PAS 64:2013

Mitigation and recovery of water damaged buildings – Code of practice

bsi.

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Foreword

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BSI permits the reproduction of the text in Annex M, on pages 44 to 46.

Supersession

This PAS supersedes PAS 64:2005, which is withdrawn.

Presentational conventions

The provisions in this PAS are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in italic type, and does not constitute a normative element.

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This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Particular attention is drawn to the following specific regulations:

- The Management of Health and Safety at Work Regulations 1999 [1]
- The Electricity at Work Regulations 1989 [2]
- The Provision and Use of Work Equipment Regulations 1998 [3]
- The Special Waste Regulations 1996 [4]
- The Health and Safety at Work etc Act 1974 [5]
- The Workplace (Health, Safety and Welfare) Regulations 1992 [6]
- The Control of Asbestos Regulations 2006 [7]
- The Construction (Design and Management) Regulations 2007 [8]

Introduction

Water damage to a building can lead to increased public health risk and a reduction in its value and usefulness, which can increase over time if not dealt with in a managed and co-ordinated way.

Mitigating water damage by effective drying solutions is an important part of the total recovery process. Cleaning protocols and assessment of indoor air quality might also be required depending on the profile of the water damage incident.

This PAS provides recommendations and guidance for the restoration of a water damaged building from the initial incident to the point at which repair and reinstatement commence.

1 Scope

This PAS gives recommendations for the mitigation and recovery of buildings damaged by water. It is applicable to all forms of water damage to buildings.

It covers the mitigation and recovery process including:

a) initial inspection of a water damaged building;
b) setting drying and cleaning goals (including air quality goals);
c) selecting the drying and cleaning techniques and equipment to be used;
d) monitoring the drying and cleaning progress;
e) verifying drying and cleaning goals have been met;
f) documentation for provision to the customer.

It also provides further guidance to support the application of this PAS including descriptions of techniques and equipment in current use, example forms and example calculations.

This PAS does not cover building repair and reinstatement. However, it is recognized that the restorative drying process is a primary stage of the overall repair and reinstatement process.

It does not cover the restoration of contents other than the implications for drying or restoring the building.

It is for use by restorers and may be of interest to building owners and occupiers, insurance companies and their representatives and those involved in the subsequent repair and reinstatement of a building.

2 Terms and definitions

For the purposes of this PAS, the following terms and definitions apply.

2.1 air

invisible gaseous substance which has the capacity to carry moisture in varying, measurable quantities

2.2 atopic

predisposition towards developing an allergic hypersensitivity reaction

NOTE A person with atopy will typically have one or more of the following hypersensitivity reactions: eczema (atopic dermatitis), allergic rhinitis (hay fever), allergic conjunctivitis or allergic asthma. People with atopy also have a tendency to have food allergies.

2.3 building

main structure with walls and roof plus its permanent fixtures and fittings

NOTE 1 Examples of permanent fixtures and fittings include sanitary appliances and fitted kitchens.

NOTE 2 Buildings insurance policies usually include outbuildings but cover is policy specific and may be referred to in the event of a claim.

2.4 cleaning

process of locating, identifying, containing, removing and disposing of unwanted substances, odour and staining from an environment or material to reduce damage or harm to human health, animals, wildlife or valuable items

2.5 cleaning goal

pre-determined target cleanliness level based on suspected contamination, presence of odour, staining and measurement of actual levels of pollutants by an established method

2.6 contaminant

substance that could cause harm to humans, animals, wildlife and the environment or property

NOTE *Examples of contaminants include mould, mildew, fungi, bacteria, viruses, asbestos, lead, arsenic, oil, sewage and effluent.*

2.7 contents

items contained within a building that are not structural materials or fixtures and fittings

NOTE *Examples of contents include free standing appliances, artwork, clothing, curtains, electronic equipment, furniture, rugs and personal possessions. Contents insurance is usually policy specific and may be referred to in the event of a claim.*

2.8 decontamination

removal, neutralization or dilution of surface or air borne particles that could be harmful to humans, animals, wildlife and the environment

2.9 desiccant

substance that has a high affinity for water and is used as a drying agent

NOTE *Examples of desiccants include calcium oxide and silica gel.*

2.10 drying

process to remove absorbed moisture from wet structural materials

2.11 drying goal

target moisture level based on a known equilibrium moisture content (EMC) (see **2.13**) or equilibrium relative humidity (ERH) (see **2.14**) or wood moisture equivalent (WME) (see **2.44**) or other accepted method of measuring moisture

2.12 environmental moisture control

process of controlling moisture in both affected and unaffected areas of a building to control or reduce the likelihood of secondary damage

2.13 equilibrium moisture content (EMC)

percentage moisture content (see **2.22**) of a structural material at the point where the structural material is saturated with moisture at the relative humidity and temperature of the surrounding air

2.14 equilibrium relative humidity (ERH)

relative humidity of the indoor air at the point where the indoor air and the building are no longer losing or gaining moisture from each other

2.15 extraction

initial removal of standing or excess water from buildings and contents

NOTE *Examples of extraction methods include vacuuming and pumping.*

2.16 humidity ratio (HR)

also known as specific humidity
amount of moisture in a defined mass of air expressed as either kilogram per kilogram (kg/kg) or grams per kilogram (g/kg)

2.17 hygroscopic material

material that readily retains moisture or water vapour from air

2.18 indoor air quality

air quality within and around a building

NOTE *This is particularly relevant to the health and comfort of the occupants of the building. The indoor air quality can be affected by gases, particulates, microbial contaminants or any mass or energy stressor that can induce adverse health conditions.*

2.19 initial inspection

collection of data to determine the degree of loss to the physical structure and contents of the affected building and contents

2.20 method statement

written procedure outlining steps and how to perform a desired task

2.21 mitigation

act of limiting current and future loss or damage to building and contents

2.22 moisture content

amount of moisture present in a structural material expressed as a mass or a percentage of the mass of the structural material when dry

2.23 moisture map

documented visual guide accompanied by field test results taken at incremental points, indicating the extent of water damage

NOTE *An example of a moisture map is given in* ***A.2****.*

2.24 pathogenic agent

microorganism (such as a bacterium or virus) that causes disease in humans, animals or plants

2.25 permeance

degree or factor to which a structural material transmits water in its liquid or gaseous form

2.26 pre-incident condition

condition of the building and contents at the time before the incident

2.27 primary damage

damage sustained as a result of direct contact with water or contaminants

NOTE 1 *Examples of primary damage include staining, swelling, dissolving, cupping and buckling of hard wood, delamination of furnishings and fixtures, migration of dyes, weakening of adhesives, rusting and corrosion and microbial contamination.*

NOTE 2 *See also definition of secondary damage (****2.36****).*

2.28 psychrometry

study of the relationship between atmospheric air mixtures in regards to air, humidity and temperature

NOTE *Psychrometry deals with measuring and understanding the thermodynamic properties of air and water vapour mixtures, to enable restorers to properly analyse and manage conditions during drying.*

2.29 recovery

steps or mechanisms put in place, in a controlled way, to restore the affected area to its pre-incident condition

2.30 relative humidity

amount of moisture present in air expressed as a percentage of the amount needed for saturation at the same temperature

2.31 remediation

act of reversing or stopping secondary damage

2.32 restoration

process of repairing or renovating a building so as to restore it to its original condition

2.33 restorer

damage restoration contractor or firm that is responsible for the restoration of damaged buildings

2.34 risk zone

area in which a level of risk has been identified

2.35 schedule of works

complete detailed listing of required tasks to return the building and contents to a pre-incident condition

2.36 secondary damage

damage to structural materials sustained from indirect or prolonged exposure to contaminants migrating or absorbed moisture or humidity and mildew growth

NOTE See also definition of primary damage (2.27).

2.37 site

address or location at which work is carried out on a water damage restoration

2.38 structure

building and all permanently affixed materials and finishes

NOTE This includes items such as carpentry, plasters and finishes.

2.39 technically competent person

person who has demonstrated a level of skill, knowledge, attitude, training and experience to reasonably perform a desired task

2.40 vapour pressure

pressure exerted by humidity on the surrounding environment

NOTE Vapour pressure is directly related to the humidity ratio.

2.41 vulnerable individuals (health)

individuals being unusually severely affected by a substance either as a result of susceptibility to the effects of these substances or as a result of a greater than average exposure following a water damage incident

SOURCE: WHO Europe [9].

2.42 water damage

impairment of the habitation and function of buildings and contents by the unwanted intrusion of water and high humidity

2.43 white glove test / white towel test

rubbing of a clean white cotton glove/white cotton towel against a surface of a structural material that has been previously cleaned

NOTE An absence of any residue transfer would indicate the cleaning goal has been achieved.

2.44 wood moisture equivalent (WME)

percentage moisture content in a non-conductive structural material as taken from a moisture content scale derived by measuring the relative moisture content of wood when in contact with the non-conductive structural material

NOTE Moisture meters used in non-conductive surfaces are calibrated to a scale called WME. This is because wood is fairly consistent with regard to moisture content, even within different species, whereas other structural materials, like sand/cement or plaster, vary according to their particular composition. Consequently, structural materials are measured on the WME scale which would be equivalent to the moisture content a piece of wood would assume if placed in contact with the material being tested.

3 Mitigation and recovery process

NOTE The objective of drying and cleaning a building after water damage is to remove excess water, to inhibit further deterioration and to return affected structural materials to their drying goal; whilst mitigating potential health risks to employees, visitors and occupiers during and post remediation and minimizing the disruption to building owners or occupiers.

3.1 General

The restorer should implement the principles of project management during a water damage mitigation and recovery project, which should include the following stages:

a) initial inspection (see **3.2**);

b) setting drying goals and the time frame to achieve these drying goals (see **3.3**);

c) setting cleaning goals and the time frame to achieve these cleaning goals (see **3.4.1**);

d) assessment of the impact of the water damage on the indoor air quality of the building (see **3.4.2**);

e) selecting drying techniques and equipment (see **3.5**);

f) selecting cleaning techniques and equipment (see **3.6**);

g) selecting indoor air quality cleaning techniques (see **3.7**);

h) monitoring the drying progress and verifying drying goals have been met (see **3.8**);

i) verifying cleaning goals have been met (see **3.9**);

j) verifying indoor air quality goals have been met (see **3.10**);

k) documentation for provision to the customer (see Clause **4**).

*NOTE Drying, cleaning and indoor air quality goals and the methods used to achieve these goals are components of a process leading to a mitigated and recovered building. Consequently, the decision to incorporate each component and the precedence in which order they are completed is based on the results obtained during the initial inspection (see **3.2**). The results from the initial inspection are used to establish the extent of the scale of building material moisture levels, uncleanliness and the pollution of the indoor air as a direct result of the water damage when compared to a typical building in normal use.*

3.2 Initial inspection

The restorer should perform an initial inspection of the building, within a defined time frame as documented in their service standard procedures.

NOTE 1 The aim of this initial inspection is to gather data on site specific conditions which influence the decision making process.

The service standard procedures should document:

a) the time frame within which the initial inspection is to be performed following the reporting of the water damage incident including:

   1) time frame for a single building;

   2) time frame for multiple buildings in accordance with a defined order of precedence as given in b);

b) the precedence for types of water damage incidents and affected groups of individuals for which a priority response is required.

NOTE 2 The initial inspection is usually performed as soon as possible (within 24 hours) following the discovery of the water damage. Some incidents benefit from a faster response time (2 to 4 hours) as this will increase the effects of mitigation measures (e.g. if standing water is present; when the source of water is immediately likely to be harmful for occupants health; or when occupants are at a higher risk of harm from a water damage incident, such as elderly or disabled occupants).

The restorer should identify and record:

i) the estimated depth and/or area and/or volume of water involved in the damage;

ii) the building type, construction materials used, build techniques and any relevant historical or construction issues;

iii) the source of the water damage;

   NOTE Sources and categories of water damage are given in Annex B.

iv) the length of time the building has been affected by water damage;

v) pre-existing water damage to the building or other sources of potential damage which might negatively influence the restoration attempt;

vi) a schedule of emergency mitigation works to make safe, limit further loss, extract standing water and control harmful contaminants within the building;

vii) areas outside of the initial loss that might be at risk and require environmental moisture control;

viii) damage to structural materials or finishes that are deemed to be not restorable, which require demolition and removal or are barriers to evaporation that might require removal to expedite drying in accordance with a defined stripping out guide;

*NOTE An example guide to the stripping out of structural materials is given in **A.3**.*

ix) damage to services such as electrical, gas or clean water supply that might need emergency attention, a temporary supply required or fully repaired to allow works to commence;

x) actual moisture measurement readings and corresponding drying goals for each of the structural materials being dried and the moisture currently held within the air externally and internally (humidity ratio);

xi) a schedule of works for drying the structural materials, based on achieving the drying goals whilst taking account of occupiers' health, safety, wellbeing and environmental impacts;

xii) a schedule of works for cleaning the structural materials, based on achieving the cleaning goals whilst taking account of occupiers' health, safety and wellbeing;

xiii) an assessment of the effect of the water damage on indoor air quality;

xiv) potential health risks to employees, visitors and occupiers during and post remediation, and any mitigation measures incorporated into the restoration plan as a result;

xv) energy meter readings prior to works commencing (gas, electricity, etc.).

*NOTE 3 An example of an initial inspection form is given in **A.1**.*

*NOTE 4 An example of a moisture map that can be used in conjunction with the initial inspection form is given in **A.2**.*

3.3 Setting drying goals and the time frame to achieve these drying goals

The restorer should set the target moisture content of the structural materials being dried, and refer to this as the drying goal (see **2.11**).

NOTE 1 This can be done by reference to a pre-determined moisture measurement threshold of the structural material or by comparing to structurally similar but unaffected parts of the building. Examples of practical moisture measurement thresholds are given in Annex C.

NOTE 2 An example of a drying goal recording document is given in Annex D.

The restorer should use the appropriate moisture measurement equipment in order to survey and set the drying goal(s). Moisture measurements should be taken from the air outside of the building, the air inside the building, and from within the structural materials themselves as this data assists in the decision process to choose a drying method.

