

**Date of Survey 8/8/08    Report 12/08/08**

**Surveyor Jeff Charlton**

**Report Number 29/08**

### **1.00 Introduction**

The following report follows industry accepted and acknowledged principles and procedures of the ACGIH *American Conference of Governmental Industrial Hygienists* The IICRC (USA) *Institute of Inspection Cleaning Restoration Certification* with specific reference to the S500 and S520 Standards. These standards have been adopted in the absence of specific UK guidance.

#### **1.01 Biography of report author Jeff Charlton**

A specialist in disaster recovery and damage mitigation with 20 years experience in recovery and restoration. . Founder chairman and Fellow of BDMA *British Damage Management Association* and Senior technician. Member of the HVCA committee responsible for the development of the TR17 standard for ventilation system hygiene. Certified level 1 Infra Red Thermographer with FLIR. Certified asbestos surveyor to BIOH MDHS P402 and Asbestos identification by Polarised Light Microscopy. A member of the Indoor Air Quality Association and Academy of Experts.

Qualified in the USA as a **CR Certified Restorer**, **WLS Water Loss Specialist** and **CMH Certified Mechanical Hygienist**. A member of the US toxic mold task force and contributor to the S500 & S520 mould standards. A qualified mold remediation and inspection technician **AMRT Applied Microbial Remediation Technician** in USA. Qualified Hazmat decontamination technician and certified ASD *Applied Structural Drying*. Certified member of AIAQC *American Indoor Air Quality Council* .A member of the American Board of Homeland Defence and certified Forensic Examiner

#### **1.02 Note.**

Please note I have no professional qualification in building surveying, construction or medicine and remarks made are for discussion purposes only. Additional relevant information can be found on my web site [www.disasteradvice.co.uk](http://www.disasteradvice.co.uk) and you should enlist competent advice from specialists prior to any actions or decisions based on information contained within this report.

### **2.00 Report Outline**

To inspect the property and investigate or identify potential mould growth triggers, namely water intrusion, poor ventilation or condensation factors. To assess indicating factors relevance and develop a sampling strategy to confirm possible mould development or residue. To assess the potential and prove where possible the growth or presence of both viable and non viable mould spores or possible mycotoxins.

#### **2.01 . Inspection Protocols**

The survey will follow a recognised method of comparison where possible. Measurement of existing and unaffected areas will be measured against survey target areas. Where Industry recognised standards exist they will be utilised or referred to where possible.

## 2.02 Overview of Mould

Mould is ubiquitous and can be found anywhere in the world and is said to make up 25% off the worlds bio mass. This said it should not be found in elevated quantities within our living zone as it will destroy our building and health as it consumes organic or cellulose containing material. Humans are organic and infection or allergies are possible and most likely in those with reduced immune systems. All mould is allergenic although some people show no reaction at first continual exposure can often lead to chronic response.

The objective of this survey is to assess if mould currently or possibly present at levels higher than ambient or normal conditions. Speciation of some moulds can be used as an indicator of water damage or high humidity. While limited mould presence is generally acceptable or unavoidable some species should not be found in elevated numbers within a building.

All mould is said to be allergenic but some species (genus) are said to be toxic. These toxic moulds generally release fungal metabolites in the form of mycotoxins and VOCs *volatile organic compounds* which can assist in their growth or defence mechanisms. These mycotoxins are not always toxic but invariably are and they can cause a variety of serious health risks.

The mycotoxins are held within the spore shell while the spore is alive or viable. Viable means that the mould is inactive but requires moisture and a food source to trigger its growth.

Non viable spores describes where the spore is dead and cannot proliferate; unfortunately dead mould is possibly more dangerous or allergenic than live mould as the mycotoxins it holds are likely to be released during spore shell decay or destruction.

Mould growth generally but not always requires the following conditions;

- Moisture either free of high humidity usually over 80%
- Temperatures between 5 and 38c
- Food source; paper, cellulose, wood, dust, etc
- Limited air movement
- Limited UV (sunlight)

Where mould spores have proliferated from the above conditions they will normally be found to be present within the material affected even after cleaning and removal. This presence usually means that even small amounts of future moisture can reactivate the spores into proliferation. Industry standards in the USA (the UK do not have standards) requires the removal of all materials identified as contaminated with mould growth; however hard materials with visible or assessed settled spores only can usually be decontaminated where no growth is present.

