

# REW ENVIRONMENTAL CONSULTANTS, INC.

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April 7, 2015

Delivered to via: [kkelley@northhampton-nh.gov](mailto:kkelley@northhampton-nh.gov)

Kevin Kelley, Building Inspector  
Building Department  
237A Atlantic Avenue  
North Hampton, New Hampshire 03862

RE: Interior Evaluation for Mold  
237A Atlantic Avenue, North Hampton

Provided herewith are the results of six (6) spore trap samples used in identifying airborne mold spores and particulate particles. Included is a single culture plate analysis of bulk dust collected from the rug in the main (central) area. All samples were collected from the North Hampton Public Library at the subject address on 25-Mar-2015.

## ***Objective***

To capture and quantify a broad spectrum of fungal spores (both viable and non-viable) present in the air.

To assess whether the concentrations present suggest a fungal problem in the indoor air.

## ***Sampling Protocols and Sample Representativeness***

Spore trap samples (or air samples) work by having a known volume of air pass through a sampling cassette (known as a spore trap) equipped with a slide. Particles in air impact a sticky surface on the slide and consequently adhere to, and are captured on, this sticky surface. Microscopy analysis of the captured particles is then completed.

Each air sample was collected for 5 minutes at a flow rate of 15 liters per minute (l/m) using a manufactured-set and calibrated flow pump. Air samples represent the center area of the library (ID 01993582), the office area (ID 01957959), the Craig Room (ID 1929795), and the attic (ID 1957591). All were collected at 4 feet above the floor.

Wall cavity samples were collected using the same methodology above except that these air samples represent the space in the wall. Subsequent to accessing the wall using a drill bit and creating a 3/8 inch opening, two spore trap samples were

Associated with



**MOLD ASSESSING AND REMEDIATION SERVICES, LLC**  
Danvers, Massachusetts and Naples, Florida  
978-375-7086 or 239-825-4424  
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collected from the wall cavities of the Craig room (ID 01958879) and the from the storage room in the attic (ID 01959063). These samples were collected at intervals of 30 seconds and 1 minute (at 15 l/m), respectively. The duration of sample collection was based on the presence or absence of insulation.

The bulk dust sample (ID 5003242015) was captured in a 4 micron size basket under vacuum. The sample size is 2 feet by 5 feet. It was collected from an area subject to high foot traffic in the main (central) area of the library, near the coffee station. The sample was collected from the same area as 01993582 (the above spore trap).

Sampling locations were selected based on site-specific issues such as water intrusion or in areas that we believe would yield a best representation of indoor conditions. Sampling data represents a specific moment in time and subject to temporal and spatial distribution.

It is important to note that the attic is a vented area and subject to outside air exchange.

The results are given in spores per cubic meter of air (spores/m<sup>3</sup>) or colony forming units per gram (CFU/g) as in the case of (bulk dust) culture plate analysis. Spore trap analysis counts all cells, living or dead. CFU is a unit used to estimate the number of viable fungi in a sample. Viable is living mold.

All samples were transferred under a chain-of-custody to Air Allergens and Mold Testing (AAMT) located in Stone Mountain, Georgia. Appended to this report are the AAMT results.

### ***Walk-Through Visual Assessment***

A visual evaluation for the presence of mold was conducted 25-Mar-2015. The visual inspection was completed for the first floor (the office, Craig Room, and main or central area) and the attic (a storage room and the principal area).

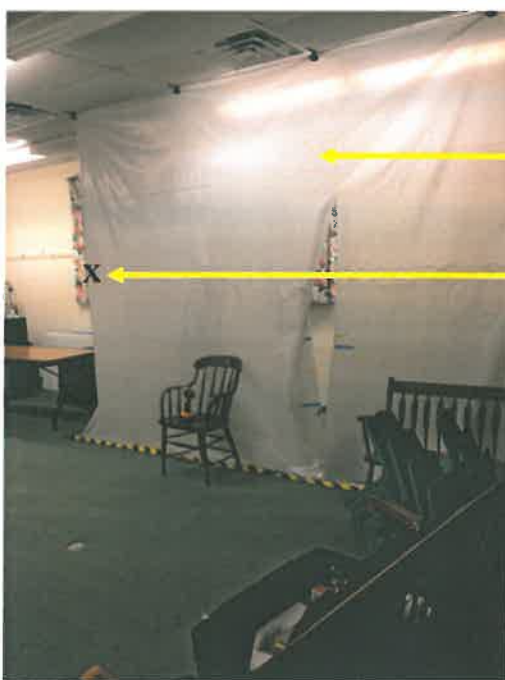
Water intrusion has occurred as a result of ice jams. Water intrusion has damaged building materials in the office and in the Craig Room. Damaged building materials include, rugs, sheet rock (or wall board), suspended ceiling components, and insulation (in the walls, ceiling and attic). Not so obvious is impact to furring strips or wall studs.



**Central Area of Library: No obvious evidence of mold, no associated odor**

**Spore Trap Sample: A1 Central  
(01993582)**

**Rug Sample: A7 Central Rug  
(5003242015)**



**Craig Room: No obvious evidence of mold, no associated odor**

**Containment (erected by others): Water intrusion occurred on the inside area of containment.**

**Spore Trap Sample A3 Craig Room  
(1929795)**



**Craig Room: No obvious evidence of mold, no associated odor**

**Inside containment: Water damage to wall and insulation in the wall. Moisture reading of wall was 31%, which is above the acceptance range of less than 16%. This means the internal wall cavity is wet. Water stains can be seen on the wall.**

**Rug contained 21% moisture**

**Spore Trap Sample: A4 Craig Room Wall (1958879)**



**Craig Room: Water damage to ceiling insulation. Moisture reading of insulation was 24%.**

**Water stains can be seen on the wall above the suspended ceiling.**



**Attic: No obvious evidence of mold, no associated odor**

**Spore Trap Sample: A6 Attic (1957591)**



**Attic: No obvious evidence of mold, no associated odor**

**Area is the wall cavity on the other side of the storage room wall in the attic**

**Spore Trap Sample: A5 Attic Wall (1959063) (refer to X)**

### **Air Quality Analysis**

Air analysis from the central area (near the coffee station), the office and the Craig room reveal an elevated concentration of ***Aspergillus/Penicillium***: 1,222 spores/m<sup>3</sup>, 1,440 spores/m<sup>3</sup> and 742 spores/m<sup>3</sup>, respectively. A lower concentration of ***Aspergillus/Penicillium***, at 218 spores/m<sup>3</sup>, was revealed in the attic sample.