NOTE 3 Guidance on moisture measurement is given in Annex E.

The drying goal(s) should be set within 48 hours after the initial inspection.

3.4 Setting cleaning goals and the time frame to achieve these cleaning goals

3.4.1 Structural materials

The restorer should set the target level of cleanliness for each of the structural materials being cleaned, and refer to this as the cleaning goal.

NOTE 1 This can be done by reference to a pre-determined cleaning goal for the structural material or by comparing to structurally similar but unaffected parts of the building.

The cleaning goal(s) should be documented and communicated to all interested parties.

NOTE 2 Examples of cleaning goal recording documents are given in Annex F.

The restorer should use the appropriate equipment in order to survey and set the cleaning goal(s).

The cleaning goal(s) should be documented within 48 hours of the initial inspection.

3.4.2 Indoor air quality

Where poor indoor air quality is suspected, the restorer should set a target level of indoor air quality within the building and refer to this as the indoor air quality goal(s).

The indoor air quality goal(s) should be documented within 48 hours of the initial inspection.

*NOTE 1 This can be done by reference to a pre-determined indoor air quality goal for the structure or by comparing to external conditions or structurally similar but unaffected parts of the building. Information on environmental sampling and air quality goals is given in **G.2.4**.*

NOTE 2 *Indoor air quality can deteriorate quickly over a short period in time dependent on the prevailing environmental conditions. Monitoring of indoor air quality may therefore be considered on an ongoing basis and not only conducted at the beginning and end of the project.*

The restorer should use the appropriate equipment in order to survey and set the indoor air quality goals.

A health risk analysis for exposure to poor indoor air quality should be undertaken. The health risk analysis should include the occupants, the restorer attending site, other representatives of organizations that might attend the site, or any other person that might reasonably be expected to attend site (e.g. members of the public).

NOTE 3 *Guidance on biological amplification during a water damage is given in Annex B.*

NOTE 4 *An example occupant health risk analysis from exposure to poor indoor air quality is given in Annex G.*

3.5 Selecting the drying techniques and equipment

NOTE 1 *Once moisture evaporates from structural materials and contents into the air, humidity is likely to increase within the structure unless this moisture is removed by use of ventilation or dehumidification. Failure to remove evaporating moisture can retard the drying process and in the worst instances, create conditions in which secondary damage can occur, e.g. mould and microbial growth.*

NOTE 2 *Examples of drying methods and systems are given in Annex H.*

In order to dry a building quickly and efficiently, the drying method should be selected on evaluation of the following factors:

a) indoor and outdoor humidity ratio;
b) potential health risks to employees, visitors and occupiers during mitigation and restoration;
c) potential security risks of leaving windows/doors or other apertures open to assist drying;
d) the wider environmental impact of the drying method;

   ***NOTE** An example of an environmental impact assessment of drying method is given in Annex I.*

e) the ambient air temperature in which the drying method is being used;
f) the availability of sufficient power;
g) the estimated time frame it will take to reach the drying goals;
h) its effect on structural materials;
i) the availability of drying equipment;
j) its effect on the controlled demolition and repair process, i.e. can some materials be left in situ rather than removed;
k) a cost benefit analysis;

   ***NOTE** An example of a cost benefit analysis is given in Annex J.*

l) the impact of the drying method on the occupier and their ability to use the property during the drying process if they are remaining in residence;
m) the ability of the restorer to monitor the drying method appropriately taking into account any constraints (such as the remoteness of the property).

3.6 Selecting the cleaning techniques and equipment

In order to clean materials quickly and efficiently, the cleaning method should be selected on evaluation of the following factors:

a) potential health risks to employees, visitors and occupiers due to the cleaning process;
b) the wider environmental impact of the cleaning method;
c) the availability of sufficient power;
d) safe disposal of waste generated from the cleaning process.

3.7 Selecting the indoor air quality cleaning techniques

***NOTE** After a water damage incident, microbial activity can increase which in turn can affect the quality of the air within the indoor environment.*

The restorer should assess the likely impact of poor indoor air quality as a direct result of the water damage incident for the following factors:

a) the source of the water;
b) the presence of substances in the water that could promote microbial growth (e.g. sewage);
c) the length of time the water has been left unmitigated;
d) the temperature of the environment, internally and externally;
e) the amount of moisture in the air (g/kg);
f) whether an occupant or other person exposed to the indoor environment claims symptoms which can be attributed to poor indoor air quality;
g) the presence and levels of visible mould and microbial growth;
h) the likely presence and levels of mould and microbial growth in hidden voids such as partition walls;
i) the presence of a person that is especially vulnerable to poor indoor air quality (see **G.1**).

3.8 Monitoring the drying progress and verifying drying goals have been met

The restorer should design a monitoring programme in accordance with the drying method used.

As part of the monitoring programme, the restorer should monitor the drying equipment installed and record the measurement of moisture and its progress towards the drying goal.

Restorers should document a service standard where the frequency of the monitoring is determined by the type of incident, the drying method and risks to the occupier's health, safety and wellbeing.

Where monitoring activity indicates that drying goals are not being achieved in the expected manner, the restorer should review what factor(s) are having a negative impact on the drying regime.

NOTE 1 *The restorer may review their initial loss assessment to establish a reason for the drying failure or conduct a further loss assessment taking into account prevailing conditions.*

Once the reason for the failure has been identified, the restorer should set new drying goals and the time frame to achieve these drying goals in accordance with **3.3** and select the drying techniques and equipment to be used in accordance with **3.5**.

NOTE 2 *The restorer might need to recommend the use of an alternative method for drying to address the drying failure.*

A completion inspection should be undertaken and documented to verify that the drying goals have been met. The moisture measurement data for each affected material should be recorded and communicated to all interested parties.

NOTE 3 *Interested parties would normally include the customer, homeowner, insurer, loss adjuster, surveyor or building repairer.*

NOTE 4 *For examples of drying goal data, see Annex K.*

3.9 Verifying cleaning goals have been met

After cleaning, a completion inspection should be undertaken and documented to verify that the cleaning goals have been met.

The cleaning goal should be verified through one or more of the following:

a) visual inspection to include removal of all visible deleterious material and removal or suitable treatment of stains;

b) white glove or white towel test (as defined in **2.43**);

c) appraisal of material surfaces for biological activity using suitable sampling and analysis techniques.

The cleaning goal measurement data for each affected material should be recorded and communicated to all interested parties.

3.10 Verifying indoor air quality goals have been met

Where remedial action has been undertaken to improve the indoor air quality within the building, a completion inspection should be undertaken and documented to verify the indoor air quality goals have been met.

This should include:

a) removal of odour specific to the water damage incident;

b) visual inspection to include the reduction or removal of visible particulates such as dust;

c) air sampling using suitable sampling and analysis techniques.

NOTE 1 *Guidance on indoor air quality surveying techniques is given in **G.2**.*

NOTE 2 *Attention is drawn to the legislative requirements in:*

- *Workplace (Health, Safety and Welfare) Regulations 1992 [6];*
- *Air Quality Standards Regulations 2010 [10].*

The indoor air quality measurement data for each affected room should be recorded and communicated to all interested parties.

4 Documentation for provision to the customer

The restorer should maintain, retain and provide to the customer as a minimum the following records:

a) internal and external psychrometric records (including relative humidity, humidity ratio and temperature);

b) structural materials moisture content records, including drying goals, cleaning goals and moisture contents at the start and completion of the drying works;

c) the scope of work together with the mitigation and recovery plans to include any survey results of pre-incident moisture ingress or building faults that might influence the drying programme;

d) where relevant, contents and personal property inventories signed and dated by the restorer (and customer/consumer if present at the time);

   NOTE *It might be relevant to maintain contents and personal property inventories, for example, where the restorer has authority to move them to storage.*

e) detailed work logs/diary, including a description of:
   1) actions;
   2) timing;
   3) location;
   4) methods used;

f) photographic records;

g) equipment logs or similar documents that include a description of all equipment, materials, supplies and products used on the project, the quantity and length of time used (where applicable) and other relevant information;

h) site specific risk assessment documentation signed and dated by the restorer;

i) electrical and gas readings, including detailed calculations of how much power the equipment has used;

j) a completion certificate indicating that mitigation and recovery of the water damaged building has been carried out in accordance with PAS 64:2013, which includes as a minimum:
   1) the final moisture content readings of affected materials and confirmation where drying goals have been met;
   2) a statement confirming cleaning methods undertaken and the evidence to confirm that cleaning goals have been met;
   3) a statement confirming indoor air quality assessments undertaken and the evidence to confirm the indoor air quality conditions have been met;
   4) where applicable, a statement which details why a material or structural component cannot or has not been restored.

NOTE 1 *An example completion certificate is given in Annex L.*

NOTE 2 *An example of an information leaflet is given Annex M.*

5 Building repair and reinstatement

NOTE 1 Although this PAS cannot cover all the current best practice in building repair and reinstatement, it is important to note that the drying phase of a building is often a critical element of the overall recovery process.

If the restorer responsible for the drying phase of the building is not responsible for the building repair phase, then a hand-off document should be made available detailing important aspects of the drying works. This should include as a minimum:

a) a description of materials removed during the drying process to assist in the specification for restoration;

b) structural material drying goals;

c) the residual moisture contents of structural materials at the end of the drying phase;

d) any identified building defects or pre-existing moisture ingresses that were not specified as part of the water damage loss;

e) the building's internal temperature and humidity.

NOTE 2 Where the building contractor is appointed during the mitigation/drying phase, it is beneficial to the building repair and reinstatement stages if the restorer engages and liaises with the contractor as soon as possible. This is to ensure that the building repairer can specify the reinstatement works correctly.

NOTE 3 It is important for the building repairer (or any person responsible for the building prior to reinstatement works) to maintain normal ambient internal temperature and humidity conditions, as changes could adversely affect the repair process. Maintenance of dry and warm conditions inside the building helps to avoid the possibility of the re-wetting of the building, which could occur in certain atmospheric conditions. The building repairer may need to take into account other building maintenance issues or instances of non-flood related damp penetration of the building prior to the commencement of the reinstatement works. Some structural material drying goals might not be suitable for some reinstatement works (e.g. for the application of certain finishes such as wood flooring).

NOTE 4 Some properties, especially those at greater risk of periodic flooding (for example those properties on a recognized floodplain), might be appropriate for repairing with resilient measures to assist the building in coping with a water damage incident in the foreseeable future.

NOTE 5 Further guidance on resilient building repair and reinstatement is given in Guide to resistant and resilient repair after a flood [11].

Annex A (informative)
The initial inspection

A.1 Example initial inspection form

Figure A.1 provides an example of an initial inspection form for recording the loss assessment to a water damaged structure.

Figure A.1 – Example initial inspection form

Customer name		
Tel	Fax	Email
Address		
		Postcode

Report type	Callout / Interim / Final
Incident date	Report date

Building type	Building construction
Information relevant to construction or historical importance	

VAT registered	VAT no.

Emergency Y/N	Peril description	Source	Volume of water involved
Pre-existing conditions Y/N	Area (m²)	Commercial / domestic	No. of rooms affected
Electricity supply Y/N	Electricity meter reading	Gas supply Y/N	Gas meter reading
Clean water supply Y/N	Category of water damage		

Details and findings

Summary of action taken and outcome

Building works required	Restorable	Strip out
Areas susceptible to secondary damage		

Figure A.1 – Example initial inspection form *(continued)*

Alternative drying approach to be considered
Likely cost benefit of alternative approach

Equipment	Equipment type	Equipment power usage (kW·h)	Date on site	Date off site	No. of hours used (h)	Total power consumption (kW)

Damage in picture form (either photos or floor plan)

Building details	Room	Description	Area (m^2)	Affected area (m^2)	Structural material	Repair/replace

Room	Date of visit	RH	Temp	Wall type[A)]	Wall finish[B)]	Floor	Floor finish

Moisture readings	Room	Meter used	Drying goal	Date of visit	Date of visit	Date of visit	Date of visit

Sub-contractors	Laundry	Asbestos	Storage	Skips	Oil	Document	Electronic
	Mechanical	Data	Fine art	Antique			

A) For example, brick with plaster.
B) For example, wallpaper or tile.

A.2 Moisture map

A moisture map is a visual representation of the moisture conditions found at the building. It is a useful tool in recording changes in the moisture contents of the structural material as the drying work progresses. Figure A.2 provides an example moisture map.

Figure A.2 – Example moisture map

Sketch areas affected, record readings and reading locations using most appropriate instrument setting for the materials being tested. Show placement of drying equipment. Please identify highest moisture test areas with numerical identifier and location of equilibrium test boxes.

