*ERMI and ARMI Sampling Guide**

The Environmental Relative Moldiness Index (ERMI) and the American Relative Moldiness Index (ARMI) was developed by Dr. Steve Vesper and the United States Environmental Protection Agency. EMSL is licensed by the USEPA to perform MSQPCR methods to analyze your samples for the ERMI and ARMI.

What is the ERMI?

- The **ERMI** is an acronym for **E**nvironmental **R**elative **M**oldiness **I**ndex.
- It was developed by scientists at the USEPA to provide a straightforward, objective, and standardized way to obtain results for indoor air quality investigations.
- The EPA is developing an ERMI ranking system based on dust samples collected from homes across the U.S.
- The ERMI will help predict the moldiness of homes. Homes with high ERMI values have a greater chance of having a mold problem then homes with a low ERMI.
- 36 different fungi make up the ERMI and are designated as Group I (those found in atypical, water damaged homes) and Group II (those commonly found in all homes):

What is the ARMI?

- The **ARMI** is an acronym for **A**merican **R**elative **M**oldiness **I**ndex.
- It was developed by EPA as more cost effective analytical method than the ERMI
- It has been proven by EPA to have good correlation with the ERMI for predicting the moldiness of homes
- **13 different fungi make up the ARMI and are designated a Group 1 (found in atypical, water damaged homes) and Group 11 (commonly found in all homes). The fungi for the ARMI are boldfaced below.**

Group I - *Stachybotrys chartarum*, ***Chaetomium globosum***, *Cladosporium sphaerospermum, Aspergillus versicolor,* ***Eurotium (A.) amstalodami***, *Penicillium variabile, Aspergillus flavus,* ***Aspergillus restrictus***, *Penicillium crustosum,* ***Penicillium chrysogenum***, ***Aspergillus niger***, *Aspergillus sclerotiorum, Penicillium purpurogenum, Aspergillus fumigatus, Penicillium corylophilum, Aureobasidium pullulans,* ***Aspergillus ochraceus***, *Penicillium brevicompactum,* ***Paecilomyces variotii***, ***Aspergillus sydowii***, *Penicillium spinulosum,* ***Wallemia sebi***, *Aspergillus unguis, Scopulariopsis brevicaulis, Scopulariopsis chartarum*, ***Aspergillus penicillioides***, *Trichoderma viride*

Group II - *Acremonium strictum*, ***Alternaria alternata***, *Aspergillus ustus*, ***Cladosporium cladosporioides v1***, *Cladosporium cladosporioides v2*, ***Cladosporium herbarum***, *Epicoccum nigrum*, *Mucor & Rhizopus* group, *Penicillium chrysogenum*, *Rhizopus stolonifer*

What is MSQPCR?

- **MSQPCR** is an acronym for **M**old **S**pecific **Q**uantitative **P**olymerase **C**hain **R**eaction.
- The ERMI value is determined using the MSQPCR method in the lab.
- It was developed by scientists at the USEPA to detect and quantify fungi associated with indoor air quality problems.
- It's a **FAST, ACCURATE, and SENSITIVE** DNA-based analytical method for identifying and quantifying molds to the species level.
- The method looks for the presence of DNA sequences that are unique to a particular mold species.

	Spore Traps	Cultures	MSQPCR
Speed	Results available in 24 hrs or sooner.	6-10 days	Results available in 24 hrs or sooner.
Identification	Genus level of all identifiable mold spores (no ID of hyphae)	Genus and/or species level of viable spore-producing molds (no ID of hyphae)	Genus and species level of client selected molds
Quantification	Spores	Colony Forming Units	Cells*
Accuracy	GOOD	BETTER	BEST
Viability	Cannot be determined	Can be determined	Cannot be determined
Sampling Time	Limited due to possibility of overloading sample	Limited due to possibility of overloading sample	No restrictions

Comparison of MSQPCR analysis to spore trap and culture analysis.

*In PCR, all fungal cells contain DNA including spores and hyphae.

