DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY DUGWAY PROVING GROUND
DUGWAY UT 84022-5000

REPLY TO
ATTENTION OF:

CSTE-DTC-DP-WD-LS

AUG 10 2006

MEMORANDUM FOR Mr. Jorge Alvarez, U.S. Army Developmental Test Command, CSTE-DTC-TT-S, Aberdeen Proving Ground, MD 21005-5055.

SUBJECT: Abbreviated Test Report for the Genesis Air Test, Test Project No. 2006-DT-DPG-GENES-D1032, WDTC-TR-06-078

1. Subject report addendum is forwarded to you for retention.

2. Point of contact is Willard Rome, DSN 789-5713, commercial (435) 831-5173.

3. We value your comments; please take a moment to complete our customer survey at http://www.wdtc.army.mil/ServCustomerSurvey.asp

4. West Desert Test Center – "EXCELLENCE IN TESTING."

Encl

FOR DOUGLAS A. TAMILIO
LTC, IN
Commander, West Desert Test Center

Test Project No. 2006-DT-DPG-GENES-D1032
WDTC Document No. WDTC-TR-06-078

FINAL TEST REPORT
FOR THE
GENESIS AIR TEST

WILLARD ROME
Life Sciences Division

TANYA SPACKMAN
Dugway Data Services Team (DDST)
UNDER CONTRACT NO. DAAD-9[1S6-06-D-000]

WEST DESERT TEST CENTER
U.S. ARMY DUGWAY PROVING GROUND
DUGWAY, UT 84022-5000

JULY 2006

Prepared for:
Government Scientific Source, Inc.
12351 Sunrise Valley Drive
Reston, Virginia 20191-3415

U.S. Army Developmental Test Command
Aberdeen Proving Ground, MD 21005-5055

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13. SUPPLEMENTARY NOTES

14. ABSTRACT
The Genesis Air 2002B.mil (Genesis Air, Lubbock, Texas) was tested to determine its ability to remove fungal spores (*Aspergillus niger*) from room air. The Genesis Air 2002B.mil significantly reduced the percentage of spores in the atmosphere an average of 93.5 percent.

15. SUBJECT TERMS
Genesis Air 2002B; fungal spores; *Aspergillus niger*; Fungus Test Chamber

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
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SECTION 1 EXECUTIVE DIGEST

Mold

1.1 SUMMARY

a. The Genesis Air 2002B.mil (Genesis Air, Lubbock, Texas) was tested to determine its ability to remove fungal spores (*Aspergillus niger*) from room air. Testing was originally planned to include challenging its ability to remove bacterial spores, but the fungus test chamber was restricted, prohibiting testing with bacteria concurrently with fungal testing. Only testing with fungi was performed.

b. The Genesis Air 2002B.mil significantly reduced the percentage of spores in the atmosphere an average of 93.5 percent.

1.2 TEST OBJECTIVE

Determine the ability of the Genesis Air 2002B.mil to remove airborne fungal spores from room air.

1.3 TESTING AUTHORITY

On 16 January 2006, U.S. Army Developmental Test Command (DTC), Aberdeen Proving Ground (APG), Maryland, issued a test authorization (Reference 1) by activation of the U.S. Army Test and Evaluation Command (ATEC) Decision Support System (ADSS) for West Desert Test Center (WDTC), U.S. Army Dugway Proving Ground (DPG), Utah, to conduct the Genesis Air Test (Test Project No. 2006-DT-DPG-GENES-D1032).

1.4 TEST CONCEPT

a. The Genesis Air 2002B.mil was the representative unit for the GAP™ technology in this test. The test was conducted in a room-size fungus test chamber at 28±5°C.

b. One Genesis Air 2002B.mil was supplied by the customer for testing. This model had six sampling ports (two aft of each section of the system) installed by the manufacturer. WDTC/DPG conducted initial inspection and pretest function checks before the challenge testing began.

1.5 SYSTEM DESCRIPTION

Genesis Air systems use GAP™ technology, a three-stage germicidal and air-cleaning process. It is designed to trap particles down to 0.3 microns in its primary filtering stage. The second stage uses ultraviolet (UV) tube to neutralize and destroy organic contaminants such as airborne bacteria and viruses. The third stage uses the power of a photocatalyst section consisting of a titanium oxide (TiO_2)-coated membrane to safely convert dangerous chemical particles into benign components. The membrane is placed with its pleats perpendicular to the UV tube to minimize shadows and maximize exposure, activating the photocatalytic reaction. All stages of the system were employed in this test.

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SECTION 2. DETERMINATION OF FINDINGS

2.1 RECEIPT INSPECTION

2.1.1 Objective

Determine that the Genesis Air 2002B.mil received for testing is free of defects before testing, is modified with sampling ports as required for testing, and all phases of the technology are in place and respond properly.

2.1.2 Criterion

The three phases of the GAP™ technology must be in place and respond to controls as stated in the operations guide (Reference 2) (Appendix A, Item 1).

2.1.3 Inspections Procedure

A visual inspection was performed to confirm:

a. The presence and proper placement of a high-capacity particulate filter.

b. The UV tube was in place and functioning in response to controls.

c. The pleated TiO_2 filter was present and properly positioned (perpendicular to the UV tube to minimize shadowing).

2.1.4 Inspection Findings

The Genesis Air 2002B.mil was received ready for testing, operable and with all sampling ports and phases in place.

2.1.5 Technical Analysis

The three phases of the GAP™ technology were in place and responded to controls, meeting the criterion (Appendix A, Item 1).

2.2 LIVE BIOLOGICAL CHALLENGE

2.2.1 Objective

Determine the ability of the Genesis Air 2002B.mil to remove airborne fungal spores from room air.

2.2.2 Criteria

None. However, initially, the Genesis Air 2002B.mil must reduce the concentration of spores by a percentage of a known concentration. Ultimately, the technology should show reduction of agent-containing particles per liter of air (ACPLA) over a period of time (Reference 3).

2.2.3 Test Procedure

a. Testing was conducted in the Fungus Test Chamber at the WDTC/DPG Carr Test Facility. The Fungus Test Chamber and Genesis Air 2002B.mil were conditioned to establish baseline parameters before the introduction of the challenge organism.

b. *Aspergillus niger* spores, a fungus that is a common contaminant of food, were used as the challenge organism.

c. All-glass impingers (AGIs) were located to sample from sampling ports on the Genesis Air 2002B.mil. These were attached to a vacuum pump and used to measure the viability of airborne biological material. Three AGI locations were used: in the test chamber, in the Genesis Air 2002B.mil exhaust, and in the middle of the Genesis Air 2002B.mil.

d. Aerodynamic Particle Sizer® (APS™) spectrometers were used to measure the concentration of biological material in the test chamber and the concentration of biological material exhausted from the Genesis Air 2002B.mil.

e. A disseminator was used to generate a cloud of fungal spores in the test chamber. The disseminator operator controlled the cloud density and maintained the cloud at its maximum concentration for the duration of each trial. At key intervals, AGI samples were collected to show the viability of the spores in the cloud.

f. At the end of each challenge, the concentration of spores was allowed to return to background level and AGIs were changed.