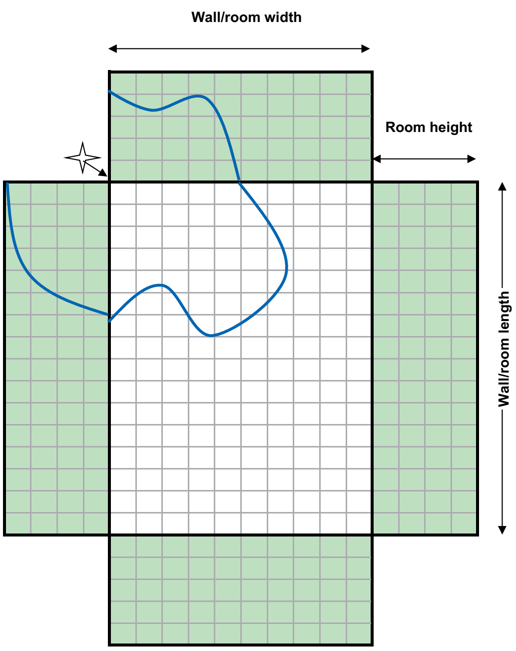
Loss assessment by room/area

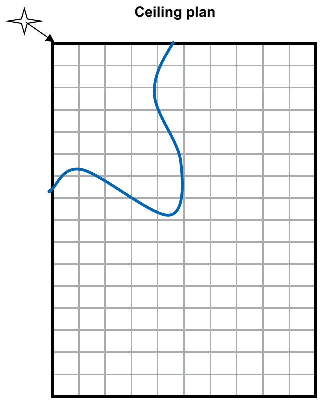
Policy holder name ____ **Job number** ____ **Policy holder postcode** ____

First visit to policyholder Time ____ Date ____ **Start of drying** Time ____ Date ____

Room ____ Category of water damage (1, 2, 3 or 4) ____ Floor, wall and ceiling plan - Rectangular room

		Visit number, visit date & readings									Drying goals
	Visit no.	1	2	3	4	5	6	7	8	9	
	Date										
Outside RH (%)											
Outside temp (°C)											
Outside humidity ratio (g/kg)											
Inside RH (%)											
Inside temp °C											
Inside humidity ratio (g/kg)											
Floor	MC										
	%WME										
	%ERH										
	%MC										
Ceiling	MC										
	%WME										
	%ERH										
	%MC										
Wall 1	MC										
	%WME										
	%ERH										
Skirting	%MC										
Wall 2	MC										
	%WME										
	%ERH										
Skirting	%MC										
Wall 3	MC										
	%WME										
	%ERH										
Skirting	%MC										
Wall 4	MC										
	%WME										
	%ERH										
Skirting	%MC										
	MC										
	%WME										
	%ERH										
	%MC										
	MC										
	%WME										
	%ERH										
	%MC										
	MC										
	%WME										
	%ERH										
	%MC										
	MC										
	%WME										
	%ERH										
	%MC										





Room/area		
Length 1		m
Width 1		m
Height		m
Area	0.00	m²
Volume	0.00	m³

	Covering	Construction
Floor		
Ceiling		
Wall 1		
Wall 2		
Wall 3		
Wall 4		

Key

	mould	overlay position
wet (affected) area	dry unaffected area	affected furniture
H1 high test point 1	ERH ERH box location	D1 ERH drill point 1
D dehumidifier	A airmover	F fan

A.3 Stripping out of structural materials

The decision to strip out a structural material depends on the incident characteristics (such as the category of water and the duration in contact with a particular structural material), the data collected at the initial inspection phase and subsequent checks on progress.

Table A.1 and Table A.2 are examples of guides for stripping out of structural materials. Regional variations might occur where localized and/or historic techniques differ from standard or modern construction techniques.

***NOTE** Attention is drawn to section 5.8 in Building Regulations document L1B [12] on the conservation of fuel and power in existing dwellings.*

Table A.1 – Guide to stripping out of structural materials after a water damage incident – External and internal walls

Conditions that warrant stripping out	Actions and issues to consider	Inspection and drying options
Gypsum plaster directly applied to masonry background		
• Top coat (skim) and/or undercoat de-bonded (blown) • Vinyl paint layer or multiple layers of emulsion inhibiting drying of plaster (minimum 5 days' drying attempted) • Surface and in-depth moisture readings indicate high levels of moisture in masonry background (>22% WME) and pre-incident conditions, such as failed damp proof course (DPC) have been discounted (minimum 5 days' drying attempted)	• Scratching off or perforation of paint when wet to allow moisture to evaporate from plaster • Target drying wall areas • Visible joint between new and old plaster/skim when repaired • If the removal of plaster is deemed necessary, remove to nearest available repair depth (i.e. 50 mm)	• Dehumidification and air movement specified to the room dimensions • Tenting wall areas and use of target drying • Directional heat to promote evaporation from wall surface (e.g. infrared heaters) • Removal of skirting boards to promote evaporation if skirting board above 20% WME
Lime-based plaster on a cement-sand rendered background over masonry		
• Top coat (skim) and/or render de-bonded (blown) from masonry background • Vinyl paint layer or multiple layers of emulsion inhibiting drying of render (minimum 10 days' drying attempted)	• Pre-incident conditions, have been identified and repair takes these into consideration • Scratching off or perforation of paint when wet to allow moisture to evaporate from render • Change of drying method to target dry wall areas • Visible joint between new and old render/skim when repaired • If removal of render deemed necessary, remove to nearest available repair depth (i.e. 50 mm)	• Dehumidification and air movement specified to the room dimensions • Tenting wall areas and use of target drying • Directional heat to promote evaporation from wall surface (e.g. infrared heaters) • Removal of skirting boards to promote evaporation if skirting board above 20% WME

Table A.1 – Guide to stripping out of structural materials after a water damage incident – External and internal walls *(continued)*

Conditions that warrant stripping out	Actions and issues to consider	Inspection and drying options
Plasterboard on adhesive dabs applied to masonry or fixed to timber studwork		
• Plasterboard has collapsed/ sagged/blown/permanently lost structural integrity • Plasterboard submerged in a category 3 (black water) loss • In-depth moisture readings indicate high levels of moisture in masonry background, removal required for access • Access required to remove silt/ mud/contamination from void in studwork behind plasterboard • If category 1 (clean water) loss and no loss of structural integrity attempt drying first (minimum 5 days attempted)	• Visible joint between new and old plasterboard when repaired • If removal undertaken, remove to nearest available joint/joist for ease of reinstallation • Voids within partition walls require inspecting, cleaning, sanitizing where required	• Removal of skirting boards to promote evaporation • Use of borescope and/or access panel to inspect moisture/ cleanliness condition in void/ partition behind plasterboard • Injection drying systems to dry structure behind plasterboard and within partition walls
Paint finish: Emulsion, eggshell, gloss		
• Paint layer(s) acting as a barrier to evaporation and inhibiting drying of material (minimum 5 days' drying attempted) • Cost vs benefit analysis of labour to remove paint versus replacement of item and repaint	• Scratching off or perforation of paint when wet to allow moisture beneath to evaporate • Visible joint/line between new and old paint when repainted	• Dehumidification and air movement specified to the room dimensions
Wallpaper		
• Wallpaper (especially vinyl) acting as a barrier to evaporation and inhibiting drying of wall	• Early decision to remove when wet as glue is weakest and will re-bond when dried	• Dehumidification and air movement specified to the room dimensions

Table A.2 – Guide to stripping out of structural materials after a water damage incident – Floors and floor finishes

Conditions that warrant stripping out	Actions and issues to consider	Inspection and drying options
Vinyl tiles/sheet cover over concrete/screed floor		
• Vinyl is a barrier to evaporation and concrete/screed shows moisture damage which is pertinent to the loss • Vinyl tiles have lifted/de-bonded	• Adhesive backing (glue/bitumen) might also be a barrier to evaporation – consider removal • Asbestos-containing material (ACM) test might be required and removal *NOTE Attention is drawn to legislation on working with asbestos.* • Vinyl tiles might be acting as a damp proof membrane (DPM) in certain circumstances – investigate prior to disturbance • Floor levels might require correcting before relaying flooring • Check type of insulation installed beneath screed/concrete by drilling/exposing – drying required?	• Tenting isolated floor areas and use of target drying • Use of ERH tests to set drying goals and confirm goals achieved • If relaying with wood product, see BS 8201 for recommendations on laying flooring • Injection drying systems to dry insulation beneath concrete/screed if applicable
Quarry/ceramic floor tiles over concrete/screed floor		
• Evidence suggests category 3 (black water) has permeated beneath/through floor tiles and cleanliness can only by confirmed by removal of tiles • Tiles have lifted/de-bonded • Detailed, professional cleaning has not removed staining from porous tiles (e.g. limestone)	• Quarry tiles might be acting as a DPM in certain circumstances – investigate prior to disturbance • Floor levels might require correcting before relaying flooring • Check type of insulation installed beneath screed/concrete by drilling/exposing – Drying required?	• Tenting isolated floor areas and use of target drying • Use of ERH tests to set drying goals and confirm goals achieved • If relaying with wood product, see BS 8201 for recommendations on laying flooring • Injection drying systems to dry insulation beneath concrete/screed if applicable
Suspended timber floor with chipboard		
• Chipboard has swollen beyond the potential of drying back (generally >25% MC) • Chipboard affected by category 3 (black water) and cleanliness difficult to establish without removal • Access required to remove silt/mud/contamination from sub-floor void • If category 1 (clean water) loss and no loss of structural integrity, attempt drying first (minimum 5 days attempted)	• Removal of chipboard might render floor temporarily unusable • Removal of items fixed to chipboard (kitchen units) might render room temporarily unusable • Check if insulation is affected under chipboard/between joists • Check for pre-incident conditions such as long-term rot of joists embedded in wall	• Heat/speed drying techniques might dry large areas very quickly (2 to 3 days) • Dehumidification and air movement correctly specified to the room dimensions • Injection drying systems to dry insulation/void beneath chipboard if applicable

Table A.2 – Guide to stripping out of structural materials after a water damage incident – Floors and floor finishes *(continued)*

Conditions that warrant stripping out	Actions and issues to consider	Inspection and drying options
Suspended timber floor with softwood tongue and groove floorboards		
• If category 1 (clean water) loss and no loss of structural integrity attempt drying first (minimum 5 days attempted) • Wood affected by category 3 (black water) and cleanliness difficult to establish without removal – localized only • Access required to remove silt/mud/contamination from sub-floor void 7 to 10 days' drying might save floorboards prior to access	• Removal of floorboards might render floor temporarily unusable • Removal of items fixed to floorboards (kitchen units) might render room temporarily unusable • Check if insulation is affected under floorboards/between joists • Check for pre-incident conditions such as long-term rot of joists embedded in wall • Check void area is free from debris, pre-incident damp and ventilation is correct via air-bricks • Sanding might be required to remove cupping to allow for flooring refit	• Heat/speed drying techniques might dry large areas very quickly (2 to 3 days) • Dehumidification and air movement correctly specified to the room dimensions • Injection drying systems to dry insulation/void beneath floorboards if applicable • Impervious barrier (1000 gauge plastic) to cover subfloor, if it is not isolated from general ground water • If attempting to save floorboards, lift every 5th to 10th floorboard to blow dry air underneath the board to prevent cupping
Parquet blocks set in bitumen on solid concrete base		
• Parquet tiles have lifted/de-bonded • Parquet affected by category 3 (black water) and cleanliness difficult to establish without removal • If category 1 (clean water) loss and no loss of structural integrity attempt drying first (minimum 5 days attempted)	• Adhesive backing (glue/bitumen) might also be a barrier to evaporation – consider removal • Adhesive (bitumastic) might contain ACM – test prior to removal and follow ACM procedure • Sanding might be required to remove cupping • Colour (patina) match issues if replaced with new tiles • Re-staining might be required	• Use ERH tests on concrete to set drying goals and confirm goals achieved • If relaying with wood product, see BS 8201 for recommendations on laying flooring • Dehumidification and air movement correctly specified to the room dimensions
Chipboard over insulation on solid concrete or screed base – Floating floor		
• Chipboard has swollen beyond the potential of drying back (generally >25% MC) • Chipboard affected by category 3 (black water) and cleanliness difficult to establish without removal • Access required to remove silt/mud/contamination from sub-floor void • If category 1 (clean water) loss and no loss of structural integrity, attempt drying first (minimum 5 days attempted)	• Removal of chipboard might render floor temporarily unusable • Removal of items fixed to chipboard (kitchen units) might render room temporarily unusable • Check if insulation is affected under chipboard/between joists	• Consider using injection drying systems to dry insulation/void beneath chipboard if applicable

Annex B (informative) Sources of water damage and their health risks for occupants

B.1 General

Water can contain biological and/or chemical pathogens which can be a hazard to the health of animals and humans. The source of the water is an important factor as water is found in a number of conditions, for example, in a clean and treated state for human consumption, and also in an unsanitary state, such as flood water from a river.

The length of time the water is in situ in a building can increase the level of risk as water can be a stimulus for accelerated biological activity. Bacteria, viruses and mould spores are commonly present in a building but lay dormant until water triggers the growth cycle.

Therefore the likelihood of the rate of increase in biological activity is related to the following conditions:

a) pre-existing site conditions (e.g. levels of cleanliness at the building);
b) the source of the water (e.g. from a clean or unsanitary source);
c) the circumstances after the loss has occurred (e.g. time without mitigation, temperature and humidity).

B.2 Categorization of water damage

Traditionally the restoration industry has attempted to categorize the risk associated with a water loss dependent on the factors stated in **B.1**. The categorization process is useful as it allows the restorer to prioritize losses and the potential risk to occupants, especially during times when resources are at a premium, such as a regional flood event.

The techniques of categorization are based on the accumulation of data from the following evidence:

a) risk assessment;
b) knowledge of the water damage incident (initial inspection);
c) chemical/biological analysis.

B.3 Clean water from an internal source

Most of the water used for heating, drinking and washing within a building is not considered hazardous to health. Water within a central heating system, can contain chemicals used to inhibit rust and increase efficiency of the system and this can be harmful if swallowed. If left untreated, water damage involving clean water could increase the risk of biological activity over time, dependent on the environmental conditions within the building.

B.4 Waste water from an internal source

Water from the waste of appliances (such as a dishwasher or washing machine) or from the waste of a fixture (such as a bath, sink or shower) can contain some chemical or biological agents that can be harmful if swallowed and can cause irritation to the skin, especially in susceptible people. In general, waste water such as described here is not considered immediately hazardous to health unless knowledge of the use of the appliances or fixtures suggests otherwise. If left untreated, water damage involving internal waste water could increase the risk of biological activity over time, dependent on the environmental conditions within the building.

B.5 Water containing faecal matter and urine originating from an internal source

Water damage originating from the waste of toilets or backflows from waste pipes that contain faecal matter and urine can be harmful by inhalation, harmful in contact with skin and harmful if swallowed. Certain factors such as the dilution rate of the harmful agents within the water help determine the level of toxicity encountered. Testing and analysis for bacteria and viruses to confirm the hazardous nature of the water can take time which in itself is problematic as delay without mitigation could increase the risk of exposure. In these circumstance to assume the water is harmful and to manage the exposure risks accordingly is often the most appropriate course of action to protect the health of occupants and restoration workers.