***Chaetomium*** and/or ***Stachybotrys*** were also indicated, both of which are water indicator microorganisms. The highest concentration occurs on the first floor central area at 349 spores/m<sup>3</sup> for ***Chaetomium*** and 611 spores/m<sup>3</sup> for ***Stachybotrys***.

Hyphae were indicated in the central area, office and attic samples. Hyphae occur highest in the central area and office at 218 hyphae/m<sup>3</sup>.

Background contains spores, pollen and miscellaneous organic and inorganic particles such as skin, dust, soil, insulation, carbon, etc. An acceptable background concentration is <100,000 particles/m<sup>3</sup>. All interior air samples are elevated and exceed this concentration, the highest background concentration occurs in the sample taken from the office at 244,004 particles/m<sup>3</sup>.

### **Discussion/Conclusion**

The mold type ***Aspergillus/Penicillium*** is the primary (or 1st) colonizers in damp or moisture/water intrusion areas of homes and commercial buildings. It is also a common mold found in both inside and outside air. A normal concentration of this mold is between 250 and 400 spores/m<sup>3</sup> in the New England outdoor air.

***Chaetomium*** or ***Stachybotrys*** are tertiary (3rd) colonizers of indoor building materials and are usually associated with chronic long standing water/moisture issues. ***Chaetomium*** and/or ***Stachybotrys***, both of which are water indicator microorganisms, occur consistently in the building. These microorganisms indicate wet or intermittently wet building materials, which is likely the source of this type of mold in the building.

Generally, when mold spores of these types are found in the indoor air it can imply drying-out conditions. In other words, building materials including carpets have been wet and now in the process of drying out; spores tend to be released in this state, especially when disturbed.

Both wall cavity samples indicate the presence of ***Chaetomium***. The Craig Room wall cavity sample contains a relatively high concentration indicating wet or previously wet conditions and is likely drying. Growth is likely occurring behind the wall and requires remediation.

Although not sampled because of the likely presence of insulation, the west wall in the office area is suspect as a source location or reservoir for increased mold concentrations in this location.

The presence of hyphal fragments or fruiting structures usually indicates amplification (growth) of fungi on building substrates. Based on the results, there is active growth.

As given, background contains spores, pollen and miscellaneous organic and inorganic particles such as skin, dust, soil, insulation, carbon, etc. All interior air samples are elevated possibly implying an improperly functioning HVAC unit, poor air filtration or poor ventilation and filtration. The HVAC should be serviced and evaluated for efficient and balanced air movement.

Disturbance to any area such as walls, insulation, ceilings and rugs for treatment or for water damage repair should only occur under negative air conditions. No work should be initiated in absence of a licensed (preferred) or certified mold remediator.

### ***Opinion***

There is no immediate threat to public health; however, air quality is compromised with the elevated presence of primary and tertiary colonizers of indoor building materials primarily caused by water intrusion. Remediation is necessary to improve indoor air quality.

### ***Recommendations***

- Containment is required for those areas recommended for remediation or repair. These areas include the Craig Room and office.
- During remediation efforts, all work should be completed under negative air to prevent the broadcast of mold spores. Negative air can be accomplished by using a scrubber to clean the air of microorganisms.

#### ***Craig Room/Office***

- Vents associated with the HVAC should be sealed prior to and during all work.
- Remove dry wall, wall insulation and ceiling tiles (as deemed to be impacted by water). Remove ceiling insulation (as deemed to be impacted by water).

Inspect rug and treat for mold. Removal is not anticipated at this time.

Inspect furring strips (metal or wood), clean, treat for mold (an EPA registered biocide) and seal with anti-microbial sealant.

Inspect external wall (concrete block or brick), clean, treat for mold using an EPA registered biocide and apply anti-microbial sealant.

Replace building materials.



#### *Attic*

- Selectively remove insulation from the attic with emphasis in those areas impacted by water on the first floor. Replace as needed.

#### *Central Area/First Floor*

- Clean carpets in the Craig Room, central area, and vestibule. Treat to prevent sorption from long term and intermittent wetness. Treat to prevent mold growth using anti-microbial agent (biocide).

Vacuum carpets using vacuums with HEPA filtration. HEPA filtration will guard against the distribution of mold spores. This is recommended for future vacuum.

- Vacuum walls and applicable surfaces with HEPA filtration. Selectively sanitize surfaces.
- Air scrubbing is recommended at completion. A minimum of 20 air exchanges should occur during air scrubbing. This usually takes 12 to 18 hours, depending on the number of scrubbers, the volume of air (in cubic feet), and placement. Two scrubbers are anticipated for a 12 hour event.
- Before any remediation work begins however, workers should dress in proper PPE (Personal Protective Equipment) before entering into isolated remediation areas.

#### *Heating and Air Conditioning*

- As provided above, the HVAC should be serviced and evaluated for efficient and balanced air movement. Filters used should be MERV 8 or MERV 10 to filter mold spores and certain particulates. MERV 8 filtration is anticipated.
- Cleaning of air ducts is not anticipated at this time.

#### *Follow-up Sampling*

- Post-remediation or post-work samples will be needed to determine the effectiveness of remedial work and improvement to air quality.
- Post-remediation samples will also serve to identify mold reservoirs that were not identified under this preliminary assessment.



If you have questions, please call me (978-375-7086).

