NATIONAL BUREAU OF STANDARDS REPORT

6954

PERFORMANCE TESTS OF A FRAM THROW-AWAY TYPE AIR FILTER
manufactured by
Fram Aire Corporation
Division of Fram Corporation
Providence, Rhode Island

by

Carl W. Coblentz and Paul R. Achenbach

Report to

General Services Administration
Federal Supply Service
Washington 25, D. C.

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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C. W. Coblentz and P. R. Achenbach
Mechanical Systems Section
Building Research Division

to
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1. Introduction

At the request of the Federal Supply Service, General Services Administration, the performance characteristics of two specimens of the Fram throw-away type air filter were determined. The scope of this examination included the arrestance of Cottrell precipitate in laboratory air, the pressure drop, and the dust-holding capacity of the specimens at 370 ft/min face velocity.

2. Description of Test Specimen

The filters were manufactured and supplied for test purposes by the Fram Aire Corporation, Division of Fram Corporation, of Providence, Rhode Island, and were intended to be identical in construction. The test specimens were nominal 20 x 20 x 1 in. filters and measured 19 3/4 in. square and 15/16 in. thick on the outside. The filter medium was held in a cardboard frame with channel-shaped cross section which left a net face area of 17 7/8 in. square, i.e., 2.22 sq ft.

The weights of the two specimens were 240 and 235 grams, respectively (approx. 8 1/2 oz). The filter media were of a light plastic felt about 1/2-in. thick. The medium would not sustain combustion and according to the manufacturer's claims was treated with a bactericidal substance. A perforated metal sheet was installed in the frame to support the downstream face of the filter media.

3. Test Method and Procedure

The filter was tested at a face velocity of 370 ft/min corresponding to an air flow rate of 820 cfm. The arrestance determinations were made with the NBS "Dust Spot Method" described in a paper by R. S. Dill entitled, "A

Test Method for Air Filters," (ASHVE Transactions, Vol. 44, p. 379, 1938). The filter under test was supported in a frame which fitted the test apparatus and was carefully sealed to prevent any by-pass of air or inward leakage into the test apparatus, except through the measuring orifice. The desired rate of air flow through the filter was established, and samples of air were drawn from the center points of the test duct 2 feet upstream and 8 feet downstream of the test specimen at equal rates, and passed through known areas of Whatman No. 41 filter paper. The arrestance determinations were made with laboratory air into which Cottrell precipitate was injected and diffused at a ratio of 1 gram per 1,000 cu ft of air.

The two sampling papers used for each arrestance determination were selected to have the same light transmission when clean. The light transmission was measured with a sensitive photometer on the same portion of each paper before and after the test. In order to obtain similar increases of opacity with both samplers, different size areas were used upstream and downstream of the filter. The arrestance, A (in percent), was calculated by the following formula:

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

where S_D and S_U are the downstream and upstream areas and ΔD and ΔU the observed changes in the opacity of the downstream and upstream sampling areas, respectively.

Whereas the arrestance determinations were made with Cottrell precipitate only, cotton lint was added during the loading process in a ratio of 4 parts to every 96 parts by weight of Cottrell precipitate, including that amount used for arrestance measurements. The Cottrell precipitate had been previously sifted through a 100 mesh screen and the cotton lint was prepared by grinding No. 7 cotton linters in a Wiley mill with a 4 millimeter screen.

Arrestance determinations were made at the beginning and at the end of the loading period of each test specimen and at several intermediate load conditions. The pressure drop across the filter under test was recorded after each increment of 20 grams of dust had been introduced into the test duct. The test was terminated when the pressure drop reached 0.5 in. W.G.

4. Test Results

A summary of the test results of the two specimens is presented in Table 1 which shows the dust load, pressure drop, and the arrestance values.

Table 1

Performance of a
Fram Throw-away Type Air Filter
1 inch Nominal Thickness, 370 ft/min Face Velocity

Dust Load g/sq ft	Pressure Drop in. W.G.	Arrestance %
	FIRST SPECIMEN	
0	0.120	-
5	0.131	54*
39	0.220	66*
72	0.310	69
126	0.496	76*
	SECOND SPECIMEN	
0	0.110	-
5	0.116	50*
47	0.214	65
100	0.353	73
135	0.505	73

* Indicates average of two arrestance determinations.

The "Dust Load" shown in this table is the dust received by 1 sq ft net filter area. It is the weight of the Cottrell precipitate and lint introduced into the test apparatus divided by the net face area of the filter and diminished by the percentage of dust fallout upstream of the filter. This dust fallout was determined at the conclusion of the test by sweeping out the test duct and calculating the percentage of fallout to the total dust introduced.

It will be noted that the pressure drop and the arrestance of the first specimen was a little higher than that of the second one, associated with a slightly higher weight of the first specimen. The initial arrestances of the filters were 54% and 50%, and the final arrestances, 76% and 73%, respectively. The pressure drops of the

clean filters were 0.120 and 0.110 in. W.G., respectively. The dust-holding capacity, which is the dust load per unit area at the final pressure drop of 0.5 in. W.G., averaged 130 g/sq ft. The first specimen, presumably because of its higher arrestance, had a dust load of 126 g/sq ft at 0.496 in. W.G., whereas the second specimen showed 135 g/sq ft at 0.505 in. W.G.

Figure 1 presents a graph of the values shown in Table 1 with smooth curves approximating the line of the least mean square distances from the points of observation of both specimens. The average arrestance of approximately 67% is taken as the imaginary horizontal line which would enclose equal areas above and below the arrestance curve.