## 2.03 Indicators of Mould

Visible water stains, a history of leaks or water damage, continuous health concerns, chronic or acute health issues.

## 2.04 Mould Health Issues

This short description is designed to inform you of possible health issues which may develop due to high moisture content and associated mould growth. This section is for general information purposes only and does not necessarily reflect mould present in your property.

### **2.05 Those at risk from mould**

Those people usually affected or at risk from mould exposure are:

- Over 55 with reduced immune systems
- Infants with underdeveloped immune systems
- Heavy alcohol users
- Smokers and drug abusers
- Those recovering from invasive surgery or undertaking chemo therapy
- Long term use of prescription drugs.

### **2.06 Typical Health affects from mould exposure**

This explanation is very broad based and is intended as a guide only to assist those that may have suffered acute or chronic health affects, the source of which cannot or has not been identified by the medical profession. It should be recognised that antibiotics are derived from mould and their benefits are well accepted although uncontrolled exposure to antibiotic producing mould is poorly recognised or understood.

- **The following symptoms are said to be typical reactions to mould exposure:**
- Headache
- Sore eyes, throat and general flu like symptoms
- Chest infection
- Coughing up blood
- Nose bleeds
- Liver problems
- Digestive problems
- Depression
- Leukaemia
- Brain tumour
- Spontaneous abortion
- Allergies

### **2.07 Mould decontamination**

Mould cannot be permanently neutralised by toxic chemicals, bleach or paints. Bleach will kill spores but the resultant release of mycotoxins may result in a greater health risk. Toxic paints have been found to offer a short lived repair and many moulds will penetrate anti mould paints after some years if suitable conditions exist. The state of New York have developed mould decontamination guidelines

<http://www.nyc.gov/html/doh/html/epi/moldrpt1.shtml> and these are of a similar specification to asbestos removal on both sides of the Atlantic.

Subject to the outcome of this report, sample analysis, I can provide supervision, restoration and suitable decontamination protocols if requested.

## **2.08 Supporting UK Legislation or information**

Occupiers Liability Act

(Housing Act 2004)

Housing Health & Rating System Regulation 2005 (SI 2005 No 3208)

CIRIA Construction Industry Research & Information [www.ciria.org/flooding/disinfection](http://www.ciria.org/flooding/disinfection)

RICS royal Institute of Chartered Surveyors (Paper on mould & UK properties)

[http://www.rics.org/Builtenvironment/Buildingpathology/InfestationFungal/Toxic\\_mould\\_21082002.html](http://www.rics.org/Builtenvironment/Buildingpathology/InfestationFungal/Toxic_mould_21082002.html)

## **2.09 Property Construction /Type**

The property inspected is of modern construction and is approximately 5 years old.

## **2.10 Summary**

The client requested the inspection due to suspected health effects often associated with mould growth. There were additional concerns regarding construction detail and damage caused by water ingress believed to be caused by leaking roof sections.

## **2.11 Informed facts**

The property has been affected at various times by water ingress, some mould is visible and the floor was to be replaced due to water damage.

## **2.12 Collected Information and fact**

## **2.13 Historic damage markers**

- a. The laminate hard wood floors display typical “cupping” and swelling usually associated with water damage.
- b. Staining to paint finishes.
- c. Swelling and cracking to joints where skirting meet walls.
- d. Limited visible mould

## **2.14 Overview**

### **2.15 Health & safety Note**

From the visible mould growth coupled to ideal growth conditions there is in my opinion some concern for the health of those visiting the home. This follows from guidance given from CIRIA <http://www.ciria.org.uk/flooding/disinfection.htm> and supported by the ABI. In this document they advise that people with reduced immune systems should not live in the property and that contractors should wear toxic cartridge respirators. The age and or informed medical history of the family would I believe substantiate the recommendation to relocate.

