JEES
Environmental Services

FOURTH ROUND OF MOLD SPORE AIR & WIPE SAMPLE RESULTS FOR THE WEST BOYLSTON PUBLIC SCHOOLS WEST BOYLSTON, MASSACHUSETTS

PREPARED BY:

Edward P. Nowak
President
Jackie & Ed's Environmental Services (JEES)
Charlton, Massachusetts

PREPARED FOR:

Richard A. Meagher
Superintendent
West Boylston Public Schools
West Boylston, Massachusetts

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P: 508-523-5923 • F: 508-248-4437 • e-mail: ed.nowak@jeesinc.com
P.O. Box 940 • Charlton City, MA 01508

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Mr. Richard Meagher
Superintendent
West Boylston Public Schools
125 Crescent Street
West Boylston, MA 01583

Dear Mr. Meagher:

JEES of Charlton, Massachusetts, services were retained by the West Boylston Public Schools (WBPS) to repeat the air and surface (wipe) sampling for mold spores JEES performed in September of 2020, February of 2021 and August of 2021. This testing was performed in the building used for both the high and middle school as well at the elementary school. Both schools are located on Crescent Street in West Boylston, Massachusetts. This testing was performed on Wednesday, August 18, 2021. JEES was informed by WBPS that the WBPS custodial staff had conducted cleaning and disinfection procedures prior to the collection of the mold spore samples. This report details the findings of the mold spore air testing performed. In addition, background information for this project is provided in the following text.

1.0 BACKGROUND

JEES was contacted by WBPS in January of 2022 regarding repeating the mold spore testing. During our conversations, JEES was informed by you that to address the microbial concerns of parents and teachers, they wanted to repeat the mold testing performed twice last year. The premise being if there were very low levels of mold spores present, which would indicate the schools had been effectively cleaned.

For mold growth to occur, the right conditions must be present. These conditions include temperature, nutrients, fungal spores, and moisture. All occupied buildings provide the proper temperature and nutrients for fungal growth. Fungal spores are readily brought in from the outside via footwear, open windows, plants, flowers, pets, produce, etc. The only element missing is moisture. Once excessive moisture is present, mold growth is likely to occur within 48 to 72 hours.

Exposure to the mold spores can result in a variety of health effects ranging from general malaise to a variety of respiratory ailments. The health effects a person experiences are usually determined by an individual's sensitivity to mold spores and the state of their immune system. With the large population attending these schools, there is a high likelihood of some occupants being sensitive to the exposure to elevated levels of mold spores.

Regarding the timeline, JEES was informed that WBPS wanted the testing done prior to April vacations of 2022. Testing would be of the same scope as the work performed at the beginning of the school year.

In each school, JEES tested the air and the surface of the air handlers/unit ventilators of roughly 15% of all rooms. The air and surface samples were analyzed for the type and number of mold spores. For the middle/high school building, JEES tested eight rooms. For the elementary school, JEES tested six rooms.

For each sampling parameter, a field blank was collected for quality control. The outside air was tested as well for comparison purposes.

JEES' observations and findings regarding mold spores and mold contamination are provided in Section 2.0 of this report.

2.0 RESULTS AND DISCUSSION

The following text contains a discussion of the sampling data collected during this project. A spreadsheet of the mold spore air sampling data for the high and middle school building is on page 8 and the mold spore air sampling data for the elementary school building is on page 9. The spreadsheet with the wipe sampling data for the high and middle school building is on page 10 and the elementary school wipe sampling is on page 11. A summary of JEES' observations is provided first, then a discussion of the results followed by conclusions and recommendations in regards to the data gathered.

2.1 Observations

Similar to the previous inspections of the building used for both the high and middle school, JEES did not observe any mold contamination or detect any musty odors. The building appeared very clean with no signs of any accumulation of dust or dirt that could harbor mold spores. JEES did inspect the common hallways and the eight sample rooms. Not every room was inspected per JEES' proposed scope of work.

