

# Environmental Relative Moldiness Index (ERMI)

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<b>Inspector:</b>	Certified Industrial Hygienist	<b>Date Collected:</b>	1/1/21
<b>Project Name:</b>	Moldy Home	<b>Date Received:</b>	1/1/21
<b>Project Number:</b>	123	<b>Date Reported:</b>	1/3/21
<b>Assured Bio Identifier:</b>	CIH010121-1	<b>Analyst(s):</b>	Dr. Jones

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## Selected References

- Haugland, R. A. and S. J. Vesper. 2002. Method of identifying and quantifying specific fungi and bacteria. US Patent 6,387,652 B1.
- Vesper, S. J. 2006. Developing the EPA Relative Moldiness Index© based on mold-specific quantitative PCR. The Synergist April 2006:39-43.
- Haugland, R. A., S. J. Vesper and L. J. Wymer. 1999. Quantitative measurement of *Stachybotrys chartarum* conidia using real-time detection of PCR products with the TaqMan™ fluorogenic probe system. Molecular and Cellular Probes 13:329-340.
- Meklin, T. M., R. A. Haugland, T. Reponen, M. Varma, Z. Lummus, D. Bernstein, L. J. Wymer and S. J. Vesper. 2004. Quantitative PCR analysis of house dust can reveal abnormal mold conditions. Journal of Environmental Monitoring 6:615-620.
- Vesper, S. J., C. McKinstry, C. Yang, R. A. Haugland, C. M. Kerckmar, I. Yike, M. D. Schluchter, H. L. Kirchner, J. Sobolewski, T. M. Altan and D. G. Dearborn. 2006. Specific molds associated with asthma in water-damaged homes. Journal of Occupational and Environmental Medicine 48:852-858.

## Accreditation

Assured Bio Labs, LLC is accredited by the American Industrial Hygiene Association Laboratory Accreditation Programs, LLC (AIHA-LAP, LLC; Lab ID # 183867) in the Environmental Microbiology accreditation program for "qPCR - Mold Specific qPCR" Fields of Testing as documented by the Scope of Accreditation Certificate and associated Scope. AIHA-LAP, LLC accreditation complies with the ISO/IEC Standard 17025:2005 requirements, but this does not imply ISO certification or registration."

## Disclaimer

ERMI analytical data contained within this report only reflects both the historic and current mold burden within the property tested as of the day the sample was collected. Future mold growth is unknown and can be influenced by water intrusion events such as elevated moisture, condensation, structural or plumbing leaks and/or acts of God (major storm events) that occur subsequent to the ERMI test for which results are documented within this report. If a previous mold remediation was conducted in the property for which these results are being reported, conclusions can only be drawn concerning the current mold burden of the property, not the historic mold burden of the property. The effect of a previous mold remediation or clean-up on the current mold burden of the property is subject to a variety of confounding factors, and drawing conclusions regarding the historic mold burden are cautioned against, unless an ERMI test was conducted following the remediation. In such a case, where an ERMI sample was analyzed following mold remediation, the results of this report should be compared to the post remediation ERMI test data to make inference concerning the historical mold burden of the property. Note: Other forms of post remediation (spore-trap, culturable fungi, etc) are invalid for historic comparison with the ERMI test results contained in this report.

## Abbreviations

ND = None Detected

## Methods of Analysis

Assured Bio Labs uses the following methods for the MSQPCR analysis: CD 23: Data Reporting for MSQPCR Testing, CD 143: Preparation, Processing, and Analysis of MSQPCR Samples, CD 225: Bead Based DNA Extraction

## Notes

The Environmental Relative Moldiness Index (ERMI) is a Quantitative, Real-Time Polymerase Chain Reaction (qPCR) panel of testing for indoor molds that was developed by the United States Environmental Protection Agency (US-EPA). This panel includes 26 mold species and groups of species that are known to thrive in water-damaged homes. This panel also includes 10 species and groups of species of molds that are found in all homes, with or without water damage. Each species and group of species is enumerated from DNA extracted from dust samples taken from both the living and sleeping quarters of homes. Concentrations of each of the 36 molds are used to derive an "ERMI Score" that rates the "moldiness" of each sample against those tested by the US-EPA.

