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METAVAC INC FLUSHING N Y

PRODUCTION ENGINEERING MEASURES FOR FILTER, INFRARED, INTERFERE--ETC(U)

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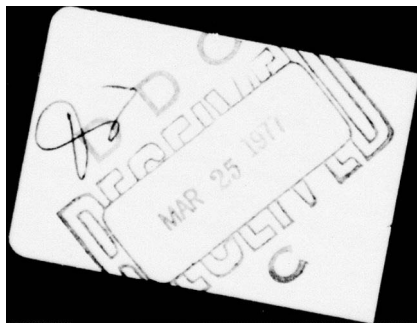
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PRODUCTION ENGINEERING MEASURES

INFRARED FILTER for 1KW SEARCHLIGHT AS/VSS-3A

TENTH QUARTERLY REPORT

1 Sept 1976 to 30 Nov 1976

CONTRACT NO. DAAB07-74-C-0379

**U.S. ARMY ELECTRONICS COMMAND
Ft. Monmouth, NJ**

John Monte

10 Jan 77

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**METAVAC, INC.
Flushing, NY**

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METAVAC, INC. - Flushing, NY
Contract No. DAAB07-74-C-0379

Production Engineering Measures
for
Filter, Infrared, Interference-Absorption Type

Tenth Quarterly Report covering period

1 Sept 1976 to 30 Nov 1976

on

Development of Production Engineering Measures^{where} undertaken for
the production of an Infrared Interference-Absorption Filter for
the Infrared Searchlight, AN/VSS-3A, 1 Kilowatt power, including
Engineering Samples, First Article samples, and a Pilot Run, under
a Contract Number DAAB07-74-C-0379, awarded to Metavac, Inc., of
45-68 162nd Street, Flushing, New York, 11358, by USAECOM, Fort
Monmouth, New Jersey 07703.

Submitted by:

METAVAC, INC.
Flushing, NY 11358

J. Monte

Project Manager

Approved by:

George H. Fadel
President

January 10, 1977

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Infrared Filter
Searchlight, AN/VSS-3A, 1KW

227 100

The work accomplished during this Quarter was devoted to the Pilot Run of filter production. Four runs of five filters each, at a rate of ten filters per day, were completed. Selected filters were submitted to the required tests, as given in the Critical Item Specifications USA ECOM C2a2204010306. No unusual failures or problems were found. Material difficulties which had been identified during the Engineering and First Article

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20. ABSTRACT (cont'd)

phases of this program were overcome, and the Pilot Run filters were not affected. Theoretical and practical difficulties encountered in the performance of the Angular Visual Security tests, defined in the Critical Item Specification, resulted in the preparation of a proposal to the U.S. Army Electronics Command to extend this program. The extension would include the development and evaluation of a breadboard device for factory and U.S. Army Depot testing of filters for infrared transmission efficiency and visual security. Preparations were made to assemble written material and data for the General Report to be put together in rough draft form for submission by April 1, 1977.

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PURPOSES OF WORK ACCOMPLISHED DURING THIS PERIOD:

The purposes of the work accomplished during this period include the following:

1. Perform the Pilot Run production of 1KW infrared filters, with the level of activity equivalent to a production rate of ten filters per day. A Pilot Run subsection consists of a continuous production of five (5) filters utilizing two vacuum chambers. A sixth filter is added to each Pilot Run as a factory-retained sample.
2. Test and evaluate the Pilot Run production filters by selecting samples and performing the required tests in accordance with methods and specification given in the Critical Item Specification USA ECOM C2a2204010306, dated 27 July 1973. This Specification also gives details of the test methods, including four Tables which define the number of filters selected from those produced during the Pilot Run to be tested for the various characteristics specified.
3. Review and evaluate test methods described in the Critical Item Specification. Particular attention is given to those tests requiring US Government furnished equipment, and those tests requiring the use of an outdoor area or test range. These tests are examined and criticized as to their level of difficulty, accuracy, and convenience to a manufacturer of near infrared transmitting filters.
4. Review and evaluate the Manufacturing Process used in this program. Particular attention is given to discovering methods or materials which may be changed to improve the ease of manufacture, reliability of the product and the potential for relatively easy increase of a production rate.
5. Collect and summarize Manufacturing Process run data, test results and methods analysis for inclusion in the General Report at the conclusion of this program. Methods analysis include interviews and discussions with manufacturing, test and supervisory personnel at the conclusion of this program.

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Contract No. DAAB07-74-C-0379

WORK ACCOMPLISHED DURING THIS QUARTER:

Four subsections of the Pilot Run were accomplished during this Quarter. A total of twenty-four filters were manufactured. Vacuum-chamber, assembly, first test and final evaluation data were recorded, using the Critical Item Specification, USA ECOM C2a2204010306. Three filters were selected as samples for detailed testing in accordance with Table II and III of the Critical Item Specification. Filters were installed in US Government furnished searchlight and the Radiation Reliability (Life) test specified in Table IV was commenced. Although some stability problems were encountered in the radiation output and electrical current input to the searchlight arc lamp, approximately 400 hours of exposure time were accumulated on the test filter before the end of the quarter. The effects of irregularities in lamp output were minimized by careful monitoring and shut-down when current changes greater than 10% were encountered. The lamp was restarted after a few minutes off-time. This procedure was found to be satisfactory in avoiding accumulating test time with reduced lamp output. It was used only twice during this period.

Preliminary interviews were held with manufacturing, assembly and supervisory personnel following each subsection of the Pilot Run. Opinions were elicited concerning the facility and accuracy of Manufacturing Process details, operation of apparatus, use of the tools and fixtures, and handling of the filters. It was found desirable to make certain recommended changes in the locations of supplies used during the preparation of the tinted cylinders for vacuum coating, and in the handling of the filters after removal from the vacuum chamber. Although minor, these changes appear to be useful in reducing the handling of the glass before and after vacuum processing. These interviews will be formalized in the next period as a more detailed review of the Manufacturing Process is made in preparation for inclusion in the General Report.

Complete test data and criticisms arising out of preliminary

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Contract No. DAAB07-74-C-0379

interviews with manufacturing, testing and supervisory personnel were assembled and prepared for summary. A meeting was held near the end of this Quarter between cognizant factory personnel and the Project Engineer in preparation for the writing of the General Report. The USA ECOM requirements as outlined in the Contract and in Government instructional documents were discussed. Some individual assignments were made for specific data collection and detailed information summaries. Additional meetings were planned for the early part of the next Quarter to continue the review of collected data and to commence specific writing of parts of the General Report.