2.2.4 Test Findings

a. APS™ data are shown in Figures B.1 through B.3. Without the Genesis Air 2002B.mil operating, the particle concentration within the test chamber at 1000 and 2000 ACPLA is seen to rise and remain fairly constant. With the Genesis Air 2002B.mil operating, the concentration within the test chamber rises, though a bit slower, and then drops significantly.

b. AGI data showed live fungal activity for the chamber air and no fungal activity for air in the Genesis exhaust stream. Actual fungal colony counts could not be made because each live spore produces a mycelium of unfixed size which rapidly spread in the solid growth medium.

c. Environmental data are in Table 1.

2.2.5 Technical Analysis

The percent reductions are in Table 1.

Table 1. Percent Reduction and Environmental Data; Genesis Air Test.

Trial Number	Percent Reduction	Temperature (°F)	Relative Humidity (%)
T-4	93.2	79.6	94.9
T-5	94.2	79.6	95.5
T-6	93.7	80.1	94.9
T-7	93.1	79.8	94.4
T-8	93.7	80.5	94.7
T-9	93.0	79.6	95.1
T-10	93.3	80.0	95.6
T-10a	93.7	80.0	95.6
T-11	90.2	80.8	95.1
T-12	93.6	79.6	95.3
T-13	95.0	79.8	95.7
T-14	95.2	80.0	93.6
Average	93.5		

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SECTION 3. APPENDICES

APPENDIX A. TEST CRITERIA

Item	Applicable Source	Test Criteria	Subtest	Met/ Not Met
1	Reference 3	The three phases of the GAP™ technology must be in place and respond to controls as stated in the operations guide (Reference 2).	2.1	Met

APPENDIX B. TEST DATA

FIGURE LIST

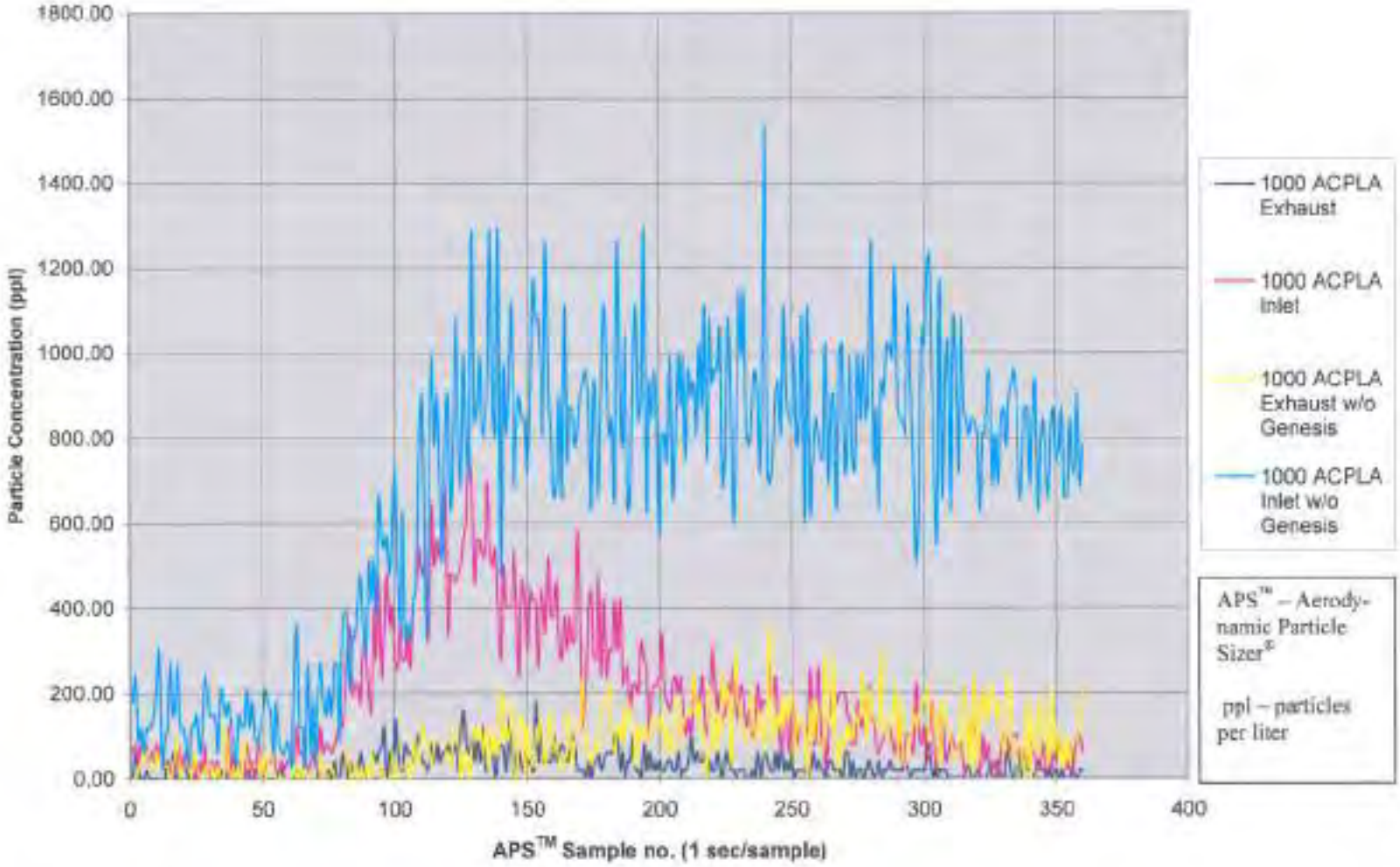

Figure B.1. Particle Concentration at 1000 Agent-Containing Particles per Liter of Air (ACPLA); Genesis Air Test.

