2023

DCA Data Centre Anti-Contamination Guide – 2023 Edition

The data centre trade association

Designed for Data Centre owners and operators to benefit from the collective experience of the industry with the trusted peer review of the DCA.

Contents

1. Change Control

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Version	Description	Date
V1.0	Initial DCA Group level circulation and Draft	12/03/2013
V1.1	Added Mark Knight to Credits, added paragraph on ISO standard 14644-1 (5.1), minor grammatical changes throughout.	26/3/2013
V1.2	Further white rust explanation, minor amends, and public release	3/4/2013
V1.3	Further clarification of term standard AC units to “non-data centre specific” and clarification of floor based anti-contamination options are not restricted only to “tak” mats	10/4/2013
V1.4	General update	04/05/2016
2019 Edition	New addition and review of the document to include: Introduction of a ‘risk register’ to demonstrate the impact of contamination in live critical spaces, new standards updated for particle and gaseous filter classes. Commentary around the EU Code of Conduct for best practises within Data Centre environments. Introduction of the ISO 14644 Table and commentary around the different size particles. Introduction of the ISO 14644-1:2015 Chart which indicates the number of air quality tests to be performed as per the size of the facility. Expansion on ‘Monitoring the Data Centre for signs of contamination’ – (5.6), minimum security qualifications for cleaning operatives.	19/11/2018
2020 Edition	New addition and review of the document to include: Changes in the EU Code of Conduct report that now show that air quality is ‘expected’ to be managed in Data Centre environments (from the optional stage). Information added to 3.6 on zinc whiskers, short-term & long-term remediation plans to be considered (sample images also	07/03/2020

	added). 3.7 – Health & Safety in the Data Centre – comments added around construction dust when building new Data Centres. New – 5.2 Air quality testing and apparatus added to the edition. 5.4 – Air filters and air conditioning & handling units, added comments for air monitoring devices now include air cleaner/purifier control functions. New 5.10 Anti-contamination products added to the document.	
2021 Edition	New addition and review of the document to include: 3.5 – Chemical Corrosion, Environmental Classification for Industrial Environments table added (G1 – GX). 5.4 – Air filters and air conditioning & handling units. Amendments to the text to include wearing PPE when filter changing is being completed and the use of life cycle costing in regard to energy use and carbon effect. Section 6 – Covid 19 information added to the document. 6.1 – Covid 19 Air filters for air cleaning & standalone filter units added. 6.2 – Covid 19 Data Centre cleaning added. 6.3 – Covid 19 UV light information added. 6.4 – Covid 19 best practice guideline table added. Section 7 – Cleaning frequency added to the document. 7.1 – Minimum recommendation for Data Centre cleaning table added to the document. Section 8 – Summary, format changed to a table for ease of viewing, additional information on Tin whiskers, particle filter class recommendation.	27/04/2021
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2. Introduction

The demands and growth of digital services has driven radical changes to ICT equipment and this in turn has driven equally radical changes to data centre designs. This has been caused by wider and greater ranges in temperature and humidity in the Data Centre together with new technological schemes and upgrades to meet these changes, which in many cases requires a new approach to anti-contamination strategy to ensure the desired reliability and energy efficiency goal of the Data Centre remains intact.

This document examines the risks posed to data centre facilities of contamination from dust, dirt, airborne particulates and other foreign flora and fauna that enter the Data Centre.

The information provided is the result of a collaborative approach by members of the Data Centre Alliance, an independent industry association. This involved a range of data centre M&E and design experts and a number of Data Centre technical cleaning specialists. The objective is to provide an independently written guideline for owners and operators to benefit from the collective experience of the industry with the trusted peer review of the DCA.

3. The risks posed to Data Centres by contamination and dirt

Data Centre owner/operators can benefit from attractive cost savings by implementing modern data centre operating temperatures and humidity guidelines, improved cooling and ventilation methods and technologies. However, these improvements demand a re-think of the anti-contamination strategy in order to enable these cost savings without compromising the Data Centres design goal.

3.1 Reliability of the data centre

Preventing dust and contaminants from infiltrating your IT equipment can reduce the risk of overheating, improve filter life and guard against unnecessary wear to components. Manufacturers such as HP, CISCO and IBM require that their equipment should be situated in a properly maintained area to ensure their hardware warranties remain intact. The relatively low cost of conducting an appropriate cleaning and anti- contamination regime can prevent service outage by minimising the risk of various, often hidden, threats to equipment and infrastructure damage.