### **2.16 Electrical Safety & Fire Hazard**

The property has been affected by a water leak or moisture intrusion. This leak will flow or fall vertically and horizontally or move in vapour form to condense on cooler surfaces (Dew Point). This travel may result in electrical contacts or services becoming wet and result in increased resistance or short circuit and resultant risk of fire. The electrical system should be tested.

## 2.17 Survey

### Inspection techniques

The inspection hypothesis was to assess the presence of mould to identify elevated levels of viable or non viable mould spores or mycotoxins and presence of elevated moisture content generally. The following equipment was used or available for comparison purposes of considered affected and non affected areas:

#### Moisture content

- Infrared Thermography FLIR camera
- Tramex ultrasonic deck scanner
- Tramex concrete meter
- Protimeter Ultrasonic and conductive meter
- Thermal Hygrometer & Psychrometric chart
- Tramex 50mm penetrative slide hammer and moisture gauge
- Calcium carbide meter
- Chlorine testing

#### Mould speciation and quantification

- Bulk sampling
- Aerocell cassette & vacuum pump
- Tape Lift

#### Air movement

- Foxboro Miran Infra red gas analyser
- Grimm particulate counter
- Smoke pencil
- Anemometer

## 2.18 Moisture Content

The following areas were investigated to identify moisture content levels in terms of WME *wood moisture equivalent*. This standard is used as almost all meters are calibrated to wood measurement

Normal moisture content would be expected to be between 5 and 10% and the Tramex concrete meter usually accepts (3) as the highest level of moisture content permissible prior to laying non permeable floor coverings.

Area	Comparison Mc %	Affected area Mc%
Top cupboard	12%	31%WME
Top Hall	12%	37%WME
Shower room top floor by door	20%	100%
Downstairs Hall	12%	23% WME
Downstairs hall	0%	80-100% ultrasonic
Bedroom	31%	100% ultrasonic

## 2.19 Specific humidity (Sh) Moisture quantity in air

This part of the survey measures the water content of the air. The significance of this is that water damaged building dry out by evaporation and this evaporation is held in the air in the form of "(Sh) *specific Humidity*". Sh is a function of the combined values of Rh

relative humidity & temperature. The wetter a building is the higher the Sh and this factor is a major point in the environmental conditions required in the development of mould or secondary damage. A comparison is made with ambient or outside air.

AREA	Rh	Temp	Specific Humidity
Outside (ambient)	63	9	.005kg/kg
Windows were open and comparison levels may be on the low side.			
Hall	62%	18c	008kg/kg

**Note.**

Although lounge windows were providing good ventilation there still appeared to be relatively high specific humidity. This could be due to either exiting damage and relevant conditions or the use of clothes dryers (Horse) for drying clothes.

**2.20 Interstitial Cavities& air movement**

All buildings are built with cavities and risers to enable air breaks for sound or temperature insulation and to allow the routing of services such as pipes and electrical cabling. This is normal but it means that all parts of the building are connected through these voids or cavities. This connection can cause contamination from one area to travel to others by air movement often created by opening doors or windows. Contamination can enter room areas through electrical sockets, seams and joints and skirting. Weather, atmospheric and environmental conditions can alter or affect sampling protocols.

1. During the inspection process air sampling took place through the walls to assess if mould was present in the wall voids below the windows in the master bedroom. During this investigation it became apparent that these areas were under both positive and negative pressures. An un calibrated anemometer with self zero gauge was applied and wind speeds of 9meters per second were recorded.
2. In my opinion this indicates that internal primary and secondary finishes or living decorative barriers are in direct contact with external elements. These elements include humidity and temperature and driven wind all of which may have detrimental effects on the building structural materials.
3. In my lay opinion the building should have a vapour barrier and indeed a barrier to external elements.
4. The presence of external "ambient air" within the building envelope and environmental conditions could in my opinion result in "dew point" being reached on surfaces which are affected or in contact with or by the conditioning effects of heating or cooling variants inside the apartment.
5. Dew point being reached on hidden surfaces could result in rot, mould associated odours and possible health issues.
6. The air seepage in this general area could be through 13amp sockets or joints generally, mould mycotoxins are sub micron in size and if present could result in serious health issues due to the extent of time spent in this office/bedroom.
7. This phenomenon if proven could also have exceptionally serious ramifications regarding the heating and cooling costs of the property.
8. The recent implementation of HIPs Home Information Sellers Packs and specifically insulation or energy audits could result in serious resale implications. (June 2007)

### 2.21 Basic Principle of sampling

To assess if the mould spore species and quantity is elevated within the affected building and to identify where if possible the presence of toxic mould genus. The ambient level of outside will be used as a reference as will air sampling from unaffected areas within the building. It should however be noted that laminar and turbulent air flow, ventilation within the building may affect sample data.