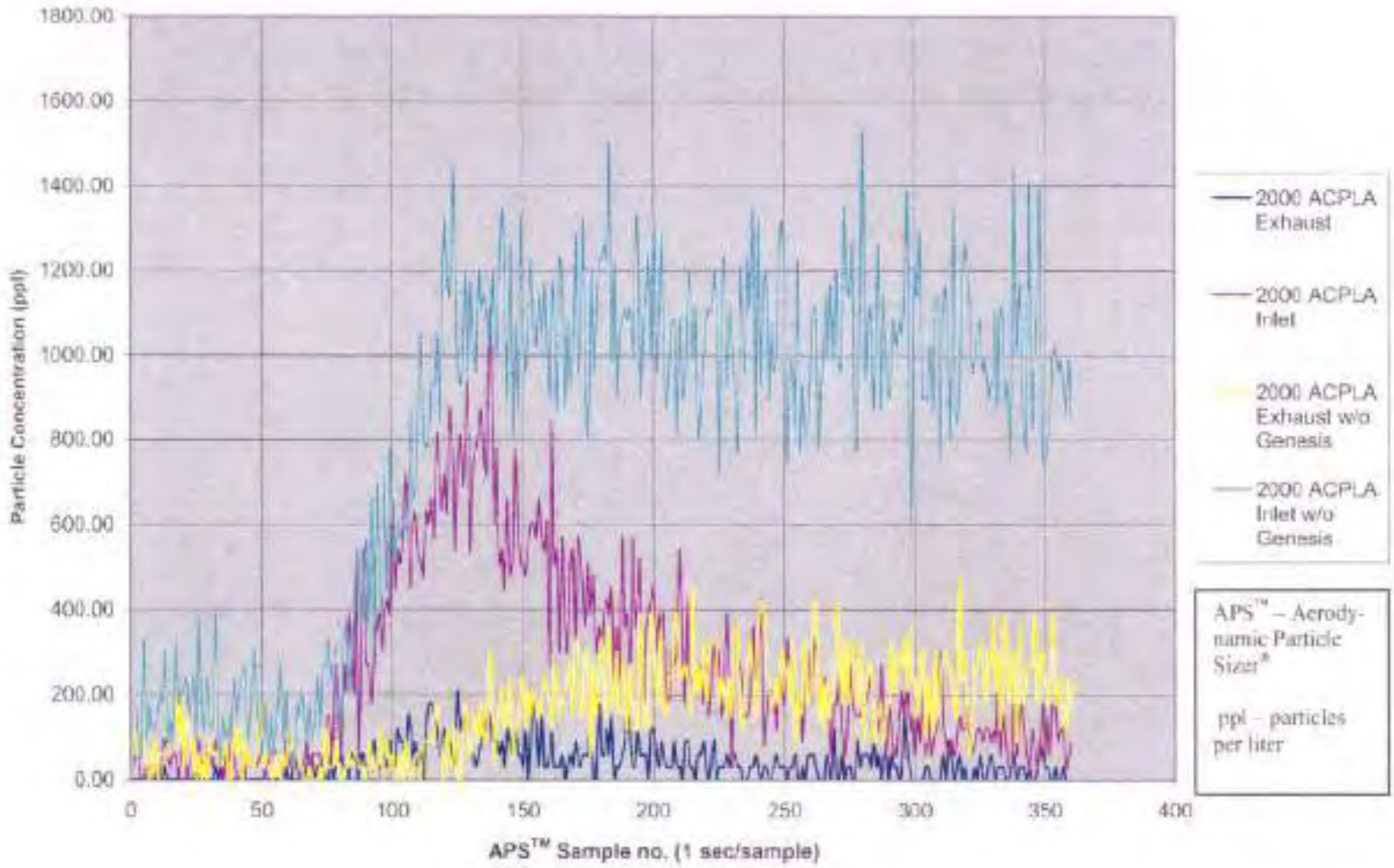

Figure B.2. Particle Concentration at 2000 Agent-Containing Particles per Liter of Air (ACPLA): Genesis Air Test.