### Guidelines to Follow When Interpreting an ERMI SCORE

The Asthma and Allergy Foundation of America has classified the following symptoms for mold allergies: Sneezing, Chronic cough, Runny nose, Nasal congestion, Itchy, watery, and red eyes, Skin rashes and hives, Sinus headaches, Reduced lung capacity and difficulty breathing

Mold-exposure symptoms differ from person to person, depending upon the sensitivities of each individual and their levels of exposure to mold. Persons that are extremely sensitive to mold, or those with suppressed immune systems, could be at higher risk for allergic reactions than those that are less sensitive and have full immune system function. Reaction to mold exposure can be immediate or delayed, depending on the individual and their susceptibility and exposure levels.

The US-EPA has developed a 36-species panel of Mold-Specific Quantitative Polymerase Chain Reaction (MSQPCR) analyses called the Environmental Relative Moldiness Index (ERMI). House dust is used as the medium for this test. Quantities of these species in 1 mg of dust are used to derive an "ERMI Score" that rates the moldiness of a home, based upon scores from approximately 1100 homes tested in the US. Assured Bio Labs recognizes three broad categories of "moldiness" that are of particular importance to occupants of homes. These levels and possible health implications are listed in the ERMI diagnostic chart (see Page 3).

It should be noted that there is no implicit human-health recommendation with an ERMI score. An ERMI score should be used in conjunction with individual mold species quantifications and symptoms of home occupants to arrive at an action decision. An ERMI score is simply a guideline for determining levels of mold exposure for home occupants. As research by the US-EPA and Assured Bio Labs accumulates, interpretations of ERMI scores could change.

We have included the sums of the logs of Group 1 and 2 mold species. These are used for calculating the ERMI score. However, the sum of the logs of Group 2 molds can also be used as a general indicator. This value should be between 7-14 for a home in which mold species have come into equilibrium with outdoor species. Values lower than this usually indicate that the home is new and has not yet equilibrated to the outdoor environment. Values are also commonly low after a remediation event. Values that are high could indicate that cleaning regimes are insufficient, or that a water intrusion event was large enough to cause Group 2 molds to grow in number along with Group 1 molds.

### Reporting Limits

**Method Detection Limit (MDL):** The American Industrial Hygiene Association defines this term in AIHA-LAP, LLC Policy Document – Module 9 as "The minimum concentration of an analyte that, in a given matrix and with a specific method, has a 99 percent probability of being identified, qualitatively or quantitatively measured, and reported to be greater than zero."

**Reporting Limit (RL):** The American Industrial Hygiene Association defines this term in AIHA-LAP, LLC Policy Document – Module 9 as "The lowest concentration of analyte in a sample that can be reported with a defined, reproducible level of certainty."

Values less than one will be rounded up to one per reported unit. The reporting limit(s) and result(s) are calculated based on the sampling information (i.e. collection volume, area, mass, etc.) provided by the customer as noted on the Chain of Custody. The results apply to the sample(s) as received.

### Method Detection Limits (in Spores)

Afumi – 0.6582, Aochr1 – 851.5, Arest – 4.372, Asclr – 0.1649, Aungu – 0.4572, Avers2-2 – 38.19, Apeni2 – 0.3027, Cspha – 0.0328, Eamst – 0.0897, Ppurp – 0.5208, Stac – 0.1615, Aflav – 30.23, Anigr – 0.3142, Asydo3 – 29.95, Apull – 0.0938, Cglob – 0.7785, Pvari2 – 0.0965, Pbrev – 7.549, Pcory – 1.662, PenGrp2 – 5.199, Pspin2 – 13.19, Pvarb2 – 7.758, SCbrv – 0.0284, SCchr – 0.6106, Tviri – 15.21, Wsebi – 7.111, Astrc – 1.346, Aaltr – 42.41, Cclad1 – 0.0403, Cclad2 – 1.049, Cherb – 0.023, Austs2 – 0.0900, Enigr – 0.0051, Muc1 – 0.0244, Pchry – 4.897, Rstol – 0.6515