Mr. D. Merritt of the USA Night Vision Laboratory visited the plant during the Quarter to observe a subsection of the Pilot Run of filter production and to discuss test results and test problems. Particular attention was given to problems of the Radiation Reliability (Life) test and the Angular Visual Security test. Both tests have had difficulties arising out of use of US Government furnished searchlights and the need for a US Government contractor's outdoor test-range at Rocky Point, New York. A decision was made to request an extension to the present program during which time some alternate test methods will be examined in detail. The purpose of this examination will be to develop a test method suitable for use within the filter manufacturing factory or at U.S. Army depots where filters may be stored or used for repairs of searchlights. The alternate test method must be compatible with the required results as defined in the Critical Item Specification, and must be easily cross-calibrated with filters tested directly by the methods described in the Critical Item Specification as it is now written. The request for Extension to the present contract program schedule was prepared and submitted to the USA ECOM at the end of this Quarter. This extension proposal is discussed in more detail in the section: Criticism of the Angular Visual Security test.

OBSERVATIONS AND CONCLUSIONS:

The Manufacturing Process developed during the first phases of this program was found to be satisfactory. This process utilizes methods and techniques widely employed in the vacuum-coating industry and no unusual changes were made nor were any special problems encountered during the Pilot Runs. The minor adjustments and corrections to the Process were found to be adequate and are considered flexible enough to permit a significant increase in production rate of the infrared filters, should it become desirable at a future time. Small adjustments would be required to suit the particular characteristics of the desired filters and the vacuum equipment available, but, in the main, the Process could be followed and satisfactory filters manufactured in quantity as needed.

Material problems were encountered during the last period in this program. The glass cylinders are subject to intensive radiant heating and require careful preparation to avoid irregularities which may be places of local stress build-up, leading to catastrophic failure. Cut ends must be lightly beveled. Cylinders must be inspected before tinting for vacuoles or elongated bubble, fine, hairline cracks near the ends, and built-in stress as formed. None of these defects can be removed entirely in the regular manufacture of the cylinders by glass makers, hence careful inspection and edge treatment are necessary. Inspection using crossed polarizers is helpful in detecting built-in stress. A group of cylinders found to contain noticeable dark fringing when viewed between the polarizers were subjected to rapid heating in an electric oven. After a period of approximately two hours, the glass temperature was measured and found to be above 270°C. Within the following thirty minutes, all of these cylinders cracked or broke down violently. Two factory-sample filter assemblies were made using known pre-stressed glass. After being exposed to a one-KW arc lamp for about two hours, each failed catastrophically. All cylinders were carefully inspected for this

built-in stress before continuing into the Manufacturing Process.

Fresh potting compound, less than three months old, was found to yield satisfactory sealing with good adhesion to the glass and silicone rings. No deterioration after exposure to the 1KW arc lamp for a period of over 800 hours was found, which could be identified as coming from sealing compound. The tinting applied to the glass cylinders also found to be consistent and reasonably uniform in color. No significant changes in spectral transmission were found which could be identified as coming from changes or irregularities in the tinting. Almost no pin-holes were found in the tinting but a few dark or opaque spots were discovered from time to time. These were small (less than one millimeter in diameter) and few in number (never more than five in any tinted cylinder surface), and are not considered to be detrimental in any way. Examination of the filters subjected to the 800 hours Radiation Reliability test showed that the opaque spots did not change or serve as the root of any noticeable defects.

Final assembly is a critical part of the Manufacturing process and must include handling of the coated glass cylinders. Certain location and fixture adjustments were completed to make the process more convenient and reduce the handling of the glass. These adjustments were made as the First Samples and before first Pilot Run filters were completed. Particular attention was given to the requirement that the cylinders are coaxial with the center-line of the metallic housing, and the ends square to this axis. This emphasis was the result of an early factory sample failure during operation in a searchlight, when an uneven glass end struck the frame causing a small chip which resulted in a crack failure later. No failures of this type have been encountered since this emphasis and care in using the assembly fixtures was instituted.

CRITICISM OF THE ANGULAR VISUAL SECURITY TEST:

The Angular Visual Security test as now specified in the

Critical Item Specification C2a2204010306, dated 27 July 1973, is subject to unavoidable variations in measured results. Some of these arise out of the subjective nature of the test as specified, and some out of the requirement for use of an outdoor test range at night. It was found that some correlation exists between the Figure of Merit as calculated from the spectral transmission, using weighting factors defined in the Critical Item Specification; and the Angle of Visual Security as measured by observers at the outdoor test range, as specified in the C.I.S. However, this correlation, which holds within broad limits, is not consistent over a series of outdoor tests covering both warm and cold weather conditions. The same filters previously tested during the warm months, showed a smaller angle of visual security in the winter months, even when the atmosphere was judged to be relatively clear (ground visibility in excess of five miles), and the moon not visible in the sky. The Appendix to this report shows the results of attempts to obtain this correlation over a period of about ten months.

The Test as specified is prone to variations in the measured results due to its subjectivity. The Test is also subject to variations due to changes in weather and climatic conditions. Finally, atmospheric changes near the ground can occur during one evening but not observable in a quantitative way. Hence, variations in the test results may be experienced which have nothing to do with the characteristics of the filters or the observer. It has become apparent that an alternate method of testing which would be quantitative is desirable.

However, in testing a production run, this method may be subject to many delays, and, hence, be the cause of production interruptions. A photoelectric test method could be modified to that of a factory-level, or US Army Depot level method by using an integrated light and infrared radiation collector of moderately small size. This test method would, in effect, be a combination of the Figure of Merit and Angular Visual Security

METAVAC, INC. - Flushing, NY
Contract No. DAAB07-74-C-0379

test, but a method which permits testing in a convenient location and with apparatus easy to set up and use. Since the visible and IR radiation would be sensed by appropriate detectors, the test results would be quantitative, with specified tolerances for acceptance or rejection. The test technicians would be required to do no more than install the filters and read meters. The apparatus would, by its nature, remain calibrated since the detectors are not expected to vary or change with time. The calibration would consist of cross-testing filters in the apparatus, and on the outdoor test range. "Working Standard" filters might be retained with each test apparatus for occasional checking of the calibration. This system would have the great advantage of being relatively small and convenient to use. Its application to filter checking at US Army repair Depots is a further desirable feature. Finally, high production rates of filter manufacture would not be impeded by the need for outdoor testing at frequent intervals. This suggestion was discussed with Mr. D. Biser and Mr. D. Merritt of the US Army Electronics Command and a letter of proposal for extension of the present program to include the development and test of a rough breadboard of a suitable test device, was sent to the Command near the end of this Quarter.

WORK TO BE DONE DURING THE NEXT INTERVAL:

The data accumulated during the Pilot Runs and from interviews with production and engineering personnel will be assembled and the General Report started. It is expected that a rough draft of the General Report will be completed by April 1, 1977 and submitted to the Government shortly thereafter.