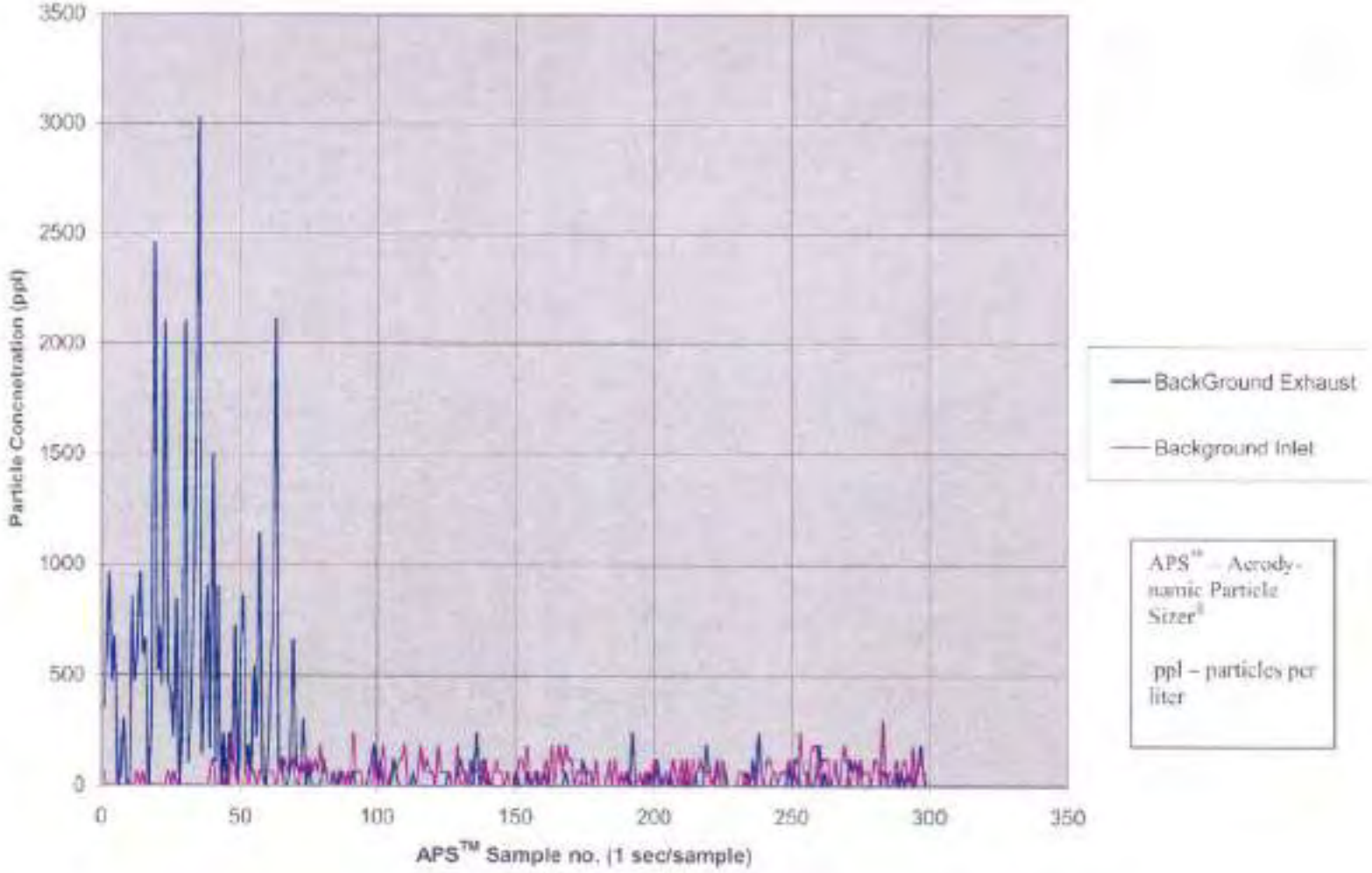

Figure B.3. Background Concentration With the Genesis Air 2002B mil Operating; Genesis Air Test.

APPENDIX C. REFERENCES

1. U.S. Army Developmental Test Command (DTC), U.S. Army Aberdeen Proving Ground (APG), Maryland, Test Authorization by activation of the U.S. Army Test and Evaluation Command (ATEC) Decision Support System (ADSS) for Genesis Air Test, Test Project Number 22006-DT-DPG-GENES-D1032, 16 January 2006.

2. Genesis Air, Lubbock, Texas, 2002B Portable Blower Unit User's Manual, http://www.genesisair.com/literature/2002B%20User%20Manual, 2005.

3. Government Scientific Source, Reston, Virginia, Test Plan for the Genesis Air Model 2002B.mtl, Undated.

APPENDIX D. ABBREVIATIONS

ACPLA – agent-containing particles per liter of air

ADSS – ATEC Decision Support System

AGI – all-glass impinger

APG – Aberdeen Proving Ground

APS™ – Aerodynamic Particle Sizer®

ATEC – U.S. Army Test and Evaluation Command

DPG – U.S. Army Dugway Proving Ground

DTC – U.S. Army Developmental Test Command

ppl – particles per liter

TiO_3 – titanium oxide

UV – ultraviolet

WDTC – West Desert Test Center

APPENDIX E. DISTRIBUTION LIST

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Anthrax

1.1 SUMMARY

a. The Genesis Air 2002B.mil (Genesis Air, Lubbock, Texas) was tested to determine its ability to remove bacterial particles from room air.

b. It was determined that the Genesis Air 2002B.mil reduced the percentage of bacterial spores in the atmosphere.

1.2 TEST OBJECTIVE

Determine the ability of the Genesis Air 2002B.mil to remove airborne bacterial spores from room air.

1.3 TESTING AUTHORITY

On 16 January 2006, U.S. Army Developmental Test Command (DTC), Aberdeen Proving Ground (APG), Maryland, issued a test authorization (Reference 1) by activation of the U.S. Army Test and Evaluation Command (ATEC) Decision Support System (ADSS) for West Desert Test Center (WDTC), U.S. Army Dugway Proving Ground (DPG), Utah, to conduct the Genesis Air Test (Test Project No. 2006-DT-DPG-GENES-D1032).

1.4 TEST CONCEPT

a. The Genesis Air 2002B.mil was the representative unit for the GAP™ technology in this test. The test was conducted in an Aerosol Simulant Exposure Chamber (ASEC), a room-size test chamber at 28±5°C.

b. One Genesis Air 2002B.mil was supplied by the customer for testing. . WDTC/DPG conducted initial inspection and pretest function checks before the challenge testing began.

1.5 SYSTEM DESCRIPTION

Genesis Air systems use GAP™ technology, a three-stage germicidal and air-cleaning process. It is designed to trap particles down to 0.3 microns in its primary filtering stage. The second stage uses ultraviolet (UV) tube to neutralize and destroy organic contaminants such as airborne bacteria and viruses. The third stage uses the power of a photo catalyst section consisting of a titanium oxide (TiO_2)-coated membrane to safely convert dangerous chemical particles into benign components. The membrane is placed with its pleats perpendicular to the UV tube to minimize shadows and maximize exposure, activating the photo catalytic reaction. All stages of thesystem were employed in this test.

2.1 LIVE BACTERIAL SPORE CHALLENGE

2.2.1 Objective

Determine the ability of the Genesis Air 2002B.mil to remove airborne bacterial spores from room air.

2.2.2 Criteria

None. However, initially, the Genesis Air 2002B.mil must reduce the concentration of particles containing bacterial spores by a percentage of a known concentration. Ultimately, the technology should show reduction of agent-containing particles per liter of air (ACPLA) over a period of time (Reference 3).

2.2.3Test Procedure

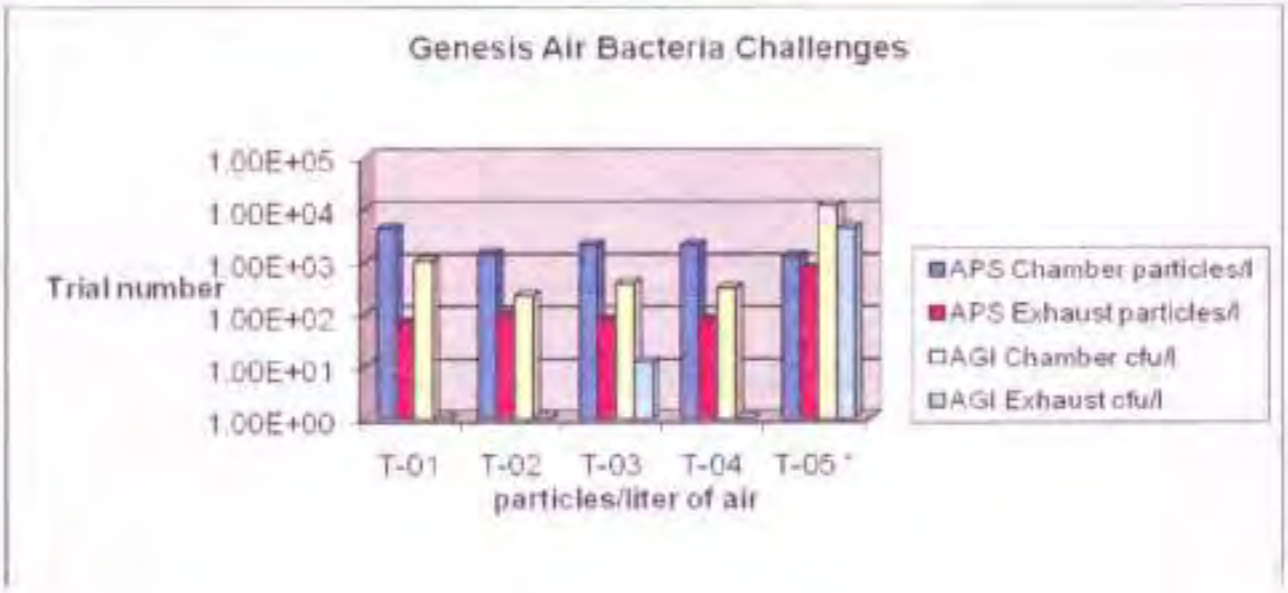
a. Testing was conducted in the Aerosol Simulant Exposure Chamber (ASEC)at the WDTC/DPG Life Sciences Test Facility. The ASEC and Genesis Air 2002B.mil were conditioned to establish baseline parameters before the introduction of the challenge organism.