B.6 Water from an external source

Water damage originating from an external water source can be more difficult to classify due to the range of sources, volume of water and levels of damage encountered. For example, the water damage can range from a small rain water ingress from a missing roof tile to a major flood from a burst river bank that might sit in a building for days and up to many metres deep.

Water damage originating from an external source can be harmful in contact with skin and harmful if swallowed. Factors such as the dilution rate of the harmful agents within the water help determine the level of toxicity encountered. Testing and analysis for bacteria and viruses to confirm the hazardous nature of the water can take time which in itself is problematic as delay without mitigation can increase the risk of exposure. In these circumstances to assume the water is harmful and to manage the exposure risks accordingly is often the most appropriate course of action to protect the health of occupants and restoration workers.

B.7 Water from a source known or suspected to contain hazardous substances

Water can sometimes contain regulated hazardous substances that have restrictions on the clean-up method and has to be performed by a licensed contractor. Where a regulated hazardous substance is suspected of being present within the water, assuming it is at a level that is harmful and managing risks of exposure appropriately is often the most appropriate course of action until analysis has been undertaken by the applicable authorities.

Generally, hazardous substances within water originate from sources such as manufacturing industries, healthcare facilities and waste treatment plants, however in a residential or light commercial environment hazardous substances can sometimes be encountered in external flood incidents where facilities such as petrol stations have been overwhelmed by flood water and petrol and oil have mixed with the water and flooded adjacent residential properties.

Sharing knowledge of hazardous substances and awareness of risks in an external flood incident, promote safer environments and is necessary where multi-agency involvement is encountered.

Restorers may attribute a numerical or colour code when describing a water damaged building. Table B.1 is an example of these codes and how they correspond to the source and content of the water.

Table B.1 – Example table of numerical and colour codes attributed to water damage

Category code	Colour code	Description of water
Category 1	Clean	Clean water from an internal source *EXAMPLE: Water obtained directly from clean water supply-lines.*
Category 2	Grey	Waste water from an internal source *EXAMPLE: Water discharged from dishwashers or washing machines.*
Category 3	Black	Water containing faecal matter and urine originating from an internal source *EXAMPLE: Water from toilet back flows.*
Category 3	Black/ Flood	Water from an external source *EXAMPLE: Flood waters from rivers and streams, surface water and groundwater.*
Category 4 (special situations)	Red	Water from a source known or suspected to contain hazardous substances *EXAMPLE: Water containing hazardous material, such as oil, asbestos, fuel, solvents.*

Annex C (informative)
Surveying for practical moisture measurement thresholds

C.1 General

Practical moisture measurement thresholds (guide only) under which a structural material is considered safe to stop mechanical drying if the indoor environment is maintained with a 6g/kg humidity ratio or less.

Table C.1 gives guidance threshold readings for typical structural materials when in equilibrium with normal indoor environmental conditions of 18 °C to 20 °C at 40% RH to 45% RH depending on the season and the individual occupier.

There is a lot of variability in structural materials within the built environment due to many factors, for example, different species of wood have different moisture contents, as do different types of brick and concrete under both general and sometimes specific conditions. Where there is doubt refer to the structural material manufacturer or distributor.

Table C.1 – Example moisture measurement thresholds

Structural material	MC %	WME %	ERH %
Wood	16.0	16	N/A
Plasterboard	3.0	12	N/A
Plaster	0.3	15	N/A
Brick	1.5	15	75
Concrete	3.5	15	75
Sand and cement screed	6.0	15	75

The drying goal can be:

a) established from the same structural material which has been unaffected by the loss;

NOTE This confirms the drying threshold or pre-existing moisture levels.

b) if a) is unavailable, in accordance with Table C.1 or the material manufacturers' specification for moisture content.

EXAMPLE A concrete floor in a lounge is affected by a burst pipe. The dining room floor is made of the same material but was not affected. The dining room concrete has an ERH of 72% at 20 °C. This then is the established drying goal. The lounge concrete floor is considered returned to pre-incident levels when the concrete is measured and the values are equal to, or less than the dining room.

Utilizing the correct technique for measuring moisture in the material is crucial to the accuracy of the test. Annex E gives guidance on which test to use for which material dependent on the project constraints.

C.2 Maintaining environmental conditions

If the inside humidity ratio (also known as the specific humidity) is greater than 6 g/kg then there is a greater possibility that some structural materials will absorb atmospheric moisture and the moisture levels might increase above the threshold. It is important therefore that drying equipment is only removed when the relative humidity and temperature has been measured using appropriate testing equipment (see Annex E) and the humidity ratio calculated. Maintaining ambient temperature ranges and humidity ratio once the drying equipment has been removed from site (e.g. central heating) will reduce the risk of re-wetting.

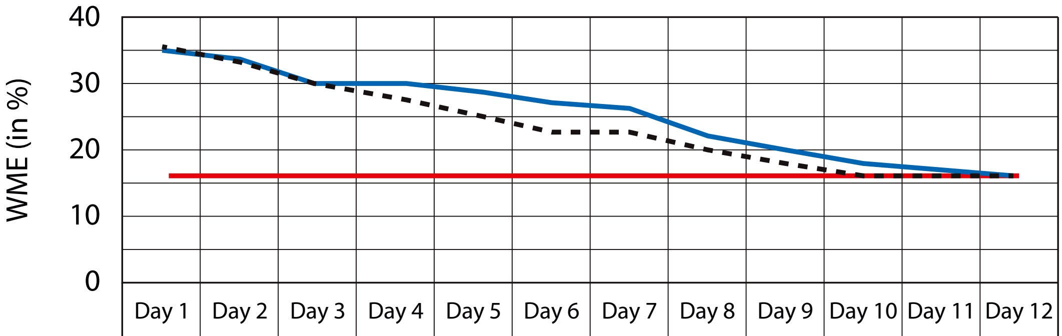
Annex D (informative)
Drying goal recording document

Moisture measurements are taken using appropriate equipment (see Annex E) from the air outside of the building, the air inside the building, and from within the structural materials themselves. Moisture content data assists in the decision process in choosing a drying method.

Figure D.1 demonstrates how the drying goal was established at 16% WME for the structural material affected. Based on the drying method and the prevailing circumstances the projected drying curve plots the predicted rate of drying for that structural material. The example shows that the actual drying curve is in close relation to the predicted drying curve.

Figure D.2 shows that the actual moisture readings are not following the predicted drying curve and the reason for the drying failure requires further investigation.

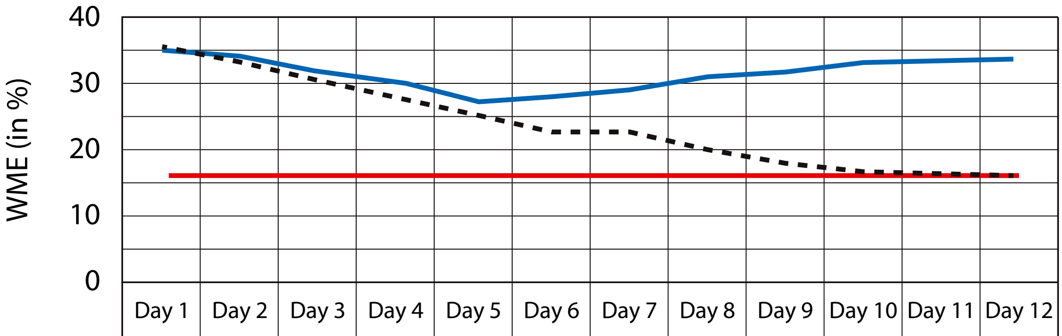
Figure D.1 – Example of drying progress for softwood floor



	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12
Projected	35	33	30	28	25	23	22	20	18	16	16	16
Actual	35	34	30	30	29	27	26	22	20	18	17	16
Drying goal	16	16	16	16	16	16	16	16	16	16	16	16

NOTE The graph is for illustrative purposes and a similar curve would be expected where visits are less frequent.

Figure D.2 – Example of drying failure for softwood floor



	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12
Projected	35	33	30	28	25	23	22	20	18	16	16	16
Actual	35	34	32	30	27	28	29	31	32	33	34	34
Drying goal	16	16	16	16	16	16	16	16	16	16	16	16

NOTE The graph is for illustrative purposes and a similar curve would be expected where visits are less frequent.

Annex E (informative) Moisture measurement

E.1 Moisture meters

E.1.1 General

Electrical moisture meters have limitations and do not always give accurate readings dependent on the structural material being measured and the method or scale of the measurement. Different manufacturers use different scales for use in structural materials other than wood, which can cause a number of problems, especially if the restorer does not understand the type of construction and the type of structural material being tested.

Initially, the restorer takes moisture content readings in affected areas to establish the extent of the water damage. This is most often done using a non-destructive method using a capacitance type moisture meter.

Where the degree of damage and circumstances indicate the possible presence of moisture below the surface, then in-depth readings are taken.

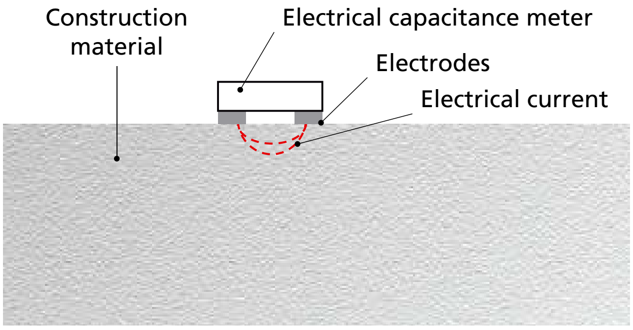
E.1.2 Types of electrical moisture meters

E.1.2.1 Electrical capacitance (survey mode)

Using two electrodes placed on the surface, current passes from the positive to the negative and a reading is given.

A dry structural material gives a low reading and water increases the capacitance due to its ability to conduct electricity. Figure E.1 illustrates an electrical capacitance meter.

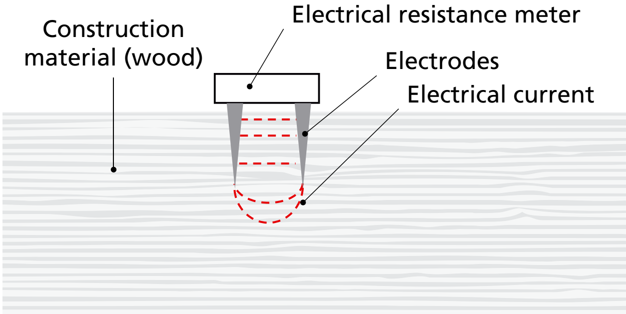
Figure E.1 – Electrical capacitance meter



E.1.2.2 Electrical resistance (conductance)

Metal pins are inserted into the structural material where electricity flows between the pins. A dry structural material has resistance against the electricity indicating a low reading. Water in the structural material increases conductance and resistance will decrease indicating a wet structural material. Figure E.2 illustrates an electrical resistance meter.

Figure E.2 – Electrical resistance meter



E.1.2.3 Calcium carbide meter

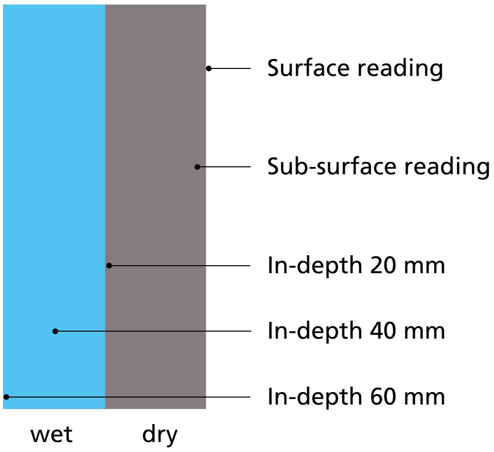
A small sample of the structural material to be tested is prepared, weighed and placed into a vessel. A reagent (calcium carbide) is then added to the vessel lid ensuring the reagent and samples are not mixed until the flask is sealed. Free moisture within the sample reacts with the reagent to produce a gas and pressure rise within the vessel that is proportional to the amount of moisture. The moisture content value is then read directly from the calibrated pressure gauge.

E.2 Moisture profiling

Moisture profiling enables the assessment of the degree of saturation. For example, if a wall is wet at depth then the true moisture profile can only be gained if in-depth readings are retaken.

Figure E.3 suggests that the structural material is dry based on surface, sub-surface and an in-depth reading at 20 mm, when in fact the moisture gradient is at 30 mm.

Figure E.3 – Potential moisture distribution through a structural material



Surface readings can be affected by the presence of condensation, salts, contamination containing metals (and metal dusts) for example, which can give false high readings.

If the taking of in-depth readings is not undertaken or permitted, then it is difficult to give a true indication if the structural material is wet or how wet it is.

As a given rule, it is necessary to drill into a structural material to confirm the presence of moisture and the depth of penetration. Where a moisture gradient or pocket of moisture occurs within the structural material, the condition is monitored and whether specialized drying techniques are necessary, are determined.

Moisture gradients can exist in dense structural materials such as brick and concrete due to uneven evaporation and interstitial condensation (occurring within the structural material itself).

E.3 Hygrometer test for dampness of concrete, cementitious and anhydrate bases to receive wood based coverings

*NOTE This subclause has been sourced from BS 8201:2011 and specifically **applies to the preparation of cementatious and anhydrate bases to receive wood based coverings** using a hygrometer test.*

E.3.1 Basis of test

The basis of the test is to use a hygrometer or hygrometer probe to measure the relative humidity in a pocket of entrapped air in a sleeve or between an impervious thermally insulated housing and the screed/ concrete base. Sufficient time is allowed for moisture equilibrium to become established between the pocket of air and the base.

Concrete under normal conditions is never completely dry. Those responsible for laying floor coverings need to

know when the moisture level of the concrete has been reduced to a value where flooring can be safely laid. Water in the coarse pores of concrete is relatively mobile and can lead to damage to flooring, whereas water in the fine pores is relatively immobile and harmless.