Dirt, dust, carbon, construction debris, calcium carbonate, metallic, paper dust, synthetic fibers, human and non-human organic fibers, and other often unseen sources of contamination are leading causes of internal corrosion and equipment malfunction in computer systems. These contaminates can be corrosive, flammable, abrasive or hydroscopic (absorb moisture). If these contaminants can accumulate, they can contribute to several problems including heat transfer, corrosion, and wear and failure of electrical contacts.

3.2 Energy Efficiency

Contaminant build up can reduce the effectiveness of heat dissipating units on servers such as heat sinks, and fans. In addition, data centre air plenums can be obstructed by various material either contaminants or equipment discarded by contractors and engineers over time.

Air filters deployed within air handling and air conditioning units to control particulates can become blocked over time negating the energy efficiency realised when first installed.

3.3 EU Code of Conduct

The European Code of Conduct for Data Centre Energy Efficiency has been created in response to the increasing energy consumption in Data Centres and the need to reduce the related environmental, economic and energy supply security impacts. The aim is to inform and stimulate Data Centre operators and owners to reduce energy consumption in a cost-effective manner without hampering the mission critical function of Data Centres.

The best practise of 3.2.12 *'Monitor and Manage Air Quality'* in the EU Code of Conduct for Data Centres has moved from an 'Optional Practice' for maintaining the air quality to an ISO 14644-1:2015 Level 8, to an 'expected' application of the recommendation in the 2020 edition of the report. The document states 'all expected practises should be applied to any Data Centre constructed from 2011 onwards.

The EU Code of Conduct for Data Centres *(Energy Efficiency)* is also strongly recommended for general good practises in Data Centre management, in particular best practice 3.2.14 *'Site Documentation'* for accurate information purposes including service and cleaning records and for any internal or external audit or assessment that may be carried out.

In addition, the EN50600 series of Data Centre design, build and operate standards also provide guidance on best practices, specifically 3-1 Management and operational information which lists information that should be handed over during the IST phase *(post clinical clean of all operational white spaces)* and regular cleaning as determined via a planned maintenance schedule.

3.4 Fire Risk

Dust and other contaminants if allowed to build up can increase the risk of fire. Floor tiles are designed to dissipate electricity by providing a conductive path to ground.

Ground in dirt greatly reduces the floors ability to dissipate static. Dirt builds up in floor voids and air plenums can block airflow and increase the risk of fire or the risk of fire suppression alarms being activated.

3.5 Chemical Corrosion

Gaseous contaminants that cannot be removed by traditional HEPA filtration are present in every environment. In high concentrations these contaminants can have a negative performance impact on both IT equipment and human beings.

Most of the gaseous contaminants found in data centres are by-products of the combustion of fossil fuels and these can cause corrosion across printed circuit boards (PCBs). This will be evidenced within the PCB through corrosive shorting across conductive points and pathways and contaminated solder joints. All of these result in a decrease in the useful life of the equipment.

This form of corrosion has become more prevalent since the Restrictions on Hazardous Substances (RoHS), or lead-free, manufacturing regulations for electronic equipment were introduced in 2006.

Data Centre operators should include an environmental contamination monitoring and control section as part of an overall site planning, risk management, mitigation, and improvement plan.

ISA Standard 71.04-1985 specifies the following levels of Indoor Air Quality (IAQ) as it specifically relates to its impact on the life expectancy of electronic equipment. The four levels defined within the standard are G1, G2, G3 and GX with G1 being the best or least contaminated. A brief description of each category is as follows:

G1. Severity Level MILD – an environment sufficiently well controlled such that corrosion is not a factor in determining equipment reliability.

G2. Severity Level MODERATE – an environment in which the effects of corrosion are measurable, and corrosion may be a factor in determining equipment reliability.

G3. Severity Level HARSH – an environment in which there is a high probability that corrosive attack will occur. These harsh levels should prompt further evaluation resulting in environmental controls or specifically designed and packaged equipment.

GX. Severity Level SEVERE – an environment in which only specially designed and packaged equipment would be expected to survive. Specifications for equipment in this class are a matter of negotiation between user and supplier.

The IAQ level can be established by the use of “Corrosivity Coupon Analysis” to measure the effect of the air on exposed copper and silver over a 30-day period. After the 30-day period the coupon is sent to a laboratory to measure the depth of rate of coupon corrosion due to contamination that has occurred. A chemical analysis can then be performed to determine which gas contaminants are present and then a molecular gas

filtration strategy can be formed to extend the life of the electronics and make a safer working environment for Data Centre staff.

There are also devices using coupon technology that allow real time monitoring and data storage. This allows characterization of gas contaminant concentrations over time. If there are regular peaks of contamination, then a control strategy can also be used to mitigate exposure.

