NATIONAL BUREAU OF STANDARDS REPORT

9502

Performance Test of a

Hi-E-95 Filter

Manufactured by

Servodyne Corporation
1375 Fitzgerald Avenue
San Francisco, California

by

Charles M. Hunt

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] 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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1. Introduction

At the request of the Public Buildings Service of the General Services Administration performance characteristics of a Servodyne Hi-E-95 filter were determined. The scope of the tests included the determination of arrestance of the particulate matter in laboratory air when the filter was clean and at intervals after it had been loaded with increasing increments of test dust. Pressure drop across the filter was also determined, starting with the clean filter and measuring it during the dust loading process until a final pressure drop close to 1 in. W.G. was obtained.

2. Description of Test Specimens

The Hi-E-95 filter consisted of a permanent rubberized wire frame and a replaceable cartridge of filter media. The frame had face dimensions of approximately 24 x 24 in. and a depth of 12 in. The cartridge consisted of filter media formed into 12 vertical pleats, each about 11-1/2 in. deep. The pleats were attached to horizontal cardboard mountings at the top and bottom. The pleats fit into and were supported by the frame. The face

dimensions of the cartridge were 22 x 22 in., giving a face area of about 3.4 ft^2. The pleats presented an effective filtering surface of 40 ft^2 or more. According to the Servodyne brochure on Hi-E filters, the Hi-E-95 filter of 12 in. depth has a rated capacity of 1000 cfm.

The filter media was about 1/8 in. in the thickness. It was light orange in color, and a light cotton backing was attached to the downstream side. The backing consisted of a square-weave cotton net with about 8 threads per inch and a non-woven cotton fabric attached to the net on the downstream side. The non-woven part of the backing contained regularly spaced openings each about 1/16th in. in diameter. The filter media itself was a soft mat of fibers. Typical fiber diameters of 2-3 microns were observed under the microscope. Neither the media nor the backing would support combustion when removed from a flame.

3. Test Method and Procedure

The filter was tested at the rated capacity of 1000 cfm. The arrestance determinations were made by means of the NBS Dust Spot Method described in a paper by R. S. Dill entitled, "A Test Method for Air Filters" (ASHVE Transactions, Vol. 44, page 379, 1938). The filter under test was installed in the test apparatus and carefully sealed to prevent any by-pass of air around the media. After establishing correct air flow through the filter, samples of air were drawn from center points of the test duct 2 feet upstream and 8 feet downstream from the test specimen. The air samples were drawn through equal areas of Whatman No. 41 filter paper.

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

In determining arrestance of the filter a timer was used to obtain upstream and downstream dust spots of approximately equal density. Downstream sampling was continuous while upstream sampling was intermittent and controlled by a timer with a 5 minute on-off cycle. Arrestance was calculated by the equation:

$$A = \left(1 - T \frac{\Delta D}{\Delta U}\right) 100, \qquad (1)$$

where A represents percent arrestance, ΔD and ΔU represent the relative change in the amount of light transmitted through the downstream and upstream papers due to the dust spots, as indicated by the photometer readings. T represents the fraction of the time that samples were drawn upstream from the filter.

The filter was loaded with test dust consisting of 96 parts by weight Cottrell precipitate and 4 parts of No. 7 cotton linters which had previously been ground in a large Wiley mill having a 4mm exit screen. The Cottrell precipitate was dispersed into the air stream at a rate of approximately 1 g per 1000 ft^3 of air, and the cotton linters were dispersed separately after each 20 gram increment of Cottrell precipitate. Arrestance determinations were made with the clean filter and at selected intervals in the dust loading process using as the test aerosol ordinary atmospheric air into which no artificial contaminant was introduced.

4. Test Results

The performance of the Hi-E-95 filter is given in table 1 where dust fed, pressure drop across the filter, and arrestance of atmospheric dust are tabulated. The data are also plotted in figure 1 where the upper curve gives the arrestance of atmospheric dust and the lower curve gives the pressure drop across the filter, both plotted as functions of the amount of test dust fed into the duct.

As shown in table 1 the initial arrestance was 80.1% and this reached a maximum measured value of 96.3% after 646 grams of dust were fed into the duct. At a still higher dust load the arrestance dropped slightly. An average arrestance of 87.1%, based on the area under the curve in figure 1 was obtained up to a pressure drop of 0.830 in. W.G. This pressure drop is 0.5 in. W.G. greater than the initial pressure drop. An average arrestance of 88.7% was estimated up to a pressure drop of 1 in. W.G.

From the lower curve in figure 1 a pressure drop of 0.830 in. W.G. was obtained after 615 grams of test dust were fed into the duct. Corrected for upstream fallout, this amounts to a dust holding capacity of 590 grams. A corrected dust holding capacity of 687 grams was estimated up to a pressure drop of 1 in. W.G.