METAVAC, INC. - Flushing, NY
Contract No. DAAB07-74-C-0379

IDENTIFICATION OF PERSONNEL:

The following personnel of Metavac, Inc., from the Engineering and Manufacturing departments, have been engaged in the work of this program during this Quarter:

<u>PERSON</u>	<u>MAN HOURS</u>
John Monte	20
Kenneth Trnka	20
Kenneth Riccardi	20
Ernest Zappulla	80
Edward Antonison	40
	<hr/>
TOTAL	180

SUMMARY OF TEST RESULTS

November 30, 1976

Filter Number

Test Item Table Number (Test Document)	27	28	29	30	31	32	33	34	35	
TABLE I Damages & Visible Defects Identification Numbers Workmanship	none correct good	none correct good	none correct good	none correct good	none correct good	none correct good	none correct good	none correct good	none correct good	
TABLE II Interference Coating Coating Bond Cleanability -soapy water alcohol	good excel. good excel.	good excel. good excel.	good excel. good excel.	good excel. good excel.	good excel. good excel.	good excel. good excel.	good excel. good excel.	good excel. good excel.	good excel. good excel.	
Spectral Transmission Figure of Merit-calculated Angular Visual Security	199 -- -- -- -- -- --	195 1.50° -- -- --	232 see attached curves -- -- --	182 0.7° -- -- --	161 -- -- -- -- -- --	204 1.10° -- -- --	211 -- -- -- -- -- --	200 -- -- -- -- -- --	215 -- -- -- -- -- --	
TABLE III Low Temperature Storage High Temperature Storage Temperature Shock Fungus Growth	good good excel. -- -- --	-- -- -- -- -- -- -- -- -- -- -- --	good good good see attached Report sheets good	-- -- -- -- -- -- -- -- -- -- -- --	-- -- -- -- -- -- -- -- -- -- -- --	good good good -- -- --	-- -- -- -- -- -- -- -- -- -- -- --	-- -- -- -- -- -- -- -- -- -- -- --	-- -- -- -- -- -- -- -- -- -- -- --	-- -- -- -- -- -- -- -- -- -- -- --
TABLE IV Radiation Reliability O-ring Seal Integrity	* *	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	NA NA	

* This filter is in Radiation Reliability test. 400 hours were accumulated and the filter removed from the searchlight temporarily for a visual and spectral transmission check. No faults were discovered. The spectral transmission showed less than 2% change when compared to the transmission measured before the test commenced.

NOTE: Test reports are enclosed for most tests on filters no. 27, 29 and 32.

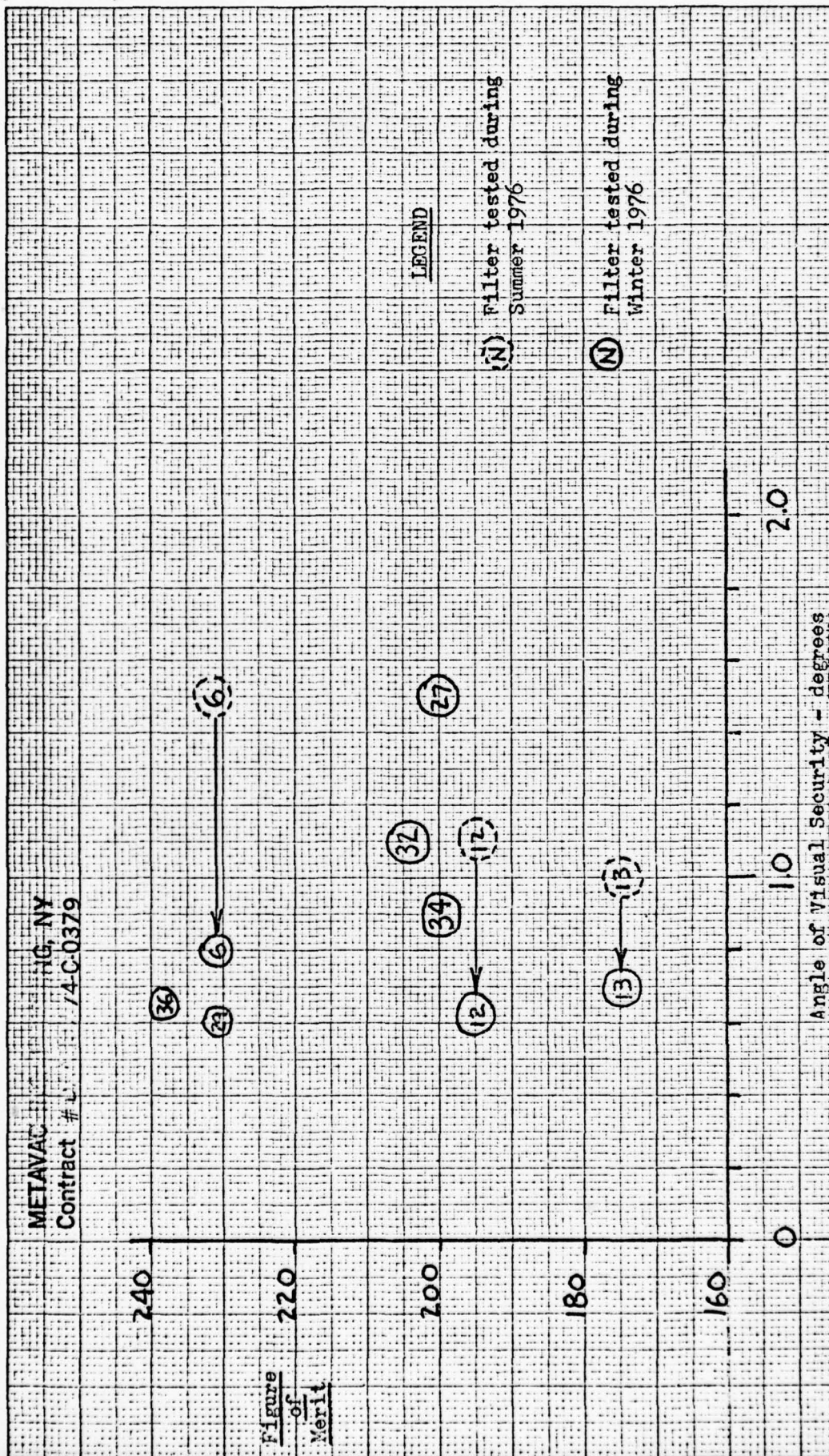


Fig. 1. RELATIONSHIP BETWEEN CALCULATED FIGURE OF MERIT AND OBSERVED ANGLE OF VISUAL SECURITY

A-2



Spectral Data Per Specification C2a 2204010306 Para. 3.4.4

Customer: USAECOM
Contract #: DAAB07-74-C-0379
Part: Filter, Infrared
Supplier: Metavac, Inc.
F.S.C. #99117

METAVAC INC. FLUSHING, NY
Contract # DAAB07-74-C-0379

TRANSMISSION

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SPECIFICATION C2a 2204010306
FIGURE OF MERIT PER PARA 4.6.4.1

METAVAC INC.-FLUSHING, NY

Contract #DAAB07-74-C-0379

A-4

Part: Infrared Filter

P/N: C2a 2204010306

Part Tested: P.E.M. 27

Date:

Test Procedure: (Ref. para 4.6.4.1)

Figure of Merit.--The measured transmission and computed Figure of Merit shall meet the requirement paragraphs 3.4.4 and 3.4.4.1. Failure to do so constitutes failure of this test.

