NATIONAL BUREAU OF STANDARDS REPORT

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SUMMARY OF RESULTS OF PERFORMANCE TESTS OF TEN CLEANABLE IMPINGEMENT TYPE AIR FILTERS

by

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U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

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THE NATIONAL BUREAU OF STANDARDS

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Heat and Power. Temperature Measurements. Thermodynamics. Cryogenics. Engines and Lubrication. Engine Fuels. Cryogenic Engineering.

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Mineral Products. Porcelain and Pottery. Glass. Refractories. Enameled Metals. Concreting Materials. Constitution and Microstructure. Chemistry of Mineral Products.

Building Technology. Structural Engineering. Fire Protection. Heating and Air Conditioning. Floor, Roof, and Wall Coverings. Codes and Specifications.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Machine Development.

Electronics. Engineering Electronics. Electron Tubes. Electronic Computers. Electronic Instrumentation.

Radio Propagation. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services. Frequency Utilization Research. Tropospheric Propagation Research. High Frequency Standards. Microwave Standards.

Ordnance Development.
Electromechanical Ordnance.
Ordnance Electronics.
These three divisions are engaged in a broad program of research and development in advanced ordnance. Activities include basic and applied research, engineering, pilot production, field testing, and evaluation of a wide variety of ordnance matériel. Special skills and facilities of other NBS divisions also contribute to this program. The activity is sponsored by the Department of Defense.

Missile Development. Missile research and development: engineering, dynamics, intelligence, instrumentation, evaluation. Combustion in jet engines. These activities are sponsored by the Department of Defense.

- Office of Basic Instrumentation
- Office of Weights and Measures.

NATIONAL BUREAU OF STANDARDS REPORT

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Summary of Results of Performance Tests of Ten Cleanable Impingement Type Air Filters

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to

Bureau of Ships, Code 327
Department of the Navy

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NBS

U. S. DEPARTMENT OF COMMERCE
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Performance Tests of Ten Cleanable Impingement-Type Air Filters

I. INTRODUCTION

At the request of the Bureau of Ships, Code 327, Navy Department (NPO-15479, Index No. NSM 130-001) qualification tests were made to determine the performance of cleanable viscid-impingement type air filters in accordance with Section 4.5 of Military Specification MIL-F-16552 (Ships) dated 1 October 1951 as modified by Amendment 1 dated 15 April 1952.

The tests were performed on ten specimen filters submitted by manufacturers at the request of the Bureau of Ships, and included determinations of the dust-arresting efficiency, pressure drop, specific dirt load and cleanability of the specimens at three face air velocities, namely 300, 600 and 900 feet per minute.

This report presents a summary of the results obtained for the ten filters, which were reported previously in seven separate reports.

II. DESCRIPTION OF THE FILTER SPECIMENS

The ten filters were of the viscid-impingement cleanable permanent type, all nominally 20x20x2 inches in size. Each had an enclosing frame of metal, approximately 19-1/2x19-1/2x2 inches in outer dimensions, leaving an opening for passage of air into the media approximately 18 inches square, with a corresponding net face area of approximately 2.27 square feet.

The filters had various types of metallic media, in most cases of ferrous metal. With each filter its manufacturer furnished an oil or adhesive for oiling the specimen. This was done in a uniform manner, in preparation for each test, by immersing the filter in the liquid and letting the excess oil drain off with the filter standing on edge for a period of from 16 to 24 hours in a room at a temperature between 70 and 90°F.

The filters are designated in this report by letters chosen at random, as indicated in Table 1. Filters designated by the same letter were submitted by the same manufacturer.

III. TEST METHOD AND PROCEDURE

The dust-arresting efficiency of each filter was determined by the NBS "Dust Spot Method" using as a test dust Cottrell precipitate at a concentration of one gram per thousand cubic feet of air. The test method is described in the paper "A Test Method for Air Filters" by R. S. Dill (ASHVE Transactions, Vol. 44, p. 379, 1938).

Dirt-holding capacity was determined by supplying to the filter air in which were dispersed cotton lint and Cottrell precipitate in the approximate proportions of 4% and 96% by weight, respectively. The average rate of feed of the contaminants was not more than 25 grams per hour per square foot of net filter face area at each face velocity. The lint used for this purpose was No. 7 cotton linters ground in a Wiley mill with 4 mm screen.

The efficiency and dirt-loading tests were made at three different air velocities, namely, 300, 600 and 900 fpm.