Students and most staff had just left for the school day when JEES began the testing. There was the usual fine dust and debris on the floor in the main hallways from foot traffic that occurred during the day. The custodial staff was starting the process of cleaning up this debris, which was minor and typical of an occupied school, when JEES began testing.

Compared to the previous rounds of testing, JEES noticed that there were almost no houseplants in the elementary school. Houseplants are a natural sources of mold spores via their soil, roots, plants, and stems. Thus, mold spores associated with the houseplants could be transported into the classroom by the ventilation system. Houseplants should be kept away from the ventilation system or windows that are opened.

The elementary school, while very clean for each round of testing, was even cleaner than before. The custodial staff informed JEES that as part of the COVID-19 protocol process, the surfaces in the school are routinely cleaned and disinfected. The cleaning and disinfection help to remove fine dust and debris.

Both school buildings are surrounded on three sides by forest and general vegetation. This vegetation can provide a natural resource for mold spores to grow during the warmer months.

2.2 High & Middle School Mold Spore Air Sample Results

The International Board of Industrial Hygienists (IBIH), American Conference of Governmental Industrial Hygienists (ACGIH) and the American Industrial Hygienist Association (AIHA) guidelines were used to interpret the mold spore air sampling data. These agencies suggest taking corrective action when the spore levels are much higher in an area of a building, which has had occupant complaints, verses an area of a building with no occupant complaints. Exact numbers for acceptable mold spore levels are not feasible due to seasonal and geographical variations. These guidelines state that ***in most cases*** the indoor air concentrations of molds should be lower than the ambient (outdoor) concentration of molds.

These organizations have noted that there is a small percentage of the population with compromised immune systems or other predisposing conditions, which can result in symptoms at lower spore levels. Nearly all organizations involved with indoor air quality (IAQ) have stated that there are a few species of fungal spores, which can be considered unsafe even at low levels.

For this testing program, air sample results were quantified as total spore per cubic meter of air (ct/m^3). Each intact spore is counted as one spore and includes both metabolically active (viable) and metabolically inactive (non-viable) spores. This method cannot distinguish between fungal genuses that produce spores with nearly identical morphology such as aspergillus and penicillium, thus these two spore types are reported together.

The field blank did not have any colonies present demonstrating that the positive sample results were not due to contamination introduced during sample collection or analysis.

An ambient air sample could not be taken due to snow cover and below freezing temperatures. Both conditions remove most mold spores from the ambient air.

JEES knows from the collection of thousands of air samples for mold spores that the typical mold spore count in a New England building this time of year ranges from 200 to 2,000 ct/m^3. The variation depends upon the cleanliness of a building, types of building materials used and the presence or absence of plants, produce and pets.

Based upon JEES' proposal to WBPS, JEES tested eight different locations in the high school/middle school building. Both the high school and middle school were tested along with the common library and the cafeteria. The locations were dispersed throughout the building.

All eight air samples had total spore counts below 230 ct/m^3, or just above the low end of the typical spore count. The average spore count for the school was only 134 ct/m^3. These results were some of the lowest to date and corroborated JEES' observations that there was no mold spore amplification occurring.

Six mold spore types were detected inside the high/middle school building, none at elevated levels. The most prevalent spore types inside the building were aspergillus, basidiospores and penicillium, which are the same spore types that were prevalent in previous testing. These spore types are described below.

Aspergillus is a very common fungus found throughout the world. Aspergillus produces a dry spore easily transported by air movement. Outside, Aspergillus can be found in nutrient rich soil, on decaying plants and on grains. Inside, Aspergillus can be detected on nearly all substrates. Exposure to *elevated levels* of these spores can result in hay fever type symptoms, asthma, and hypersensitivity pneumonitis. In rare cases, Aspergillus has been known to cause a variety of afflictions of the lung.

Basidiospores are reproductive spores produced by fungi belonging to the fungal subdivision Basidiomycotina. Fungi of this subdivision include filobasidium and cyptococcus. High levels of these spores can produce allergy type symptoms.