Obtain Transmission Percentage Values (Col. 3)

From Spectral Transmission Data Per Para 4.6.4

Wave Length Nanometers	Radiance Sensitivity x Product	Transmission Percent =	Product of Col. (2) and (3) x 10 ⁻²
(1)	(2)	(3)	(4)
765	153.600	.000	0
775	101.250	.000	0
785	83.850	.000	0
795	87.000	.001	.0009
805	77.550	.0037	.0028
815	77.715	.017	.013
825	228.360	.12	.274
835	127.585	.61	.778
845	50.400	2.5	1.260
855	27.300	7.9	2.156
865	28.435	20	5.687
875	38.805	52	20.178
885	85.575	55	47.066
895	54.000	58	31.320
905	41.375	62	25.652
915	34.900	67	23.383
925	18.955	71	13.458
935	12.935	73	9.442
945	14.080	74	10.419
955	5.300	75	3.975
965	1.877	75	1.407
975	1.944	76	1.477
985	1.593	77	1.226

Figure of Merit = Sum = 199.1749

METAVAC INC.-FLUSHING, NY
Contract # DAAB07-74-C-0379

A-5

Test Requirements: (Per para 3.4.4.1)

Figure of Merit.--The filter shall have a Figure of Merit greater than 160.00. Figure of Merit shall be computed as shown in Figure 2 by replacing Col. 3 with the contractors measured transmission in percent.

Test Results:

Part	Pass	Fail	By	Remarks
P.E.M. 27	✓		J.I.	

VSS-3A SEARCHLIGHT SET DATA

METAVAC INC. - FLUSHING, NY

Contract # DAAB07-74-C-0379

METAVAC FILTER S/N PEM 27

<u>Test Para.</u>	<u>Test</u>	<u>Requirement</u>	<u>Results</u>
-------------------	-------------	--------------------	----------------

4.4.2

4.4.2.4

Angular Visual Security

Average of three observer averages -

1.56°

Observer	<u>-Angle</u>	<u>+Angle</u>	<u>Total Angle</u>
1: <u>R. Randise</u>	<u>191.6°</u>	<u>193.5°</u>	<u>1.9°</u>
	<u>191.8°</u>	<u>193.8°</u>	<u>2.0°</u>
	<u>192.5°</u>	<u>191.1°</u>	<u>1.4°</u>

Average < 5°

1.7°

2: <u>K. Ricardi</u>	<u>192.4°</u>	<u>193.5°</u>	<u>1.1°</u>
	<u>192.8°</u>	<u>194.1°</u>	<u>1.3°</u>
	<u>192.5°</u>	<u>194.0</u>	<u>1.5°</u>

Average < 5°

1.3°

3: <u>R. Randise</u>	<u>192.4°</u>	<u>194.4°</u>	<u>2.0°</u>
	<u>191.5°</u>	<u>194.0°</u>	<u>2.5°</u>
	<u>192.6°</u>	<u>193.4°</u>	<u>.8°</u>

Average < 5°

1.7°

Date: 10/7/76

Tested by: R. Randise

Witnessed by: _____

A-6

1.00 Spectral Data Per Specification C2a 2204010306 Para. 3.4.4

Customer: USAECOM
Contract #: DAAB07-74-C-0379
Part: Filter, Infrared
Supplier: Metavac, Inc.
F.S.C. #99117

METAVAC, INC. FLUSHING, NY
Contract # DAAB07-74-C-0379

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0.00006

0.00005

0.00004

0.00003

Maximum Transmission

Lightest Area

Darkest Area

Acceptable Zone

Maximum Transmission
from 360 nanometers
through 760 nanometers
shall be .001 percent.

A-7

Serial No. PEM 29
Test set-up NO. 102
Filter temp. °C 205°C +
Data by: DM B8
Date: 9/8/76



SPECIFICATION C2a 2204010306
FIGURE OF MERIT PER PARA 4.6.4.1

METAVAC INC.-FLUSHING, NY
Contract # DAAB07-74-C-0379

A-8

Part: Infrared Filter P/N: C2a 2204010306
Part Tested: P.E.M. 29 Date:

Test Procedure: (Ref. para 4.6.4.1)

Figure of Merit.--The measured transmission and computed Figure of Merit shall meet the requirement paragraphs 3.4.4 and 3.4.4.1.

Failure to do so constitutes failure of this test.

Obtain Transmission Percentage Values (Col. 3)
From Spectral Transmission Data Per Para 4.6.4

Wave Length Nanometers	Radiance Sensitivity x Product	Transmission Percent =	Product of Col. (2) and (3) x 10 ⁻²
(1)	(2)	(3)	(4)
765	153.600	.000	0
775	101.250	.000	0
785	83.850	.000	0
795	87.000	.003	.0026
805	77.550	.012	.0093
815	77.715	.050	.0388
825	228.360	.25	.570
835	127.585	1.2	1.531
845	50.400	5.0	2.520
855	27.300	16	4.368
865	28.435	32	9.099
875	38.805	61	23.671
885	85.575	65	55.623
895	54.000	68	36.720
905	41.375	72	29.790
915	34.900	73	25.477
925	18.955	75	14.216
935	12.935	76	9.830
945	14.080	76	10.700
955	5.300	75	3.975
965	1.877	76	1.426
975	1.944	76	1.477
985	1.593	77	1.226

Figure of Merit = Sum = 232.2697

METAVAC INC.-FLUSHING, NY
Contract # DAAB07-74-C-0379

Test Requirements: (Per para 3.4.4.1)

Figure of Merit.--The filter shall have a Figure of Merit greater than 160.00. Figure of Merit shall be computed as shown in Figure 2 by replacing Col. 3 with the contractors measured transmission in percent.

Test Results:

Part	Pass	Fail	By	Remarks
PEM.29	✓		J.I.	