### 2.22 Sampling and measurement accuracy

All samples and readings were taken by self calibrating equipment. The sampling protocol is qualitative against the lab result and analysis which is quantitative.

All other Rh *relative humidity* and MC *moisture content* readings are taken with un-calibrated equipment where comparison only is required. All readings were taken when meter ranges were constant and settled.

### 2.23 Sampling Protocol

- Air samples of ambient (outside) conditions were taken via Aerocell cassettes with a sampling time of 2 minutes at 15liters per minute.
- Internal samples were taken for 2 minutes at 15 litres per minute.
- Wall samples where or if taken are for 1 min @15 litres per minute. This reduced sampling period was to take account of dust and debris within the wall which could obscure the filter fields during analysis.
- The sampling was undertaken within rooms assessed as being affected

2.24 Table 1

Area	Sample No	Sample type	Species	Quantity
Main bed wall bed foot	1/3	AC	Ascospores Pen Asp Basiospores	33 M <sup>3</sup> 100 133
Main bed wall head end	2/3	AC	Ascospores Pen Asp Basiospores	67 M <sup>3</sup> 400 167
Main bed room	3/3	AC	Pen Asp Basiospores Cladisorium	100M <sup>3</sup> 67 167

Downstairs Hall	4/3	AC	Ascospores Cladisporium Stachybotrys	100 M <sup>3</sup> 100 33
Lounge	5/3	AC	Ascospores Pen Asp Basiospores Stachybotrys	33 M <sup>3</sup> 233 100 33
Bedroom window ceiling	TL1	TL	Alternaria Ascospores Pen Asp Basiospores Cladisporium Smuts	62 cm <sup>2</sup> 262 15 46 2187 277
Ambient outside	10 (602)	AC	Ascospores Pen Asp Basiospores Cladisporium Stachybotrys	67 M <sup>3</sup> 300 33 433 67

**Key** Aerocell cassettes **AC** Tape lift **TL** Bulk sample **BLK**

## 2.25 Mould analysis report

**Please note the ambient results are likely to higher than normal due to sampling and weather constraints.**

Table 1 shows laboratory analysis which identifies both type and quantity of mould collected in the sampling protocol. In a property unaffected by water damage or high levels of moisture the mould species and quantity should be similar or less than outside.

Table 1 has been taken from the full lab analysis which also contains some other minor generic species which have no significance in light of the results.

The mould species shown here are internationally recognised and acknowledged currently as the most toxic or as a health concern. It should be recognised that the following information is provided as guidance only and is generated from recognised sources. On a legal point, the evidence to substantiate the health risks associated with moulds has not been ratified in a court of law. Therefore any mould related or suspected health issue or risk may be difficult to prove.

### 2.26 Alternaria

Common allergen with an IgE mediated respo Alternaria has been associated in some cases of hypersensitivity Pneumonitis. Acute symptoms include edema and bronchi spasms, chronic cases may develop pulmonary emphysema. As with other toxigenic molds, alternaria can also alter DNA, as well as destroy the human immune system.

### 2.27 Ascospores

The sexual spores of Ascomycetes found in sacs of 8. Found where the air is saturated. Can represent many health risks including candida, thrush, vaginitis. Ascomycota describes 75% of all mould and may include Penicilium, Aspergillus which may produce aflatoxin, a serious health concern.

## 2.28 **Aspergillus**

The genus *Aspergillus* includes over 185 species. Around 20 species have so far been reported as causative agents of opportunistic infections in man. Type I allergies (hay fever, asthma).

Type III hypersensitivity pneumonitis: Humidifier lung, Malt worker's lung, Compost lung, Wood trimmer's disease, Straw hypersensitivity, Farmer's lung, Oat grain hypersensitivity, others.

