NATIONAL BUREAU OF STANDARDS REPORT

8674

PERFORMANCE TEST OF
"KLEEN-AIR" GLASS FIBER AUTOMATIC RENEWABLE FILTER MEDIA

manufactured by the
B & M Filter Sales and Service, Inc.
Houston, Texas

by

Charles M. Hunt
and
Paul R. Achenbach

Report to
General Services Administration
Public Buildings Service
Washington, D.C.

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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1. Introduction

This report describes the results of tests obtained with a "Kleen-Air" roll-type filter media manufactured by the B and M Filter Sales and Service, Incorporated, of Houston, Texas. Earlier tests of similar media manufactured by the same company were reported in NBS Report 8571 dated November 2, 1964. The previously tested media was found to have a satisfactory arrestance, but the dust-holding capacity was below the requirement of 200 g/ft^2 cited in the Standard Air-Conditioning Specification, dated December 1964, of the General Services Administration. The present media was modified in an attempt to meet both the arrestance and dust-holding capacity requirements.

These tests were undertaken at the request of the Public Buildings Service of the General Services Administration. The tests include the determination of arrestance of Cottrell precipitate diffused into laboratory air and the dust-holding capacity. They were performed at a face velocity of 500 ft/min while the media was intermittently advanced during loading to maintain a pressure drop between 0.45 and 0.5 inches W.G. across the filter.

Two media were submitted, one heavier than that described in Report 8571 and one of comparable weight but of slightly more open construction according to Mr. Weaver of the B & M Company. This report gives only data on the latter media, because tests on the other were discontinued when it became evident that dust-holding requirements would not be met.

2. Description of Test Specimen

The present filter media resembled the original material in weight and appearance. It was 32 inches wide, 2 inches thick, and blue in color. On the downstream side it was attached to a square-weave scrim reinforcement of approximately four mesh per inch.

According to the manufacturer the fibers were coated with an adhesive consisting of tricresyl phosphate and a thickening agent. Analysis showed 9.2 g/ft^2 of a liquid of low volatility which was extractable with alcohol. In addition, about 2 grams of easily charred solid matter separated from the alcohol extract on evaporation. There was no evidence of drainage from the filter due to excessive adhesive.

3. Test Methods and Procedure

The methods of test were similar to those used in the previous tests of "Kleen-Air" filter media.

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 and 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 up on 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 dust spot test apparatus 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 two feet upstream and eight feet downstream of the test specimen at equal rates and passed through known area of Whatman No. 41 filter paper. The arrestance determinations were made with Cottrell precipitate injected into the air stream with a ratio of one gram of dust per 1,000 cu ft of air.

The light transmission of the sampling papers was measured before and after the test on the same area of each paper, and 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 opacity of 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 until 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, including the Cottrell precipitate used for arrestance measurements. Each loading increment consisted of 20 grams Cottrell precipitate and 0.8 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 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 mat, relative to a yardstick mounted in the filter housing, adjacent to the mat. A pilot light connected in parallel with the electric motor enabled the operator to note the position of the media and to record the pressure drop across the medium at the beginning and at the end of each advance cycle. 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 the two parameters became very nearly linear, enough additional determinations of advance as related to load were made to develop the best-fitted straight line through the plotted data, from which the dust-holding capacity in grams/ft^2 was determined.

The pressure drop across the media was recorded at the beginning of the test, after each arrestance determination, after introduction of each increment of Cottrell precipitate and lint into the test duct, and at the beginning and end of each advance cycle.

4. Test Results

The arrestance of the filter media in the initial state and as test dust was added is given in Table 1. The cumulative advance of the media and the pressure drop at the times the arrestance measurements were made are also given in the table.

Table 1

Performance of the Modified "Kleen-Air" Roll Filter Media at an Air Flow Rate of 2000 cfm

Nominal Dust Load[a] (grams)	Total Advance of Media (inches)	Pressure Drop (in. W.G.)	Arrestance[b] (per cent)
0	0	0.170	67.8
554	0	0.506	83.2
953	17 1/2	0.502	84.5
1187	23 1/2	0.500	84.5
1482	31 1/2	0.504	84.9
1559	33 1/2	0.452	84.8

[a] Nominal dust load is the total amount of Cottrell precipitate and lint introduced to the filter. A certain fraction of dust passes through, so that the net load retained by the filter is less than the nominal dust load.

[b] Arrestance was determined with Cottrell precipitate dispersed in air.

The filter had an initial arrestance of 67.8% and an average arrestance of 84.7% after steady-state conditions were reached.

In Table 2 the advance of the media required to keep the pressure drop between 0.45 and 0.5 inches W.G. is shown periodically during the time the dust load was increasing from 804 to 1559 grams.

Table 2

Nominal Dust Load, Advance of the Media, and
Pressure Drop of Modified "Kleen-Air" Roll Filter Media

Nominal Dust Load[a/] (grams)	Advance of Media (inches)		Pressure Drop (inches W.G.)	
	Increment	Total	Before Advance	After Advance
0	0	0	0.170	---
804	2	13 1/2	0.500	0.450
887	2	15 1/2	0.504	0.450
953	2	17 1/2	0.502	0.450
1016	2	19 1/2	0.496	0.446
1099	2	21 1/2	0.500	0.448
1187	2	23 1/2	0.506	0.450
1249	2	25 1/2	0.496	0.450
1312	2	27 1/2	0.498	0.450
1395	2	29 1/2	0.502	0.448
1482	2	31 1/2	0.506	0.454
1559	2	33 1/3	0.502	0.452
Average	2		0.501	0.450

[a/] See footnote a/, Table 1.