METAVAC INC. - FLUSHING, NY
Contract # DAAB07-74-C-0379

VSS-3A SEARCHLIGHT SET DATA

METAVAC FILTER S/N PEM 29

<u>Test Para.</u>	<u>Test</u>	<u>Requirement</u>	<u>Results</u>
4.4.2			
4.4.2.4	<u>Angular Visual Security</u>		
	Average of three observer averages -		<u>.586°</u>
	Observer <u>-Angle</u> <u>+Angle</u> <u>Total Angle</u>		
	1: <u>M. Shubel</u> <u>167.6°</u> <u>167.0°</u> <u>.6°</u>		
	<u>168.1°</u> <u>166.9°</u> <u>1.2°</u>		
	<u>167.6°</u> <u>166.4°</u> <u>1.2°</u>		
		Average < 5°	<u>1.0°</u>
	2: <u>H. McTiernan</u> <u>167.4°</u> <u>167.5°</u> <u>.1°</u>		
	<u>166.7°</u> <u>167.4°</u> <u>.7°</u>		
	<u>167.3°</u> <u>167.5°</u> <u>.2°</u>		
		Average < 5°	<u>.33°</u>
	3: <u>W. Kegel</u> <u>167.5°</u> <u>167.4°</u> <u>.1°</u>		
	<u>167.0°</u> <u>167.5°</u> <u>.5°</u>		
	<u>166.6°</u> <u>167.3°</u> <u>.7°</u>		
		Average < 5°	<u>.43°</u>

Date: 10/21/76

Tested by: R. Allet

Witnessed by: _____



SPECIFICATION C2a 2204010306
LOW TEMPERATURE STORAGE PER PARA 4.6.6.1

METAVAC INC.-FLUSHING, NY
Contract # DAAB07-74-C-0379

A-11

Part: Infrared Filter

P/N: C2a 2204010306

Part Tested: PEM 29

Date: 10/22/76

Test Procedure: (Ref. para 4.6.6.1)

Low temperature storage.--The filter shall be placed in the test chamber and exposed to an ambient temperature of minus 62°C and maintained for a period of 12 hours. The ambient temperature shall be raised to minus 54°C and maintained for 6 hours. After the exposure period, the filter shall be examined for damage. If the filter is removed from the test chamber, the examination shall be completed within 10 minutes after removing the filter from chamber. Any evidence of damage shall constitute failure of this test.

Date	Time	Temp.	By	Remarks
10/22/76	6:05	-62°C	E.A.	Start
10/23/76	6:30	-62°C	E.A.	
"	7:00	-54°C	E.A.	
"	1:10	-54°C	E.A.	

Test Requirements: (Ref. para 3.5.1)

Low Temperature Storage.--The filter shall not be damaged (See 6.4) by storage in any ambient temperature from plus 23°C to minus 62°C at any possible relative humidity within that range.

Test Results:

Part	Pass	Fail	By	Remarks
PEM 29	✓		E.A.	



SPECIFICATION C2a 2204010306

HIGH TEMPERATURE STORAGE PER PARA 4.6.6.2

METAVAC INC.-FLUSHING, NY

Contract # DAAB07-74-C-0379

A-17

Part: Infrared Filter

P/N: C2a 2204010306

Part Tested: PEM 29

Date: 10/21/76

Test Procedure: (Ref. para 4.6.6.2)

High temperature storage.--The filter shall be placed in the test chamber and exposed to an ambient temperature of 68°C with maximum humidity (90 to 98 percent) for 12 hours. At the conclusion of the exposure period the filter shall be examined for damage. Any evidence of damage shall constitute failure of this test.

Date	Time	Temp.	By	Remarks
10/21/76	5:00	69°C	E.A.	Start
10/22/76	6:00	70°C	E.A.	Finish

Test Requirements: (Ref. para 3.5.2)

High Temperature Storage.--The filter shall not be damaged by storage in any ambient temperature from plus 23°C to minus 62°C at any possible relative humidity within that range.

Test Results:

Part	Pass	Fail	By	Remarks
------	------	------	----	---------

PEM 29

✓

E.A.



SPECIFICATION C2a 2204010306

THERMAL SHOCK PER PARA 4.6.6.3

METAVAC INC. FLUSHING, NY

Contract # DAB07-74-C-0379

A-13

Part: Infrared Filter

P/N: C2a 2204010306

Part Tested: PEM 29

Date: 10/25/76

Test Procedure: (Ref. para 4.6.6.3)

Thermal Shock. --The filter shall be exposed to an ambient temperature of minus 54°C for not less than two (2) hours. The filter shall then be exposed to 260°C within two (2) minutes for not less than two (2) hours. This constitutes one cycle. The filter shall be exposed to four (4) cycles of thermal shock. At the conclusion of this test the filter shall be examined for damage. Any evidence of damage shall constitute failure of this test.

Date	Time	Temp.	By	Remarks
10/25/76	7:15	-54°C	E.A.	DATE TIME TEMP. By
	9:20	-54°C	EA	
	9:22	+260°C	EA	10/26/76 6:55 -54°C EA.
	11:35	+260°C	EA.	" 9:20 -54°C EA.
				" 9:22 +260°C EA.
10/25/76	12:30	-54°C	E.A.	" 11:50 +260°C E.A.
	2:35	-54°C	EA.	
	2:37	+260°C	EA.	10/26/76 12:40 -54°C EA
	4:50	+260°C	E.A.	" 2:45 -54°C EA
				" 2:47 +260°C EA
				" 5:00 +260°C CA

Test Requirements: (Ref. para 3.5.3)

Thermal Shock. --The filter shall not be damaged when subjected to thermal shock from minus 54°C to plus 260°C.

Test Results:

Part	Pass	Fail	By	Date	Remarks
PEM 29	✓		EA.	10/27/76	

NEW YORK TESTING LABORATORIES, INC.

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METAVAC INC. - FLUSHING, NY**Contract # DAAB07-74-C-0379**

Page 1.

REPORT OF TESTS

November 29, 1976

Lab. No. & Client — 76-49668 - Metavac, Inc.
Material — Two (2) I.R. Filters
Client's Order No. — 14982
Identification — PEM 29 and PEM 32
Submitted for — Fungus Test per MIL-Std-810C, Method 508.1, Procedure 1

A-14

Gov't. Contract No. - DAAB07-74-C-0379

PROCEDURE

Approximately 10 milliliters of distilled water (having a pH value between 5.8 and 7.2 at 25° C. (77° F.) was introduced into a tube culture of species of fungi and the spores were brought into suspension by vigorous shaking. This was repeated for the species of fungi listed below:

Group I	Aspergillus Niger
Group II	Aspergillus Flavus
Group III	Aspergillus Versicolor
Group IV	Penicillium Funiculosum
Group V	Chaetomium Globosum

The separate spore suspensions from the species of fungi were mixed together to form a composite suspension. The test units were then placed within the fungus chamber and sprayed with the suspension of mixed spores. Three pieces of cotton duct strips, prepared as specified, were also placed in the chamber as control items and sprayed with the composite suspension. The chamber was sealed and the internal chamber temperature was increased to $86^{\circ} \pm 3.5^{\circ}$ F. with a relative humidity of $97\% \pm 2\%$. These conditions were maintained for a period of four hours. The test items were then subjected to cyclic temperature and humidity conditions which included 20 hours of RH at $95 \pm 5\%$ at a temperature of $86 \pm 2^{\circ}$ F. followed by four hours of 100% RH at a temperature of 77° deg. F. These cyclic conditions were continued for a period of 28 days. At the end of seven days, the control items were inspected for abundance of growth.