Class	Severity Level	Copper Reactivity (A)	Silver Reactivity (A)	Comments
G1	Mild	< 300	< 300	Corrosion is not a factor in determining equipment
G2	Moderate	< 1000	< 1000	Corrosion effects are measurable and corrosion may not be a factor. ENIG and ImmAg PCB surface finish failures.
G3	Harsh	< 2000	< 2000	High probability that corrosive attack will occur. OSP and ImSn PCB surface finish failures
GX	Severe	> 2000	> 2000	Only specially designed and packaged equipment to survive

3.6 Chloride corrosion

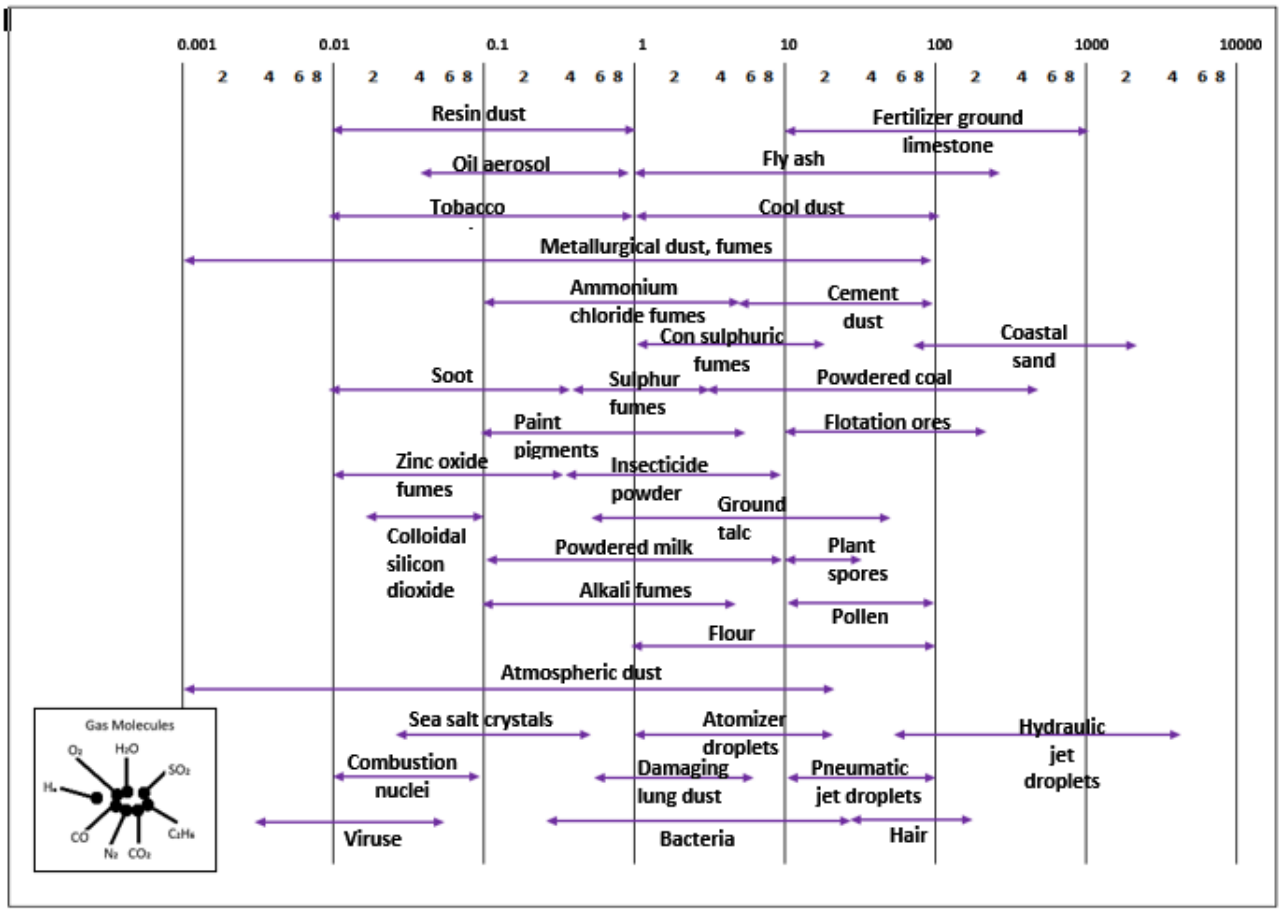
Since chloride (salt) corrodes metal, it is recommended that electronic IT equipment be cleaned or replaced if chloride levels exceed 5µg/cm2. Possible sources include smoke, chemicals, and acids. Elevated levels of chlorides are very serious for Data Centre environments since they cause severe corrosion of system components, especially where air humidity exceeds 50 RH.

