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NATIONAL BUREAU OF STANDARDS REPORT

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PERFORMANCE TEST OF A ROLL FILTER MEDIA

Manufactured by

Filter Fabricators, Inc.
Millersport, Ohio



U.S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS

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The Bureau comprises the Institute for Basic Standards, the Institute for Materials Research, the Institute for Applied Technology, the Center for Radiation Research, the Center for Computer Sciences and Technology, and the Office for Information Programs.

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Office of Standard Reference Data—Clearinghouse for Federal Scientific and Technical Information³—Office of Technical Information and Publications—Library—Office of Public Information—Office of International Relations.

¹ Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.

² Located at Boulder, Colorado 80302.

³ Located at 5285 Port Royal Road, Springfield, Virginia 22151.

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NBS PROJECT

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PERFORMANCE TEST OF A ROLL FILTER MEDIA

Manufactured by

Filter Fabricators, Inc.
Millersport, Ohio

by

Charles M. Hunt

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1. Introduction

At the request of the Design Services Administration of the General Services Administration, performance characteristics of a roll filter media manufactured by Filter Fabricators, Inc., were determined. The test included determination of the arrestance of Cottrell precipitate diffused into laboratory air, and the nominal dust holding capacity when the face velocity was maintained at 500 ft/min. and the media was intermittently advanced in such a way as to maintain the pressure drop across the filter between 0.45 and 0.5 inches W.G.

2. Description of Test Specimen

The roll filter media consisted of a white fiber glass mat about 2 inches thick backed by and cemented to a 1 - 2 mm mat of glass fibers. The media was coated with an adhesive. A section was found to have a weight of 28.7 grams per ft², and after two extractions with alcohol it had a dry weight of 20.4 grams per ft², indicating an adhesive content of 8.3 grams per ft². There was no visible evidence of drainage or excessive liquid on the media as received.

Microscopic examination of the media indicated that the individual fibers had typical diameters of about 20 micrometers with larger fibers also present having diameters of 50 - 60 micrometers.

3. Test Methods and Procedure

The media was tested at a net face velocity of 500 ft/min. The arrestance determinations were made using the "NBS Dust Spot Method for Air Filters" (ASHVE Transactions, Vol. 44, p. 379, 1938). For the test, the roll of media was installed in a roll-filter frame constructed to fit the NBS test apparatus. This apparatus provided an airtight enclosure with adapters to fit the upstream and downstream sections of the test duct. This roll-filter frame has been used previously for testing various media of this type.

The frame had two openings, 2 ft x 2 ft, one upstream and the other downstream from the filter. The roll of filter media was placed at the top of the frame on a spool and arranged so the media passed immediately upstream of the downstream opening as it unrolled. The loaded media was rolled onto a similar spool at the bottom of the frame. The bottom spool was driven by a motor actuated manually when the pressure drop across the media reached 0.5 in. W.G. Nine vertical bars in the downstream opening served to prevent appreciable deflection of the media under the influence of the air pressure difference. The edges of the media were enclosed in metal groove-type tracks to restrict by-pass of air between the media and frame.

The frame and media were installed in the test duct and carefully sealed to prevent any by-pass of air or inward flow into the test apparatus, except through the measuring orifice. After establishing the correct air flow rate through the filter, samples of air were drawn from the center points of the test duct 3 1/2 feet upstream and eight feet downstream of the test specimen at equal rates and passed through known areas of Whatman No. 41 filter papers. The arrestance determinations were made with Cottrell precipitate injected into the air stream at a rate of approximately one gram of dust per 1,000 cu ft of air.

The amount of light passing through the sampling papers was measured before and after the test on the same area of each paper. The two sampling papers used for any one arrestance determination were selected to have the same light transmission when clean.

For determining the arrestance of the filter, different size areas of sampling paper were exposed upstream and downstream of the filter in order to obtain a similar increase of opacity on the two sampling papers. The arrestance was calculated by the formula:

$$A = \left(1 - \frac{S_D}{S_U} \times \frac{\Delta D}{\Delta U} \right) \times 100$$

where the symbols S_U and S_D are the upstream and downstream sampling areas and ΔU and ΔD are the observed changes in the amount of light passing through the upstream and downstream sampling papers, respectively.