At the completion of the 28 day period of exposure, the test units were removed from the chamber and visually examined for evidence of fungus growth, deterioration, and corrosion. The test units were then returned to Metavac, Inc.

RESULTS

There was no evidence of fungus growth, deterioration or corrosion as a result of the test.

Report on sample by client applies only to sample.

Report on samples by us applies only to lot sampled.

Information contained herein is not to be used for reproduction except by special permission.

Samples retained for thirty days maximum after date of report unless specifically requested otherwise by client.

The liability of the New York Testing Laboratories, Inc. with respect to the services charged for herein shall in no event exceed the amount of the invoice.

NEW YORK TESTING LABORATORIES, INC.

Page 2.

Lab. No. 76-49668

METAVAC INC.-FLUSHING, NY
Contract # DAAB07-74-C-0379


NOTE

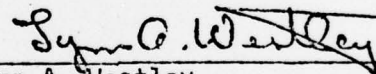
Fungus growth was evident on the control items indicating that the environment had been capable of supporting fungus growth. *SV GAR*

We certify that this report is a true report of results obtained from our tests of this material.

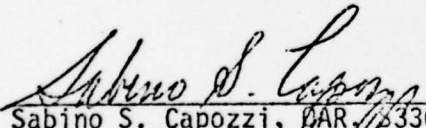
Respectfully submitted,

NEW YORK TESTING LABORATORIES, INC.


G. J. Horvitz
Chief Officer


Lynn A. Westley
Quality Assurance

PQA OF LISTED ITEMS HAS BEEN MADE BY
ME OR UNDER MY SUPERVISION AND THEY
CONFORM TO CONTRACT EXCEPT AS NOTED.


Sabino S. Capozzi, GAR, 33309A
PARTIAL TEST EVALUATION CONDUCTED

To:

Metavac, Inc.
45-68 162nd St.
Flushing, New York 11358

Att: Mr. Mort Wilson

ska

A-15



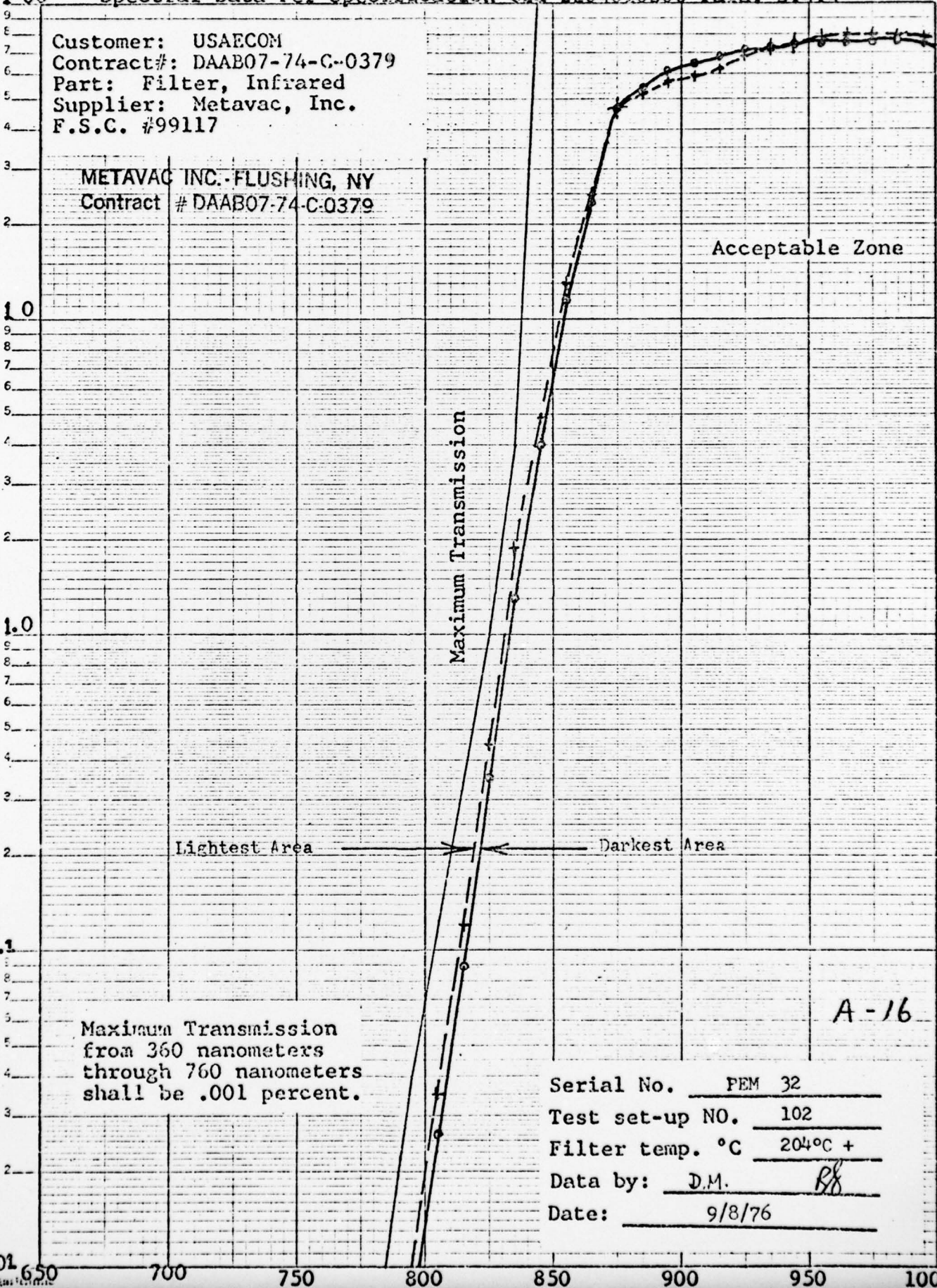
1.00 Spectral Data Per Specification C2a 2204010306 Para. 3.4.4

Customer: USAECOM
Contract#: DAAB07-74-C-0379
Part: Filter, Infrared
Supplier: Metavac, Inc.
F.S.C. #99117

METAVAC INC.-FLUSHING, NY
Contract # DAAB07-74-C-0379

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Maximum Transmission
from 360 nanometers
through 760 nanometers
shall be .001 percent.