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Table 1

Performance of Servodyne Hi-E-95 filter at 1000 cfm

Dust fed[a] (grams)	Pressure drop across filter (in. W.G.)	Arrestance atmospheric dust (percent)
0	.330	80.1
116	.374	—
208	.426	84.1
—	.426 [b]	—
250	.450	—
—	.448 [b]	—
375	.504	89.6
438	.562	—
479	.614	91.3
—	.622 [b]	—
500	.642	—
562	.740	95.0
646	.887	96.3
—	.845 [b]	—
708	.986	94.1

[a] At the end of the test 27.5g of dust were collected from the duct upstream from the filter. This is 3.9% of the total dust fed to the filter. If it is assumed that this percentage of fallout occurred uniformly throughout the loading period, then any value in the column can be corrected for fallout by multiplying by 0.961.

[b] These values were obtained after shutting down test duct overnight or over weekend and restarting.

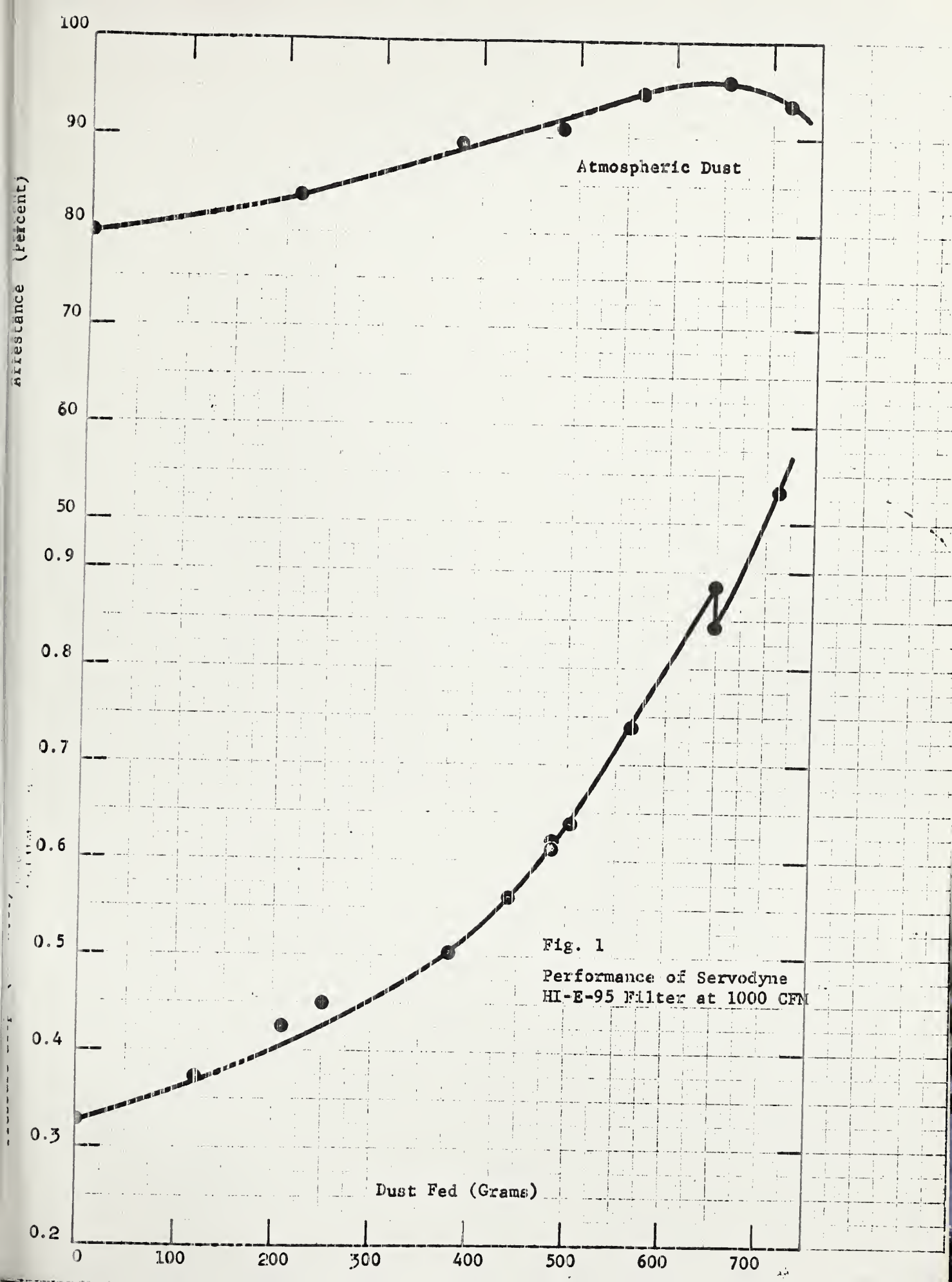

Fig. 1

Performance of Servodyne HI-E-95 Filter at 1000 CFM


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