In the tests at each velocity, the following uniform procedure was employed. The clean filter, after oiling and draining as described above, was installed in the test duct and its initial pressure drop was measured at 300, 600 and 900 fpm air velocity. The initial efficiency of the filter at the test velocity was then determined, following which the process of loading the filter with a mixture of 4 percent lint and 96 percent Cottrell precipitate by weight was started. At intervals the increasing pressure drop of the filter was recorded. At suitable periods as loading progressed, the efficiency of the filter was determined using 100 percent Cottrell precipitate. In addition, the efficiency of the filter was determined at the end of a day of loading, and at the start of the next day, to ascertain whether the rate of dirt loading was overtaxing the wetting rate of the filter adhesive. The dirt loading was continued, in general, until the rate of pressure drop rise increased to approximately 0.004 inch W.G. per gram of dirt mixture fed per square foot of filter net face area.

The filter was then removed from the test duct and cleaned by means of a stream of cold water from a high-pressure hose nozzle, directed at and into the filter media. After drying, the filter was re-oiled for subsequent tests or for measurement of its initial pressure drop after the final cleaning.

IV. TEST RESULTS

A. Performance

Table 1 presents values of the dust-arresting efficiency and the pressure drop through each filter at various specific dirt loadings (in grams of a mixture of 4% cotton linters and 96% of Cottrell precipitate, by weight, per square foot of net filter face area), at air delivery rates corresponding to net face air velocities of 300, 600 and 900 feet per minute.

B. Cleanability

Except as noted in one instance below, all of the filters, treated with the oils supplied by their manufacturers, were considered satisfactorily cleanable using cold water from a pressure hose nozzle. In general, it appeared that filters oiled with water-emulsifying oils were cleaned more readily and quickly than those with non-emulsifying oils.

Filter B1 could not be cleaned of all evident dirt by the method used, and showed an increase of about 80% in pressure drop after three loading and cleaning operations.

C. General

None of the filters evidenced any tendency for its media to become "dry" of adhesive as a result of the dirt loading rates used, which were in general from 15 to 25 grams per square foot per hour.

Table 1 Summary--Cleanable Impingement-Type Air Filters
Efficiency and Pressure Drop at Various Specific Dirt Loadings

	Efficiency, %					Pressure drop, inch W.G.				
Spec. dirt l'd'g.*	0	100	200	300	400	0	100	200	300	400
*gram/sq.ft.										
300 fpm Face Velocity										
Filter No.										
A1	37	42	48	47	66	0.04	.05	.07	.12	.26
A2	38	41	50	61	-	.05	.06	.09	.23	-
B1	43	51	57	69	-	.04	.08	.17	.38	-
B2	45	57	62	-	-	.06	.12	.28	-	-
C	47	51	55	60	63	.04	.07	.11	.19	.44
D1	44	51	55	63	70	.04	.07	.11	.20	.40
D2	47	53	61	73	-	.05	.08	.14	.29	-
E	42	51	56	65	-	.05	.09	.17	.36	-
F	51	54	63	74	-	.05	.08	.15	.41	-
G	54	52	53	69	-	.04	.06	.09	.33	-
600 fpm Face Velocity										
A1	44	51	56	62	-	.14	.18	.28	.52	-
A2	42	44	61	69	-	.15	.21	.33	.84	-
B1	55	65	65	-	-	.16	.31	.58	-	-
B2	52	64	74	-	-	.22	.37	.74	-	-
C	56	63	63	65	66	.16	.26	.32	.41	.59
D1	52	59	63	66	69	.14	.22	.29	.39	.56
D2	57	61	64	67	-	.16	.23	.32	.49	-
E	54	58	61	-	-	.18	.29	.52	-	-
F	56	61	71	73	-	.18	.26	.38	.59	-
G	60	63	63	71	-	.14	.24	.31	.55	-
900 fpm Face Velocity										
A1	53	53	59	60	-	.31	.36	.49	.79	-
A2	54	59	63	-	-	.32	.43	.59	-	-
B1	63	74	-	-	-	.45	.79	-	-	-
B2	58	71	-	-	-	.44	.75	-	-	-
C	60	68	74	74	72	.34	.53	.68	.81	1.00
D1	59	60	64	67	74	.28	.43	.57	.72	.96
D2	65	67	69	76	-	.34	.48	.65	.87	-
E	63	66	-	-	-	.40	.63	-	-	-
F	61	73	77	73	-	.36	.50	.65	.83	-
G	65	69	69	75	-	.32	.49	.63	.85	-

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards ($1.00). Information on calibration services and fees can be found in NBS Circular 483, Testing by the National Bureau of Standards (25 cents). Both are available from the Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.


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