Serial No. FEM 32
Test set-up NO. 102
Filter temp. °C 204°C +
Data by: D.M. *BS*
Date: 9/8/76

A-16

SPECIFICATION C2a 2204010306
FIGURE OF MERIT PER PARA 4.6.4.1

METAVAC INC.-FLUSHING, NY
Contract # DAAB07-74-C-0379

A-17

Part: Infrared Filter P/N: C2a 2204010306

Part Tested: 2 UNITS - 3 REM32 Date:

Test Procedure: (Ref. para 4.6.4.1)

Figure of Merit.--The measured transmission and computed Figure of Merit shall meet the requirement paragraphs 3.4.4 and 3.4.4.1. Failure to do so constitutes failure of this test.

Obtain Transmission Percentage Values (Col. 3)

From Spectral Transmission Data Per Para 4.6.4

Wave Length Nanometers	Radiance Sensitivity x Product	Transmission Percent =	Product of Col. (2) and (3) x 10 ⁻²
(1)	(2)	(3)	(4)
765	153.600	<.001	
775	101.250	<.001	
785	83.850	.0029	.002
795	87.000	.0084	.007
805	77.550	.026	.020
815	77.715	.089	.069
825	228.360	.35	.799
835	127.585	1.3	1.659
845	50.400	4.0	2.016
855	27.300	11.5	3.140
865	28.435	23.5	6.682
875	38.805	47	18.238
885	85.575	54	46.211
895	54.000	61	32.94
905	41.375	65	26.893
915	34.900	68	23.732
925	18.955	72	13.648
935	12.935	73	9.443
945	14.080	73	10.278
955	5.300	74	3.922
965	1.877	74	1.389
975	1.944	75	1.458
985	1.593	75.5	1.203

Figure of Merit = Sum = 203.749



METAVAC INC.-FLUSHING, NY
Contract # DAAB07-74-C-0379

A-18

Test Requirements: (Per para 3.4.4.1)

Figure of Merit.--The filter shall have a Figure of Merit greater than 160.00. Figure of Merit shall be computed as shown in Figure 2 by replacing Col. 3 with the contractors measured transmission in percent.

Test Results:

Part	Pass	Fail	By	DATE	Remarks
PEM 32	✓		E. J.	9-23-76	

METAVAC INC. - FLUSHING, NY
Contract # DAAB07 74 C 0379

VSS-3A SEARCHLIGHT SET DATA

METAVAC FILTER S/N PEM 32

<u>Test Para.</u>	<u>Test</u>	<u>Requirement</u>	<u>Results</u>																																																
4.4.2																																																			
4.4.2.4	<u>Angular Visual Security</u>																																																		
	Average of three observer averages -		<u>1.06°</u>																																																
	<table><tr><th>Observer</th><th><u>-Angle</u></th><th><u>+Angle</u></th><th><u>Total Angle</u></th></tr><tr><td rowspan="3">1:<u>M. Shubel</u></td><td><u>168.5°</u></td><td><u>166.5°</u></td><td><u>2.0°</u></td></tr><tr><td><u>169.1°</u></td><td><u>167.2°</u></td><td><u>1.9°</u></td></tr><tr><td><u>168.9°</u></td><td><u>167.0°</u></td><td><u>1.9°</u></td></tr><tr><td></td><td colspan="3">Average < 5°</td><td><u>1.93°</u></td></tr><tr><td rowspan="3">2:<u>H. McTiernan</u></td><td><u>167.4°</u></td><td><u>168.4°</u></td><td><u>1.0°</u></td></tr><tr><td><u>167.5°</u></td><td><u>168.4°</u></td><td><u>.9°</u></td></tr><tr><td><u>167.5°</u></td><td><u>168.1°</u></td><td><u>.6°</u></td></tr><tr><td></td><td colspan="3">Average < 5°</td><td><u>.83°</u></td></tr><tr><td rowspan="3">3:<u>W. Kegel</u></td><td><u>168.1°</u></td><td><u>168.0°</u></td><td><u>.1°</u></td></tr><tr><td><u>168.2°</u></td><td><u>167.6°</u></td><td><u>.6°</u></td></tr><tr><td><u>168.1°</u></td><td><u>167.5°</u></td><td><u>.6°</u></td></tr><tr><td></td><td colspan="3">Average < 5°</td><td><u>.43°</u></td></tr></table>	Observer	<u>-Angle</u>	<u>+Angle</u>	<u>Total Angle</u>	1: <u>M. Shubel</u>	<u>168.5°</u>	<u>166.5°</u>	<u>2.0°</u>	<u>169.1°</u>	<u>167.2°</u>	<u>1.9°</u>	<u>168.9°</u>	<u>167.0°</u>	<u>1.9°</u>		Average < 5°			<u>1.93°</u>	2: <u>H. McTiernan</u>	<u>167.4°</u>	<u>168.4°</u>	<u>1.0°</u>	<u>167.5°</u>	<u>168.4°</u>	<u>.9°</u>	<u>167.5°</u>	<u>168.1°</u>	<u>.6°</u>		Average < 5°			<u>.83°</u>	3: <u>W. Kegel</u>	<u>168.1°</u>	<u>168.0°</u>	<u>.1°</u>	<u>168.2°</u>	<u>167.6°</u>	<u>.6°</u>	<u>168.1°</u>	<u>167.5°</u>	<u>.6°</u>		Average < 5°			<u>.43°</u>	
Observer	<u>-Angle</u>	<u>+Angle</u>	<u>Total Angle</u>																																																
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	<u>168.1°</u>	<u>167.5°</u>	<u>.6°</u>																																																
	Average < 5°			<u>.43°</u>																																															

Date: 10/21/76

Tested by: R. Collet

Witnessed by: _____

SPECIFICATION C2a 2204010306
 LOW TEMPERATURE STORAGE PER PARA 4.6.6.1

METAVAC INC.-FLUSHING, NY

Contract # DAAB0174C 0379

A-20

Part: Infrared Filter

P/N: C2a 2204010306

Part Tested: PEM 32

Date: 10/22/76

Test Procedure: (Ref. para 4.6.6.1)

Low temperature storage.--The filter shall be placed in the test chamber and exposed to an ambient temperature of minus 62°C and maintained for a period of 12 hours. The ambient temperature shall be raised to minus 54°C and maintained for 6 hours. After the exposure period, the filter shall be examined for damage. If the filter is removed from the test chamber, the examination shall be completed within 10 minutes after removing the filter from chamber. Any evidence of damage shall constitute failure of this test.

Date	Time	Temp.	By	Remarks
10/22/76	5:05	-62°C	E.A.	Start
10/23/76	6:30	-62°C	E.A.	
"	7:00	-54°C	E.A.	
"	1:10	-54°C	E.A.	

Test Requirements: (Ref. para 3.5.1)

Low Temperature Storage.--The filter shall not be damaged (See 6.4) by storage in any ambient temperature from plus 23°C to minus 62°C at any possible relative humidity within that range.