Arrestance determinations were made when the media was clean at the beginning of the test, and at selected intervals of loading as the intermittent advance of the media became representative of a steady-state operation. The arrestance determinations were made with Cottrell precipitate only, while cotton linters were added during the loading process in a ratio of 4 parts to every 96 parts of Cottrell precipitate. Each loading increment consisted of 20 grams Cottrell precipitate and 0.83 grams of cotton linters. The Cottrell precipitate had been previously sifted through a 100-mesh screen, and the lint was prepared by grinding No. 7 cotton linters through a large Wiley mill with a 4-millimeter screen.

The advance of the filter media was observed through a window in the test apparatus by determining the position of a marker, attached to the filter, relative to a scale mounted in the filter housing. The advance cycle, which was actuated by a manually operated switch, began when the pressure drop across the filter reached approximately 0.50 in. W.G. and stopped when the drop was about 0.45 in. W.G.

The position of the media at the beginning of each advance cycle was recorded as well as the corresponding cumulative dust load at the time of advance. From this information a plot was made of the advance of the media vs. dust load, and when the relation between these two quantities became very nearly linear, enough additional determinations of advance vs. dust load were made to develop the best-fitted straight line through the plotted data, from which the nominal dust-holding capacity in grams/ft² was determined.

The pressure drop across the media was recorded at the beginning of the test, at selected intervals during the dust loading process, and at the beginning and end of each advance cycle.

4. Test Results

The results of tests with the Filter Fabricators roll media are summarized in Tables 1 and 2. From Table 1 an initial arrestance of 66 percent was calculated from the three initial values in the table. The average arrestance after steady state conditions were reached was estimated to be 81.6 percent.

Table 2 shows the advance of the filter media required to keep the pressure drop approximately between 0.45 and 0.5 inches W.G. as dust was fed to the filter. The advance of the filter media is plotted in Figure 1 as a function of total dust fed, and a line is drawn through the points representing steady state conditions. Nominal dust holding capacity was calculated from the slope of the line by the relationship:

$$\text{Nominal dust holding capacity} = \frac{12}{SW} ,$$

where S is the slope of the line in inches advance per gram of dust load, and W is the width of the test duct where it meets the downstream side of the filter, which in this case is 2 ft. A nominal dust holding capacity of 188 grams per ft² was obtained. In Table 3 the average arrestance in the steady state and nominal dust holding capacity are compared with requirements for a type-E filter according to General Services Administration Air Conditioning Standard of December 1964.

Table 1

Performance of Filter Fabricators Roll Filter Media at 500 ft/min.

Total dust fed (grams)	Total advance media (inches)	Pressure drop (inches)	Arrestance of Cottrell precipitate (percent)
0	0	0.139	(72.7, 63.0, 61.4)*
476	0	.502	80.6, 82.1
756	11.4	.502	81.6, 82.2
1010	21.1	.496	82.8, 80.3
1247	28.0	.478	81.6, 82.3
1496	36.1	.492	79.7, 83.0
			Average arrestance 81.6 percent

* Initial arrestance values in parentheses not included in average.

Table 2

Total Dust Fed, Advance of Media, and Pressure Drop of
Filter Fabricators Roll Filter Tested at 500 ft/min.

