NATIONAL BUREAU OF STANDARDS REPORT

7515

PERFORMANCE TESTS OF A CLEANABLE VISCOUS-IMPINGEMENT AIR FILTER, MODEL NO. 914 M-V TYPE EZKLEEN

Manufactured by
Research Products Corporation
Madison, Wisconsin

by

C. W. Coblentz and P. R. Achenbach

Report to

U.S. Army Chemical Procurement District
New York 7, N.Y.

NBS

U. S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

THE NATIONAL BUREAU OF STANDARDS

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Manufactured by
Research Products Corporation
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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 U.S. Army, Chemical Procurement District, New York the performance characteristics of a preproduction sample of a cleanable viscous-impingement type air filter were determined for compliance with the requirements in Table 1, paragraph 4.2.2 of Federal Specification F-F-300 dated October 29, 1957, and entitled Cleanable Viscous-Impingement type Air-Conditioning Filters using the applicable procedures listed in the table. The scope of this examination included the determination of the arrestance of Cottrell precipitate in laboratory air, the pressure drop, and the dust-holding capacity at a face velocity of 350 ft/min, and the cleanability of the test specimen.

2. Description of Test Specimen

The test specimen was manufactured by the Research Products Corporation of Madison, Wisconsin. It was identified as Model No. 914 M-V Type E Z Kleen and was supplied for test purposes by the U.S. Army, Chemical Procurement District, New York.

The nominal size of the filter was 20 x 16 x 1 inches, the actual dimensions were 19 9/16 x 15 5/8 x 7/8 inches. The filter media was held by a frame made of aluminum sheet formed into a U-shaped channel with a free opening of 17 3/4 x 13 7/8 inches, corresponding to a net face area of 1.71 sq ft. The weight of the clean filter oiled and drained was 472 g (approximately 1 lb.).

The filter medium consisted of a stack of aluminum sheets, each of which had been slit and expanded to resemble a screen. The perforations of the screens on the upstream side of the filter were larger than those on the downstream side. The filter media was supported within the frame by an aluminum wire grid of 4 1/2 in. squares on the downstream side of the filter and by a diagonal cross of wire on the face side.

The adhesive supplied by the manufacturer was identified as "Super Filter Coat" and was said to have odor-absorbing properties. This characteristic was not investigated in this test.

3. Test Method and Procedure

The filter was tested at a face velocity of 350 ft/min. corresponding to an air flow rate of 600 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:

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

where S_D and S_U are the downstream and upstream areas and ΔD and ΔU the 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

The results of the test are presented in Table 1 which shows the values determined for the pressure drop and the arrestance at different dust load conditions.

Table 1

PERFORMANCE OF RESEARCH PRODUCTS CORPORATION
AIR FILTER MODEL NO. 914 M-V TYPE EZKLEEN

(Face Velocity, 350 ft/min)

Dust Load g/sq ft	Pressure Drop in. W.G.	Arrestance %
0	0.050	45
55	0.075	45
106	0.117	48
162	0.176	46
214	0.285	53
234	0.339	--
268	0.458	51
286	0.510	--

The "Dust Load" shown in this table is the average dust received by each square foot of 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 upstream of the test specimen and calculating the percentage of fallout in relation to the total dust introduced. Figure 1 is a graph of the values shown in Table 1.

It will be noted that the arrestance of the clean filter was 45 percent with a pressure drop of 0.050 in. W.G. The arrestance increased to 53 percent with a dust load of 214 g/sq ft and a pressure drop of 0.285 in. W.G. The final dust load at 0.510 in. W.G. was 286 g/sq ft.

The test specimen was loaded twice and cleaned and freshly oiled after each test. Although the pressure drop across the filter was observed to the nearest 0.001 in. W.G., no change of the pressure drop could be determined after two loading and cleaning cycles. Figure 1 indicates that the dust load at 0.400 in. W.G. was 255 g/sq ft and that the average arrestance was approximately 48 percent. A comparison of the observed results and the requirements of Federal Specification F-F-300 is made in Table 2, showing compliance with respect to initial arrestance, dust-holding capacity, and cleanability.

Table 2

COMPARISON OF TEST RESULTS WITH REQUIREMENT OF FEDERAL SPECIFICATION F-F-300

	Required	Observed
Initial Arrestance, %	45	45
Dust Holding Capacity at 0.4 in. W.G., g/sq ft.	250	255
Increase of Pressure Drop After Loading and Cleaning, in. W.G.	0.01max.	<.001

RESEARCH PRODUCTS CORPORATION
CLEANABLE VISCOUS IMPINGEMENT AIR FILTER
MODEL NO. 914 M-V TYPE EZKLEEN

FACE VELOCITY, 350 FT/MIN.