When concrete is allowed to dry, the coarse pores become empty first because water in coarse pores exerts a higher vapour pressure, and hence evaporates more quickly than water in fine pores. Because the size of the pores controls the vapour pressure that arises in them, it also controls the vapour pressure of a small volume of air entrapped between the concrete surface and an impervious housing (or box). The vapour pressure determines the relative humidity of that entrapped air so a hygrometer or probe reading indicates the extent to which harmful moisture is still present.

Experimental evidence has shown that when the measured relative humidity falls to 80% RH, the water has evaporated from the coarse pores and the screed is sufficiently dry to allow installation of resilient floor coverings. If some allowance is made for errors in determining the relative humidity, the concrete should be considered dry when the relative humidity falls to 75% or less.

For these reasons, the hygrometer probe or sleeve methods for dampness measurement are recommended over other methods.

E.3.2 Apparatus and equipment

E.3.2.1 *Insulated impermeable box*, which can be sealed to the floor surface using a preformed butyl sealant tape to create an enclosed pocket of air which is isolated from the humidity and fluctuations in temperature of the outside air (see Figure E.4). It is essential that readings can be taken while the apparatus is in position on the floor without breaking the seal and releasing the trapped pocket of air.

NOTE Other forms of apparatus might be suitable but the width of the area should not be less than 150 mm and it is essential that the principles of thermal insulation and vapour barrier are followed, so that an insulated vapour-proof space is created. Suitable vapour barrier materials are sheet metal, glass, 2 mm thick clear acrylic sheet, or 2 mm thick PVC-U (polyvinyl chloride, un-plasticized), and the apparatus should have a maximum U-value of 1.0 W/(m^2·K).

E.3.2.2 *Hygrometer or relative humidity (RH) probe*, for measuring relative humidity to an accuracy of ±3% RH. This can be a hair, paper, synthetic fibre or electronic hygrometer of the clock type, or an electronic relative humidity probe.

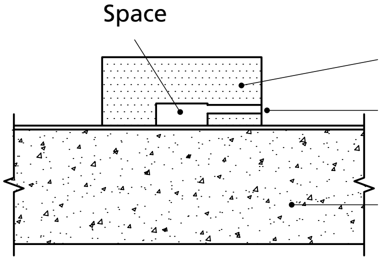
E.3.2.3 *Preformed butyl sealant tape*.

E.3.2.4 *Adhesive tape*.

E.3.2.5 *Protective mats (rubber or polyethylene)*.

E.3.2.6 *Hygrometer sleeve* if using procedure given in **E.3.5.**

Figure E.4 – Apparatus for hygrometer test



E.3.3 Suitability

The method of test is appropriate for measurement of percentage relative humidity values above porous surfaces such as screeds and concretes. Low permeance surfaces such as power floated concrete require extended testing periods before true readings can be achieved, and any surface treatment such as concrete curing compounds or waxes should be removed.

NOTE The method might not be suitable for use on proprietary screeds and is not suitable for performance assessment of surface applied moisture barriers.

E.3.4 Hygrometer probe method

E.3.4.1 Turn off any artificial aids used for accelerating drying at least four days before final readings are attempted. Accelerated drying should not be used for freshly laid screeds.

*NOTE This subclause (**E.3**) has been sourced from BS 8201:2011 and specifically **applies to the preparation of cementatious and anhydrate bases to receive** wood based coverings using a hygrometer test. For the purposes of general water damage restoration, equilibrium may be assumed when two consecutive readings taken at 4 h intervals show no change.*

E.3.4.2 Seal the apparatus firmly to the floor and allow sufficient time for the entrapped air to reach moisture equilibrium with the screed or base.

E.3.4.3 For an unbonded screed, where the damp-proof membrane is placed between the base and screed as described in BS 8204-1 allow a period of not less than 4 h before taking the first reading.

NOTE Equilibrium may be assumed when two consecutive readings taken at 4 h intervals show no change.

E.3.4.4 For very thick constructions, i.e. direct finished base slabs or bonded screeds (where the damp-proof membrane is placed below the base slab as described in BS 8204-1) allow a period of at least 72 h to elapse before taking the first reading.

NOTE Equilibrium may be assumed when two consecutive readings taken at 24 h intervals show no change.

E.3.4.5 Constructions with thickness greater than 200 mm can take considerably longer than one week before moisture equilibrium is established. To prevent edge effects with these very thick constructions, the area of 1 m^2 surrounding the instrument should be covered with an impervious sheet material during the test.

E.3.4.6 To minimize the time required for the instrument to be in a position on the floor, the following technique can be applied. Cover the positions to be measured with impervious mats (**E.3.2.5**) not less than 1 m × 1 m, taped to the floor at their edges. Leave in position for at least three days in the case of screeds and seven days in the case of thick constructions. After removing the mat (**E.3.2.5**), immediately seal the instrument to the centre of the covered area. The instrument should be left overnight for equilibrium to be reached.

E.3.4.7 To avoid expensive equipment being left on site, the probe (**E.3.2.2**) should be removed from the apparatus shown in Figure E.4 and the hole plugged before the box (**E.3.2.1**) is sealed to the subfloor.

E.3.4.8 After allowing time to reach equilibrium, remove the plug, insert the RH probe (**E.3.2.2**) promptly, and allow at least thirty minutes for this to reach equilibrium before readings are taken.

E.3.4.9 A number of simultaneous measurements might be necessary to give a representative survey. This should take into account the size and layout of the installation, as well as any variation in the subfloor construction.

E.3.4.10 If readings greater than 75% RH are obtained, remove the equipment and allow the floor to dry before further readings are attempted.

E.3.5 Hygrometer sleeve method

E.3.5.1 Before drilling into the concrete, check that there are no services within the concrete subfloor.

E.3.5.2 Drill the correct size diameter hole into the concrete to a depth of 40% of the concrete subfloor's overall thickness.

E.3.5.3 Using a small brush, clean the inside of the hole free from dust and vacuum away any loose debris from within the hole.

E.3.5.4 Place the proprietary sleeve into the hole ensuring it is a firm fix and finishes flush with the concrete surface and the cap is firmly in place.

E.3.5.5 After a minimum of 72 h, remove the cap and immediately inset a proprietary relative humidity reading probe into the sleeve.

E.3.5.6 After a minimum of 30 min, take a reading and record it. Remove the probe and replace the cap.

E.3.5.7 After a further minimum 24 h period, repeat the procedure (**E.3.5.5** to **E.3.5.6**) at a minimum of 24 hr intervals until two consecutive readings are identical to each other. At this point the trapped air is in equilibrium.

E.3.6 Verification of hygrometer or probe

As the accuracy of a hygrometer can drift with time or in transit, it should be recalibrated frequently. The accuracy of the hygrometer or RH probe at 75% RH can be checked by sealing it in a desiccator or humidity cabinet over a saturated solution of analytical or general purpose reagent grade sodium chloride, at a constant temperature of (20 ±2) °C for a minimum of 12 h.

Annex F (informative)
General decontamination clearance – Achieving the cleaning goal

F.1 Decontamination and cleaning practices

Cleanliness can be provided by dilution, neutralization or removal. Where chemical sanitizers or disinfectants are used, risk assessment procedures for these chemical sanitizers or disinfectants should be followed.

NOTE *Attention is drawn to Control of Substances Hazardous to Health (COSHH) Regulations 2002 [13].*

F.2 Cleaning goal survey and recording documents

Table F.1 provides an example cleaning goal recording document, used to record the levels of contamination in each of the water damaged rooms and Table F.2 provides an example of comments associated with the planned cleaning schedule.

NOTE *Once works are complete, Table F.1 can also be used as an auditing tool to indicate whether the planned works were acceptable or unacceptable.*

Figure F.1 – Cleaning goal survey document

Claim:	Surveyed by:	Date:
Circumstances:		

	Room affected						
Area affected							
Overall appearance							
Odour control							
Indoor air quality							
Entrance / exit							
Stairs (internal and external)							
External areas							
Switches, sockets and data points							
Walls							
Ceiling							
Light fittings							
All doors							
Windows and glazed partitions							
Mirrors							
Radiators							
Ventilation grilles							
Hard floor – Polished or non-slip							
Electrical items							
Cleaning equipment							
Low surfaces							
High surfaces							
Voids beneath suspended floors							
Other voids							
Shower and equipment							
Toilets and bidets							
Sinks							
Bath							
Other							

Key

0 No contamination	2 Light contamination	4 Heavy contamination
1 Light contamination in a small area	3 Medium contamination	5 Very heavy contamination

Figure F.2 – Example cleaning goal recording document

Claim: 4762	Surveyed by: D. Smith	Date: 03/04/13

Room	Specific problem	Action required	Cleaning goal	Measurement criteria	Action taken by	Date
Kitchen	Visual soiling remains on vinyl tiles to left hand wall	Wet wipe with an appropriate disinfection wipe	Visually clean and free from soiling	White glove test and visual observation	J. Bloggs	05/04/13

Annex G (informative)
Indoor air quality

G.1 Exposure to poor indoor air quality after water damage incident

Current research suggests that some groups are especially vulnerable to exposure of microorganisms in a damp environment and these are documented as:

a) children;

b) the elderly;

c) pregnant women;

d) those with cardiovascular or respiratory problems;

e) persons with immunodeficiency;

f) atopic individuals (those with allergies).

Figure G.1 gives an example of an occupant health risk matrix. The aim is to provide a method to establish the level of risk that might be encountered as a result of poor indoor air quality so hazards are identified more easily.

NOTE 1 The list of especially vulnerable groups is a guide to additional care. Further guidance can be sought from a qualified medical practitioner when required.

NOTE 2 For further information on indoor air quality and the effect of dampness and mould on vulnerable people, see the European Union's publication Indoor air quality [14] and WHO guidelines for indoor air quality: dampness and mould [15].

NOTE 3 Indoor air quality can deteriorate over time depending on the prevailing environmental conditions. Monitoring of indoor air quality may therefore be considered on an ongoing basis and not only conducted at the beginning and end of the project.

Figure G.1 – Example occupant health risk matrix

Water category	Tick	Length of time since water damage incident	Tick	Current humidity ratio	Tick
Clean internal		≤ 1 day		<4 g/kg	
Unsanitary internal		> 1 day ≤ 2 days		5 to 8 g/kg	
Unsanitary external		> 2 days ≤ 5 days		9 to 12 g/kg	
Hazardous		> 5 days		≥13 g/kg	

Occupant claims symptoms	Tick	Recognized high risk occupants [A)]	Tick	Visible mould	Tick	Likelihood of hidden mould	Tick
No		Unoccupied building		None visible		None	
Yes		No high risk occupants		Light		Low	
		One high risk occupant		Moderate		Medium	
		More than one high risk occupant		Heavy		High	

Conclusions drawn

[A)] Occupants at high risk and may require relocation include children, the elderly, pregnant women, those with cardiovascular or respiratory problems, those with immunodeficiency and atopic individuals (those with allergies).

G.2 Indoor air quality surveying techniques

G.2.1 Visual inspection

A visual inspection for mould and microbial growth is the initial step in identifying a possible environmental health risk associated with poor indoor air quality after a water damage incident and in determining remedial strategies. A visual inspection can include assessments of hidden areas where damage might be present, such as basements, voids, attics, inside partitions and cavities. Carpet backing and underlay, wallpaper, plaster mouldings, behind coving and skirting boards, insulation and other materials that are suspected of hiding microbial growth are also assessed.

Plasterboard, structural wood and other cellulose-containing surfaces are more susceptible to microbial growth. Ventilation systems are visually inspected for damp conditions and/or microbial growth on system components such as filters, insulation, and coils/fins, as well as for overall cleanliness.

Equipment such as a moisture meter or infrared camera (such cameras reveal temperature differentials which indicate to the restorer which areas to investigate further) or a borescope (to view spaces in partitions or behind walls) might be helpful in identifying hidden sources of microbial growth, the extent of water damage, and in determining if the water source is active.

Personal protective equipment (such as gloves and respiratory protection) is used when assessment work might disturb mould and microbial growth. Efforts are also made to minimize the generation and migration of any dust and microbes.

G.2.2 Environmental sampling

Decisions about appropriate indoor air quality remediation strategies can generally be made on the basis of a visual inspection. Environmental sampling might be helpful in some cases.

However, if environmental samples are to be collected, a sampling plan should be developed that includes a clear purpose, sampling strategy, and addresses the interpretation of results, as many types of sampling can be performed (e.g. air, surface, dust, and bulk materials) on a variety of microbial components and metabolites, using diverse sampling methodologies.

Environmental sampling should be conducted and recorded by a technically competent person, who is trained in the sampling methods and is aware of the limitations of the methods used.

NOTE Test laboratory accreditation. *Users of this PAS are advised to consider the desirability of selecting test laboratories that are accredited to BS EN ISO/IEC 17025 by a national or international accreditation body. It is important to seek assurance that the laboratory used can demonstrate proficiency and quality control standards commensurate with the analysis being carried out.*

G.2.3 Decontamination and cleaning practices

Cleanliness can be provided by dilution, neutralization or removal. Chemical sanitizers and disinfectants may be used in decontamination and cleaning practices in accordance with risk assessment procedures including how to deal with any harmful residues produced as a result as these could have an impact on occupiers.

NOTE *Attention is drawn to Control of Substances Hazardous to Health (COSHH) Regulations 2002 [16].*

G.2.4 Indoor air quality goals

Generic indoor air quality goals can be difficult to establish as the relationship between microbial exposure and health effects cannot be precisely quantified. In practice, after a water loss, restorers aim to control moisture in the air and the building structure by utilizing appropriate cleaning and drying techniques. This will generally be sufficient to reduce microbial amplification to a safe condition.

During an environmental sampling programme, external air conditions as well as internal air conditions are usually sampled and an indoor air quality goal is set and documented based on the relationship between the volume and species of mould and microbes found. Complete eradication of internal microbes is not normally feasible or achievable; hence a reduction in the rank of particularly toxic species is normally specified as the most achievable; measurable and desirable indoor air quality goal.

