NATIONAL BUREAU OF STANDARDS REPORT

7331

PERFORMANCE TEST OF AN OWENS-CORNING
"DUST-STOP TYPE C" AIR FILTER

by

Carl W. Coblentz and Paul R. Achenbach

Report to

Public Buildings Service
General Services Administration
Washington 25, D. C.

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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Mechanical Systems Section
Building Research Division

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1. INTRODUCTION

At the request of the Public Buildings Service, General Services Administration, the performance characteristics of two specimens of a new type "C" throw-away type "Dust-Stop" air filter were determined. The scope of this examination included the determination of the arrestance of Cottrell precipitate in the laboratory air, the pressure drop, and the dust-holding capacity when the filters were operated at 350 ft/min face velocity.

2. DESCRIPTION OF TEST SPECIMENS

The filters were manufactured and supplied for test purposes by the Owens-Corning Fiberglas Corporation of Toledo, Ohio. Two specimens were arbitrarily selected from a factory-sealed carton containing six filters of the same kind.

The nominal 20x20x1 inch filters actually measured 19 1/2 x 19 1/2 x 15/16 inches with a net face area of 17 7/8 inches square, i.e. 2.22 square feet. The filter media consisted of a mat of bonded glass fibers. According to the manufacturer's information, hexachlorophene had been added to the adhesive to provide a means for absorbing odors. The filter media was supported on both faces by perforated sheets of thin metal; the perforations consisted of 1 1/2 inch diameter cut-outs with approximately 1/32 inch material left between the holes. The downstream face was further reinforced by a V-shaped brace, the ends of which were held in the channel-shaped cardboard frame. The weights of the two specimens were 392 grams and 375 grams (13 7/8 and 13 1/4 ounces), respectively.

3. TEST METHOD AND PROCEDURE

The performance of the test specimens was determined at a face velocity of 350 ft/min, i.e. an air flow rate of 780 cfm. The arrestance measurements were conducted in accordance with the "NBS Dust Spot Method," as 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 wooden frame that 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 cubic feet of air.

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

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

where S_D and S_U are the downstream and upstream areas and ΔD and ΔU the changes of the opacity of the exposed areas of the downstream and upstream sampling papers, 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 lint was prepared by grinding No. 7 cotton linters through 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 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 after the pressure drop reached 0.5 in. W.G.

4. TEST RESULTS

The results observed during tests of the two specimens are presented in Table 1, which shows the dust load, the pressure drop, and the arrestance values.

Table 1

Performance of Owens-Corning "Dust-Stop" Air Filter 1-inch thick, 350 ft/min Face Velocity

Pressure Drop in. W. G.	Dust Load g/sq ft	Arrestance %
	Specimen No. 1	
0.095	4	64*
0.190	54	70*
0.265	106	73*
0.353	157	77*
0.491	225	75*
0.511	231	--
	Specimen No. 2	
0.095	4	69
0.216	60	74
0.264	85	76
0.314	111	81
0.378	135	82
0.447	160	82
0.501	177	81

* Indicates average of two arrestance determinations.

The "dust load" shown in this table is the weight of dust received per 1 square foot of net filter area. It is the amount of 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 fall-out upstream of the filter. This dust fall-out was determined at the conclusion of the test of each specimen by weighing the amount of dust that was swept out of the upstream part of the test duct, and calculating the percentage of fall-out to the total amount of dust introduced. The "dust-holding capacity" shown in Table 2, the Summary of Test Results, presents the dust load at the final pressure drop of 0.50 in. W.G. across the filter.

Table 2

Summary of Test Results

	Specimen No. 1	Specimen No. 2	Average
Pressure Drop, Clean, in. W.G.	0.093	0.090	0.092
Arrestance, Clean, %	64	69	67
Arrestance, Loaded, %	75	81	78
Arrestance, Average during loading, %	73	77	75
Dust-Holding Capacity, g/sq ft	227	175	201

There was a considerable difference in the performance of the two test specimens. The difference may have been caused by different density of the filter media or unlike amounts of adhesive applied to the media. Specimen No. 1, which was 17 grams (about 5%) heavier than the second specimen, showed an initial pressure drop of 0.093 in. W.G. against 0.090 in. W.G. of the lighter filter. The initial arrestance of the two specimens differed considerably; it was 64 percent and 69 percent for specimens 1 and 2, respectively. Corresponding to the lower arrestance, the dust-holding capacity of the first specimen was about 130 percent of that for the second one.

Figure 1 is a graphical representation of the values shown in Table 1 with smooth curves approximating the lines of the least mean square distances from the respective points of observation. The curves indicate a dust-holding capacity of 227 grams for specimen No. 1 and of 175 grams for specimen No. 2 at the limiting value of 0.50 in. W.G. Both specimens revealed an increase in arrestance as the filters were loaded up to approximately 0.4 in. W.G. Thereafter, the arrestance values decreased, which may indicate that some dust was being pulled off the media. The average arrestance of the two specimens during the loading period, up to a maximum pressure drop of 0.50 in. W.G., was approximately 73 and 77 percent, respectively. Table 2 shows a summary of the test results of each specimen and the averages for the two specimens.