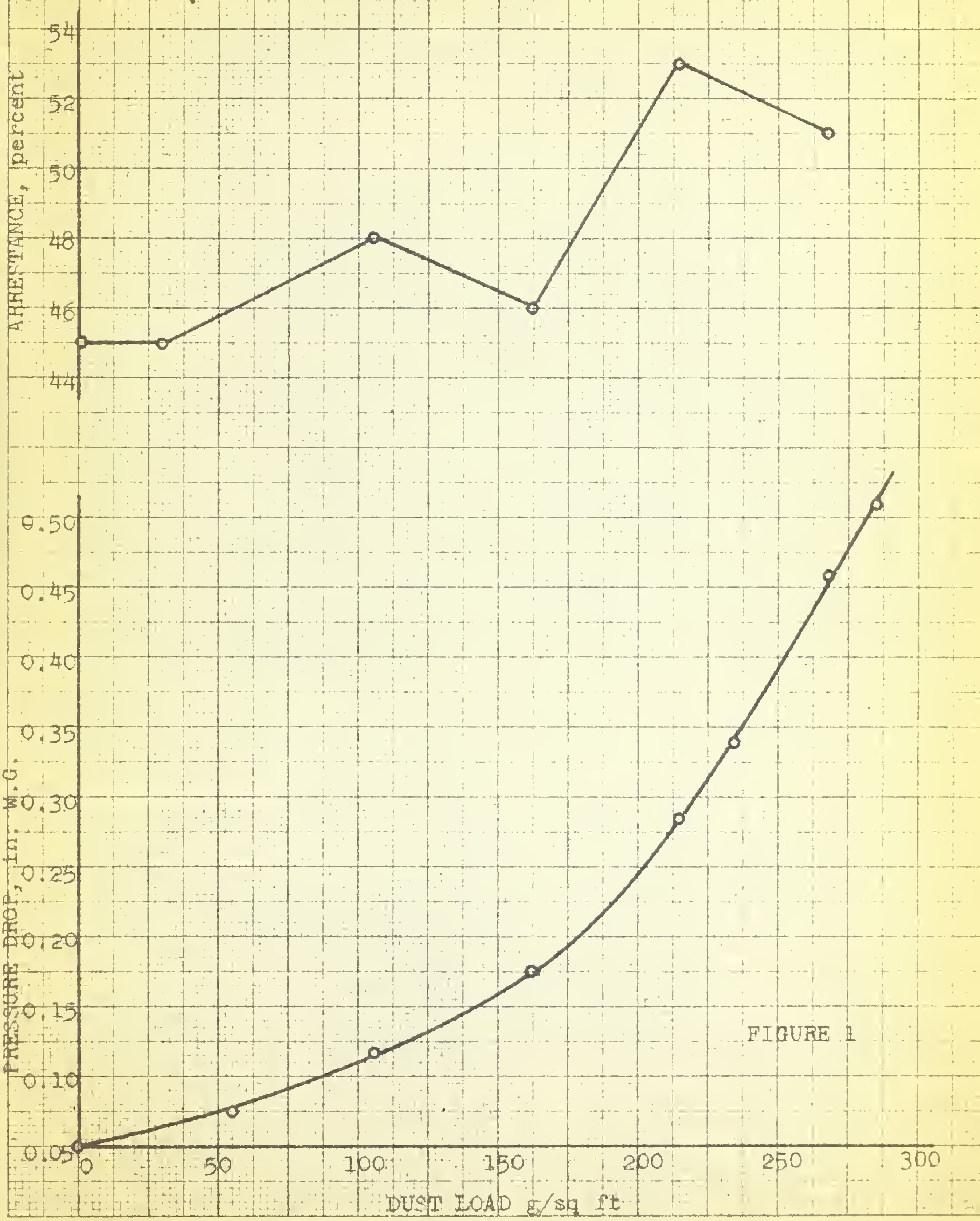

FIGURE 1

U. S. DEPARTMENT OF COMMERCE
Luther H. Hodges, *Secretary*

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

THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its major laboratories in Washington, D.C., and Boulder, Colorado, is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant publications, appears on the inside of the front cover.

WASHINGTON, D. C.

Electricity. Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics. High Voltage.

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. Crystal Chemistry.

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

Polymers. Macromolecules: Synthesis and Structure. Polymer Chemistry. Polymer Physics. Polymer Characterization. Polymer Evaluation and Testing. Applied Polymer Standards and Research. Dental Research.

Metallurgy. Engineering Metallurgy. Microscopy and Diffraction. Metal Reactions. Metal Physics. Electrolysis and Metal Deposition.

Inorganic Solids. Engineering Ceramics. Glass. Solid State Chemistry. Crystal Growth. Physical Properties. Crystallography.

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

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

Data Processing Systems. Components and Techniques. Computer Technology. Measurements Automation. Engineering Applications. Systems Analysis.

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

CENTRAL RADIO PROPAGATION LABORATORY

Ionosphere Research and Propagation. Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services. Vertical Soundings Research.

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

Radio Systems. Applied Electromagnetic Theory. 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.

RADIO STANDARDS LABORATORY

Radio Physics. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time-Interval Standards. Millimeter-Wave Research.

Circuit Standards. High Frequency Electrical Standards. Microwave Circuit Standards. Electronic Calibration Center.

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