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Instead of short duration air sampling, the EPA has developed the sampling protocol around dust samples. Mold spores in air samples can be subject to large fluctuations over short periods. Spores accumulate in dust and can be representative of contamination problems occurring in the building. Dust samples are straight forward to collect.

How do I collect a dust samples?

1. Obtain a 3-piece PCR air/dust-sampling cassette from EMSL.
2. Remove the upper and lower plugs of the cassette.
3. Attach a high volume pump to the cassette through the lower opening.
4. Attach a small piece of tubing to the upper opening. Cut a 45 degree angle at the end of the tubing.
5. Attach a high volume pump to the cassette through the lower opening.
6. Begin collecting dust through the upper tubing and into the cassette. There is no upper or lower limit to sampling.
7. According to the EPA, a composite sample can be created by sampling the floors of 2 primary rooms, the common living area and a bedroom. In the common living area, mark a 3-foot by 6-foot (18 square foot) rectangular sampling area with tape next to the sofa (or large chair). Vacuum this rectangular area for 5 min starting at one corner of the marked sampling area and slowly sweeping over the sampling area back and forth with slight overlapping on each pass until the entire area is vacuumed. (Care was taken not to disturb the tape.) The process is then repeated in the bedroom next to the bed.
8. Replace the upper and lower plugs of the cassette
9. Ship the cassette to EMSL Analytical, Inc. No refrigeration is needed.

What type of report will I get from the lab and how do I interpret it? (See attached sample report.)

- Your customized report will identify how many of the molds were found that make up the ERMI/ARMI and the quantity of each.
- The report will also calculate the ERMI/ARMI value and reports whether the value falls within EPA's Level 1, 2, 3, or 4 designations. These levels were determined from the EPA's preliminary research and will be refined further as new research is performed. An ERMI/ARMI result in Level 1 or Level 2 indicates that there is a low likelihood that the building has a mold contamination problem. An ERMI/ARMI result in Level 3 indicates a moderate likelihood and a Level 4 indicates a high likelihood of a mold problem. An appropriate, more in-depth follow up assessment and determination of the contamination can now take place in Level 3 and 4 buildings.

Other types of sampling methods that can be analyzed by PCR

- Although other types of samples are acceptable for PCR testing only dust samples can be used to determine the ERMI/ARMI. The EPA has developed the ERMI/ARMI and a national database using dust samples and it is not recommended that you compare this dataset with other sampling methods.

1. Air samples (Obtain a 3-piece PCR air/dust-sampling cassette from EMSL).
2. New ViaCells from Zefon can be used for PCR testing.
3. Swabbed samples of areas of visible growth.
4. Bulk samples (except for drywall which can be very problematic, client can send bulk dry wall with visible growth that we will swab in the lab).

How do I collect an air sample?

1. Obtain a 3-piece PCR air/dust-sampling cassette from EMSL.
2. Remove the upper and lower plugs of the cassette.
3. Attach a high volume pump to the cassette through the lower opening.
4. Begin collecting air through the upper tubing and into the cassette. There is no upper or lower limit to sampling.
   a. Volume of air to collect and flow rate: minimum amount 600L of air, recommend 1600 L of air; flow rate should be between 5-15 L per minute
5. Replace the upper and lower plugs of the cassette.
6. Ship the cassette to EMSL Analytical, Inc. No refrigeration is needed.

EMSL Analytical, Inc. - Microbiology
107 Haddon Ave., Westmont, NJ 08108 Tel: 800-220-3675 Fax: 856-858-0648

EMSL ANALYTICAL, INC.