Penicillium spores are potent allergens which can cause hay fever and upper respiratory irritation *at elevated levels*. Certain species of penicillium are known opportunistic pathogens which can cause lower respiratory infections as well as fungal infections. Penicillium is very common in temperate regions of the world. Penicillium produces a dry spore which is easily transported by air currents.

2.3 Elementary School Mold Spore Air Sample Results

JEES used the same sampling and analytical techniques for the elementary school as used for the high/middle school building. The elementary school building (herein referred to as "the building"), is less than a mile away from the high/middle school building.

The field blank did not have any colonies present demonstrating that the positive sample results were not due to contamination introduced during sample collection or analysis.

Per the reasons stated above, an ambient air sample was not collected. Instead, results were compared to the "typical" spore count range as described in Section 2.2 of this report.

Since the elementary school building is smaller, per JEES' proposal, six locations were used to assess this school, versus eight for the high/middle school. All floors of the school were tested, and the sample locations were spread out through the school.

All six locations had spore counts on the lower end of the typical spore count range. The highest sample result came from Room 103 with 578 ct/m^3. This result is likely skewed high as the custodial staff had just emptied the trash in this room a few minute prior to sampling, hence, any dust or fine debris with mold spores attached could have been dispersed into the air. The other five samples had spore counts below 200 ct/m^3, the lower end of the typical spore count for an occupied building.

The air sampling data did not indicate any issues with mold spore amplification occurring. The data also showed the cleaning and disinfection procedures employed by the school were helpful in reducing the concentration of microbial allergens present.

For this building, three mold spore types were identified, none at elevated levels. The most prevalent spore types were aspergillus and penicillium. These spore types were described in the previous section.

2.4 High and Middle School Mold Spore Wipe Sample Results

While there are no standards for wipe samples, wipe sampling is used to identify if a building material is a reservoir for mold spores. Typically, a non-contaminated surface should have a spore count of less than 1,000 for a 25 square centimeter area. Building surfaces with a spore count between 1,000 and 3,000 are considered suspect while results above 3,000 are indicative of a building material being contaminated.

Wipe sampling is also used to detect the presence of fungi that do not produce spores that are not readily dispersed via air movement.

The blank wipe sample did not have any colonies present, demonstrating that any positive sample results were not due to contamination introduced during sample collection or analysis.

JEES collected a wipe sample from the unit ventilator in each classroom tested, except for Room 402 where the air supply diffuser was tested. For the library, the front desk under a supply diffuser was sampled.

For this round of testing (fourth to date), the spore counts were the lowest. All eight samples were below the detection limit of 2 spores per square inch. Hence, no mold spores were present! This data confirmed JEES' observations that the cleaning and disinfection done by the WBPS custodial staff was very thorough.

2.5 Elementary School Mold Spore Wipe Sample Results

JEES used the same sampling and analytical techniques for the elementary school as used for the high/middle school building. The focus for the elementary school building (herein referred to as "the building"), was the unit ventilators, the same focus as the high/middle school building. Unit ventilators would be the most likely way to disperse allergens into the air of the building as they are the main means of air movement in a room.

The blank wipe sample did not have any colonies present, demonstrating that any positive sample results were not due to contamination introduced during sample collection or analysis.

JEES collected a wipe sample from six different rooms with the unit ventilator in each room sampled. This round of testing had by far the lowest spore counts to date, the same as the HS/MS sample results. Only one unit ventilator had any spores present. The sample from the unit ventilator in Room 304 had 11 cladosporium spores. All the other samples had spore counts below the limit of detection of 2 spores per square inch.

The only spore type detected was cladosporium and this spore type is described in the following text.

Cladosporium is very common throughout the temperature regions of the world. Cladosporium is not pathogenic but can aggravate the respiratory systems at elevated levels. Cladosporium produces dry spores which are readily transported by wind and foot traffic. Cladosporium can grow on a wide variety of substrates including most soils, plant litter, and leaf surfaces.

2.6 Recommendations and Conclusions

Presented on the following page are conclusions and recommendations based upon the data collected and observations made during this project.