Other: *A. fumigatus*: allergic bronchopulmonary aspergillosis (ABPA), allergic fungal sinusitis *Aspergillus* spp. are well-known to play a role in three different clinical settings in man: (i) opportunistic infections; (ii) allergic states; and (iii) toxicoses.

Immunosuppression is the major factor predisposing to development of opportunistic infections. Almost any organ or system in the human body may be involved. Onychomycosis, sinusitis, cerebral aspergillosis, meningitis, endocarditis, myocarditis, pulmonary aspergillosis, osteomyelitis, otomycosis, endophthalmitis, cutaneous aspergillosis, hepatosplenic aspergillosis, as well as *Aspergillus* fungemia, and disseminated aspergillosis may develop. These moulds are associated with certain kinds of cancer and disease in kidneys, liver etc.

## 2.29 **Basiospores**

Probably common.

Type I allergies (hay fever, asthma).

Type III hypersensitivity pneumonitis: Lycoperdonosis (puffball spores), Mushroom culture hypersensitivity. Asexual forms may cause rare opportunistic infections.

The yeast *Cryptococcus neoformans* is a basidiomycete (Bird Droppings).

## 2.30 **Botrytis** Type I allergies (hay fever, asthma).

Type III hypersensitivity pneumonitis: Winegrower's lung.

## 2.31 **Chaetomium**

Not well studied. Type I allergies (hay fever, asthma). Uncommon agent of onychomycosis (nail infection). Chaetomin. *Chaetomium globosum* produces chaetoglobosins.

Sterigmatocystin is produced by rare species. Other compounds produced (which may not be mycotoxins in the strict sense) include a variety of mutagens. *Chaetomium* spp. are among the fungi causing infections wholly referred to as [phaeohyphomycosis](#). Fatal deep mycoses due to *Chaetomium atrobrunneum* have been reported in an immunocompromised host. Brain abscess, peritonitis, cutaneous lesions, and onychomycosis may also develop.

## 2.32 **Cladosporium**

A mould found in the decay of organic material and usually a marker for a water damaged home. Can often be found around windows where condensation has caused water pooling. Often associated with asthma eczema. Common and important allergen. Type I allergies (hay fever, asthma).

Type III hypersensitivity pneumonitis: Hot tub lung, Moldy wall hypersensitivity.

## 2.33 **Curvularia**

Common.

Type I allergies (hay fever, asthma).

Other: A relatively common cause of allergic fungal sinusitis

## 2.34 **Epioccum**

Common.

Type I allergies (hay fever, asthma).

### 2.35 Fusarium

Type I allergies (hay fever, asthma). Causes keratitis, endophthalmitis, onychomycosis, mycetoma, and disseminated infection in immunocompromised patients; infections in burn victims, and systemic opportunistic infections in severely disabled hosts. Tricothecenes (type B); T-2 toxin; zearalenone (F-2 toxin), vomitoxin, deoxynivalenol, and fumonisin. Zearalenone is not acutely toxic, and actually may have positive effects with controlled ingestion.

### 2.36 Penicillium

*Penicillium* spp. are occasional causes of infection in humans and the resulting disease is known generically as penicilliosis. *Penicillium* has been isolated from patients with keratitis [584], endophthalmitis, otomycosis, necrotizing esophagitis, pneumonia, endocarditis, peritonitis, and urinary tract infections. Most *Penicillium* infections are encountered in immunosuppressed hosts. Corneal infections are usually post-traumatic [584]. In addition to its infectious potential, *Penicillium verrucosum* produces a mycotoxin, ochratoxin A, which is nephrotoxic and carcinogenic.

### 2.37 Rusts

Type I allergies (hay fever, asthma).

### 2.38 Smuts

Type I allergies (hay fever, asthma).

### 2.39 Stachybotrys

This mould produces Tricothecenes and T2 toxin which is described as one of the most toxic chemicals and has been used as a chemical-biological warfare agent by the USA and Iraq. Tricothecenes are potent inhibitors of DNA, RNA, and protein synthesis. They modulate inflammatory reactions and alter alveolar surfactant phospholipid concentrations. It has specific relevance in lung disease, asthma infection and sick building syndrome. Stachybotrys has been linked with bleeding lung (pulmonary hemosiderosis) in infants. The effects of Stachy are often associated with other moulds present which may trigger defence toxins that affect humans.