FRAM AIR FILTER

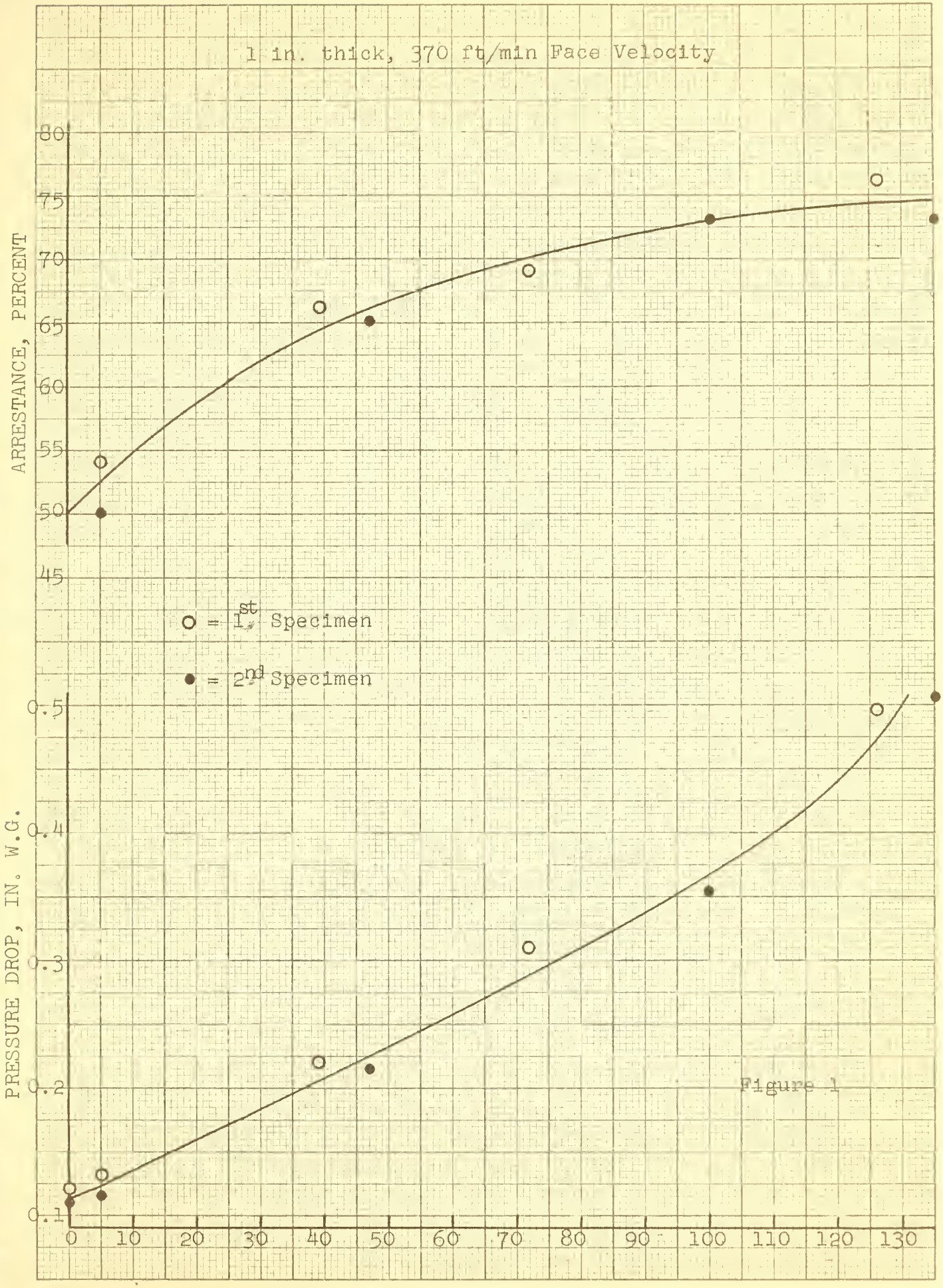

Figure 1

U.S. DEPARTMENT OF COMMERCE
Frederick H. Mueller, *Secretary*

NATIONAL BUREAU OF STANDARDS
A. V. Astin, *Director*

THE NATIONAL BUREAU OF STANDARDS

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WASHINGTON, D.C.

ELECTRICITY. Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics.

METROLOGY. Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Scale. Volumetry and Densimetry.

HEAT. Temperature Physics. Heat Measurements. Cryogenic Physics. Rheology. Molecular Kinetics. Free Radicals Research. Equation of State. Statistical Physics. Molecular Spectroscopy.

RADIATION PHYSICS. X-Ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

CHEMISTRY. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Molecular Structure and Properties of Gases. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

MECHANICS. Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Combustion Controls.

ORGANIC AND FIBROUS MATERIALS. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Plastics. Dental Research.

METALLURGY. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion. Metal Physics.

MINERAL PRODUCTS. Engineering Ceramics. Glass. Refractories. Enameled Metals. Constitution and Microstructure.

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APPLIED MATHEMATICS. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics.

DATA PROCESSING SYSTEMS. Components and Techniques. Digital Circuitry. Digital Systems. Analog Systems. Applications Engineering.

ATOMIC PHYSICS. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics.

INSTRUMENTATION. Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

Office of Weights and Measures.

BOULDER, COLO.

CRYOGENIC ENGINEERING. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Gas Liquefaction.

IONOSPHERE RESEARCH AND PROPAGATION. Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services.

RADIO PROPAGATION ENGINEERING. Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation-Terrain Effects. Radio-Meteorology. Lower Atmosphere Physics.

RADIO STANDARDS. High frequency Electrical Standards. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time Standards. Electronic Calibration Center. Millimeter-Wave Research. Microwave Circuit Standards.

RADIO SYSTEMS. High Frequency and Very High Frequency Research. Modulation Research. Antenna Research. Navigation Systems. Space Telecommunications.

UPPER ATMOSPHERE AND SPACE PHYSICS. Upper Atmosphere and Plasma Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.


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