NOTE *For information on a measurement strategy for the detection of fungi in indoor environments, see BS ISO 16000-19.*

Annex H (informative) Drying methods, systems and equipment

NOTE As the circumstances surrounding each water damage incident are different, the restorer makes a decision as to the most appropriate drying system to be used based on 3.5.

H.1 Open drying system

Open drying allows for the exchange of high humidity air (i.e. high levels of evaporated water vapour) within the structure, with low humidity air from outside the structure, or areas being dried (see Figure H.1). This method does not use mechanical dehumidification but uses or relies on enhanced air movement to increase the rate of exchange of air. In order for this technique to be truly effective, the outside conditions (humidity ratio) should be drier than the internal humidity ratio conditions. A building's security, occupant's preferences, heat loss and other influencing factors when opening up the structure to the outside should be taken into consideration.

When outdoor air is cool but dry, heat has to be added to the internal structure to maintain an appropriate indoor temperature in relation to the relative humidity and humidity ratio to encourage evaporation to continue (see Figure H.2).

Figure H.1 – Open drying system

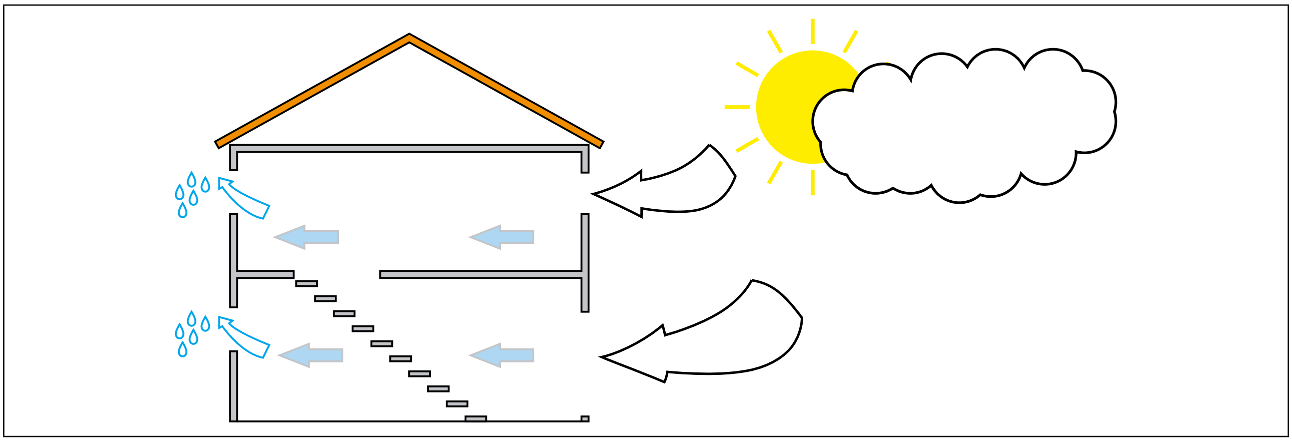
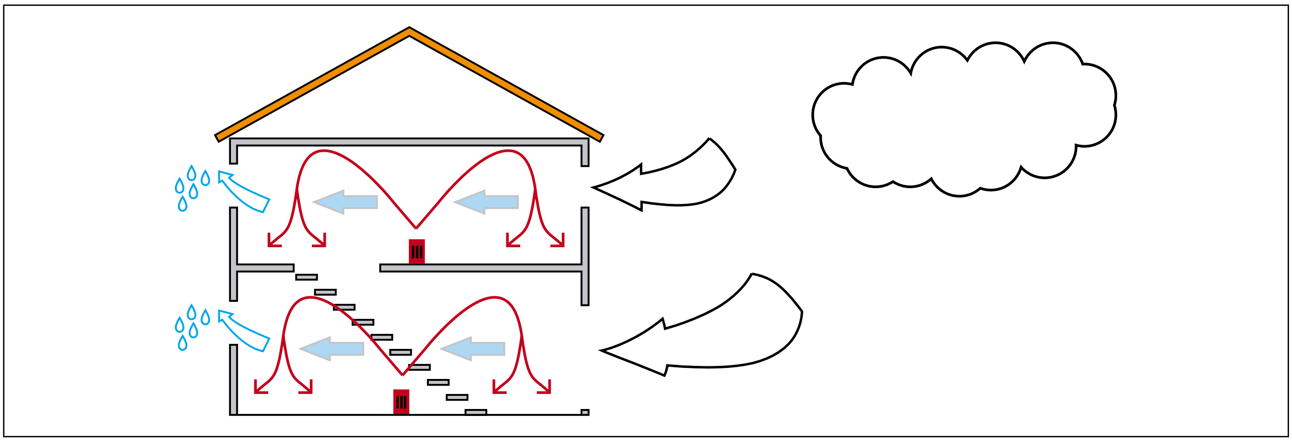


Figure H.2 – Open drying system with heating equipment



H.2 Combination drying system

A combination drying system uses both open drying and mechanical dehumidification. This system can be used when the balance of a better drying environment between the outside and inside fluctuates and site specific conditions allow.

H.3 Closed drying system

When an open drying system is impractical for the reasons stated in **H.1**, a closed drying system can be considered. This involves the closing of windows, doors and other apertures to the outside and installing dehumidification equipment to remove and control the evaporated moisture (see Figure H.3).

Dehumidification equipment requires temperature control to promote a better rate of evaporation. The dehumidification equipment efficiency can be maximized through monitoring it on a regular basis (in accordance with the manufacturer's instructions) and controlling the temperature.

H.4 Air exchange and heat drying

Air exchange and heat drying systems function by increasing the temperature of the indoor ambient air, which increases the rate of evaporation from wet structural material.

Heated air is circulated throughout the building, often by means of additional mechanical air movement (see Figure H.4). The heated air takes on the evaporated water from the wet structural materials, thereby increasing its humidity ratio. The resulting moisture is continually exhausted via the convectant system which can recover much of the heat prior to expelling the moisture to the outside. The heat captured is then reintroduced to pre-heat incoming air. The building is kept closed when drying is being undertaken with convectant systems. Movement of the air into or out of the building is controlled by the convectant system to control vapour pressure and promote optimal drying conditions. Other natural building airflow has no meaningful effect on the result.

Figure H.3 – Closed drying method (with dehumidification equipment and background heating)

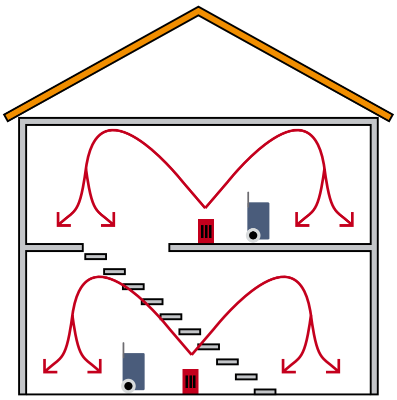
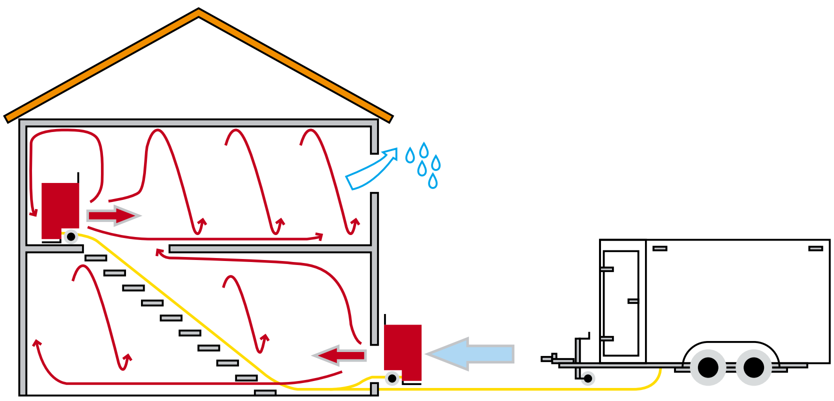


Figure H.4 – Air exchange and drying using an external heat source



H.5 Using mechanical dehumidification in closed drying systems

H.5.1 General

Although in the UK, the outdoor air is often suitable for controlling the humidity in the inside environment, other project constraints might mean that mechanical dehumidification in a closed drying system might be necessary. This can be due to building security issues, significant heat loss concerns or the safety and preference of the building occupants.

Mechanical dehumidifiers work by removing the excess moisture in the air that has been generated by evaporation from the wet structural materials. The exact number and type of dehumidifiers can be calculated accurately by a restorer to ensure the correct dehumidification is in use. This calculation is based on the volume of air that the dehumidifier can process and the amount of moisture in the air being removed at a given temperature and relative humidity.

H.5.2 Mechanical dehumidification equipment

H.5.2.1 General

There are three methods of dehumidification common in the drying industry which have the effect of removing moisture from the air:

a) refrigerant dehumidifier (see **H.5.2.2**);

b) desiccant dehumidifier (see **H.5.2.3**);

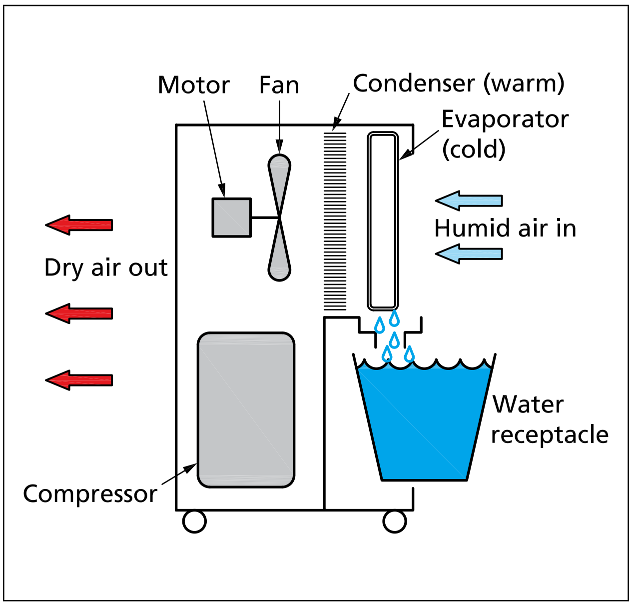
c) convectant dehumidifier (see **H.5.2.4**).

H.5.2.2 Refrigerant dehumidifier

For a refrigerant dehumidifier, the internal air is cooled below its dew point, which results in controlled condensation on the dehumidifier's internal evaporation coils. Water is then collected in its liquid form for removal from the area being dried, either by automatically pumping away from the machine, or the periodic removal of collection containers, by hand.

A refrigerant dehumidifier works across a range of conditions, and are most efficient between 21 °C to 30 °C and above 40% relative humidity. Figure H.5 gives a schematic representation of a refrigerant dehumidifier.

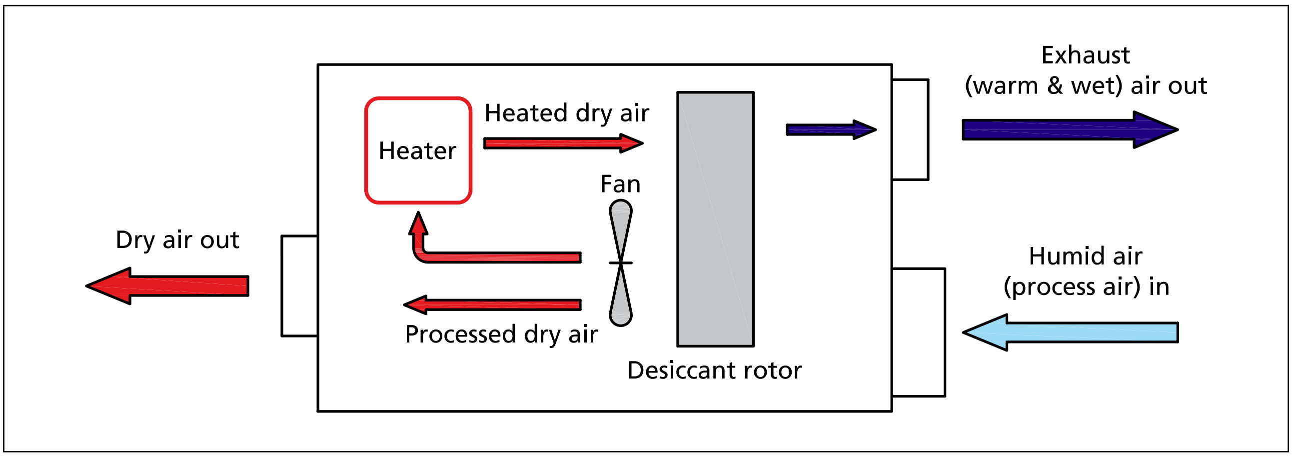
Figure H.5 – Refrigerant dehumidifier



H.5.2.3 Desiccant dehumidifier

The damp internal air is blown through a desiccant material; this removes moisture by direct adsorption in which moisture molecules cling to the surface of the desiccant material. The machine has two outlets; one which blows out dry air and a second, which blows the wet, processed air out of the area being dried. Desiccant dehumidifiers can collect moisture from the air in low temperatures. Desiccant dehumidifiers work across a range of conditions, and operate between 4 °C and 27 °C. Figure H.6 gives a schematic representation of a desiccant dehumidifier.

Figure H.6 – Desiccant dehumidifier



H.5.2.4 Convectant dehumidifier

The temperature in the room is increased by re-circulating the room's air through the convectants heating system. This warms the structure promoting evaporation and creating drying conditions. Once the internal air has reached a pre-defined temperature or if the relative or specific humidity reaches pre-defined levels, the machine switches to exhaust mode expelling wet air to the outside. At the same time, fresh air in equal amounts is automatically drawn in from the outside or from an unaffected part of the building, heating it and re introducing it back into the room to repeat the process until the room is dry.Figure H.7 gives a schematic representation of a convectant dehumidifier.

H.5.3 Heating equipment

Where the heating system of the building is inoperable or is insufficient for the drying method being used, a secondary heat source might be required. This is to both achieve desirable drying conditions and to accelerate evaporation of moisture from structural elements and/or contents items. Heating systems may also be utilized to target specific troublesome drying areas as heating the building material directly encourages evaporation. However, heating alone, without the correct balance of dehumidification, might be dangerous as uncontrolled evaporation is the precursor to secondary damage.