3.7 External contamination factors

External contamination factors in the form of airborne contaminants can have a significant effect on the reliability of Data Centre facilities. The location of the Data Centre and the profile of types of contaminating particles and gases present will determine the environmental controls necessary to protect the working data handling and storage systems.

The airborne contaminants come in the form of fine particles and gases. The principal threat is due their capability to penetrate electronic devices, servers, and switching mechanisms. Damage may occur in the form of corrosion or build-up of deposits causing circuit breaks or short circuits.

Particle Diameter, Micrometres (M)



Particle Type Contamination.

Sea salt crystal particles - 0.03 to 0.5 micron can dissolve in water droplets and leach into devices triggering corrosion damage. Supply air filtration and Intake louvres can reduce ingress of these particles into the building. Especially damaging to electrical devices.

Bioparticles pollen seeds spore's bacteria virus - can cause accumulation and blocking. Deposition and decay can promote chemical reactions fungal growth and possible vermin activity. Should also be minimised to protect the health of people when inside the building. Can contribute to chemical reactions and corrosivity. Supply air filtration can reduce this problem.

Fine sand mineral desert dust - Is a problem in dry areas and desert regions. Air filtration can reduce this problem to an acceptable level. Mineral dust needs sample analysis for composition abrasive capability and corrosivity. Supply air filtration can reduce this problem. In extreme situations dust collection capability may be required.

Construction or excavation dust - Will be a problem with building activity in the locality of any Datacentre facility. Likely to occur more frequently in urban locations. In extreme situations frequent changes of supply air system pre-filters may be required.

Fine combustion particles - (PM1 - PM2.5 size) Usually linked to urban location traffic emissions which are especially toxic to people. Burning of fossil fuels, coal, oil and gas also produce these particles. They are a complex mixture of combustion products and are chemically active.

Dust from industrial processes - May have a variety of compositions (see chart above). Proximity and prevailing winds may influence concentrations drawn into Datacentre intake ducts. Air filtration must have required filtration efficiency and capacity to remove particles from the airstream.

Acidic Gas Type Contaminants

It must be said that a driving consideration for ventilating Data Centres is the low cost and energy saving given by 'free cooling' using colder outdoor air. This air can be used to supply hot areas such as server halls to reduce operating temperatures. Coastal locations usually have cool air in abundance, but the air often carries corrosive salt crystal particles. Apart from the crystals gaseous chlorine compounds can also be a problem and urban locations are associated with acidic gases. Typical acidic gaseous compounds such as NOx and SOx, Ozone, hydrogen sulphide, chloride and ammonia can be removed with appropriately designed molecular filtration.

Improved capability for low-cost real-time air monitoring

The market for low-cost real-time air monitoring has burgeoned over the last few years. The problems with air pollution and latterly Covid-19 has driven a need to know in detail the levels of particulate matter and corrosive/toxic gases in buildings. This information can be gathered, stored and displayed in real-time on dashboards by phone, tablet or full monitor display. Fast direct information enables design of targeted air filtration systems for particle and gas contaminants of concern. PM1, PM2.5 size particles can be further analysed by sample testing if necessary.

3.8 "Tin" or "zinc" whiskers and "white rust"

Tin or Zinc whiskers are minute electrically conductive pure-metal crystalline structures that grow on components and products having electroplated tin as a surface finish. Zinc whiskers can grow in abundance within data centres, causing bridging and shorting between electrical conductors and component terminations. While zinc whiskers remain attached to their source i.e. floor panels, pedestals, etc they are basically dormant, however when the whiskers are disturbed and dislodged they become airborne and circulate freely throughout the environment. Disturbance is likely to be caused by routine maintenance activities in the Data Centre, including for example, lifting, sliding, reinstalling of access floor tiles or overhead trays, and installing of network cables.

Once inside IT equipment, zinc whiskers as electrically conductive structures, can cause various electrical failures, ranging from intermittent to permanent short circuits. Zinc whiskers can also become a physical impediment to moving parts or obscure optical surfaces and sensors within some equipment.

Both short- and long-term corrective actions can be considered for solutions to zinc whisker problems. Short term actions include replacing affected components with ones that have a

protective insulating compound that coats most of the exposed electronic circuitry, minimising activities that require significant handling of the infected material (floor panels for instance).