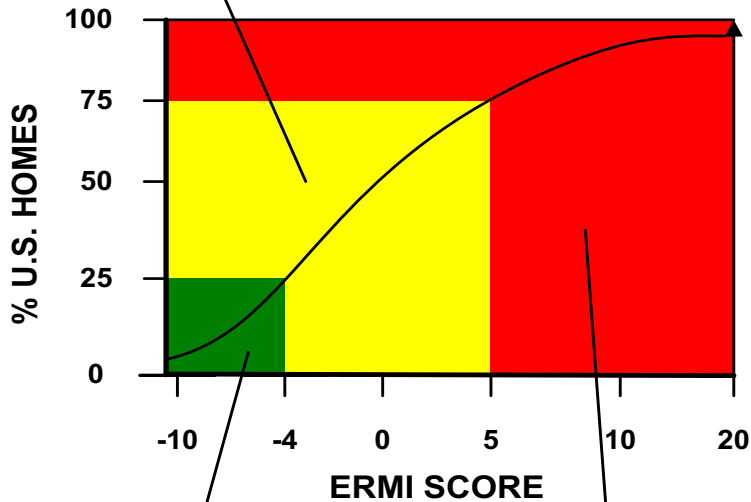
### Reporting Limit Calculations

Unless otherwise stated in comments, the following equation is used to calculate the reporting limit per sample:  $RL = MDL/5 \text{ mg}$ .



## ENVIRONMENTAL RELATIVE MOLDINESS INDEX (ERMI)

**ERMI = (-4 to 5) MODERATE**  
Mold-exposure symptoms will vary with the individual. Some individuals exhibit a greater sensitivity to mold than others.



**ERMI = (-10 to -4) LOW**  
These homes hold the lowest ERMI value. Occupants of these homes are least likely to show symptoms of mold exposure. However, mold-exposure symptoms are not impossible.

**ERMI = (5 to 20) High**  
Occupants of these homes are the most likely to show mold-exposure symptoms. However, mold-exposure symptoms are not certain. Some individuals who are least sensitive to mold may remain asymptomatic even when the ERMI score exceeds 5.



## Key to ERMI Assays

<u>Assay name</u>	<u>Target species / group of species</u>
<u>Group 1 Molds</u>	
Afumi	<i>Aspergillus fumigatus, Neosartorya fischeri</i>
Aochr1	<i>Aspergillus ochraceus/ostianus</i>
Arest	<i>Aspergillus restrictus/caesillus/conicus</i>
Asclr	<i>Aspergillus sclerotiorum</i>
Aangu	<i>Aspergillus unguis</i>
Avers2-2	<i>Aspergillus versicolor</i>
Apeni2	<i>Aspergillus penicillioides</i>
Cspha	<i>Cladosporium sphaerospermum</i>
Eamst	<i>Eurotium (Aspergillus) amstelodami/chevalieri/herbariorum/rubrum/repens</i>
Ppurp	<i>Penicillium purpurogenum</i>
Stac	<i>Stachybotrys chartarum</i>
Aflav	<i>Aspergillus flavus/oryzae</i>
Anigr	<i>Aspergillus niger/awamori/foetidus/phoenicis</i>
Asydo3	<i>Aspergillus sydowii</i>
Apull	<i>Aureobasidium pullulans</i>
Cglob	<i>Chaetomium globosum</i>
Pvari2	<i>Paecilomyces variotii</i>
Pbrev	<i>Penicillium brevicompactum/stoloniferum</i>
Pcory	<i>Penicillium corylophilum</i>
PenGrp2	<i>Penicillium crustosum/camemberti/commune/echinulatum/solitum</i>
Pspin2	<i>Penicillium glabrum/lividum/purpurescens/spinulosum/thomii</i>
Pvarb2	<i>Penicillium variabile</i>
SCbrv	<i>Scopulariopsis brevicaulis/fusca</i>
SCchr	<i>Scopulariopsis chartarum</i>
Tviri	<i>Trichoderma viride/atroviride/koningii</i>
Wsebi	<i>Wallemia sebi</i>
<u>Group 2 Molds</u>	
Astrc	<i>Acremonium strictum</i>
Aaltr	<i>Alternaria alternata</i>
Cclad1	<i>Cladosporium cladosporioides</i> svar. 1
Cclad2	<i>Cladosporium cladosporioides</i> svar. 2
Cherb	<i>Cladosporium herbarum</i>
Austs2	<i>Aspergillus ustus</i>
Enigr	<i>Epicoccum nigrum</i>
Muc1	<i>Mucor amphibiorum/circinelloides/hiemalis/indicus/mucedo/racemosus/ramosissimus and Rhizopus azygosporus/homothalicus/microsporus/oligosporus/oryzae</i>
Pchry	<i>Penicillium chrysogenum</i>
Rstol	<i>Rhizopus stolonifer</i>