H.5.4 Air movement

Increasing air movement over the surface of a wet structural material encourages evaporation of the moisture within. Air movement also encourages turbulence within the area being dried, which can make drying equipment and techniques more effective.

Air movement can also be introduced into voids and cavities by means of air injection techniques which encourages drying in hard to reach structural components. This is often referred to as target drying or air manipulation techniques (see Figure H.8).

H.6 Target drying

It can be preferable to concentrate the drying effort to the air layer close to the affected structural material and not the whole air space in the room. This is done by containing the area being dried by means of impermeable materials such as plastic sheeting or specially designed mats, attached to the wall, floor or targeted area (see Figure H.9).

Figure H.10 shows the application of a basic tenting system installed to target dry a wall. Use of this method allows for the processing of the air within the tented area and not the whole of the room, which is more efficient.

Figure H.7 – Convectant dehumidifier

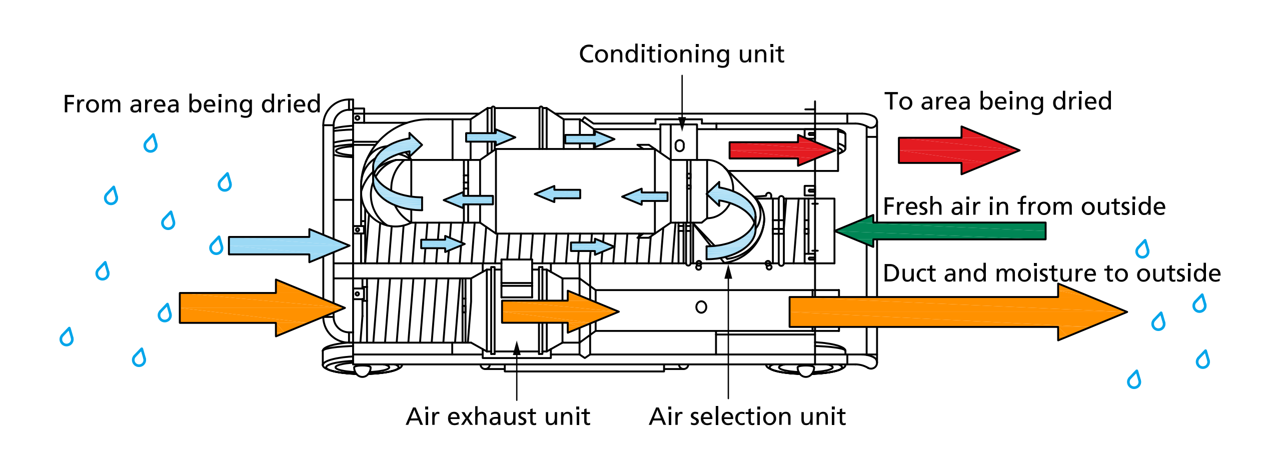


Figure H.8 – Air mover

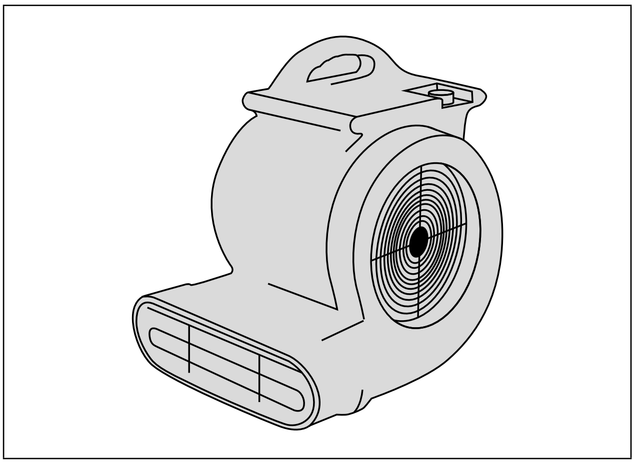


Figure H.9 – Direct air mats

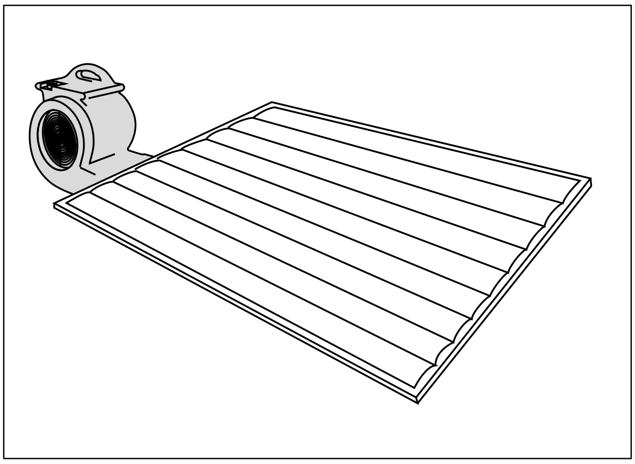
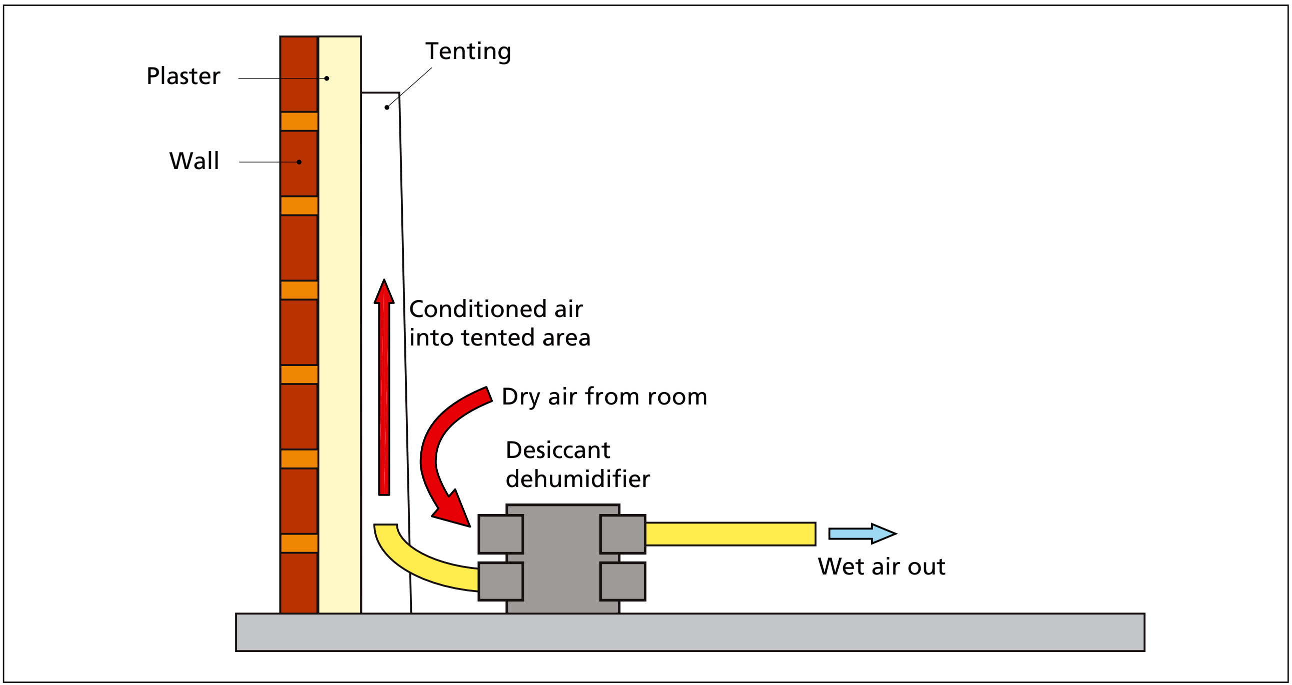


Figure H.10 – Tenting



Annex I (informative)
Example environmental impact assessment

I.1 General

When assessing the environmental impact of the drying system the following may be considered:

a) the equipment power usage (in kW·h) over the period of drying;

b) how this power usage converts into kilograms of carbon dioxide (CO_2) equivalent ($kgCO_2e$);

c) the CO_2 omissions generated by the restorer's vehicle in delivering, monitoring and collecting equipment.

The CO_2 emissions of the drying equipment can be calculated using the manufacturer's declared power usage of the drying equipment based on the ampere and watt draw of the drying equipment.

NOTE One unit of grid electricity coverts to 0.5246 $kgCO_2e$ (SOURCE: Defra [17]).

I.2 Environmental impact assessment calculations for the drying of a building

Example case – two room dishwasher leak

Table I.1 identifies the anticipated kilowatt usage for the drying equipment on site. Using the power conversion factor for grid electricity (0.5246) [17] a calculation of the amount of CO_2 equivalent emissions is made.

If it is suspected that the drying machinery has been switched off during its time within the water damaged building, the power usage is calculated taking this into account. For example, if it is suspected that an electrical item with an power usage of 18.00 kW·h per day is on for 8 hours per day, then the power usage is calculated at 8/24ths of 18.00 kW·h = 6kW·h.

Table I.2 shows an example of the total mileage incurred for a restorers vehicle attending a water damaged building and the resulting emissions for that vehicle.

Table I.2 – Mileage

SWB 2.2 TDCi Diesel – Return journey (total)	CO_2 emissions	No of visits required	CO_2 g/km total emissions per claim
km	g/km		kg
80	213	3	51.120

NOTE The results of the calculation are emissions of 51.120 $kgCO_2e$ for the transport of drying equipment and monitoring visits to dry the building.

Table I.1 – Equipment

	Power usage per day kW·h/day	No. of units on site	No. of days days	Total power usage kW·h	Total CO_2 emissions $kgCO_2e$
Dehumidifier	18.0	2	10	360	188.86
Air mover	13.2	3	10	396	207.74
Total power usage				756	396.60

NOTE 1 Total power usage = Power usage per day x No. of units on site x No. of days

NOTE 2 Total CO_2 emissions = Total power usage x 0.5246 (power conversion factor for grid electricity [17]).

NOTE 3 The calculation predicts emissions of 396.60 kg CO_2e in order to dry the building.

Annex J (informative)
Cost benefit calculation assessment

J.1 General

In a water damage recovery project other related but separate costs can be impacted by the effectiveness and choice of the mitigation and recovery methodologies used. One of the ways of understanding the impacts is to undertake a cost benefit analysis which incorporates the known elements and the unknown or predicted components. It is useful to document this sensitivity to uncertainty at the initial commencement of works and throughout the mitigation process.

These typically include:

a) impact on stripping out of structural material and subsequent repair schedule;

NOTE Attention is drawn to section 5.8 in Building Regulations document L1B [12] on the conservation of fuel and power in existing dwellings.

b) the impact on business and the consequential impact of any business interruption insurance;

c) alternative accommodation costs for occupiers or pets;

d) impact on contents storage costs;

e) environmental impacts of the drying programme;

f) electrical running costs;

g) any other case specific costs or project constraints.

Cost benefit analysis is a systematic process for calculating and comparing benefits and costs of a water damage mitigation project. It involves comparing the total expected cost of each option against the total expected benefits, to see whether the benefits outweigh the costs, and by how much.

J.2 Drying equipment power usage comparisons

A cost benefit analysis of different drying equipment comprises the equipment's power usage per day, the number of units required on site and the number of days it will be used.

Total power cost (£) = Power usage (kW·h/day) x Cost per kW·h (£) x No. of units on site x No. of days (day)

As an example, Table J.1 compares the power usage of two different equipment types to dry the same building.

In this example, the daily power usage for Equipment 2 is lower per day, but when the additional information is included in the analysis, then Equipment 1 is more cost effective on a cost only basis. This is a known cost which allows for an accurate level of certainty.

Table J.1 – Example cost benefit analysis of power usage costs of two types of drying equipment used to dry a building

NOTE The actual costs used in this Table are for indicative purposes only and are not to be relied on or used in any way as referential to true costs.

	Power usage per day	Cost per kW·h	No of units required on site	Duration	Total power cost
	kW·h/day	£		days	£
Equipment 1	*15.05*	*0.10*	*4*	*28*	*168.56*
Equipment 2	*13.20*	*0.10*	*8*	*28*	*295.68*

J.3 Drying versus stripping out and replacement of structural material

Sometimes, where a material has not been permanently damaged by water it is necessary to assess whether it is beneficial to dry or strip out and replace the material.

Complexity is added, where a combination of drying and stripping out/replacement is necessary, for example, when a ceiling has collapsed and requires part replacement.

As an example, Table J.2 and Table J.3 show the cost benefit process for a water damaged lounge with a floor area of 20 m² that has four wet walls and a wet ceiling.

By comparing costs in Table J.2 and Table J.3 it can be seen that the cheaper drying option of £304.25 is more cost effective than the complete stripping out and replacement of the walls and ceilings at a combined total of £2,752.42.

Table J.2 – Example estimated costs for stripping out and replacing the lounge ceiling and plastered walls after suffering from water damage

NOTE *The actual costs used in this Table are for indicative purposes only and are not to be relied on or used in any way as referential to true costs.*

Item	Plaster board ceiling (20 m²)	Plaster walls (43.2 m²)
Stripping out (£/m²)	*8.80*	*9.10*
Disposal (£/m²)	*3.00*	*3.00*
Protection of surfaces (m² floor) (£/m²)	*6.28*	*6.28*
Put back (£/m²)	*22.00*	*18.00*
Re-finish- paint (emulsion) (£/m²)	*6.00*	*6.00*
Total estimate per squared metre (£/m²)	***46.08***	***42.38***
Total estimate for the actual area (£)	***921.60***	***1,830.82***

Table J.3 – Two example costs for drying and cleaning the lounge ceiling and plastered walls after suffering from water damage

NOTE *The actual costs used in this Table are for indicative purposes only and are not to be relied on or used in any way as referential to true costs.*

Item	Equipment 1	Equipment 2
Installation labour and consumables (£/m²)	*7.12*	*2.66*
Drying equipment costs per squared metre (walls and floor area) (£/m²)	*5.60*	*2.92*
Monitoring (£/m²)	*1.20*	*1.00*
Cleaning (£/m²)	*0.90*	*0.50*
Estimated power consumption (£/m²)	*3.33*	*2.13*
Re-finish paint (emulsion) (£/m²)	*6.00*	*6.00*
Total estimate per squared metre (£/m²)	***24.15***	***15.21***
Total estimate for the actual area (£)	***483.00***	***304.25***

J.4 Consequential impact

Other factors, such as the needs of the occupier, might also determine the drying method. For example, an occupier might not wish to be in alternative accommodation for an extensive period. Therefore, these consequential costs are considered alongside the mitigation and recovery costs.