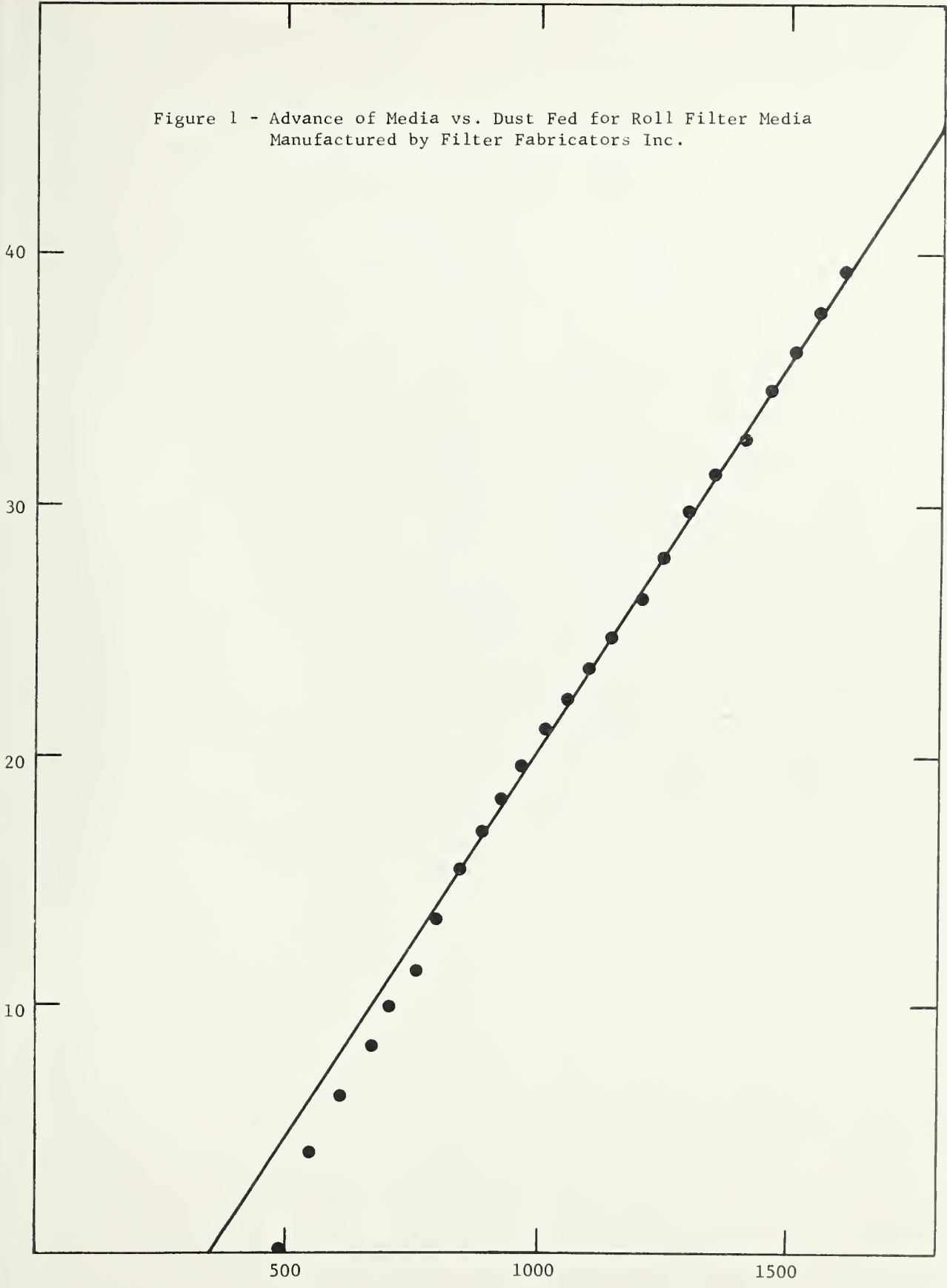
Total dust fed (grams)	Advance of media (inches)	Pressure drop before advance	(inches W.G.) after advance
0	0	0.139	-
54	0	.163	-
95	0	.198	-
137	0	.227	-
241	0	.293	-
304	0	.342	-
386	0	.410	-
429	0	.453	-
498	0	.520	0.443
550	4.0	.500	.448
602	6.3	.510	.455
664	8.3	.506	.454
706	9.9	.500	.451
760	11.4	.537	.455
801	13.6	.511	.449
847	15.4	.501	.444
890	17.0	.501	.449
931	18.4	.500	.451
968	19.6	.502	.447
1018	21.1	.500	.451
1059	22.3	.501	.452
1101	23.5	.500	.452
1147	24.8	.501	.449
1205	26.3	.504	.452
1251	28.0	.501	.449
1301	29.8	.500	.450
1350	31.3	.500	.450
1413	32.6	.502	.450
1462	34.6	.500	.450
1506	36.1	.500	.448
1554	37.8	.500	.451
1603	39.4	.500	.450

Table 3

Comparison of Filter Fabricators Roll Filter Media Performance
with GSA Requirements for a Type-E Media

	Filter Fabricators media	Requirement Type-E media
Nominal dust holding capacity (grams per square foot of media leaving the air stream)	188	200
Average arrestance of Cottrell precipitate in steady state (percent)	81.6	75.0

Figure 1 - Advance of Media vs. Dust Fed for Roll Filter Media
Manufactured by Filter Fabricators Inc.



Dust Fed (Grams)