b. *Bacillus subtilus var. niger*, a rod shaped bacteria that forms spores, was used as the challenge organism. *Bacillus subtilus* var. *niger* (BG) is normally a non-pathogenic for humans and is used in aerosol testing by the U.S. Army as a stimulant for *Bacillus anthraces* (Anthrax).
c. All-glass impingers (AGIs) were located to sample from sampling ports on the Genesis Air 2002B.mil. These were attached to a vacuum pump and used to measure the viability of airborne biological material. Two AGI locations were used: the Genesis Air 2002B.mil intake, and in the Genesis Air 2002B.mil exhaust.
d. Two Aerodynamic Particle Sizers® (APS™) were used to measure the concentration of biological material in the test chamber and the concentration of biological material exhausted from the Genesis Air 2002B.mil.
e. A Sonotec disseminator was used to generate a cloud of particles containing BG in the test chamber. The disseminator operator controlled the cloud density and maintained the cloud at its maximum concentration for the duration of each trial. At key intervals, AGI samples were collected to show the viability of the spores in the cloud.
f. At the end of each challenge, the concentration of particles was allowed to return to background level and the AGIs were changed.

3. Results.

3.1 Five challenges (trials) of the Genesis with airborne spores were conducted. Trial T-5 was a test of the second and third stages of the Genesis system (filter removed).

3.2 Data



Trial T-05 was conducted with the filter removed from the Genesis.

3.3 Analysis

As designed and tested, the Genesis was able to remove or neutralize better than 98% of airborne bacterial spores as it processed the chamber air. The filter stage of the system excludes particles greater than 3 microns and appears to be responsible for removing more than 50% of the airborne bacterial spores. AGI data from the Genesis exhaust was below the detection limits of the laboratory analysis methodology.

Virus

1.1 SUMMARY

a. The Genesis Air 2002B.mil (Genesis Air, Lubbock, Texas) was tested to determine its ability to remove viral particles from room air.

b. It could not be determined if the Genesis Air 2002B.mil reduced the percentage of spores in the atmosphere.

1.2 TEST OBJECTIVE

Determine the ability of the Genesis Air 2002B.mil to remove airborne viral particles from room air.

1.3 TESTING AUTHORITY

On 16 January 2006, U.S. Army Developmental Test Command (DTC), Aberdeen Proving Ground (APG), Maryland, issued a test authorization (Reference 1) by activation of the U.S. Army Test and Evaluation Command (ATEC) Decision Support System (ADSS) for West Desert Test Center (WDTC), U.S. Army Dugway Proving Ground (DPG), Utah, to conduct the Genesis Air Test (Test Project No. 2006-DT-DPG-GENES-D1032).

1.4 TEST CONCEPT

a. The Genesis Air 2002B.mil was the representative unit for the GAP™ technology in this test. The test was conducted in an Aerosol Simulant Exposure Chamber (ASEC), a room-size fiest chamber at 28±5°C.

b. One Genesis Air 2002B.mil was supplied by the customer for testing. . WDTC/DPG conducted initial inspection and pretest function checks before the challenge testing began.

1.5 SYSTEM DESCRIPTION

Genesis Air systems use GAP™ technology, a three-stage germicidal and air-cleaning process. It is designed to trap particles down to 0.3 microns in its primary filtering stage. The second stage uses ultraviolet (UV) tube to neutralize and destroy organic contaminants such as airborne bacteria and viruses. The third stage uses the power of a photocatalyst section consisting of a titanium oxide (TiO_2)-coated membrane to safely convert dangerous chemical particles into benign components. The membrane is placed with its pleats perpendicular to the UV tube to minimize shadows and maximize exposure, activating the photocatalytic reaction. All stages of tliesystem were employed in this test.

2.1 LIVE VIRUS CHALLENGE

2.2.1 Objective

Determine the ability of the Genesis Air 2002B.mil to remove airborne virus particles from room air.

2.2.2 Criteria

None. However, initially, the Genesis Air 2002B.mil must reduce the concentration of virus particles by a percentage of a known concentration. Ultimately, the technology should show reduction of agent-containing particles per liter of air (ACPLA) over a period of time (Reference 3).

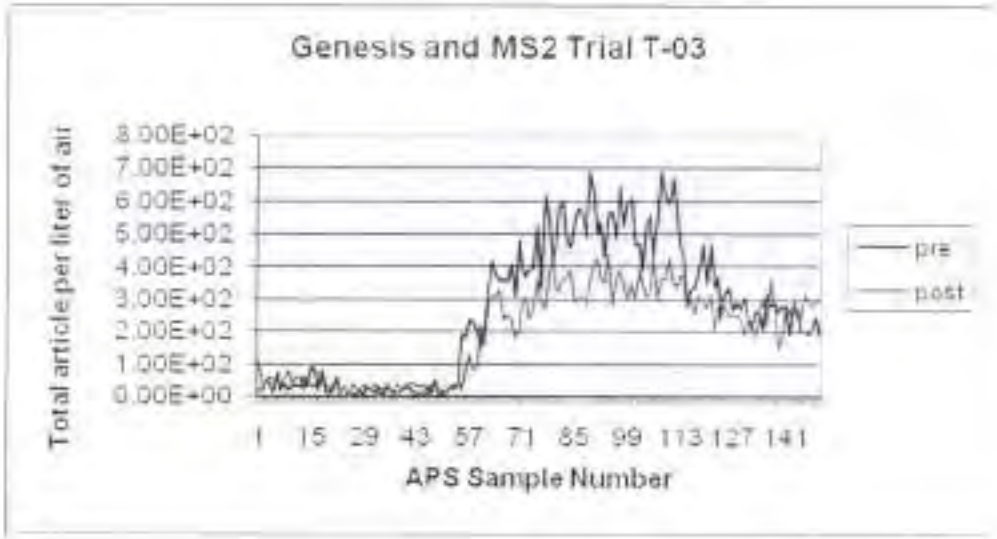
2.2.3Test Procedure

a. Testing was conducted in the Aerosol Simulant Exposure Chamber (ASEC)at the WDTC/DPG Life Sciences Test Facility. The ASEC and Genesis Air 2002B.mil were conditioned to establish baseline parameters before the introduction of the challenge organism.