In Figure 1, advance of the media has been plotted as a function of the nominal dust load. Nominal dust-holding capacity was calculated from the slope of the line in the figure 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. In this example, W = 2 ft, and the calculation gives

$$\text{Nominal dust-holding capacity} = \frac{12}{.0266 \times 2} = 226 \text{ g/ft}^2.$$

This capacity is higher than the requirement of 200 g/ft^2, and the average arrestance of 84.7% with Cottrell precipitate is in excess of the required arrestance of 75%, incorporated in the December 1964 revision of the GSA "Standard Air-Conditioning Specification".

ADVANCE OF FILTER VS. DUST LOAD FOR
"KLEEN-AIR" GLASS FIBER AUTOMATIC
RENEWABLE FILTER MEDIA

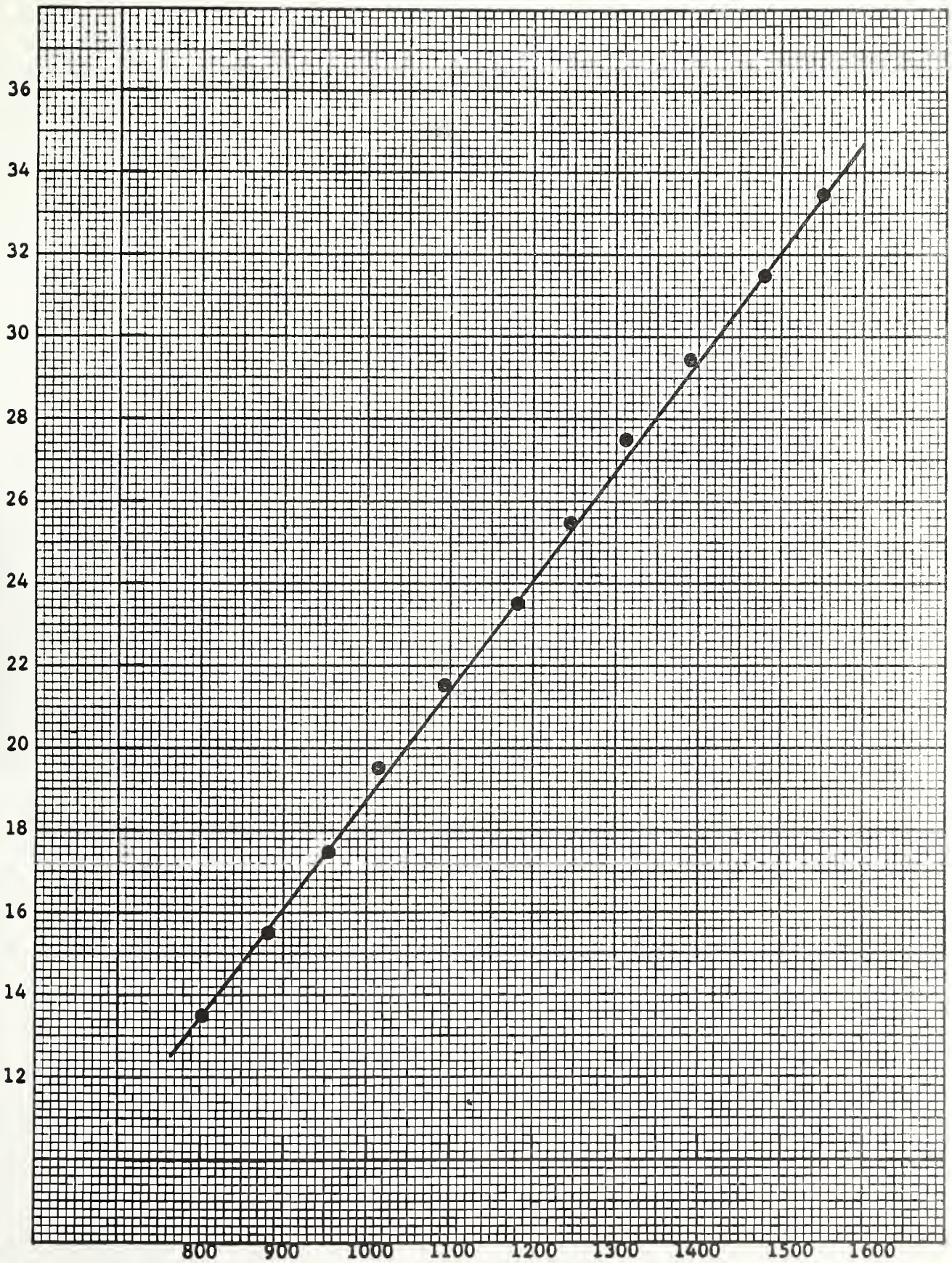

FIGURE 1


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