ERMI DNA Mold Testing

What is ERMI-DNA?

The ERMI (Environmental Relative Moldiness Index) test is a DNA-based mold identification tool developed by scientists at the U.S. Environmental Protection Agency (EPA). The ERMI test leverages the same DNA technology that has revolutionized forensic and criminal investigation.

DNA mold testing leverages a technology called quantitative PCR (qPCR) that is used in many scientific fields including genetics and cancer research. The qPCR technology directly probes the DNA of mold with incredible accuracy to detect which species of mold are present and how many spores of each species are contaminating the indoor environment.

The technology is based on targeting short, species-specific sequences of DNA and allows for the rapid identification and quantification of molds in a matter of hours, eliminating the need for plating and culturing or identifying and counting. Genetic probes can prove particularly useful in situations where fungi are not otherwise easily differentiated on the basis of morphology (e.g. *Aspergillus* and *Penicillium*) or where culture methods are not useful because spores have lost their viability.

Developed by Scientists at the U.S. EPA

Extensive research conducted by the EPA, using state-of-the-art DNA forensics, established the Environmental Relative Moldiness Index or ERMI. The DNA-based ERMI test analyzes a single sample of dust from a home using a highly specific DNA-based method for quantifying mold species. The ERMI report includes the detection and concentrations of 36 mold species along with the ERMI value itself. This provides a single number to rank the "moldiness" making it easy to compare the results to a national scale (as a less expensive choice, the ARMI test includes detection of 13 mold species).

Homeowners/Buyers

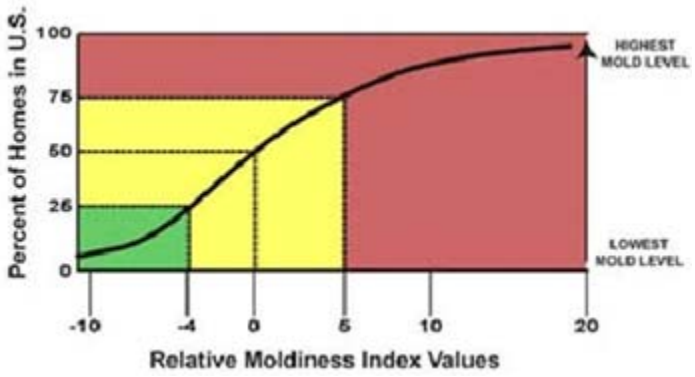
Recognizing the potential health hazards that mold presents to your family – asthma, allergies, infections and certain types of toxicities – means making mold detection a regular part of home maintenance.

The ERMI test can compare the home's mold level with the EPA's Relative Moldiness Index which is based on the 1,100 home HUD American Healthy Home Survey. The ERMI index helps determine how much mold is in the home and exactly what type of mold is present.

The ERMI test was performed on 1,100 homes across the U.S. as part of the American Healthy Homes Survey conducted by the U.S. Department of Housing and Urban Development.

Because the ERMI (Figure below)) was developed using a nationally representative sampling of homes, one can place any home in the U.S. on this ERMI scale and assess its relative mold burden. One way this information may be useful is in identifying homes that have suffered water damage but do not display easily identifiable signs of it.

EPA ERMI INDEX CHART



Why ERMI-DNA is better

Using the Environmental Relative Moldiness Index (ERMI) test, inspectors can accurately assess the extent of the problem or threat and help home or building owners proactively manage mold and prevent it.

In addition to the simplicity of taking only one composite sample, the ERMI test offers several advantages over traditional mold screening methods. Carpet dust acts as a reservoir for mold spores and is more representative of mold levels over time versus traditional short term air samples. Further, the use of a DNA-based method for this test allows for increased precision of mold identification as it is based on a biochemical assay using calibrated instrumentation.

- More robust results
  - ERMI analysis captures both the diversity and concentration of mold present in assessing the mold burden.
  - The ERMI report includes the detection and concentrations of 36 mold species along with the ERMI value itself making it easy to compare the results to a national scale. PCR is also species specific, which may allow assessment for certain mold species associated with adverse health effects or environmental conditions.

- Greater sensitivity and specificity
  - Unlike traditional mold testing methods, the ERMI test not only verifies the presence of mold, it specifically identifies the mold species.
  - Also, unlike live culture analysis, PCR reports non-viable as well as viable molds, which is important because non-viable molds are potentially allergenic.
  - It also results in fewer "false-negatives" than live culture analysis.

- Improved reliability
  - ERMI is an objective method involving analysis by automated instrumentation, thereby eliminating the subjectivity and potential human error inherent in microscopic determinations.
  - PCR is also generally more reliable than live culture analysis because not all species may grow on the media used and because fast-growing species may overtake the slow-growing species.

- Faster and easier
  - Simple, single sample collection and elimination of the need to culture samples, reduce time to result to hours rather than days.