b. *MS2 phage*, a bacteria phage that affects E. coli, was used as the challenge organism.

c. All-glass impingers (AGIs) were located to sample from sampling ports on the Genesis

3.2.2 APS Data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6.00E+02
5.00E+02
4.00E+02
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2.00E+02
1.00E+02
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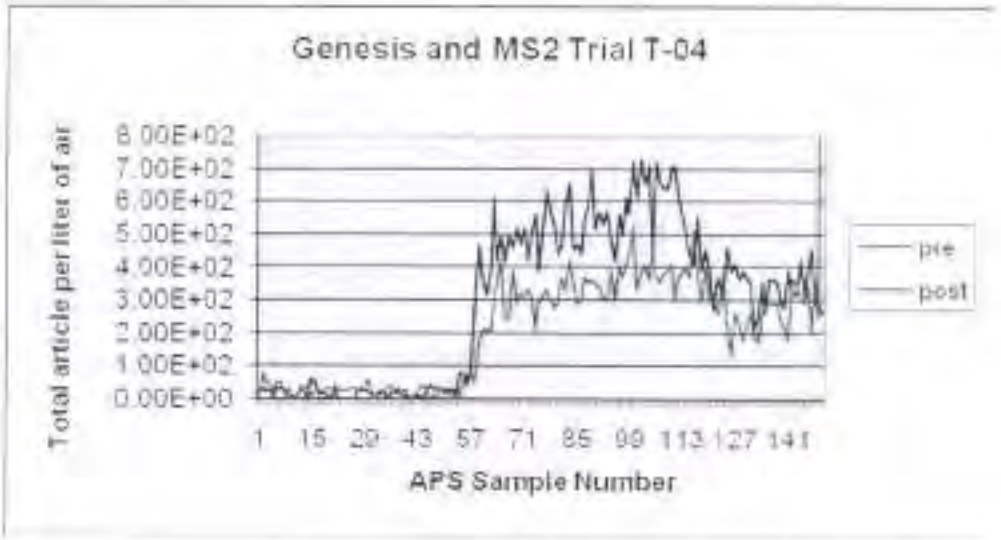
APS Sample Number
pre
post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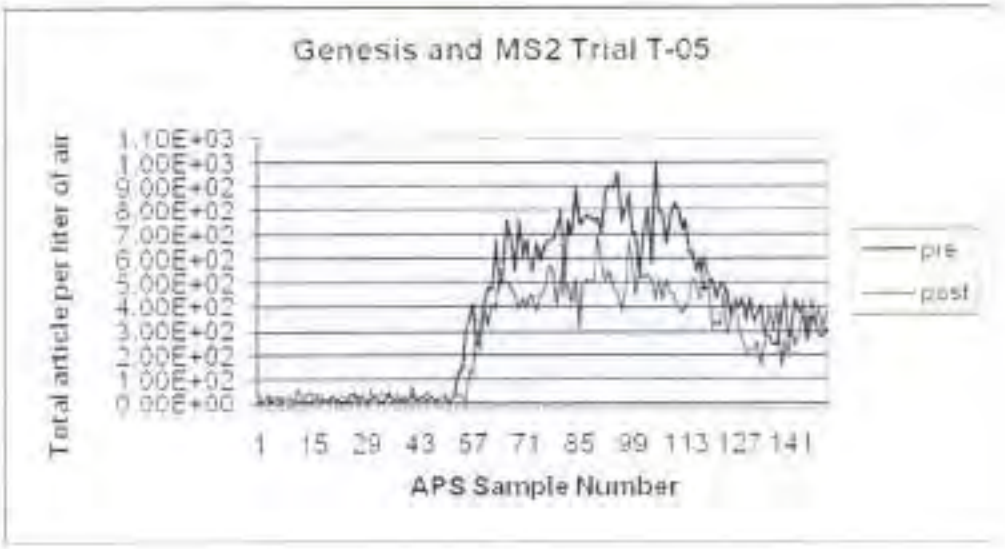
APS Sample Number
pre
post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6.00E+02
5.00E+02
4.00E+02
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1.00E+02
0.00E+00
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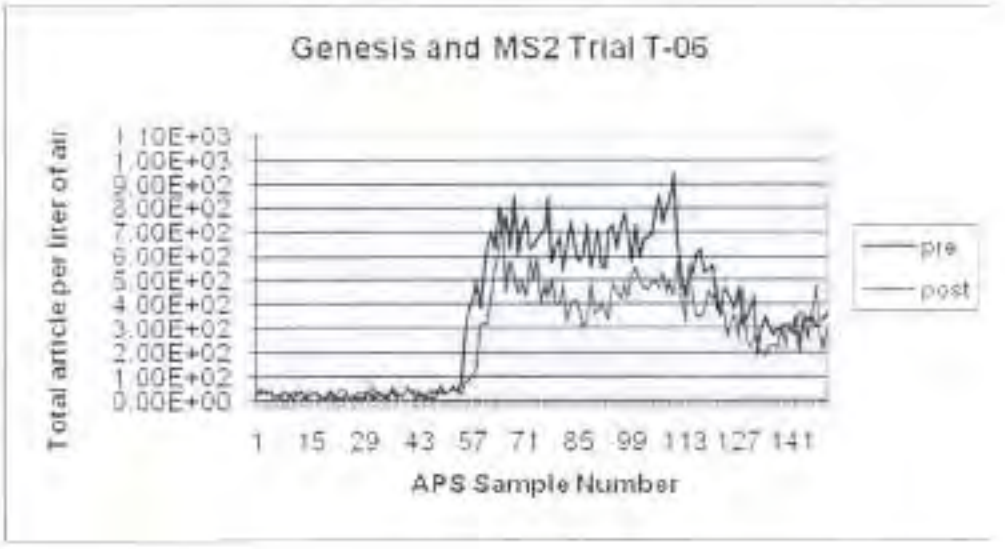
APS Sample Number
pre
post


Genesis and MS2 Trial T-06
Total article per liter of air
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4.00E+02
3.00E+02
2.00E+02
1.00E+02
0.00E+00
1 15 29 43 57 71 85 99 113 127 141
APS Sample Number
pre
post

Air 2002B.mil. These were attached to a vacuum pump and used to measure the viability of airborne biological material. Two AGI locations were used: the Genesis Air 2002B.mil intake, and in the Genesis Air 2002B.mil exhaust.
d. Two Aerodynamic Particle Sizer® (APS™) spectrometers were used to measure the concentrationof biological material in the test chamber and the concentration of biological material exhausted from the Genesis Air 2002B.mil.
e. A Sonotec disseminator was used to generate a cloud of virus particles in the test chamber. The disseminator operator controlled the cloud density and maintained the cloud at its maximum concentration for the duration of each trial. At key intervals, AGI samples were collected to show the viability of the spores in the cloud.
f. At the end of each challenge, the concentration of particles was allowed to return to background level and the AGIs were changed.