Client: Mold Consultant
1234 Testing Way
South Jersey, NJ 08003
Attention: Mr. Consultant
Project: 05/18/1903

EMSL Order ID: 370600000
Date Received: 10/10/2006
Date Analyzed: 10/10/2006
Date Reported: 10/10/2006

Fungal Species Identification and Enumeration by Mold Specific Quantitative Polymerase Chain Reaction (MSQPCR) (EMSL Method:M050)

based on USA EPA SOP MERB-020, Revision No. 3, 7/11/02

Lab Sample Number	6793-1		-		-		-	
Client Sample ID	1		-		-		-	
Sample Location	Composite dust		-		-		-	
Sample size	6.6 mg dust		-		-		-	
EPA 36 Species Identification Group 1	Total cells in sample	cells/ mg dust	Total cells in sample	cells/ mg dust	Total cells in sample	cells/ mg dust	Total cells in sample	cells/ mg dust
Aspergillus flavus	ND	ND	-	-	-	-	-	-
Aspergillus fumigatus	ND	ND	-	-	-	-	-	-
Aspergillus niger	502	76	-	-	-	-	-	-
Aspergillus ochraceus	ND	ND	-	-	-	-	-	-
Aspergillus penicilliodes	ND	ND	-	-	-	-	-	-
Aspergillus restrictus	ND	ND	-	-	-	-	-	-
Aspergillus sclerotiorum	ND	ND	-	-	-	-	-	-
Aspergillus sydowii	ND	ND	-	-	-	-	-	-
Aspergillus unguis	ND	ND	-	-	-	-	-	-
Aspergillus versicolor	1,879	285	-	-	-	-	-	-
Eurotium (A.) amstelodami	76,535	11,596	-	-	-	-	-	-
Aureobasidum pullulans	72,844	11,037	-	-	-	-	-	-
Chaetomium globosum	73	11	-	-	-	-	-	-
Cladosporium sphaerospermum	ND	ND	-	-	-	-	-	-
Paecilomyces variotii	113	17	-	-	-	-	-	-
Penicillium brevicompactum	ND	ND	-	-	-	-	-	-
Penicillium corylophilum	ND	ND	-	-	-	-	-	-
Penicillium crustosum (group2)	ND	ND	-	-	-	-	-	-
Penicillium purpurogenum	4,386	665	-	-	-	-	-	-
Penicillium spinulosum	ND	ND	-	-	-	-	-	-
Penicillium variabile	965	146	-	-	-	-	-	-
Scopulariopsis brevicaulis	30	4	-	-	-	-	-	-
Scopulariopsis chartarum	512	78	-	-	-	-	-	-
Stachybotrys chartarum	ND	ND	-	-	-	-	-	-
Trichoderma viride	ND	ND	-	-	-	-	-	-
Wallemia sebi	34,476.4	5,224	-	-	-	-	-	-
Sum of the Logs	**26.0**		**-**		**-**		**-**	