**Assured Bio Identifier:** CIH010121-1  
**Sample ID:** 21  
**Description:** Master Bedroom and Living Room

**Sample Condition:** Intact  
**Sample Type:** Dust  
**Sample Mass:** 5 mg

Group 1 Mold Species	Assay Name	Spores/mg dust	Group 2 Mold Species	Assay Name	Spores/mg dust
<i>Aspergillus fumigatus</i>	Afumi	7	<i>Acremonium strictum</i>	Astrc	ND
<i>Aspergillus ochraceus</i>	Aochr1	ND	<i>Altemaria altemata</i>	Aaltr	197
<i>Aspergillus restrictus</i>	Arest	ND	<i>Cladosporium cladosporioides</i> svar. 1	Cclad1	ND
<i>Aspergillus sclerotiorum</i>	Asclr	370	<i>Cladosporium cladosporioides</i> svar. 2	Cclad2	ND
<i>Aspergillus unguis</i>	Aungu	ND	<i>Cladosporium herbarum</i>	Cherb	444
<i>Aspergillus versicolor</i>	Avers2-2	ND	<i>Aspergillus ustus</i>	Austs2	ND
<i>Aspergillus penicillioides</i>	Apeni2	ND	<i>Epicoccum nigrum</i>	Enigr	ND
<i>Cladosporium sphaerospermum</i>	Cspha	42	<i>Mucor amphibiorum</i>	Muc1	1
<i>Eurotium amstelodami</i>	Eamst	ND	<i>Penicillium chrysogenum</i>	Pchry	ND
<i>Penicillium purpurogenum</i>	Ppurp	ND	<i>Rhizopus stolonifer</i>	Rstol	ND
<i>Stachybotrys chartarum</i>	Stac	567			
<i>Aspergillus flavus</i>	Aflav	ND			
<i>Aspergillus niger</i>	Anigr	ND			
<i>Aspergillus sydowii</i>	Asydo3	2,696			
<i>Aureobasidium pullulans</i>	Apull	ND			
<i>Chaetomium globosum</i>	Cglob	ND			
<i>Paecilomyces variotii</i>	Pvari2	1			
<i>Penicillium brevicompactum</i>	Pbrev	ND			
<i>Penicillium corylophilum</i>	Pcory	ND			
<i>Penicillium crustosum</i>	PenGrp2	4,392			
<i>Penicillium glabrum</i>	Pspin2	ND			
<i>Penicillium variabile</i>	Pvarb2	ND			
<i>Scopulariopsis brevicaulis</i>	SCbrv	1,654			
<i>Scopulariopsis chartarum</i>	SCchr	ND	<b>Sum of logs of Group 1 species:</b>	18.3	
<i>Trichoderma viride</i>	Tviri	ND	<b>Sum of logs of Group 2 species:</b>	4.9	
<i>Wallemia sebi</i>	Wsebi	2			

**ERMI Score: 13.4**