### 2.40 Torula

Type 1 allergen, Hay fever, asthma

### 2.41 Ulocladium

Type I allergies (hay fever, asthma).

Ulocladium cross-reacts with Alternaria, adding to the allergenic burden of Alternaria-sensitive patients. Rare subcutaneous tissue infection

#### Note.

The significance of the findings should be assessed by the sample result differences between outside and inside the building which identifies the differences in naturally occurring and building mould species and quantity. It is quite usual to find all species present in the outside open environment but elevated quantities inside a building are a significant concern.

#### **2.42 Analysis Overview**

- The lab analysis and results show that the property is contaminated with potentially toxic mould and in my opinion a substantial health risk may be present to anyone that enters the property.
- The building has been affected by moisture intrusion and or high levels of humidity the responsive drying program was not fit for purpose and can reasonably be said to have caused uncontrolled evaporation which would have been adsorbed into hydrophilic materials and exasperated the mould growth.
- The visible mould growth points to the very high risk of mould formation within the interstitial cavities and voids.
- The health risks and hazards associated with mould will require engineering controls when removing mould contamination and invisible spores and mycotoxins.
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- The mould species shown here are internationally recognised and acknowledged currently as the most toxic or as a health concern.
- Stachybotrys in particular produces T2 toxin which is described as one of the most toxic chemicals and is used as a chemical-biological weapon.
- The significance of the findings should be assessed by the sample results of outside and inside the building which identifies the high differences in naturally occurring mould.
- The lab analysis and results show that the property is grossly contaminated with potentially toxic mould and in my opinion a substantial health risk may exist to anyone that enters the property.
- The health risks and hazards associated with mould will require engineering controls when removing mould contamination and invisible spores and mycotoxins.
- Increased thermal drop in insulated cavities point to a possible dew point therein and condensation, a factor in mould growth.
- There is a possibility that dew point was reached within steel HVAC systems
- There is currently a potential latent loss or degradation of building materials from moisture or mould.
- There is a potential for ongoing indoor air quality issues

- There is a possibility that conditions will deteriorate as and when the building becomes tighter.
- Potential for corrosion and intermittent faults within micro circuitry and electronic equipment caused by high humidity leakage from cavities into wall mounted metal cable and pipe runs
- I have extreme concerns regarding the construction detail and in particular secondary vapour barriers on external walls and potential for mould growth.
- There is a potential for interstitial vapour travel and dew point being reached behind paper and again the potential for mould growth.

#### **2.43 Recommendations**

- a. Prior to any remediation works, a full construction investigation should be considered to assess roof and general construction leakage.
- b. Both air and water (moisture) ingress should be considered.
- c. A negative pressure test is recommended and the use of trace gas such as SF6 considered.
- d. Water ingress challenge testing should be considered under negative pressure
- e. The natural ventilation of the apartment should be investigated as I have a suspicion that current ventilation exhaust or air exchange rates are inadequate.
- f. Mould should only be remediated by competent personnel to avoid cross contamination or re emergence at a later date.

#### **2.44 Concluding Remarks**

- a. The property requires a substantial and in depth investigation to confirm or deny areas of concern as identified or considered within this report.
- b. A competent protocol must be developed to ensure all aspects of contamination is removed.
- c. The high wind speeds found in the wall cavities and possible mould or decay makes this sleeping and living area a possible health hazard.
- d. Apart from the obvious leakage points the windows were found to be loose and a considerable heat loss will result with expected dew point and the risk of condensation considered.
- e. The new wood floor should not be fitted until all leaks have been repaired and the concrete, *sand cement screed* dried to within manufacturer's recommendations, this may take some time unless competent drying procedures are installed.
- f. Due to ventilation and dilution factors sampling should be re-assessed when the apartment has been closed overnight.

I believe the levels of mould contamination in the property may not reflect the true levels of spores as the apartment was extremely well ventilated at the time of survey although windows were closed during the sampling process.