Sincerely,  
REW Environmental Consultants, Inc.  
Mold Assessing and Remediation Services, LLC

Dick Warren, LSP, LMA, LMR  
Owner-Principal

Hayden Warren, CGC, CMA, CMR  
Owner-Principal

Website: [www.mars-mold.com](http://www.mars-mold.com)

**Sample Analysis  
for**

**Atlantic Avenue**

**M.A.R.S. REW Environmental**

Company: M.A.R.S. REW Environmental  
 Attention: Richard Warren  
 Address: 500 Maple Street, Danvers, MA  
 01923

Air Allergen Mold Testing, Inc.  
 2041 Hessian Court  
 Stone Mountain, Ga. 30087  
 Phone (770) 938-4861 Fax (770) 270-0853  
 Linear Spore Trap Analysis by SOP AAMTDX001

Report Date 04/06/2015  
 Date Received 3/25/2015  
 Analyzed by R. Billups  
 Date Amended  
 Report Number 7250

Project: Atlantic Avenue

Location	A1 Central			A2 Office			A3 Craig Room		
AAMT Nbr	7250-001			7250-002			7250-003		
Spore Trap Serial #	01993582			01957959			01929795		
Sample/Cassette Type	Allergenco D Posi-Track			Allergenco D Posi-Track			Allergenco D Posi-Track		
Liters Collected	75 L			75 L			75 L		
Humid/Temp	64 / 71			64 / 71			64 / 71		
Particulate	soil	carbon		soil	gypsum board		soil	carbon	
Fibrous Particulate	cellulose	insulation		cellulose	insulation		cellulose	insulation	
Skin Fragments	0-25			0-25			0-25		
Background / Cubic Meter	175,413			244,004			104,573		
Hyphae / m <sup>3</sup>	218			218					
Pollen / m <sup>3</sup>									
Spore Name	Raw Ct	Spore / m <sup>3</sup>	% of Total	Raw Ct	Spore / m <sup>3</sup>	% of Total	Raw Ct	Spore / m <sup>3</sup>	% of Total
Predominately Outdoor									
Alternaria									
Arthrinium									
Ascospores									
Basidiospores									
Bipolaris									
Curvularia									
Epicoccum									
Nigrospora									
Periconia/Myxomycete									
Pithomyces									
Spegazzinia									
Torula									
Indoor - Outdoor									
Aspergillus/Penicillium	28	1,222	56.0	33	1,440	63.5	17	742	100.0
Cladosporium									
Water Related									
Chaetomium	8	349	16.0	11	480	21.2			
Stachybotrys	14	611	28.0	8	349	15.4			
Trichoderma									
Total Spores	50	2,182	100	52	2,269	100	17	742	100

Limit of Detection @600x

44

44

44

Limit of Detection @300x

13

13

13

Please see attached sheet for additional information and important notes.

Top 3 organisms =

Richard Billups, Laboratory Director

Company: M.A.R.S. REW Environmental  
 Attention: Richard Warren  
 Address: 500 Maple Street, Danvers, MA  
 01923

**Air Allergen Mold Testing, Inc.**  
 2041 Hessian Court  
 Stone Mountain, Ga. 30087  
 Phone (770) 938-4861 Fax (770) 270-0853  
 Linear Spore Trap Analysis by SOP AAMTDX001

Report Date 04/06/2015  
 Date Received 3/25/2015  
 Analyzed by R. Billups  
 Date Amended  
 Report Number 7259

Project: Atlantic Avenue

Location	A1 Central			A4 Craig Room Wall			A5 Attic Wall		
AAMT Nbr	7250-001			7250-004			7250-005		
Spore Trap Serial #	01993582			01958879			01959063		
Sample/Cassette Type	Allergenco D Posi-Track			Allergenco D Posi-Track			Allergenco D Posi-Track		
Liters Collected	75 L			75 L			75 L		
Humid/Temp	64 / 71			64 / 71			64 / 71		
Particulate	soil	carbon		gypsum board			gypsum board		
Fibrous Particulate	cellulose	insulation							
Skin Fragments	0-25			0-25			0-25		
Background / Cubic Meter	175,413			Overloaded			Overloaded		
Hyphae / m <sup>3</sup>	218								
Pollen / m <sup>3</sup>									
Spore Name	Raw Ct	Spore / m <sup>3</sup>	% of Total	Raw Ct	Spore / m <sup>3</sup>	% of Total	Raw Ct	Spore / m <sup>3</sup>	% of Total
Predominately Outdoor									
Alternaria									
Arthrinium									
Ascospores									
Basidiospores									
Bipolaris									
Curvularia									
Epicoccum									
Nigrospora									
Periconia/Myxomycete									
Pithomyces									
Spegazzinia									
Torula									
Indoor - Outdoor									
Aspergillus/Penicillium	28	1,222	56.0						
Cladosporium									
Water Related									
Chaetomium	8	349	16.0	3	40	100.0	1	13	100.0
Stachybotrys	14	611	28.0						
Trichoderma									
Total Spores	50	2,182	100	3	40	100	1	13	100

Limit of Detection @600x  
 Limit of Detection @300x

44  
 13

44  
 13

44  
 13

Please see attached sheet for additional information and important notes.

Top 3 organisms =

  
 Richard Billups, Laboratory Director

Company: M.A.R.S. REW Environmental  
 Attention: Richard Warren  
 Address: 500 Maple Street, Danvers, MA  
 01923

**Air Allergen Mold Testing, Inc.**  
 2041 Hessian Court  
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 Phone (770) 938-4861 Fax (770) 270-0853  
 Linear Spore Trap Analysis by SOP AAMTDX001

Report Date 04/06/2015  
 Date Received 3/25/2015  
 Analyzed by R. Billups  
 Date Amended  
 Report Number 7250

Project: Atlantic Avenue

Location	A1 Central			A6 Attic					
AAMT Nbr	7250-001			7250-006					
Spore Trap Serial #	01993582			01957591					
Sample/Cassette Type	Allergenco D Posi-Track			Allergenco D Posi-Track					
Liters Collected	75 L			75 L					
Humid/Temp	64 / 71			64 / 71					
Particulate	soil	carbon		carbon	soil				
Fibrous Particulate	cellulose	insulation		insulation					
Skin Fragments	0-25			0-25					
Background / Cubic Meter	175,413			30,360					
Hyphae / m <sup>3</sup>	218			87					
Pollen / m <sup>3</sup>									
Spore Name	Raw Ct	Spore / m <sup>3</sup>	% of Total	Raw Ct	Spore / m <sup>3</sup>	% of Total	Raw Ct	Spore / m <sup>3</sup>	% of Total
Predominately Outdoor									
Alternaria									
Arthrinium									
Ascospores									
Basidiospores									
Bipolaris									
Curvularia									
Epicoccum									
Nigrospora									
Periconia/Myxomycete									
Pithomyces									
Spegazzinia									
Torula									
Indoor - Outdoor									
Aspergillus/Penicillium	28	1,222	56.0	5	218	35.7			
Cladosporium									
Water Related									
Chaetomium	8	349	16.0	1	44	7.2			
Stachybotrys	14	611	28.0	8	349	57.1			
Trichoderma									
Total Spores	50	2,182	100	14	611	100			

Limit of Detection @600x

44

44

Limit of Detection @300x

13

13

Please see attached sheet for additional information and important notes.