A. Mold Air Sampling Data: The mold spore air sampling data did not show any elevated levels of "total" mold spores, or the cumulative total of all spores present. None of the air samples collected from either building indicated mold spore amplification was occurring. The amount of mold spores detected were some of the lowest in the four rounds of testing performed for the WBPS.

B. Mold Spore Wipe Sampling Data: The mold spore wipe sampling data correlated well with the air sample data. All wipe samples from both schools had extremely low spore counts with only 1 of 15 wipe samples having any mold spores present above the limit of detection. This data corroborated JEES' observations that the unit ventilators appeared very clean.

C. Proactive Measures: Per JEES' initial testing, JEES recommends that the WBPS continue to replace any water stained suspended ceiling tiles as soon as there are detected. JEES recommends the WBPS continue to tell teachers to keep any houseplants or other vegetation away from the unit ventilators. Finally, the WBPS should conduct weekly cleaning and disinfection procedures in compliance with state and federal guidelines relating to COVID-19 precautions.

D. Stipulations: Please note that these results and interpretations are based upon the information gathered during this field program. Changes in the conditions present at the time of testing including previous weather patterns, activities in the schools, maintenance activities and the environmental atmosphere, may result in data different from that which was collected. This report is designed to serve as a quittance document, and not to be used to support or refute compliance with any local, state, or federal statutes, or be used in any related medical or legal claims.

WEST BOYLSTON PUBLIC SCHOOLS
HIGH & MIDDLE SCHOOL
AIR SAMPLE MOLD SPORE RESULTS
TUESDAY, MARCH 1 - 2022

SAMPLE NUMBER & LOCATION	TOTAL CT/M^3	ALTERNARIA CT/M^3	BASIDIOSPORES CT/M^3	CLADOSPORIUM CT/M^3	EPICOCCUM CT/M^3	PENICILLIUM/ ASPERGILLUS CT/M^3	SMUTS/ MYXOMYCETES/ PERICONIA CT/M^3
WBHS-BLK, Field Blank from the Library	<1	<1	<1	<1	<1	<1	<1
WBHS-1, Front Desk of the Library	162	0	76	0	10	76	0
WBHS-2, Room 100 Desk b Unit Ventilator	226	0	150	0	0	76	0
WBHS-3, Center of Room 102B	86	10	0	0	0	76	0
WBHS-4, Room 209 by Hallway	86	0	38	0	0	38	10
WBHS-5, Cafteria by Registers	<10	<10	<10	<10	<10	<10	<10
WBHS-6, Room 402 Back Desk	210	0	0	0	0	210	0
WBHS-7, Room 201 Desk by Flasks	152	0	38	38	0	76	0
WBHS-8, Room 304 by Teacher's Desk	19	0	0	0	0	19	0
SAMPLE AVERAGES:	134	1	43	5	1	82	1

Notes:

1. CT/M^3 = spore count per cubic meter. Field blank sample results are in counts only.
2. Any fungi which is an opportunistic pathogen at an elevated level has been highlighted.
3. Any elevated results typically associated with air quality complaints have been highlighted.

WEST BOYLSTON PULBIC SCHOOLS
HIGH & MIDDLE SCHOOL
WIPE SAMPLE MOLD SPORE RESULTS
TUESDAY, MARCH 1 - 2022

SAMPLE NUMBER & LOCATION	TOTAL COUNT
WBHS-WBLK, Field Blank from the Library	<40
WBHS-W1, Library's Front Counter	<2
WBHS-W2, Room 100 Unit Ventilator	<2
WBHS-W3, Room 102B Unit Ventilator	<2
WBHS-W4, Room 109 Unit Ventilator	<2
WBHS-W5, Center Unit Ventilator in the Cafeteria	<2
WBHS-W6, Room 402 Supply Vent	<2
WBHS-W7, Room 204 Unit Ventilator	<2
WBHS-W8, Room 304 Unit Ventilator	<2
SAMPLE AVERAGES:	<2

NOTES:

1. Count = Identifiable spore.

Sample results preceded by a < sign are below the analytical detection limit.