Long term solutions include, but are not limited to:

- Carefully planned and controlled removal of all affected or suspicious panels/pedestals/cable trays while protecting equipment and personnel.
- Thorough cleaning of the Data Centre environment, using H-type vacuums to remove as much zinc whisker debris as possible, IT equipment should be protected before any cleaning is undertaken.
- Installation of replacement floor structures that are not prone to zinc whisker formation, including all aluminium or steel structures with conductive epoxy powder coatings or paints instead of zinc for corrosion protection.

All information available is in agreement that simply washing zinc whisker infected material is not an effective long-term remedy as the whiskers will grow back. Regular cleaning and coating zinc whisker prone surfaces may be a solution; however, the zinc whisker could possibly grow through some conformal coatings, dependent on their properties and thickness. Long term testing is required to validate such remediation approaches.

3.9 White rust

Atmospheric moisture contains a small amount of contaminates (salt or minerals) and zinc will react quickly with it to form zinc hydroxide, a chalky white and relatively unstable oxide of zinc. Where freshly galvanized steel is exposed to this type of moisture (rain, dew, condensation) in oxygen deficient environment, the moisture will continue to react with the zinc and aggressively consume the coating.

The most common condition in which white rust occurs is with galvanized products that are nested together, tightly packed, or when water can penetrate between the items and remain for extended periods such as construction sites where materials are stored outside through poor weather conditions. White rust can cause particulate contamination of the Data Centre as a result of the white chalky matter becoming loose and airborne within the facility.

3.10 Severe white rusting

This is characterised by a noticeable darkening and apparent etching of the galvanized coating under the affected area, with the white rust formation appearing bulky. The galvanized coating thickness should be checked to determine the extent of attack on the coating.

3.11 Health and safety in the data centre

Safety issues to the eyes regarding airborne dust and grit can be created when technicians maintain floor tiles or overhead venting equipment, especially after long periods where particulates have been allowed to accumulate. The effects on humans of long-term exposure to increased levels of chemicals and zinc whiskers are not fully understood but should be considered a risk.

Construction of new Data Centres are known to generate high dust levels due to the tasks involved. Before any activity that generates dust begins, the type of construction dust must be considered. Working methods and procedures for preventing airborne dust arising in the first place should be the top priority. If airborne dust cannot be avoided, then working methods for minimising the amount of airborne dust generated and breathed in must be followed.

3.12 Flora & Fauna

Floor voids and hidden areas within the data centre can be havens for mice and rats, these chew through cabling causing outage. They can also build nests using shredded paper and debris that can raise the risk of fire. Rodent droppings if left in the void will become extremely poisonous.

4 Advice on data centre design to minimise contamination

4.1 Geographic Location

Consideration should be given to the location of a Data Centre in order to minimize the risk of contamination issues. Situating a data centre in an area that is high in airborne contaminants whether natural (i.e., close proximity to the sea giving rise to increased levels of sodium chloride in the air) or man-made (i.e., close proximity to a transportation hub such as an airport or bus station) will increase the risk of contamination penetrating the structure and the IT kit.

4.2 Floors, ceilings, walkways and layout

All unsealed concrete should be painted and/or sealed, concrete materials and exposed concrete surfaces continually oxidise and breakdown, this releases loose sand and lime. Lime dust is particularly corrosive when combined with water or is humidified. The oxidisation is amplified if the unsealed concrete is found in the sub-floor, due to the constant airflow being moved over the surface.

Data Centres should ensure all unused drill holes are sealed & painted within the technical area of the facility.

Ideally, only one entrance should be used to gain access to the Data Centre, this improves the restriction of contamination entering the Data Centre. People entering the Data Centre are a source of contamination for many reasons, hair and fibres from clothes, mud and dirt on footwear all contribute directly to the contamination levels.

Therefore, careful consideration of minimising the entrances to the Data Centre and the management of control measures on each entrance is recommended.

Simply walking across the Data Centre floor can agitate settled contamination, making it airborne for induction into equipment. Restricting the access for unnecessary entry onto the live technical floor is also extremely important.

Compressed fibre ceiling tiles are not recommended for use within the Data Centre; the compressed fibre tiles are cellulose which shed contamination when touched by maintenance teams. Ceiling panels with smooth surfaces or encapsulated edges are recommended within the technical area.

All potential exposure points in the data centre should be addressed to minimise potential influences from outside the controlled environment.