Top 3 organisms =

  
 Richard Billups, Laboratory Director

**Company:** M.A.R.S. REW Environmental

**Attention:** Richard Warren

**Address:** 500 Maple Street, Danvers, MA  
01923

**Project:** Atlantic Avenue

**Air Allergen Mold Testing, Inc.**

2041 Hessian Court  
Stone Mountain, Ga. 30087  
Phone (770) 938-4861 Fax (770) 270-0853  
Linear Spore Trap Analysis by SOP AAMTDX001

**Report Date** 04/06/2015

**Date Received** 3/25/2015

**Analyzed by** R. Billups

**Date Amended**

**Report Number** 7250

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**Spore Trap Comments**

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Sample 7250-004 for Sample ID: 01958879, A4 Craig Room Wall, background Overloaded with gypsum board particles > 2,000,000 / meter cubed.

Sample 7250-005 for Sample ID: 01959063, A5 Attic Wall, background Overloaded with gypsum board particles > 2,000,000 / meter cubed.

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Background is a combination of debris, skin and fibers.

\* Water Related refers to organisms that are commonly found in areas of high water activity. This can be in the form of high Relative Humidity (RH), meaning consistently above 50%.

\*\*Spore Total symbols are; ND is None Detected, DS is Defective Slide and NT is No Trace

  
Richard Billups, Laboratory Director





<b>Company</b>	Air Allergen
<b>Project</b>	Atlantic Avenue
<b>Location</b>	A1 Central
<b>SampleType</b>	Allergenco D Posi-Track
<b>AAMT Nbr</b>	7250-001
<b>Date Analyzed</b>	04/06/2015

Information on specific organisms listed can be viewed on our Fungal Organisms Description page.  
Background particle information can be found on the How to Read Our Reports section.

Richard Billups, Laboratory Director



# Air Allergen Mold Testing, Inc.

Company: M.A.R.S. REW Environmental

Attention: Richard Warren

Address: 500 Maple Street Danvers, MA  
01923

2041 Hessian Court

Stone Mountain, Ga. 30087

Phone (770) 938-4861 Fax (770) 270-0853

Report Number 7250

Culture Plate Analysis of Bulk, Dust, Swab  
for Fungi by SOP AAMTFC001

Report Date 04/06/2015

Date Received 3/25/2015

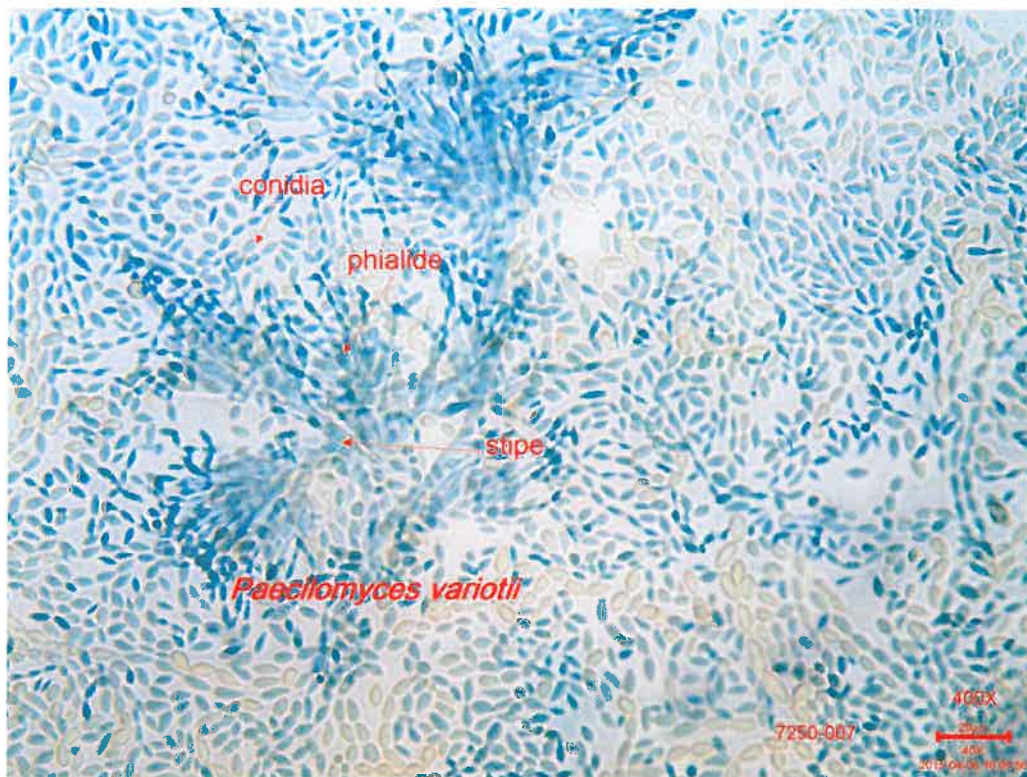
Analyzed by R. Billups

Job Number 7250

Date Amended

Project: Atlantic Avenue

Location		A7 Central Rug							
AAMT Nbr		7250-007							
Sample ID		5003242015							
SampleType		Dust							
Metrics		0.3							
Limit of Detection	Dilution	Raw Count	Identification	CFU/	Limit of Detection	Dilution	Raw Count	Identification	CFU/
333	0.01	1	<i>Alternaria alternata</i>	333					
333	0.01	5	<i>Cladosporium sp.</i>	1,667					
333	0.01	4	<i>Epicoccum nigrum</i>	1,333					
333	0.01	1	<i>Glocladium sp.</i>	333					
333	0.01	1	<i>Paecilomyces variotii (a) (b)</i>	333					
Total				4,000/g	Total				



<b>Company</b>	Air Allergen
<b>Project</b>	Atlantic Avenue
<b>Location</b>	A7 Central Rug
<b>SampleType</b>	Dust
<b>AAMT Nbr</b>	7250-007
<b>Date Analyzed</b>	04/06/2015

Information on specific organisms listed can be viewed on our Fungal Organisms Description page.  
Background particle information can be found on the How to Read Our Reports section.