How ERMI-DNA Compares

- Currently most mold samples are collected from the air. Inspectors pump air, often for as little as 5 minutes, onto a sticky device called a spore trap (not unlike flypaper).
- They send the spore trap to a lab for analysis, and the lab sends back a report based on the shape and size of the spores they observe under a microscope.
- It is important to keep in mind that a mold cannot be identified as belonging to a particular species using a spore trap/microscopic analysis.
- There is also currently no standardized method for sampling or analysis of spore traps and no QC program in the industry for spore identification or counting on spore traps.
- Recent studies have only served to reinforce that sampling and analytical errors inherent in traditional mold testing often render results that are inaccurate and unreliable.

Below is a table that summarizes many of the advantages and disadvantages of different mold testing methods:

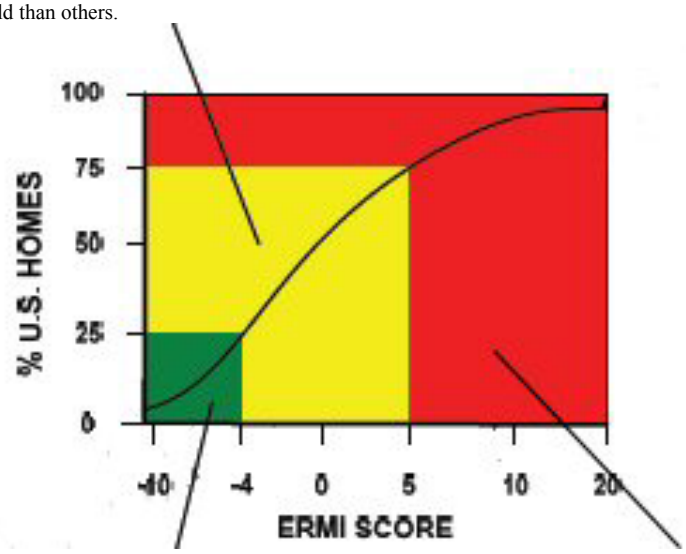
Method	Advantage	Disadvantage
Culture	Easy sampling Inexpensive	Qualitative to semi-quantitative Genus level identification Viable spores only Multiple samples required Slow turn-around-time (7-10days) Snap-shot sample may not be representative Inherently underestimates concentration due to: - Media limitations - Competitive inhibition - Clumping - Non-viability or dormancy No standardized protocol for sampling or analysis
Total Spore Count (Microscopic Exam)	Quick time-to-result (1 day) Inexpensive	Genus level identification (Presumptive identification at best) Snap-shot sample Multiple samples necessary Viability unknown Only representative of area sampled Genus level identification Inconsistant collection efficiencies Bias toward larger/dyer spores Accuracy highly dependent on lab expertise No standardized sampling or analysis
RT-PCR (ERMI)	Very quick time to result (2 hrs) DNA-based Highly sensitive Highly accurate & precise Species level identification Legally defensible Quantitative results More representative, historical sample Single composite sample Standardized methodology Simpler interpretation via comparison to national index	Depending on the testing laboratory, the ERMI test can be more expensive than a single spore trap analysis; however, air sampling with spore traps frequently involves obtaining multiple samples, resulting in multiple analyses (4-6) ERMI testing can only be performed by a licensed laboratory.

Test Method

The EPA recommends taking a living room and bedroom sample as a composite using the same dust collector for both rooms (other areas can be sampled separately).

1. In a common living area (family or living room), sample a total of 18 square feet from the long (front side of the sofa floor (or other commonly used chair(s)).
2. In the most frequently used bedroom, sample a total of 18 square feet from the floor on the most frequently used side of the bed.
3. The samples are vacuumed into a special dust collecting device for a 5 minute sampling period.
4. The sampling device is sealed and sent to the laboratory for analysis. Results are usually available in 5 business days.

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



-10 to -4 (lowest ERMI values)
Occupants least likely to show symptoms of mold exposure. However, mold exposure symptoms are not impossible.

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

http://www.epa.gov/nerlcwww/moldtech.htm

Key to ERMI Assays

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

Sample ID: JoeABC123-1

Description: Composite dust sample from living room (beside couch) and bedroom (beside bed)

Group 1 Molds	Spores/mg dust
Afumi	11
Aochr1	8
Arest	1
Asclr	0
Aungu	2
Avers2-2	37
Apeni2	1
Cspha	5
Eamst	306
Ppurp	0
Stac	13
Aflav	1
Anigr	3
Asydo3	147
Apull	233
Cglob	4
Pvari2	9
Pbrev	1
Pcory	1
PenGrp2	0
Pspin2	0
Pvarb2	5
SCbrv	3
SCchr	1
Tvir	1
Wsebi	4

Group 2 Molds	Spores/mg dust
Astrc	2
Aaltr	77
Cclad1	[illegible]
Cclad2	1
Cherb	1[illegible]
Austs2	8
Enigr	1
Muc1	2
Pchry	0
Rst	1

ERMI Score: 9.6

Provided by Kip Davis, Tiger Group Home & Building Inspections