Owens-Corning "Dust-Stop, Type C"

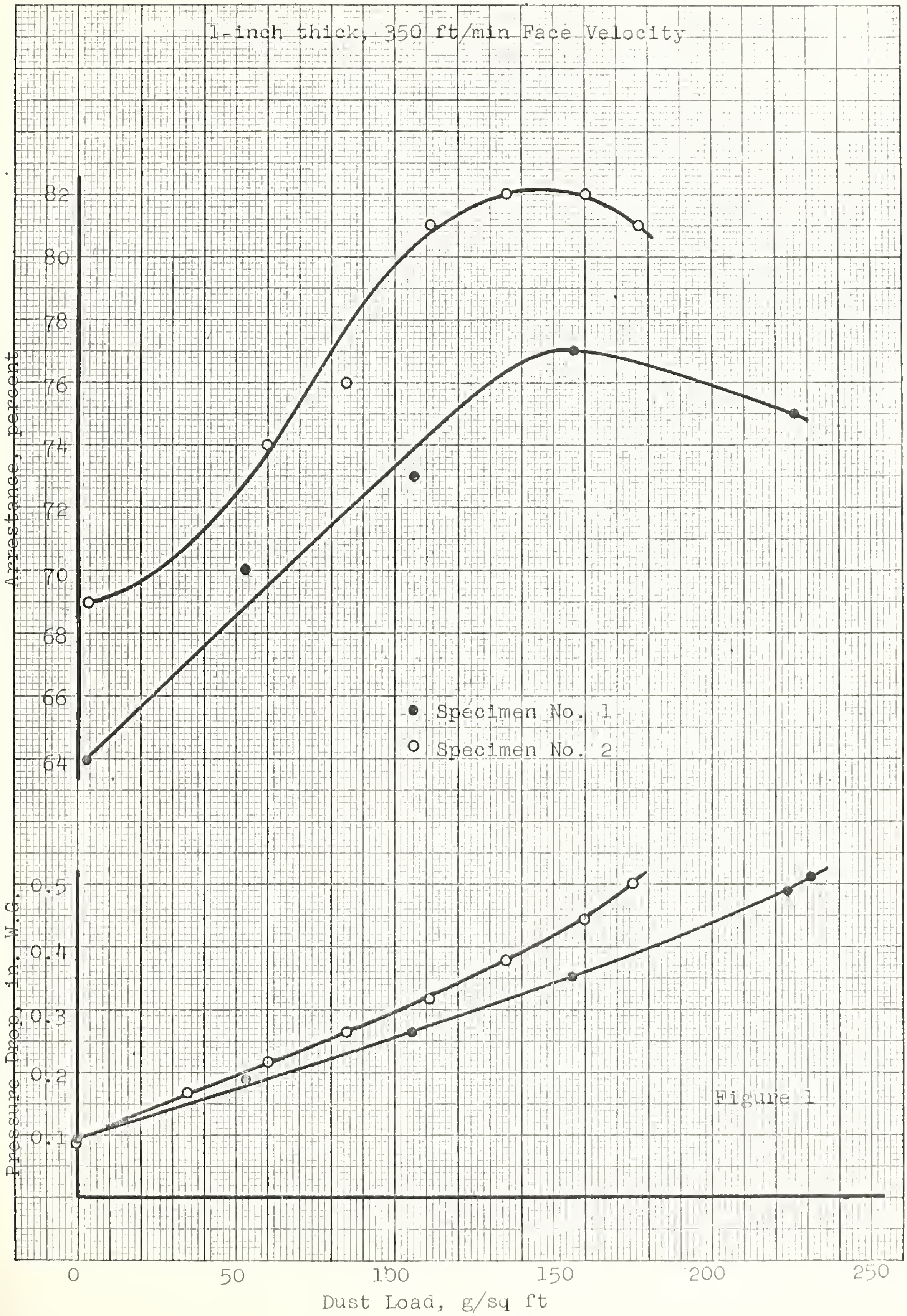

Figure 1

U. S. DEPARTMENT OF COMMERCE
Luther H. Hodges, *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. Equation of State. Statistical Physics.

Radiation Physics. X-ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

Analytical and Inorganic Chemistry. Pure Substances. Spectrochemistry. Solution Chemistry. Standard Reference Materials. Applied Analytical Research.

Mechanics. Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Rheology. 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. Electrolysis and Metal Deposition.

Mineral Products. Engineering Ceramics. Glass. Refractories. Enameled Metals. Crystal Growth. Physical Properties. Constitution and Microstructure.

Building Research. Structural Engineering. Fire Research. Mechanical Systems. Organic Building Materials. Codes and Safety Standards. Heat Transfer. Inorganic Building Materials.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics. Operations Research.

Data Processing Systems. Components and Techniques. Digital Circuitry. Digital Systems. Analog Systems. Applications Engineering.

Atomic Physics. Spectroscopy. Infrared Spectroscopy. Solid State Physics. Electron Physics. Atomic Physics.

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

Physical Chemistry. Thermochemistry. Surface Chemistry. Organic Chemistry. Molecular Spectroscopy. Molecular Kinetics. Mass Spectrometry.

Office of Weights and Measures.

BOULDER, COLO.

Cryogenic Engineering. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Cryogenic Technical Services.

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 Interval 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.

Upper Atmosphere and Space Physics. Upper Atmosphere and Plasma Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.

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