NATIONAL BUREAU OF STANDARDS REPORT

10 131

PERFORMANCE TEST OF A ROLL FILTER MEDIA

Manufactured by

The Fram Corporation
General Products Division
Henderson, North Carolina

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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THE OFFICE FOR INFORMATION PROGRAMS promotes optimum dissemination and accessibility of scientific information generated within NBS and other agencies of the Federal government; promotes the development of the National Standard Reference Data System and a system of information analysis centers dealing with the broader aspects of the National Measurement System, and provides appropriate services to ensure that the NBS staff has optimum accessibility to the scientific information of the world. The Office consists of the following organizational units:

Office of Standard Reference Data—Clearinghouse for Federal Scientific and Technical Information [3]—Office of Technical Information and Publications—Library—Office of Public Information—Office of International Relations.

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[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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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 Fram Corporation, 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 constant velocity, 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 color of the upstream face was blue. The media was coated with an adhesive. The media was found to have a weight of 34.4 grams per ft^2, and after three extractions with alcohol it had a dry weight of 23.5 grams per ft^2, indicating an adhesive content of 10.9 grams per ft^2. 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 an average diameter of about 35 micrometers with individual fibers ranging in diameter from 20 to 50 micrometers.

3. Test Methods and Procedure

The media was tested at an estimated net face velocity of 500 ft/min. based on the measured pressure drop across an orifice at the entrance to the test duct. 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 2 ft x 2 ft openings, 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 airflow 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 airstream 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 mark on 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/ft^2 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 Fram Corporation roll media are summarized in Tables 1 and 2. From Table 1 an initial arrestance of 75 percent was calculated from the three initial values in the table. The average arrestance after steady state conditions were reached was estimated to be 82.2 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:

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

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 178 grams per ft^2 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.

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Table 1

Performance of Fram Corporation Roll Filter Media

Total dust fed (grams)	Total advance media (inches)	Pressure drop (inches)	Arrestance of Cottrell precipitate (percent)
0	0	0.180	(75.4, 73.8)*
129	0	.257	-
254	0	.338	-
316	0	.380	-
462	0	.498	-
733	14.0	.498	80.8, 84.3
977	20.6	.450	80.0, 82.1
1018	20.6	.502	83.9, 82.3
1259	30.3	.480	80.0, 83.8

Average arrestance
82.2 percent

* Initial values in parentheses not included in average.

Table 2

Total Dust Fed, Advance of Media, and Pressure Drop of Fram Corporation Roll Filter

Total dust fed (grams)	Advance of media (inches)	Pressure drop (inches W.G.) before advance	after advance
0	0	0.180	-
4	0	.190	-
87	0	.228	-
129	0	.257	-
212	0	.310	-
254	0	.338	-
316	0	.380	-
441	0	.462	-
462	0	.498	-
491	0	.501	0.449
546	4.8	.499	.450
610	7.5	.502	.447
659	10.3	.499	.445
733	12.1	.498	.447
780	14.0	.502	.448
835	16.3	.504	.440
906	18.5	.505	.447
977	20.6	.509	.450
1096	24.2	.500	.452
1204	28.5	.498	.442
1267	30.3	.499	.455
1319	32.3	.502	.452
1366	34.0	.498	.443
1414	35.8	.500	-

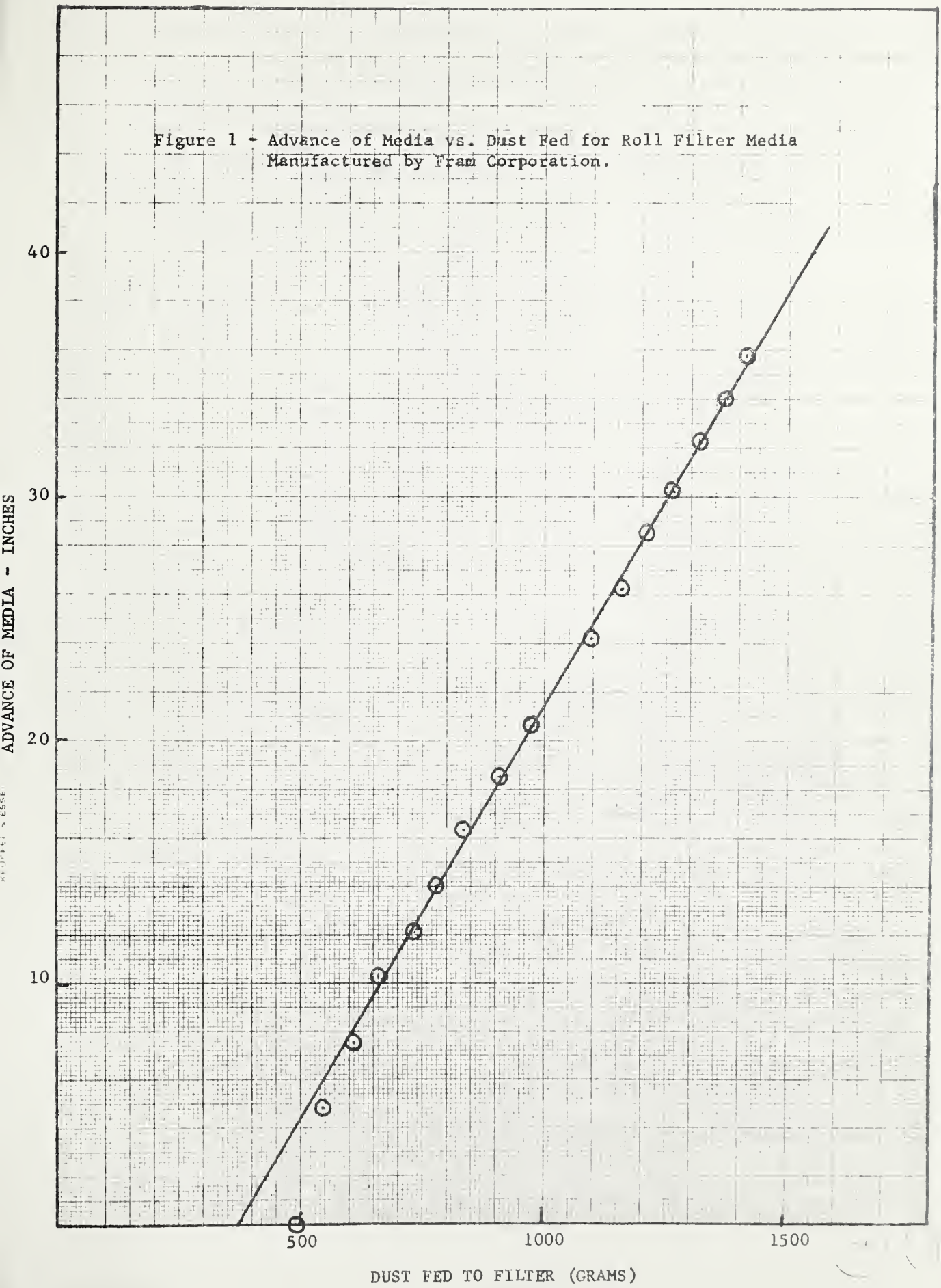
Table 3

Comparison of Fram Corporation 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)	178	200
Average arrestance of Cottrell precipitate in steady state (percent)	82.2	75.0

Figure 1 - Advance of Media vs. Dust Fed for Roll Filter Media Manufactured by Fram Corporation.

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