Continuing with the example in Table J.2 and Table J.3, it might be that Equipment 2 has 100% chance of success but will take 2 weeks to dry the room. Equipment 1 also has a 100% chance of success in drying the room, but will achieve the drying goals in an estimated 5 days. The occupier is disabled and they do not wish to be in alternative accommodation for 4 weeks while the lounge is being dried as the building has been modified for their disability. The cost of the alternative accommodation is £100 per night. Therefore using Equipment 2 to dry the lounge will cost a predicted £1,400 in alternative accommodation whereas using Equipment 1 to dry the building will cost a predicted £500 in alternative accommodation. When these consequential costs are added to the drying costs, Equipment 1 becomes more cost effective and preferential to the circumstances of the occupier.

Table J.4 – Comparison between methods of drying and consequential cost impacts

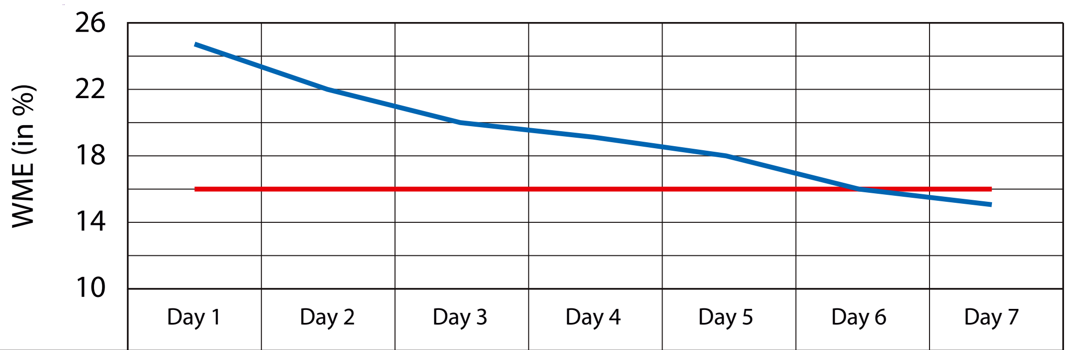
Method of drying	Total drying and refinishing costs	Alternative accommodation costs	Impact on building costs	Impact other	Total cost comparison
	£	£	£	£	£
Equipment 1	*483.00*	*500.00*	*0.00*	*0.00*	*983.00*
Equipment 2	*304.25*	*1,400.00*	*0.00*	*0.00*	*1,704.25*

Annex K (informative)
Drying goal data

K.1 Progress towards drying goal

Figure K.1 shows a chart showing the drying progress of a dining room floor from the initial elevated moisture level to its drying goal.

Figure K.1 – Example of drying progress of dining room floor



	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Actual	25	22	20	19	18	16	15
Drying goal	16	16	16	16	16	16	16

K.2 Psychrometric calculations

Figure K.2 is an example of a psychrometric chart which is a common method for calculating airborne moisture loads.

The drying options with regard to load, performance of drying equipment, and the ongoing monitoring of the drying envelope can be determined using a psychrometric chart.

One kilogram of air occupies 0.833 cubic metres at sea level.

One litre of moisture weighs one kilogram.

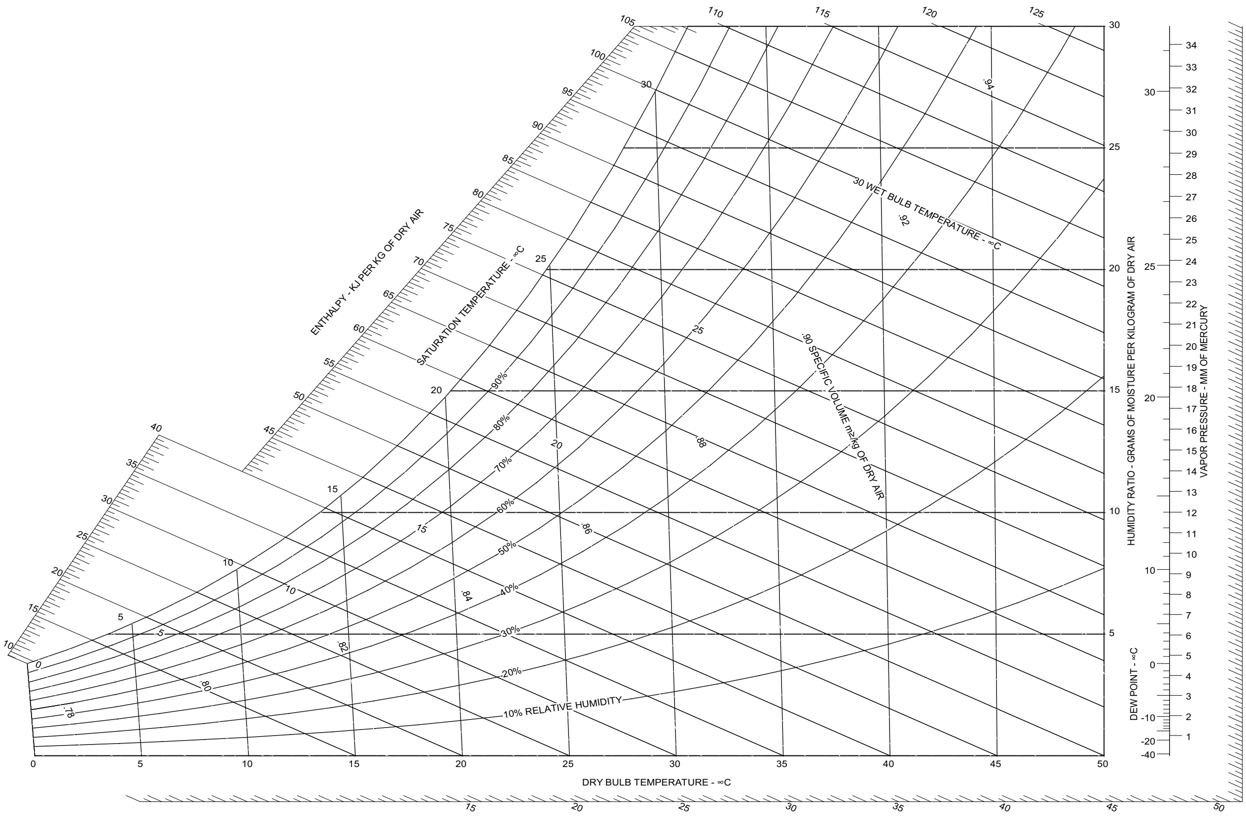
The use of a thermal hygrometer will give readings of temperature in Celsius (°C) and relative humidity (RH %).

Where these measurements cross on the chart, readings of humidity ratio aligned horizontally can be deduced.

By knowing the total cubic capacity of the building area(s) to be dried, the moisture load by mass is calculated by:

$$\text{Humidity ratio (kg/kg)} \times \frac{\text{Total cubic capacity}}{0.833} = \text{total moisture load (kg/kg)}$$

Figure K.2 – Example psychrometric chart



SOURCE Linric Company, www.linric.com

Annex L (informative)
Example completion certificate

Completion certificate for the mitigation and recovery of a water damaged building in accordance with PAS 64

The building has been mitigated and recovered to pre-incident conditions in accordance with PAS 64.

Drying goals				
Affected areas	Drying goal	Technique/ equipment used	Substantiation of drying goal	Signature

Cleaning goals				
Affected areas	Cleaning goal	Technique/ equipment used	Substantiation of cleaning goal	Signature

Indoor air quality (where applicable)			
Contamination risk	Process of control/ removal	Measurement protocol	Signature

Certificate details			
Customer name		Restorer name	
Address		Address	
Client reference		Restorer reference	
Date of incident		Type of incident	
Completion date		Equipment power usage (kW·h)	

Certificate details
It is understood and agreed that this completion certificate relates solely to the water and associated damage arising from the incident detailed above. No liability can be accepted for damage arising from pre-existent or subsequent incidents.

Pre-loss exclusions

Signed by	Print name	Date

Annex M (informative)
Example of an information leaflet for building owners/occupiers

Mitigation and recovery of water damaged buildings – Code of practice (PAS 64)

Information leaflet for property owners/occupiers

Overview

PAS 64 is a BSI Code of Practice. It provides recommendations and guidance on how to mitigate and restore water damaged buildings.

This leaflet gives information to a property owner or occupier on what they can expect from any Restoration Company who follows this Code of Practice. It also gives details on the various methods and equipment that might be used to dry a building.

Why is it important to deal with water damage to a building?

Not dealing with water damage to a building in the correct way can lead to:

- additional health risks to its occupants, employees and visitors;
- repair costs increasing;
- secondary damage occurring;
- the value and usefulness of the building decreasing.

What are the steps involved in the restoration?

This will differ depending on the nature of the damage and other factors but typically your Restoration Company will carry out the following:

1) Initial inspection

The Restorer will gather information to help them decide on the best way to dry and/or clean the building. They will consider:

- the building type, construction materials and build techniques;
- the source and extent of the water damage;
- relevant information regarding the health, safety and wellbeing of occupiers.

It may be necessary for emergency mitigation works to be carried out to limit further loss, including removal of standing water and the control of harmful contaminants in the building.

2) Drying goals

If possible the Restorer will take a reading from an unaffected area as this will help them to establish what is known as the “drying goal”. They should also measure moisture content from the air inside and outside of the building and from structural materials that have been affected. This will help them to decide on the most appropriate drying method.

3) Cleaning goal

The Restorer should establish a target cleanliness for the affected structural materials, contents, and/or the indoor environment (air quality) being cleaned. This is known as the “cleaning goal”. Sometimes there is no need for cleaning to be done.

4) Deciding on the best approach to dry the building

The Restorer will consider a number of factors when deciding how to dry the building:

- indoor and outdoor temperature and humidity;
- potential risks to employees, visitors and occupiers;
- potential security risks of leaving doors/windows open to assist drying;
- the environmental impact of the drying method;
- the availability of sufficient power;
- the predicted time it will take to reach the drying goals.

5) Ongoing monitoring

The Restorer will monitor that the drying approach they have chosen is working. They should do this by checking the moisture levels at regular intervals. They do not always need to visit the building to do this as some equipment allows this monitoring to be done remotely (they should inform you if this is the case).

If the building is not drying as expected it might highlight that there is another unknown cause of the water damage and/or that the drying method being used should be changed. Both of these scenarios are relatively rare.

The Restorer should carry out a final completion inspection to establish that the drying goals have been met (i.e. the building is "dry").

Documentation

The Restorer should maintain documentation, including:

- internal temperature and humidity readings taken on each visit;
- moisture records for the affected structural materials, including drying goals and moisture content on completion;
- scope of works and any details which may influence the drying programme;
- contents and personal property inventories;
- detailed work log/diary (including decision making log, evidence of biological assessments, pre-incident conditions);
- equipment logs;
- site specific risk assessment documentation.

Drying methods and systems

Open drying system

Ventilation is increased within a building, which can be done by simply opening windows. For this to work the outside air should be warmer and drier than the inside air.

Closed drying system

All windows and doors are shut and dehumidification equipment is installed to remove and control the evaporated moisture.

Combination drying system

The use of an open drying system is combined with the use of mechanical dehumidification equipment. This system is typically used when conditions change resulting in the outside of the building not always being drier than the inside.

Air exchange and heat drying system

Equipment is used to increase the temperature of the indoor air helping to improve the rate of evaporation from wet structural material, which in turn is extracted from the building.

The warmer air is typically heated and circulated using machinery. The heated air absorbs the evaporated water from the wet structural materials. This is then either pumped out of the building or put through machinery which removes the extra water.

Mechanical dehumidification equipment

Refrigerant dehumidifiers

The internal air is cooled below its dew point, which results in condensation appearing on the dehumidifier's internal evaporation coils. Water is then collected and removed from the area being dried, either by automatically pumping it away from the machine, or through containers being removed by hand.

Desiccant dehumidifiers

The damp internal air is blown through a desiccant material; this removes moisture by direct absorption and vapour pressure differences. The machine has two outlets; one which blows very dry air back into the building and a second, which blows very wet air out of the building. Water is not collected in its liquid form but is extracted from the area being dried via air movement.

Convectant dehumidifiers

The temperature in the room is increased by re-circulating the room's air through the machine's heating system. Once the internal air has reached a pre-defined temperature or if the relative or specific humidity reaches pre-defined levels, the machine switches to exhaust mode expelling wet air to the outside.

Air movement

Increasing air movement over the surface of a wet structural material encourages evaporation of the moisture within. Air movement also encourages turbulence within the area being dried, which can make drying equipment and techniques more effective.

Heating equipment

When the normal heating system in the building does not work or is insufficient, a secondary heat source may be needed. This is to both achieve the required drying conditions and to accelerate the evaporation of moisture from the structure. Heating systems may also be used to target specific troublesome drying areas as heating the building material directly will encourage evaporation. However, heating alone may be dangerous as uncontrolled evaporation can lead to secondary damage to the building.

Target drying

Sometimes a wet wall in a single room is the only area that has been damaged. If so, it may be preferable to just dry the air close to the affected wall. This is done by containing the area being dried by using plastic sheeting or specially designed materials, which are attached to the wall or "targeted" area.

It is important that you follow all instructions the Restorer gives you on how and when to use the equipment they install. Not doing so may result in the restoration process taking longer and/or further damage occurring to the building.

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