2. Counts indicating heavy mold growth and have been highlighted.

3. Any fungi detected which are an opportunistic pathogen have been highlighted.

WEST BOYLSTON PUBLIC SCHOOLS
ELEMENTARY SCHOOL
AIR SAMPLE MOLD SPORE RESULTS
TUESDAY, MARCH 1 - 2022

SAMPLE NUMBER & LOCATION	TOTAL CT/M^3	CLADOSPORIUM CT/M^3	PENICILLIUM/ ASPERGILLUS CT/M^3	SMUTS/ MYXOMYCETES/ PERICONIA CT/M^3
WBES-BLK, Field Blank by the Library	<1	<1	<1	<1
WBES-1, Room 103 by the Hallway	578	0	530	48
WBES-2, Center of Room 120	148	38	110	0
WBES-3, Top of Room 115 Play Mat	150	0	150	0
WBES-4, Library by Mrs. Gargais' Class	76	0	76	0
WBES-5, Center Desk In Room 204	38	0	38	0
WBES-6, Room 304 by the Hallway	<10	<10	<10	<10
SAMPLE AVERAGES:	198	8	181	10

Notes:

1. CT/M^3 = spore count per cubic meter. Field blank sample results are in counts only.
2. Any fungi which is an opportunistic pathogen at an elevated level has been highlighted.
3. Any elevated results typically associated with air quality complaints have been highlighted.

WEST BOYLSTON PULBIC SCHOOLS
ELEMENTARY SCHOOL
WIPE SAMPLE MOLD SPORE RESULTS
TUESDAY, MARCH 1 - 2022

SAMPLE NUMBER & LOCATION	TOTAL COUNT	CLADOSPORIUM COUNT
WBES-BKJW - Field Blank from the Library	<40	<40
WBES-W!, Library Unit Ventilator	<2	<2
WBES-W2, Room 103 Unit Ventilator	<2	<2
WBES-W3, Room 120 Unit Ventilator	<2	<2
WBES-W4, Room 115 Unit Ventilator	<2	<2
WBES-W5, Room 204 Unit Ventilator	<2	<2
WBES-W6, Room 304 Unit Ventilator	11	11
SAMPLE AVERAGES:	11	11

NOTES:

1. Count = Identifiable spore.

Sample results preceded by a < sign are below the analytical detection limit.

2. Counts indicating heavy mold growth and have been highlighted.

3. Any fungi detected which are an opportunistic pathogen have been highlighted.

3.0 SAMPLING AND ANALYTICAL METHODOLOGIES

All sampling and analyses were performed in strict accordance with applicable methods when appropriate. A description of all the sampling procedures and equipment used during this field effort is provided below. The descriptions below are organized by sampling parameter.

3.1 Biological Sampling

All biological sampling was completed using procedures recommended by the American Industrial Hygienist Association (AIHA) and American Conference of Governmental Industrial Hygienists (ACGIH). For organizational purposes, this text has been segregated by sampling parameter.

3.1.1 Total Spore Count Air Sample Collection

A calibrated Bio-Pump was used to draw air at a nominal rate of 15.0 liters/minute. Air was drawn through an Air-O-Cell® cassette housing a clear slide. As air is drawn through the slots in the Air-O-Cell® cassette, any microscopic particles, including mold spores, are deposited on the slide. The Bio-Pump is specifically designed for use with Air-O-Cell® and Via-Cell® cassettes.

All samples were 7 minutes in duration, with a final corrected sample volume of 105.0 liters. Sample volumes were corrected to standard temperature (68° Fahrenheit) and pressure (29.92" Hg). Prior to and after sampling the Bio-Pump's flow rate was checked with an Air-O-Cell Flow Meter. A field blank was taken to check for contamination in the sample recovery area and of the sampling media.