Test Results:

Part	Pass	Fail	By	Remarks
PEM 32	✓		E.A.	



SPECIFICATION C2a 2204010306

HIGH TEMPERATURE STORAGE PER PARA 4.6.6.2

METAVAC INC.-FLUSHING, NY

Contract # DAAB07-74-C-0379

A-21

Part: Infrared Filter

P/N: C2a 2204010306

Part Tested: PEM 32

Date: 10/21/76

Test Procedure: (Ref. para 4.6.6.2)

High temperature storage.--The filter shall be placed in the test chamber and exposed to an ambient temperature of 68°C with maximum humidity (90 to 98 percent) for 12 hours. At the conclusion of the exposure period the filter shall be examined for damage. Any evidence of damage shall constitute failure of this test.

Date	Time	Temp.	By	Remarks
10/21/76	5:00	69°C	E.A.	Start
10/22/76	6:00	70°C	E.A.	Finish

Test Requirements: (Ref. para 3.5.2)

High Temperature Storage.--The filter shall not be damaged by storage in any ambient temperature from plus 23°C to minus 62°C at any possible relative humidity within that range.

Test Results:

Part	Pass	Fail	By	Remarks
------	------	------	----	---------

PEM 32	✓		E.A.	
--------	---	--	------	--

12-333

SPECIFICATION C2a 2204010306
THERMAL SHOCK PER PARA 4.6.6.3

METAVAC INC.-FLUSHING, NY

A-22

Contract # DAAB07-74-C-0379

Part: Infrared Filter

P/N: C2a 2204010306

Part Tested: PEM 32

Date: 10/25/76

Test Procedure: (Ref. para 4.6.6.3)

Thermal Shock.--The filter shall be exposed to an ambient temperature of minus 54°C for not less than two (2) hours. The filter shall then be exposed to 260°C within two (2) minutes for not less than two (2) hours. This constitutes one cycle. The filter shall be exposed to four (4) cycles of thermal shock. At the conclusion of this test the filter shall be examined for damage. Any evidence of damage shall constitute failure of this test.

Date	Time	Temp.	By	Remarks
10/25/76	7:15	-54°C	EA	DATE TIME TEMP BY
	9:20	-54°C	EA	
	9:22	+260°C	EA	10/26/76 6:55 -54°C EA
	11:35	+260°C	EA	9:20 -54°C EA
10/25/76	12:30	-54°C	EA	9:22 +260°C EA
	2:35	-54°C	EA	11:50 +260°C EA
	2:37	+260°C	EA	10/26/76 12:40 -54°C EA
	4:50	+260°C	EA	2:45 -54°C EA
				2:47 +260°C EA
				5:00 +260°C EA

Test Requirements: (Ref. para 3.5.3)

Thermal Shock.--The filter shall not be damaged when subjected to thermal shock from minus 54°C to plus 260°C.

Test Results:

Part	Pass	Fail	By	Date	Remarks
PEM 32	✓		EA	10/27/76	

NEW YORK TESTING LABORATORIES, INC.

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METAVAC INC.-FLUSHING, NY

Contract # DAAB07-74-C-0379

Page 1.

REPORT OF TESTS

November 29, 1976

Lab. No. & Client — 76-49668 - Metavac, Inc.
Material — Two (2) I.R. Filters
Client's Order No. — 14982
Identification — PEM 29 and PEM 32
Submitted for — Fungus Test per MIL-Std-810C, Method 508.1, Procedure 1

A-23

Gov't. Contract No. - DAAB07-74-C-0379

PROCEDURE

Approximately 10 milliliters of distilled water (having a pH value between 5.8 and 7.2 at 25° C. (77° F.) was introduced into a tube culture of species of fungi and the spores were brought into suspension by vigorous shaking. This was repeated for the species of fungi listed below:

Group I	Aspergillus Niger
Group II	Aspergillus Flavus
Group III	Aspergillus Versicolor
Group IV	Penicillium Funiculosum
Group V	Chaetomium Globosum

The separate spore suspensions from the species of fungi were mixed together to form a composite suspension. The test units were then placed within the fungus chamber and sprayed with the suspension of mixed spores. Three pieces of cotton duct strips, prepared as specified, were also placed in the chamber as control items and sprayed with the composite suspension. The chamber was sealed and the internal chamber temperature was increased to $86^{\circ} \pm 3.5^{\circ}$ F. with a relative humidity of $97\% \pm 2\%$. These conditions were maintained for a period of four hours. The test items were then subjected to cyclic temperature and humidity conditions which included 20 hours of RH at $95 \pm 5\%$ at a temperature of $86 \pm 2^{\circ}$ F. followed by four hours of 100% RH at a temperature of 77° deg. F. These cyclic conditions were continued for a period of 28 days. At the end of seven days, the control items were inspected for abundance of growth.

At the completion of the 28 day period of exposure, the test units were removed from the chamber and visually examined for evidence of fungus growth, deterioration, and corrosion. The test units were then returned to Metavac, Inc.

RESULTS

There was no evidence of fungus growth, deterioration or corrosion as a result of the test.

Report on sample by client applies only to sample.

Report on samples by us applies only to lot sampled.

Information contained herein is not to be used for reproduction except by special permission.

Samples retained for thirty days maximum after date of report unless specifically requested otherwise by client.

The liability of the New York Testing Laboratories, Inc. with respect to the services charged for herein shall in no event exceed the amount of the invoice.

NEW YORK TESTING LABORATORIES, INC.

Page 2.

Lab. No. 76-49668

METAVAC INC.-FLUSHING, NY
Contract # DAAB07-74-C-0379

NOTE

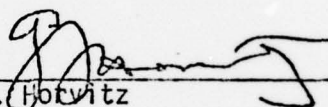
Fungus growth was evident on the control items indicating that the environment had been capable of supporting fungus growth. *SV GAR*

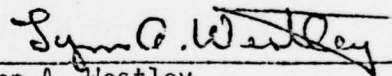
A-24

We certify that this report is a true report of results obtained from our tests of this material.

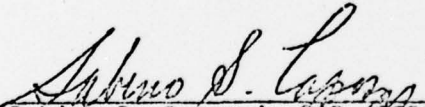
Respectfully submitted,

NEW YORK TESTING LABORATORIES, INC.


G. J. Horvitz
Chief Officer


Lynn A. Westley
Quality Assurance

PQA OF LISTED ITEMS HAS BEEN MADE BY
ME OR UNDER MY SUPERVISION AND THEY
CONFORM TO CONTRACT EXCEPT AS NOTED.


Sabino S. Capozzi, PAR 83309A
PARTIAL TEST EVALUATION CONDUCTED

To:

Metavac, Inc.
45-68 162nd St.
Flushing, New York 11358

Att: Mr. Mort Wilson

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