Richard Billups, Laboratory Director

# CHAIN OF CUSTODY

**Air Allergen & Mold Testing**  
 2041 Hessian Court  
 Stone Mountain, Ga. 30087  
 Phone (770) 938-4861  
 Fax (770) 270-0853  
[www.mold-testing-lab.com](http://www.mold-testing-lab.com)  
[airallergent@gmail.com](mailto:airallergent@gmail.com)

**Company:** M.A.R.S./REW ENV CONS INC  
**Contact:** RICHARD WARREN  
**Address:** 500 MAPLE STREET  
**City, State, Zip:** DANVERS, MASSACHUSETTS  
**Phone:** 978-375-7086  
**Email:** REWENVY@MSN.COM

**Project:** ATLANTIC AVENUE  
 NORTH HAMPTON, NH

**Date and Time Collected:** 03-24-2015  
**Collected by:** RW

Sample ID	Location	Test Type*	Volume** / Area***	TAT	RH	Temp	Notes
01993582	A1 CENTRAL	SPORE	75	Same Day	64	71	
01957959	A2 OFFICE	SPORE	75		64	71	
01929795	A3 CRAIG ROOM	SPORE	75		64	71	
01958879	A4 CRAIG RM WALL	SPORE	75		64	71	
01959063	A5 ATTIC WALL	SPORE	75		64	71	
01957591	A6 ATTIC	SPORE	75		64	71	
5003242015	A7 CENTRAL RUG	VAC/COL	10 SF		64	71	FILTER PLUGGED PROB.
							COS OF RUG FIBERS AND
							DIRT...LIMITING UPTAKE

\* Microscopic Exam  
 Spore Trap = AOC, Allergenco, Micro 5, etc.  
 Tape, Swab, Bulk (Specify)(Qualitative only)

TAT = Up to 3 hours, Same Day, Next Day, 2 - 5 day  
 (Applies to Spore Traps & Direct Microscopic Exams only)  
 (Same day must be at lab by 2:00 PM ET)

\* Fungi Culture

Air, Bulk, Dust, Swab (specify to genus or species level)

Relinquished by  
 Time and Date

Received by  
 Time and Date

FEDEX  
 UPS  
 UPS

Drop Off

Other

Air Allergen # 7250

Report type : Lab Results ☒

Lab Results with Remediation ☐

AAMT  
 Control # D101  
 Rev. 0  
 4/6/2010

## How To Read Our Reports

AAMT Test #		
Customer Sample #		
Spore Trap Serial #		
Location		
Volume (L)	75	Amount of Air sampled, out of 1000 Liters
Skin Fragments %		26-50
Background / m <sup>3</sup>	126,853	Total particles in 1 cubic meter of air (1000 liters)
Hyphae / m <sup>3</sup>	1067	

Spore Name	Raw Count	Spores/m	% Total
Alternaria	2	83	0.4
Arthrinium			
Arthrospores			
Ascospores			
Basidiospores			
Bipolaris			
Curvularia			
Epicoccum			
Nigrospora	5	207	0.9
Periconia/Myxomycete			
Pithomyces			
Spiegazzinia			
Tetraploa			
Torula			
Urediniospores			
<b>Predominantly Outside</b>			
Aspergillus/Penicillium	400	16,593	73.1
Cladosporium	127	5,268	23.2
<b>Inside / Outside</b>			
Chaetomium	10	415	1.8
Stachybotrys	3	124	0.5
Trichoderma			
Ulocladium			
<b>Water Damage</b>			
<b>Total</b>	<b>547</b>	<b>22,690</b>	<b>100</b>

Please see attached sheet for additional information.

Limit of Detection @ 600x	44	Each spore counted by the analyst represents this many spores at one cubic meter, at the specified magnification
Limit of Detection @ 300x	13	

## How to Read Our Reports

1. Notice that the major groups of spores are separated into Inside / Outside and Predominantly Outside and Water damage.

This is to make it easier to compare important groupings on the report.

- The spore types, as well as the number identified is important. High levels of *Aspergillus* / *Penicillium*, and any level of the Water Damage organisms should be of concern.
- The Outside, or Background sample is used to verify that the sampling equipment is operating correctly. The Outside sample can also be used to determine if the HVAC is operating correctly and as a comparison to the spores recovered inside.
- The background is represented as particles per cubic meter. The higher the number of particles the more likely that the HVAC is not operating correctly, or there may be overcrowding in the room. High levels of particles can also be an indicator of poor air quality that can lead to respiratory irritation.
- Skin fragments are common in the indoor air. Again, as the % of fragments rise, the more chance that it may be indicating poor circulation or overcrowding.
- Particles and Fibers are identified on page 2 of the report. If there is something important to note about the fibers or if dust mite parts are observed, it will be noted here.
- Hyphae are analogous to the stem of a plant. The spores arise from the hyphae, therefore, hyphae should be taken into account when looking at the total spore count, although they are not a part of that number. Hyphae can also give rise to new fungus growth in HVAC systems and carpeting.
- The spore types are explained in the Organism section of the report.
- The Limit of Detection is equal to one spore counted by the analyst divided by the inverse of the volume sampled and by the percent of the slide analyzed. If the detection limit is 41, it means that if there are 41 spores of that type in 1 cubic meter of air, that reading 30% of the slide at 600x (magnification) will result in a raw count of 1.