3.1.2 Total Spore Count Air Sample Analysis

After the samples had been collected, each sample was uniquely identified and labeled. A "Chain of Custody" was then completed, detailing the sampling time, duration, location and type of analysis to be completed. The Chain of Custodies used for this sampling program are included in the Appendix. Samples were then placed in sealed plastic bags and shipped to EMLAB of Phoenix, Arizona. EMLAB has passed the AIHA proficiency tests and uses analytical procedures outlined by the American Conference of Governmental Hygienists and in the FDA Good Laboratory Practice Guideline. EMLAB carried out all procedures in a sterile environment with quality control and assurance steps implemented to prevent cross contamination and improper identification. This methodology identifies nearly all molds and spores and is regarded as the best method for screening for IAQ related biological contaminants.

Upon receipt of the samples, the slide was removed from the Air-O-Cell cassettes and each slide was stained before viewing under a microscope. The analyst then viewed at least 50% of the entire slide area using a zig-zag viewing pattern. The number and type of fungal spores as well as any mycelial fragments present were recorded. Mycelial fragments are from the vegetative portion of fungal growth. Fungal spore identification was based upon spore morphology and staining properties. Exact identification of some fungal spores is not possible with this methodology as two different genuses have nearly identical looking spores. An example of this would be aspergillus and penicillium spores. This method counts both viable (colony forming) and non-viable (non-colony forming) spores.

3.2.1 Wipe Sample Collection

Wipe samples were collected using EMLAB's Transport System with a buffered Butterfield Solution. EMLAB's Transport System is used for collecting and maintaining the viability of microbiological organisms between sampling and laboratory investigation. Before sampling, the sterile swab was immersed in the buffered Butterfield Solution, and then the swab was wiped over a nominal 100 square centimeter area of the material to be sampled. The swab was then inserted into a plastic vial containing the buffered Butterfield Solution. Next, the vial was sealed, labeled, and shipped to the laboratory.

3.2. Wipe Sample Analysis

After the samples had been collected, each sample was uniquely identified and labeled. A Chain of Custody was then completed, detailing the sampling time, duration, location, and type of analysis to be completed. The Chain of Custodies used for this sampling program are included in the Appendix. Samples were then placed in sealed plastic bags and shipped to EMLAB of Phoenix, Arizona. EMLAB has passed the AIHA proficiency tests and uses analytical procedures outlined by the American Conference of Governmental Hygienists and in the FDA Good Laboratory Practice Guideline. EMLAB carried out all procedures in a sterile environment with quality control and assurance steps implemented to prevent cross contamination and improper identification.

Identification of spores was completed by microscopic analysis with identification based upon spore morphology, and staining properties. Quantification was completed using a grid system where a certain number of grids were counted, and the final count extrapolated based upon the magnification used.

4.0 QUALITY ASSURANCE & QUALITY CONTROL

Implementation of quality assurance procedures for IAQ programs are designed so work is done:

1. By competent, trained individuals experienced in the methodologies being used.

2. Utilizing the appropriate and properly calibrated equipment.

3. Using approved procedures for sample collection, handling and documentation.

JEES' measurement and sampling devices are uniquely identified and calibrated with documented procedures and acceptance criteria before and after each sampling program. Records of all calibration data are maintained in personal field notebooks.

Data are recorded on standard forms when applicable. Bound field notebooks are used to record observations, comments, and miscellaneous elements affecting data, calculations or evaluations. Notes also include unusual circumstances which may have affected the sampling program.

All sampling procedures incorporate appropriate quality control measures. This includes calibration of personnel pumps sampling rates prior to and after all field efforts. For every field effort, a field and trip blank are taken to prevent false positives from sample recovery area and media contamination respectively. All instruments are calibrated according to method specifications, using protocol gases where appropriate, for example with carbon monoxide and carbon dioxide probes.

All data and calculations are thoroughly reviewed for completeness and accuracy before the publication of any reports. All laboratory results are scrutinized for possible mistakes or unusual data. In summary, all equipment, samples and data are thoroughly reviewed in an effort to provide realistic and representative results for each and every program.