The positive pressurization of the Data Centre will help limit contamination infiltration. Areas to be inspected in the Data Centre should encompass:

1. Breaches within the sub-wall.

2. Breaches within the ceiling void.

3. All door-sweeps are correctly in position and are not damaged in any way.

4. All entrance doors should fit correctly in the frame.

5. Walkways and pathways should be protected with material that removes contamination from shoes and soles.

Contamination generating activities and equipment within the data centres building include toner dust from copiers and printers (and the paper used) should be segregated and the relevant doors/air-locks installed.

5. Advice for operational data centres

5.1 Measurement and standards

It is recommended that all controlled environments are measured for airborne particulates to ensure contamination controls in place are effective. ISO 14644-1 International Standard for Clean Rooms and Associated Controlled Environments is an industry recognised body for air quality testing and controlled environment classification and was updated to reflect current methods of operation in 2015. Although the standard is not specifically designed for only data centre facilities, it is accepted that without measurement there is no control, and it can be a valuable measure if used within the context of this overall guide. This is because the standard is concerned only with the amount of airborne particulates within a volume of air, and therefore cannot measure settled or trapped particulates and the overall status of a Data Centre's anti-contamination performance or risk profile.

Therefore, in summary, compliance against the standard cannot be relied upon if taken in isolation; however, the DCA recommend compliance as part of the overall recommendations and advice contained within this document.

The table below shows the ISO 14644 Air Cleanliness Classifications in terms of maximum particle concentrations allowed for different particles sizes.

Against the ISO 14644-1 classes, Data Centres are advised to reach classes 7-9, with the recommended class being 8.

ISO 14644-1 Table

Class	Maximum Particles/m2						FED STD 209E equivalent
	≥0.1 µm	≥0.2 µm	≥0.3 µm	≥0.5 µm	≥1 µm	≥5 µm	
ISO 1	10	2					
ISO 2	100	24	10	4			
ISO 3	1,000	237	102	35	8		Class 1
ISO 4	10,000	2,370	1,020	352	83		Class 10
ISO 5	100,000	23,700	10,200	3,520	832	29	Class 100
ISO 6	1,000,000	237,000	102,000	35,200	8,320	293	Class 1000
ISO 7				352,000	83,200	2,930	Class 10000
ISO 8				3,520,000	832,000	29,300	Class 100000
ISO 9				35,200,000	8,320,000	293,000	Room Air

The remaining classes fall into the below categories:

ISO 1 – 2 are recognised with Semi-Conductor Laboratories

ISO 3 – 6 are recognised with Hospital theatres and clean room facilities.

The ISO 14644-1: 2015 *(classification by air cleanliness)* standard now determines the number of air quality tests to perform against the size of the facility in m2– please see the chart below.

ISO 14644-1 Testing Locations

Area of Data Centre (m2) less than or equal to	Minimum number of sampling locations to be tested
10	5
24	6
28	7
32	8
36	9
52	10
56	11
64	12
68	13
72	14
76	15
104	16
108	17
116	18
148	19
156	20
192	21
232	22
276	23
352	24
436	25
636	26
1000	27
>1000	Equation to be added

Just for clarity:

If room > 1,000 m2 then a formula dictates the number of tests:

N = 27 x (A/1000) where: N = Number of tests to be performed, A = Area in m2

The DCA Certification Scheme which audits against all the best practice standards for operating a data centre includes testing against the ISO 14644 standard as part of the certification criteria.

5.2 Air quality testing and apparatus

Particle counters are sensitive measuring devices, which have been designed to use lasers and photo-optics to collect particle size and quantity data. The particle counter has a pump that draws air into a fixed volume at a constant rate for a known period of time, the laser beam illuminates the airborne particles and light is redirected or absorbed, a detector measures the amount of light scattered to determine the particle quantity.

It is always extremely important to keep the sample inlet capped when the particle counter is not in use. Any debris or large contamination getting inside the sensor can adversely impact sensor performance as well as the data.

The air quality testing instrument itself should be kept free from contamination; the externals of the unit should be wiped with approved cleaning agents.

It is crucial, and a regulatory requirement that critical monitoring and measurement instruments are calibrated annually. Manufacturers recommend at least an annual calibration, however, users of continuous particle measuring systems should consider more frequent assessments to ensure confidence between service.

At the time of air cleanliness testing in the Data Centre, the following criteria must be followed:

- The air particle machine is fully calibrated with a conformance certificate.
- Air particle testing is undertaken at 1 meter in height from the floor surface.
- The particle machine is not moved while the air is being sampled.
- The CRAC/AHU systems are run at full capacity.
- New AC filters have been installed before testing.
- Positive pressure is maintained in the space.
- All 'dirty' works (or works that may contribute to the particle count) have ceased
- Doors to the enclosure are closed.
- Activity in the space is kept to an absolute minimum when air testing.