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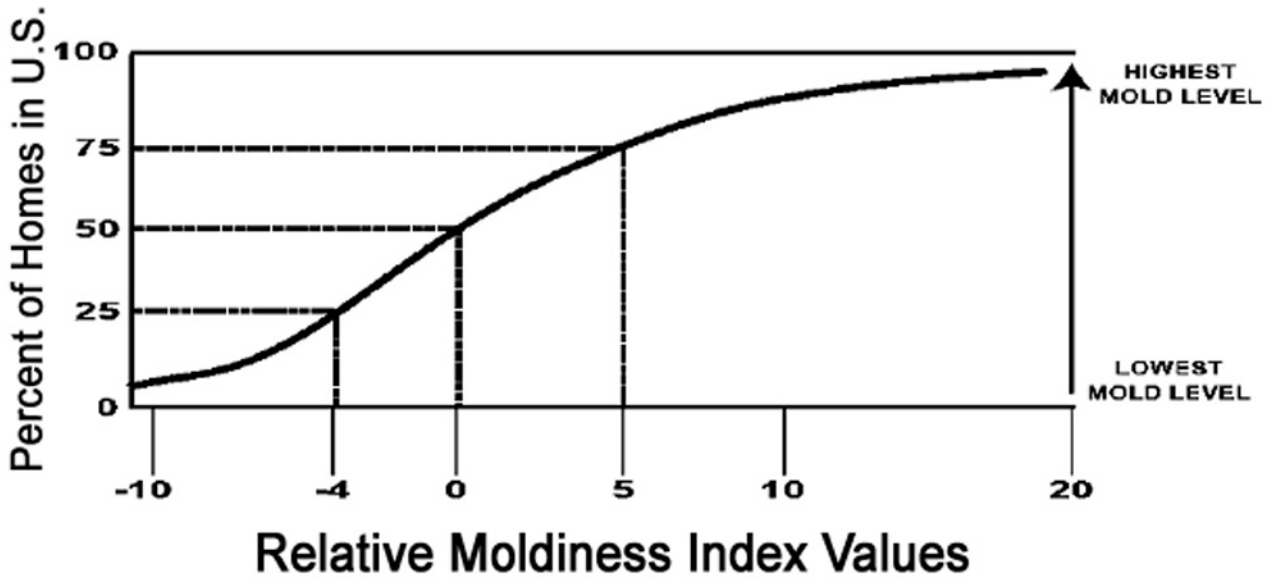
Lab Sample Number	6793-1		-		-		-	
Client Sample ID	1		-		-		-	
Sample Location	Composite dust		-		-		-	
Sample size	6.6 mg dust		-		-		-	
EPA 36 Species Identification Group 2	Total cells in sample	cells/ mg dust	Total cells in sample	cells/ mg dust	Total cells in sample	cells/ mg dust	Total cells in sample	cells/ mg dust
Acremonium strictum	ND	ND	-	-	-	-	-	-
Alternaria alternata	112	17	-	-	-	-	-	-
Aspergillus ustus	ND	ND	-	-	-	-	-	-
Cladosporium cladosporioides I	7,742	1,173	-	-	-	-	-	-
Cladosporium cladosporioides II	151	23	-	-	-	-	-	-
Cladosporium herbarum	208	31	-	-	-	-	-	-
Epicoccum nigrum	5,291	802	-	-	-	-	-	-
Mucor and Rhizopus group	361	55	-	-	-	-	-	-
Penicillium chrysogenum	ND	ND	-	-	-	-	-	-
Rhizopus stolonifer	ND	ND	-	-	-	-	-	-
Sum of the Logs	**11.8**		**-**		**-**		**-**	
ERMI Value:	**14**		**-**		**-**		**-**	
ERMI Interpretation* (see graph and description below)	**Level 4**		**-**		**-**		**-**	

Approved EMSL Signatory

AIHA EMLAP Lab ID # 100194



Based on preliminary data published by the US EPA (chart above), the following ERMI levels can help predict whether an indoor environment is moldy. As research progresses, forthcoming data may change this interpretation and further refine the ERMI.

ND=None detected; the result is below the analytical detection limit or not present.

Level 4 = Buildings with an ERMI in the 4th quartile have the greatest likelyhood of having a mold problem.

Level 3 = Buildings with an ERMI in the 3rd quartile have a greater likelyhood of having a mold problem.

Level 2 = Buildings with an ERMI in the 2nd quartile have a lower likelyhood of having a mold problem.

Level 1 = Buildings with an ERMI in the 1st quartile have the lowest likelyhood of having a mold problem.

Related published paper: Quantification of Stachybotrys chartarum conidia in indoor dust using real time, fluorescent probe-based detection of PCR products. 2001. Jennie D Roe, Richard A Haugland, Stephen J Vesper and Larry J Wymer. JEAEE Vol.11.

Rapid Monitoring by Quantitative Polymerase Chain Reaction for Pathogenic Aspergillus During Carpet Removal From a Hospital. 2004. Alice N. Neely, PhD, Vince Gallardo, MS, Ed Barth, MS, Richard A. Haugland, PhD, Glenn D. Warden, MD, and Stephen J. Vesper, PhD. Infection Control and Hospital Epidemiology, Vol. 25.

Quantitative Polymerase Chain Reaction Analysis of Fungi in Dust From Homes of Infants Who Developed Idiopathic Pulmonary Hemorrhaging. 2004. Vesper, Stephen J. PhD; Varma, Manju PhD; Wymer, Larry J. MS; Dearborn, Dorr G. MD, PhD; Sobolewski, John MS; Haugland, Richard A. PhD. Journal of Occupational & Environmental Medicine. 46(6):596-601.