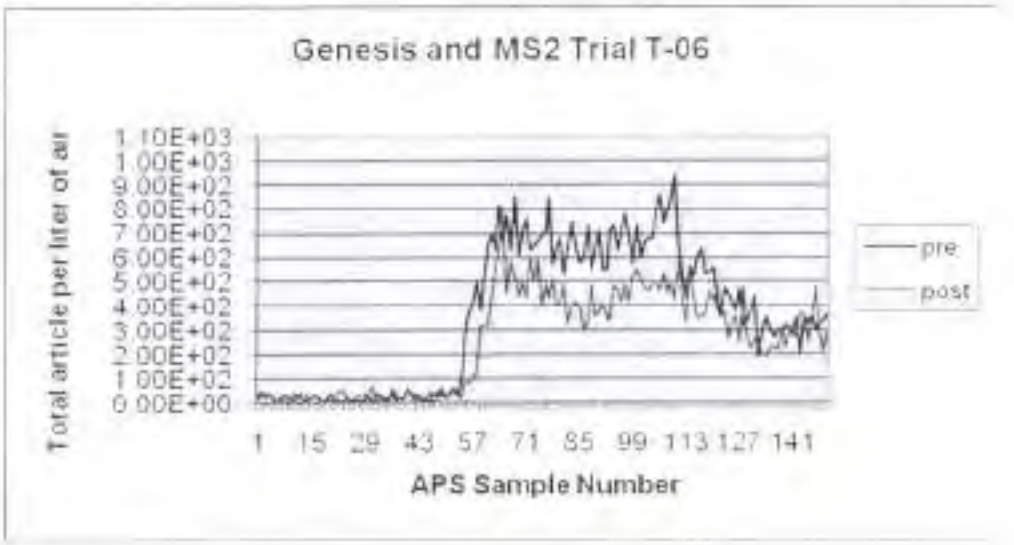
3. Results.

3.1 No live MS2 was found in either the intake AGI or the exhaust AGI after each challenge. Analysis of the APS data shows a slight reduction in the total number of particles per liter of air going into the Genesis and being exhausted back into the room. The lack of live viral material in the air samples could be caused by several factors. The AGI samplers could have failed to initiate and collect a sample. The virus particles could have died right after dissemination. This is not uncommon with liquid disseminations of some viruses simply because they cannot withstand the sudden drying after being released in a low humidity room.

3.2 Data

3.2.1 Test log

RIAL	DATE	APS START TIME	DISSEMINATION START TIME	AGI/GENESIS START TIME	AGI END TIME	DISSEMINATION END TIME	GENESIS END TIME	CALCULATED SLURRY CONCENTRATION	SLURRY FEED RATE
eTrial	22-Mar-07	16:40:00	16:42:00	NA	NA	16:47:00	NA	4.20E+10	0.352
eTrial 2	22-Mar-07	17:20:00	17:21:00	NA	NA	17:26:00	NA	1.05E+10	0.352
EN01	22-Mar-07	17:40:00	17:41:00	17:41:00	17:46:00	17:46:00	NA	1.05E+10	0.352
EN02	22-Mar-07	18:05:00	18:10:00	18:11:00	18:16:00	18:16:00	18:18:00	1.05E+10	0.352
EN03	22-Mar-07	18:30:00	18:35:00	18:36:00	18:41:00	18:41:00	18:43:00	1.05E+10	0.352
EN04	22-Mar-07	18:55:00	19:00:00	19:01:00	19:06:00	19:06:00	19:08:00	1.05E+10	0.352
EN05	22-Mar-07	20:10:00	20:15:00	20:16:00	20:21:00	20:21:00	20:23:00	1.05E+10	0.352
EN06	22-Mar-07	20:45:00	20:50:00	20:51:00	20:56:00	20:56:00	20:58:00	1.05E+10	0.352


Genesis and MS2 Trial T-06
Total article per liter of air
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1.00E+03
9.00E+02
8.00E+02
7.00E+02
6.00E+02
5.00E+02
4.00E+02
3.00E+02
2.00E+02
1.00E+02
0.00E+00
1 15 29 43 57 71 85 99 113 127 141
APS Sample Number
pre
post

1.1 SUMMARY

a. The Genesis Air 2002B.mil (Genesis Air, Lubbock, Texas) was tested to determine its ability to remove airborne particles containing fungal spores, bacterial spores, and virus particles from room air. The Genesis Air 2002B.mil was tested as delivered from the manufacturer.

b. *Aspergillus niger* (black bread mold) spores, *Bacillus subtilus* var. niger (non-pathogenic) spores, and MS2 coliophage (virus) were used in the test.

c. It was determined that the Genesis Air 2002B.mil significantly reduced the percentage of airborne particles containing biological material from the room air in the atmosphere.

1.2 TEST OBJECTIVE

Determine the ability of the Genesis Air 2002B.mil to remove airborne biological material from Contaminated room air.

1.3 TESTING AUTHORITY

On 16 January 2006, U.S. Army Developmental Test Command (DTC), Aberdeen Proving Ground (APG), Maryland, issued a test authorization (Reference 1) by activation of the U.S. Army Test and Evaluation Command (ATEC) Decision Support System (ADSS) for West Desert Test Center (WDTC), U.S. Army Dugway Proving Ground (DPG), Utah, to conduct the Genesis Air Test (Test Project No. 2006-DT-DPG-GENES-D1032).

1.4 TEST CONCEPT

a. The Genesis Air 2002B.mil was the representative unit for the GAP™ technology in this test. The tests were conducted in the Fungus Test Chamber and the Aerosol Simulant Exposure Chamber (ASEC), a room-size test chamber at 28±5°C.

b. One Genesis Air 2002B.mil was supplied by the customer for testing. . WDTC/DPG conducted initial inspection and pretest function checks before the challenge testing began.