5.3 Waste management: packaging and cardboard

Cardboard should not be stored or taken into the live technical facility, as cardboard releases compressed fibres. Any new equipment delivered into the facility must be unpacked in a staging area immediately outside the data centre. Fibrous dust from paper, cardboard or textiles can foul heat sinks and disrupt equipment cooling. The plastic inner wrapping can also become a source of contamination, although the problem is less severe if the plastic is manufactured from antistatic material.

The use of 'dirty pallet trucks/trolleys' in the technical facility is not recommended, all manual handling aids should be clean and free from contamination. It is recommended that loading bays and storage areas connected to the data centre where trucks/trolleys are used are sealed or protected with anti-contamination flooring material especially at egress/ingress points between the outside and the technical areas.

5.4 Air filters and air conditioning & handling units

Data Centre reliability is a top priority and so must be ensured. Air filters must be best positioned to deal with the source of airborne contamination. High concentrations of airborne contaminants combined with higher humidity levels will usually show increased rates of equipment failure in Data Centres.

Air filters used to clean incoming supply air from outside and recirculated inside air must be capable of removing airborne particles and also corrosive gases when present. Tin or Zinc whiskers can be an internal source of airborne contamination as well as White rust particles.

There is an increasing use of free cooling to reduce energy consumption in Data Centres. Use of outside air at lower temperature introduced directly into the Data Centre server hall can offer large reductions in Power Usage Effectiveness (PUE).

The current recommended particle filter class for Data Centre supply air systems is minimum BS EN ISO 16890:2016 ePM1 50% and for recirculated air systems is Coarse 70%

the equivalent as recommended by ASHRAE in "2011 Gaseous and Particulate Contamination Guidelines for Data Centres". Air monitoring can be used to determine the concentrations of Particles and Corrosive gases present. Some air monitoring devices now include air cleaner/purifier control functions.

It is recommended that particle concentrations in Data Centre operational equipment areas meet the requirements of ISO Standard 14644-1 Class 8.

For Corrosive gases it is recommended that monitored levels of corrosion meet the requirements of ISA Standard 71.04-1985 to meet class G1 Mild. Where monitored levels of corrosion exceed this then gas phase filtration needs to be used. Molecular gas filtration can be fitted to the main supply ventilation system or applied by use of standalone recirculation units. To target individual contaminant gases filters tested to BS EN ISO 10121-2:2013 can be used. Broad spectrum filters can be used to target a combination of gases.

Air filters consume significant amounts of electrical energy through the fan motor, so selection of low energy air filters is recommended. These filter classes have the lowest operating pressure drop for their rated airflow. The Eurovent energy rating for air filters gives an A+ rating for the most energy efficient air filters. Use of Life Cycle costing can confirm the air filter selection with minimum energy use and lowest carbon effect.

For particle filters best economic filter change can be made when the initial operating pressure drop of the air filter doubles at the given reference fan speed. Air filter pressure drop monitoring is recommended.

Ensure all contaminated air-conditioning filters are correctly removed from the live environment before cleaning; the filters should be placed into bags and sealed to prevent any particulate matter becoming air borne. The removing of contaminated filters inside the live data centre should be performed in a controlled & professional manner. Wearing of PPE, mask, glasses, gloves, and overalls is of course required.

Regular maintenance checks for 'belt degradation' within the air conditioning units (if belt driven) the visual sign is a fine black soot-like contamination, the contamination caused by the degrading of the AC belt will become air-borne throughout the data centre.

5.5 Cleaning processes

The following provides advice and recommendations for Data Centre managers to follow to ensure anti-contamination practice is maintained during the day-to-day operations of a Data Centre:

1. Ensure no sweeping brushes are used in any live technical facility; all contamination should be extracted and contained within 3 stage HEPA filtered vacuum cleaners. Sweeping brushes create air-borne particulate matter.

2. Ensure all contractors performing tasks within the technical facility use HEPA filtered vacuums to remove contamination/dust/debris. A traditional vacuum cleaner fitted with a standard textile dust bag can filter down to a 30-micron particle size. A normal two-ply paper dust bag will usually filter down to a particle size of 15 microns (twice as small). To eliminate biological/particulate matter contamination the level of filtration must be many times better than this since bacteria are between 1 and 10 Microns in size. Specifying 'HEPA' rated vacuum cleaners will ensure that the exhaust air is 'biologically' clean and filtered down to 0.3 Microns (100 times as small).