# FUNGAL ORGANISM DESCRIPTIONS

Organism		Recovered From	Comments	Inside / Outside Spore Type	High Water Activity Indicator	Mycotoxins Produced	Health Risk Type	Found in Combination with
<i>Aspergillus</i>	<i>Aspergillus</i> species	soil, dead leaves, carpet, gypsum board	generally recovered in large numbers	Often recovered from water damaged inside wall board and carpeting	YES	NO	keratitis, mycetoma, aspergillosis	<i>Stachybotrys</i> , <i>Chaetomium</i> , <i>Trichoderma</i> , <i>Aspergillus</i> , <i>Penicillium</i>
<i>Alternaria</i>	<i>alternata</i>	carpet and air. Mostly an outside spore on plants and in soil	occurs in small amounts	OUT	YES	YES	phaeoerythro-mycosis, infections of bone, cutaneous tissue, ears, eyes, paranasal sinuses and urinary tract	<i>Bipolaris</i> , <i>Curvularia</i> , <i>Cladosporium</i> , <i>Pithomyces</i> , <i>Epicothium</i> , <i>Drechslera</i> , <i>Exserohilum</i> , <i>Helminthosporium</i>
<i>Arthrinium</i>	species	soil, forest litter, plant materials, decaying wood, decaying wood in crawl spaces	not often occurring inside, generally outside in moderate numbers. Often found on decaying wood in crawl spaces	OUT		NO	NA	<i>Curvularia</i> , <i>Bipolaris</i> , <i>Cladosporium</i> , <i>Pithomyces</i> , <i>Epicothium</i>
Ascospores		wide variety of substrates. Plant, soil, air, cellulose materials, wood in crawl spaces	at certain times of year, found in large numbers outside	OUT	<i>Chaetomium</i> globosum, <i>Eurotium</i> species - YES. Most other genera and species, NO	dependent on genus or species recovered	Not generally involved with human disease.	<i>Basidiomycetes</i> (if outside), not generally recovered on laboratory media.
<i>Aspergillus</i>	<i>fervus</i>	common in seeds, nuts and cereals		BOTH	YES	YES	Respiratory pathogen. Second most often cause of Aspergillosis	<i>Aspergillus</i> sp., <i>Penicillium</i> sp.
<i>Aspergillus</i> ( <i>Neocarotorya</i> )	<i>fumigatus</i> ( <i>fischeri</i> )	Air, Carpet, HVAC	Must be < 1. Not tolerated at any level inside.	NA	NA	YES	Respiratory pathogen. Most often cause of Aspergillosis	<i>Aspergillus</i> versicolor, <i>Aspergillus sydowii</i> , <i>Aspergillus niger</i> , <i>Penicillium</i> sp., <i>Cladosporium</i> sp., bacteria
<i>Aspergillus</i>	<i>niger</i>	food, indoor air		BOTH	YES	YES	aspergillosis	other <i>Aspergillus</i> , <i>Penicillium</i>
<i>Aspergillus</i>	<i>ochraceus</i>	coffee beans, spores, soil		BOTH	YES	YES	aspergillosis	<i>Aspergillus</i> versicolor, <i>Aspergillus sydowii</i> , <i>Aspergillus niger</i> , <i>Penicillium</i> sp., <i>Cladosporium</i> sp., bacteria

Organism	Recovered From	Comments	Inside / Outside	High Water Activity	Mycotoxins	Health Risk	Found in
Genus	Species		Spore Type	Indicator	Produced	Type	Combination with
<i>Aspergillus</i>	soil, food, air, carpet, HVAC	Large amounts when recovered	BOTH	YES several species	YES several species	aspergillosis, allergy	<i>Penicillium</i>
<i>Aspergillus</i>	soil, food, leather		BOTH	YES	NO	aspergillosis	other <i>Aspergillus</i> , <i>Penicillium</i>
<i>Aspergillus</i>	food, indoor environment		BOTH	YES	NO	aspergillosis	other <i>Aspergillus</i> , <i>Penicillium</i>
<i>Aspergillus</i>	HVAC, insulation, carpet, air	Must be < 1. Not tolerated at any level inside.	NA	NA	YES	aspergillosis	<i>Aspergillus sydowii</i> , <i>Aspergillus fumigatus</i> , <i>Aspergillus ustus</i>
<i>Aureobasidium</i>	food, indoor, soil, leaf, seeds, fruit drinks, carpet, wet areas		INSIDE	YES	NO	corneal, peritoneal, cutaneous, pulmonary, systemic mycosis	yeasts, <i>Chaetomium</i> , <i>Stachybotrys</i> , <i>Trichoderma</i> , <i>Aspergillus</i> , <i>Penicillium</i>
Basidiospores	soil, wood, cellulose materials, plywood when wet	large amounts	OUTSIDE	YES	NO for air, YES for some mushrooms	NONE from air. Some mushrooms ingested can contain dangerous toxins	Ascospores, recovered on laboratory media as sterile mycelium, sometimes with "clumps" and/or arthrospores
<i>Bipolar</i>	soil, wood		OUTSIDE	NO	NO	NA	<i>Bipolaris</i> , <i>Curvularia</i> , <i>Cladosporium</i> , <i>Phanerochaete</i> , <i>Epilobium</i> , <i>Drechslera</i> , <i>Exserchilum</i> , <i>Helminthosporium</i>
<i>Chrysogilia</i>	soil	also known as <i>Neurospora</i>	BOTH	NO	NO	NA	NA
<i>Chaetomium</i>	Ascospores commonly associated with wet gypsum board. Present in soil	Large amounts when recovered	INSIDE	YES	NO	occasionally associated with infections of blood, brain, skin and nails	yeasts, <i>Stachybotrys</i> , <i>Trichoderma</i> , <i>Aspergillus</i> , <i>Penicillium</i>