1.5 SYSTEM DESCRIPTION

Genesis Air systems use GAP™ technology, a three-stage germicidal and air-cleaning process. It is designed to trap particles down to 0.3 microns in its primary filtering stage. The second stage uses ultraviolet (UV) tube to neutralize and destroy organic contaminants such as airborne bacteria and viruses. The third stage uses the power of a photo catalyst section consisting of a titanium oxide (TiO_2)-coated membrane to safely convert dangerous chemical particles into benign components. The membrane is placed with its pleats perpendicular to the UV tube to minimize shadows and maximize exposure, activating the photo catalytic reaction. All stages of the system were employed in these tests.

2.1 TESTING WITH AGENT CONTAINING PARTICLES PER LITER OF AIR (ACPLA)

2.2.1 Objective

Determine the ability of the Genesis Air 2002B.mil to remove airborne particles containing fungus spores, bacteria spores, and virus particles from room air.

2.2.2 Criteria

None. However, initially, the Genesis Air 2002B.mil must reduce the concentration of particles containing bacterial material by a percentage of a known concentration. Ultimately, the technology should show reduction of agent-containing particles per liter of air (ACPLA) over a period of time (Reference 3).

2.2.3Test Procedure

a. Fungus testing was conducted in a Fungus Chamber located at Carr Facility, at Dugway Proving Ground. Bacterial spore and virus testing was conducted in the Aerosol Simulant

Exposure Chamber (ASEC)in the WDTC/DPG Life Sciences Test Facility, at Dugway Proving Ground. Both test chambers and the Genesis Air 2002B.mil were conditioned to establish baseline parameters before the introduction of the challenge organism.
b. Test organisms were selected on the basis of their risk to humans. In all three cases the candidates were normally non-pathogenic to humans. The test organisms are:

1. *Bacillus subtilus var. niger*, is a rod shaped bacteria that forms spores, was used as the challenge organism. *Bacillus subtilus* var. *niger* (BG) is normally non-pathogenic for humans and is used in aerosol testing by the U.S. Army as a stimulant for *Bacillus anthraces* (Anthrax).

2. *Aspergillus niger* is black bread mold. It is a common organism associated with moldy bread. It produces spores which are easily made airborne. It is an opportunistic pathogen for humans associated with ear, nose, throat, and lung infections.

3. MS2 Phage is a virus that infects only *E. coli*. *E. coli* is normal found in the gut of mammals along with other micro-flora. MS2 is used by the U.S. Army as a viral simulant.

c. All-glass impingers (AGIs) were located to sample air entering and exiting the Genesis Air 2002B.mil. These were attached to a vacuum pump and used to measure the viability of airborne biological material. AGIs collect air at 12 liters per minute by bubbling contaminated air through a liquid impinging fluid. The data from the AGIs would give live biological material information and the difference between the concentration going into the Genesis from the air exiting would be used to determine the reduction ration of the
d. Two Aerodynamic Particle Sizers (APS™) were used to size and count the number of airborne particles in the test chamber and exhausted from the Genesis Air 2002B.mil.
e. A Sonotec disseminator was used to generate a cloud of particles containing biological materia in the test chambers. The disseminator operator controlled the cloud density and maintained the cloud at its maximum concentration for the duration of each trial. At key intervals, AGI samples were collected to show the viability of the biological material in the cloud.
f. At the end of each challenge, the concentration of particles was allowed to return to background level and the AGIs were changed.

3. Summary of Results.

3.1 Three types of tests consisting of five challenges (trials) each of the Genesis were conducted. The tests included live fungal spores, live bacterial spores, and live virus. In all three types of test there was a reduction in airborne particle concentration. In the fungal spore and bacterial spore tests, the concentration of live material appears to be reduced by the Genesis. In the virus tests, no live virus was recovered from pre-Genesis or post-Genesis air. Though live virus was disseminated during each trial, no live virus was recovered from the AGI samplers. Virus material especially wet virus material is rather fragile and can be killed simply through the mechanics of drying in the air.

3.2 The Genesis was tested as presented by the manufacturer. It comes from the factory with a 90% exclusion filter. This filter removes a majority of the airborne particles larger than 3.0

microns in diameter. The remaining particles that are smaller than 3 microns are either trapped in the second and third stages of the Genesis or are destroyed by the third stage.

3.3 In both the fungus and the bacterial spore tests of the Genesis, the testing demonstrated that the Genesis appears to be effective in reducing the number airborne particles containing biological materials by 1 to 2 logs. In the fungal spore and bacterial spore tests, the Genesis demonstrated the ability to reduce the number of viable airborne spores by approximately 2 to 3 logs.

3.4 In all three types of tests, the Genesis was challenged with concentrations of viable material many times greater than what is considered normal. For example, the normal concentration of some species of mold spores in the atmosphere ranges less than 100 per liter. To demonstrate a 3-log reduction at that concentration would be next to impossible since you cannot have fractions of viable spores. To compensate for this problem, the Genesis was challenged with concentrations that are approximately 2-logs higher than normal. Another problem that has to be compensated for is the size of a single spore. Single fungus spores are much larger than single bacterial spores. Airborne particles contain fewer fungus spores than the same size particle containing bacterial spores.

3.5 The APS was used to measure the size of airborne particles, and to give a total count of all airborne particles in the test chamber air and exhausting back into the chamber from the Genesis. The APS is a standard instrument that uses a laser to measure the diameter of airborne particles. It counts and bins the particles according to aerodynamic particle size by sampling air in 1Ml volumes per second. It will average the particle sizes ever 10 seconds and give a running total of particles. Background data is collected by the APS prior to each trial. Often this shows relatively large numbers of extremely small particles. These are water droplets and dust particles naturally occurring in the air. Data is also collected from dissemination of the biological material and for a period of time near the end of the trial after dissemination has stopped. APSs have been used to study airborne particles for more than 20 years.

3.6 AGI samplers have been in service for more than 50 years and are used to collect representative samples of air looking for viable biological material. Many different configurations exist but the primary ones use a liquid collection fluid and a critical orifice. The critical orifice fixes the sampling rate (usually 12 lpm) and bubbles the air sample through the liquid collection fluid. The fluid is then analyzed by traditional microbiological assay to determine the concentration of viable biological material. Problems do exist with different collection fluids and types of airborne biological material being sampled for as well as environmental conditions. Basically, spore forming bacteria and fungus do very well in the environment of the AGI. Vegetative cells may or may not have problems and experience dictates which collecting fluids work best. Problems do exist with using AGIs to collect airborne virus.

3.8 As designed and tested, the Genesis was able to remove or neutralize better than 98% of airborne material as it processed the chamber air. The filter stage of the system excludes particles greater than 3 microns and appears to be responsible for removing more than 50% of the airborne material.