was considered as the net amount of dust that had reached one square foot net face area of the filter, according to the formula:

$$D = \frac{D_T}{A} \times F$$

where: D = net dust load, g/sq ft
D_T = dust introduced into the test apparatus, g

A = net filter area, sq ft
F = one minus the ratio of fallout to total dust introduced during the test

4. TEST RESULTS

The pressure drop and arrestance values determined during the loading of the two specimens are shown in Tables 1 and 2. These data are also presented graphically in Fig. 1 as four smooth curves drawn to approximately fit the individual points of observation.

Table 1

Performance of 1-inch Dust-Stop Filter at 360 ft/min Face Velocity

Load g/sq ft	Pressure Drop in. W. G.	Arrestance %
0	0.100	-
4	0.105	60
54	0.195	60*
103	0.270	60
154	0.365	56
210	0.507	54*

* Average of two tests

Table 2

Performance of 1-inch Dust-Stop Filter at 540 ft/min Face Velocity

Load g/sq ft	Pressure Drop in. W. G.	Arrestance %
0	0.145	-
15	0.175	54*
90	0.313	51*
155	0.415	45*
202	0.505	45
260	0.615	36*
307	0.737	45*
335	0.840	38

* Average of two tests

It will be noted that the pressure drop of the clean filters was 0.100 in. W.G. at 360 ft/min face velocity and 0.145 in. W.G. at 540 ft/min face velocity. The arrestance at 360 ft/min face velocity remained constant at 60 percent during about half of the loading and then decreased to 54 percent. The arrestance values determined at 540 ft/min face velocity commenced at 54 percent and, then, decreased at an unsteady rate - the cause of which could be that, at this face velocity, considerable dust that was originally captured in the filter, was pulled through as the loading continued.

The dust loads accumulated by the two test specimens when the pressure had increased to 0.5 in. W.G. and 0.8 in. W.G., respectively, were taken from the lower curves of Fig. 1 and are presented in Table 3 as the Dust Holding Capacity. Also shown in this table are the Mean Arrestance values which present the average arrestance during the period in which the capacity dust load was accumulated, taken from the arrestance curves of Fig. 1.

Table 3

Dust Holding Capacity and Mean Arrestance
(Determined from Fig. 1)

Face Velocity, ft/min	360	540
Final Pressure Drop, in. W.G.	0.5	0.8
Dust Holding Capacity, g/sq ft	208	325
Mean Arrestance, percent	58	46

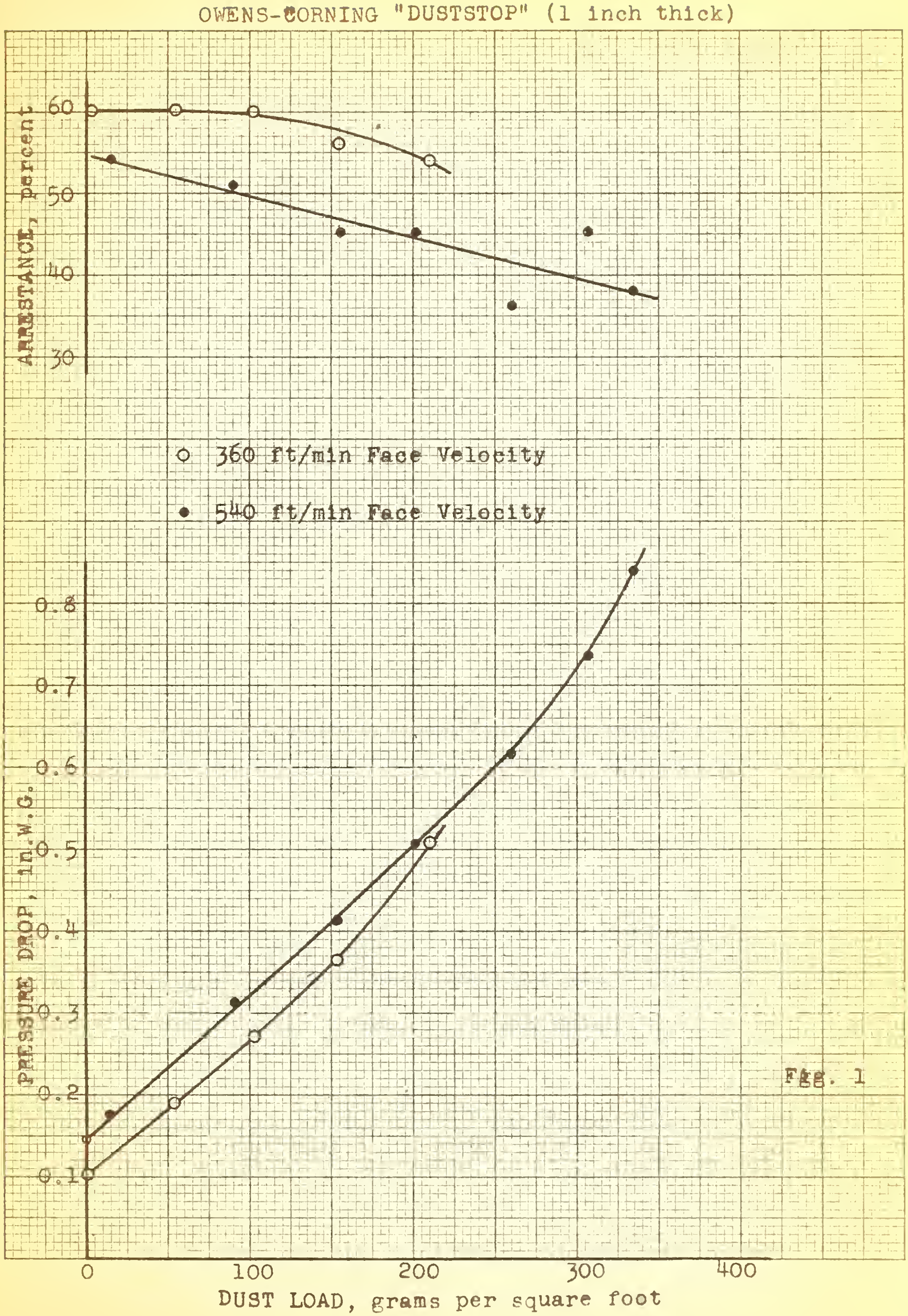
OWENS-CORNING "DUSTSTOP" (1 inch thick)
ARRESTANCE, percent
60
50
40
30
○ 360 ft/min Face Velocity
● 540 ft/min Face Velocity
PRESSURE DROP, in.W.G.
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
100
200
300
400
DUST LOAD, grams per square foot

Fig. 1

U. S. DEPARTMENT OF COMMERCE
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THE NATIONAL BUREAU OF STANDARDS

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