Organism	Recovered From	Comments	Inside / Outside	High Water Activity	Mycotoxins	Health Risk	Found in
Genus	Species		Spore Type	Indicator	Produced	Type	Combination with
<i>Cladosporium</i>	<i>cladosporioides</i>	common spore in the indoor air. Indicates normal air when greater than C.	BOTH	NO	NO	NA	<i>Alternaria, Curvularia, Pithomyces, Epicoccum, Drechslera, Exserohilum, Helminthosporium</i>
<i>Cladosporium</i>	<i>sphaerospermum</i>	high amount in indoor air indicates poor air quality	BOTH	YES	NO	NA	<i>Cladosporium cladosporioides, Aspergillus sp., Penicillium sp.</i>
<i>Cladosporium</i>	species		BOTH	NO	NO	NA	<i>Alternaria, Curvularia, Pithomyces, Epicoccum, Drechslera, Exserohilum, Helminthosporium</i>
<i>Curvularia</i>	species	soil, plant material, carpet, cellulose materials (paper)	BOTH			opportunistic pathogen of cornea and sinuses. Related to keratitis, endocarditis, mycetoma and pulmonary infection.	<i>Alternaria, Cladosporium species, Pithomyces, Epicoccum, Drechslera, Exserohilum, Helminthosporium</i>
<i>Dicyna</i>	species	soil	OUT	YES	NO	NA	<i>Chaetomium, Stachybotrys, Trichoderma</i>
<i>Epicoccum</i>	<i>nigrum</i>	plants, soil, carpet, air, seeds	primarily outside but is common inside, as well.	NO	NO	None	<i>Alternaria, Curvularia, Cladosporium species, Pithomyces, Drechslera, Exserohilum, Helminthosporium</i>
<i>Eurotium</i> <i>Eurotium</i>	<i>ernstei</i> <i>herbariorum</i>	soil, variety of food, indoor air	BOTH	NO Although, Xerophilic, often found in water damaged buildings.	NO	aspergillosis	<i>Aspergillus, Penicillium</i>
<i>Fusarium</i>	species	grains, soils, apples, potatoes, sugar beet, maize	BOTH	NO	YES several species	keratitis, occasionally mycetoma, sinusitis, septic arthritis and onychomycosis. Contains highly toxic secondary metabolites when ingested in some food grains.	<i>Aspergillus, Penicillium, Acremonium, Epicoccum</i>

Organism		Recovered From	Comments	Inside / Outside	High Water Activity Indicator	Mycotoxins Produced	Health Risk Type	Found in
Genus	Species			Spore Type				
<i>Microsporum</i>	species	human and animal scalp, skin, nails	rarely recovered in air samples	IN	NO	NO	dermatophyte. Ringworm, infections of skin, scalp and nails	<i>Trichophyton, Epidermophyton</i>
<i>Mucor</i>	species	soil, wet damp materials	common bread mold	BOTH	YES	NO	Common cause of zygomycosis	<i>Rhizopus, Absidia, Cunninghamella, Syncephalastrum</i>
<i>Myxomycete</i>		plant pathogen	low, outside	OUTSIDE	NO	NO	NO	seen at various times of the years outside with a combination of other outside spores
<i>Nigrospora</i>	species	carpet, air, soil, plants		BOTH	NO	NO	None	<i>Alternaria, Cladosporium</i> species <i>Pithomyces, Epicoccum, Drechslera, Exserohilum, Helminthosporium</i>
<i>Paeciliomyces</i>	varioii	soil, compost	thermophilic	Both	YES	YES	sinusitis, eye infections	<i>Aspergillus, Penicillium</i>
<i>Penicillium</i>	sp.	soil, food	most common spore type found in the indoor air	Both	YES	YES several species of the approximately 200 known	Aspergillosis	<i>Aspergillus, Paecilomyces</i>
<i>Periconia</i>	species	plant pathogen	low, outside	OUTSIDE	NO	NO	NO	seen at various times of the years outside with a combination of other outside spores
<i>Phoma</i>	species	plant, soil, cereal, wood		BOTH	NO	NO	occasional agent of phaseyphomycosis	found in combination with a variety of wood rot or plant pathogen fungi
<i>Pithomyces</i>	species	soil, air, plant material	at certain times of the year can be recovered in moderate amounts from common bread mold	OUTSIDE	NO	NO	NONE	<i>Alternaria, Cladosporium</i> species, <i>Epicoccum, Drechslera, Exserohilum, Helminthosporium</i>
<i>Rhizopus</i>	species	soil, damp wet materials		BOTH	YES	NO	Most common cause of zygomycosis	<i>Mucor, Absidia, Cunninghamella, Syncephalastrum</i>

Organism	Species	Recovered From	Comments	Inside / Outside Spore Type	High Water Activity Indicator	Mycotoxins Produced	Health Risk Type	Found In
<i>Rhodotorula</i>	species	wood, behind wall paper, cellulose products, carpets	pink, orange or red yeast, needs very high water activity levels	BOTH	YES	NO	NONE	Combination with <i>Sporobolomyces</i> , <i>Aureobasidium</i> , <i>Chaetomium</i> , <i>Stachybotrys</i>
<i>Scopulariopsis</i>	<i>brevicaulis</i>	soil, wood, food	has a characteristic ammoniacal odor	BOTH	NO	NO	Can infect toenail. May be a risk of subcutaneous or invasive infections of the immunocompromised	<i>Aspergillus</i> , <i>Penicillium</i>
<i>Spiegelia</i>	species	soil, plants	very small numbers outside	OUTSIDE	NO	NO	NO	seen at various times of the years outside with a combination of other outside spores
<i>Sporothrix</i>	species	soil, wood, moss		BOTH			one species is known to cause human infections	
<i>Stachybotrys</i> ( <i>Memnoniella</i> )	<i>charitum</i> ( <i>echinata</i> )	Most often actively growing on the backside of gypsum board. Carpet, HVAC provide sparse growth and sometimes only spores	Must be < 1. Not tolerated at any level inside, although individual spores are occasionally brought in on shoes from the soil.	Most often recovered inside	YES	YES	Neurotoxic. Toxins are damaging to organs but the spores do not grow at body temperature.	<i>Chaetomium</i> , <i>Trichoderma</i> , <i>Acremonium</i> , <i>Ulocladium</i> , <i>Aspergillus usui</i>
<i>Stemphylium</i>	species	soil, grass, wood, paper	in small numbers outside	OUTSIDE	NO	NO	NONE	<i>Alternaria</i> , <i>Cladosporium</i> species, <i>Epicothium</i> , <i>Drechslera</i> , <i>Exserohilum</i> , <i>Helminthosporium</i> , <i>Curvularia</i> , <i>Pithomyces</i> , <i>Bipolaris</i>
<i>Tetraploa</i>	species	plant material	very small numbers outside	OUTSIDE	NO	NO	NO	seen at various times of the years outside with a combination of other outside spores
<i>Torula</i>	species	soil, plants	very small numbers outside	OUTSIDE	NO	NO	NO	seen at various times of the years outside with a combination of other outside spores

Organism		Recovered From	Comments	Inside / Outside	High Water Activity Indicator	Mycotoxins Produced	Health Risk Type	Found In
Genus	Species			Spore Type				Combination with
<i>Trichoderma</i>	species	soil, plant material, carpet, cellulose materials (paper), decaying wood	clumps of green spores in large numbers	BOTH	YES	NO	<i>T. viride</i> is associated with aspergilloids. <i>T. harzianum</i> is associated with hypersensitivity pneumonitis	<i>Aspergillus</i> , <i>Penicillium</i> , <i>Chaetomium</i> , <i>Acremonium</i> , <i>Stachybotrys</i>
Uredinospores (Rusts)		plant pathogen	variable in numbers produced	OUTSIDE	NO	NO	NO	seen at various times of the year outside with a combination of other outside spores
<i>Wallemia</i>	<i>Sabii</i>	soil, variety of food, indoor air	produced in small numbers	BOTH	NO Although Xerophilic, often found in water damaged buildings.	NO	NO	<i>Eurotium amstelodami</i> , <i>Aspergillus versicolor</i>
<i>Trichophyton</i>	species	human and animal scalp, skin, nails	rarely recovered in air samples	IN	NO	NO	dermatophyte, Ringworm, infections of skin, scalp and nails	<i>Microsporum</i> , <i>Epidermophyton</i>
<i>Ulocladium</i>	species	soil, grass, wood, paper	In small numbers outside, moderate inside	BOTH	YES	NO	NONE	<i>Aspergillus</i> , <i>Penicillium</i> , <i>Chaetomium</i> , <i>Acremonium</i> , <i>Stachybotrys</i>
<i>Ustilago</i>	species	plant pathogen		BOTH	NO	NO	NO	soil organisms

## GLOSSARY

<b>Actinomycetes</b>	Class of filamentous bacteria associated with water damaged building materials. Strong earthy odor is present. Some genera are associated with skin and respiratory infections.
<b>Aspergillosis</b>	refers to any species of the genera <i>Aspergillus</i> and <i>Penicillium</i> that can infect the respiratory tract, sinuses, ear, eye, skin, mucous membranes and multiple systemic sites. The most common cause of aspergillosis is <i>Aspergillus fumigatus</i> and <i>Aspergillus flavus</i>
<b>Ascomycetes (ascospores)</b>	a class of fungi characterized by the presence of <a href="#">asci</a> and spores, and having two distinct reproductive phases, a perfect stage and an <a href="#">imperfect stage</a> . Outside, mainly found as plant pathogens.
<b>Basidiomycetes (basidiospores)</b>	the largest class of fungi the Basidiomycota has been divided into 2 classes, <a href="#">mushrooms</a> , and the <a href="#">jelly</a> , <a href="#">rust</a> and <a href="#">smut</a> fungi). Major contributor to wood rot.
<b>Chromoblastomycosis</b>	granulomatous inflammation with suppurative reaction, generally superficial and/or subcutaneous.
<b>Conidiophore</b>	also known as a " <a href="#">fruiting structure</a> ". Presence of a specialized hyphal structure that serves as a stalk on which the conidia are formed. Indicative of current fungal growth.

<b>Dermatophyte</b>	a fungus belonging to the genus, <i>Trichophyton</i> , <i>Epidermophyton</i> or <i>Microsporum</i> , with the ability to obtain nutrients from keratin and infect skin, hair, or nails of humans or animals.
<b>Deuteromycetes</b>	The <b>Fungi imperfecti</b> or <b>imperfect fungi</b> , also known as <b>Deuteromycota</b> , are <a href="#">fungi</a> which do not fit into the commonly established <a href="#">taxonomic</a> classifications of fungi that are based on <a href="#">biological species concepts</a> or morphological characteristics of sexual structures because their sexual form of <a href="#">reproduction</a> has never been observed; hence the name "imperfect fungi."
<b>ERMI Group 1</b>	set of fungal organisms that EPA proposes are found in homes that may have health risks due to high levels of "water loving" fungi
<b>Hyalohyphomycosis</b>	saprophytic fungi that produce colorless hyphae
<b>Hyphae</b>	string-like structures that support the spores of fungi. Also called mycelia or mycelium
<b>Keratitis</b>	inflammation of the cornea of the eye
<b>Mycetoma</b>	a localized, chronic cutaneous or subcutaneous infection classically characterized by draining sinuses, granules and swelling.
<b>Mycosis</b>	disease caused by a fungus

<b>Myxomycetes (slime mold)</b>	A class of peculiar organisms, the slime molds, formerly regarded as animals (Mycetozoa), but now generally thought to be plants and often separated as a distinct phylum (Myxophyta); essentially equivalent to the division Myxomycota. They are found on damp earth and decaying vegetable matter, and consist of naked masses of protoplasm, often of considerable size, which creep very slowly over the surface and ingest solid food.
<b>Onychomycosis</b>	a fungal infection that affects the fingernails or toenails
<b>Phaeohyphomycosis</b>	saprophytic fungi that produce dark brown to black hyphae and infect the skin and may also be subcutaneous.
<b>Sporotrichosis</b>	Subcutaneous infection that may produce ulcerations in the skin.
<b>Sterile Mycelium</b>	hyphae that have an absence of spores or conidia
<b>Subcutaneous</b>	situated or occurring directly under the skin
<b>Suppurative</b>	producing puss
<b>Uredinospores (Rusts)</b>	are the thinner-walled <a href="#">spores</a> of some <a href="#">fungi</a> : ( <a href="#">rusts</a> and <a href="#">smuts</a> ), from which the <a href="#">basidium</a> arises. Plant pathogens.
<b>Xerophilic</b>	Prefers dry places, growing under dry conditions
<b>Zygomycosis</b>	infection caused by opportunistic fungi of the zygomycete group ( <i>Rhizopus</i> , <i>Mucor</i> , <i>Rhizomucor</i> , <i>Absidia</i> , <i>Sycephalastrum</i> , <i>Cunninghamella</i> )



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