3. It is recommended that all contractors submit a 'works contamination' plan before commencement of 'dirty works' in the Data Centre, this plan should be approved by the Data Centre Manager for approval.

4. Ensure no cutting or filing of cable trays/cable baskets take place within the Data Centre, this action will create a small conductive particle which will be drawn into the air recirculation of the room.

5. Ensure all contaminated tak-mat sheets are regularly changed or if using polymeric mats, are regularly cleaned - approximately 70% of the contamination enters the Data Centre through the main access point (door), therefore these should be checked regularly.

6. Facilities management team should ensure all contractors have removed contamination following maintenance works in the technical facility.

7. A 'contamination action plan' should be implemented if refurbishment works are to be undertaken in the building (not necessarily the Data Centre) but if the Data Centre is housed within the same building as the construction work.

8. Take steps for avoiding White Rust formation by ensuring packed material remains dry. Provide/permit air circulation between the surfaces. Allow for adequate drainage on stacked items. In extreme situations you may apply water repellent or barrier coatings to prevent moisture.

5.6 Floor & Ceiling voids

All Data Centre's housing 'air return' ceiling voids/plenums should be professionally decontaminated. The contamination present within the ceiling void is subject to a constant circulated airflow. Maintenance checks should be performed on the infill bags within the ceiling void (if applicable). The infill bags contain a fibrous installation material which if the infill bag is damaged/torn in any way, the fibres will be exposed to the air flow within the ceiling plenum. Within the ceiling void plenum, a visual inspection is required to identify if any 'spray-on fire insulation' has been applied to the structural steel, if this is the case, it must be sealed as it is a source of particulate matter.

5.7 Monitoring the data centre for signs of contamination

Regular testing for Tin Whiskers should be performed as part of controlling contamination in the data centre. Should tin whiskers be identified, a remediation plan will need to be implemented as a matter of urgency.

Regular testing for Zinc Whiskers should be performed as part of controlling contamination in data centres, the whiskers are zinc crystals formed by the degradation (corrosion) of the galvanized metal surface.

Analysis of dust found settled in a Data Centre serves two purposes, Firstly, an understanding of the dust's chemical composition allows an assessment to be made of its potential to cause short circuits at different voltages and currents if it settles on electronic printed circuit boards. Secondly, an understanding of the dust's chemistry can help to identify its origin.

Settled dust for analysis can be collected on a sticky tape stud, which can then be examined using a scanning electron microscope and energy-dispersive X-ray analysis (EDX). The generated EDX spectrum can identify the dust elements and provide a rough indication of their concentration.

Characteristics of the dust's chemistry will also indicate its potential for causing short-circuiting of electronic circuit board connections, especially in conditions of elevated humidity.

Analysis of the settled dust can also help reveal its source, particles from unsealed concreate with the Data Centre space, or dry soil from a nearby construction site/or farmland may have entered the white space through the air conditioning system, all this information is valuable to Data Centre Managers.

5.8 Choosing the correct cleaning contractor

Avoid using office or "IT" cleaning contractors who cannot demonstrate specialist Data Centre knowledge and experience. In-house cleaners are often not insured to work in Data Centres.

Ensure specific tools are used, such as 'HEPA' filtered vacuums, specialist cleaning agents, tak cloth etc.

Do not use cleaning contractors that advocate the use of brooms, feather dusters, non-specialist vacuum cleaners.

Ensure contractors have knowledge of using the correct power points, the fire protection and warning system(s) needing to be isolated, the correct lifting of Data Centre floor tiles and a general good understanding of the data centre environment and awareness of its functions.

5.9 When Considering a Cleaning Provider, assess:

Experience Profile	Should have vast experience of delivering Data Centre cleaning.
References	References should be obtained to vet performance/ability of the cleaning provider.
Training – documentation and proof	All cleaning operatives should be fully trained in Data Centre cleaning and understand the environment they work in (including all risks).
Dedicated data delivery preferable	The cleaning provider should preferably be dedicated to Data Centre cleaning operations.
Accreditations	The cleaning provider should have gained the correct accreditations to engage in Data Centre cleaning, (quality management for example).
UK Geographical cover	The cleaning provider should have full geographical reach to service the needs of the Data Centre owners.
Labour resource and sufficiency of cover	The cleaning provider should also be able to respond to emergency incidences within the Data Centre or supporting locations (plant/UPS rooms).
Back-up, reporting and supporting systems	The cleaning provider should have clear reporting systems in place, air quality statistics should be backed up in reports for the client.
Ability to carry out site survey to properly assess	The cleaning provider should have the capability/ability to perform project surveys and give recommendations on the best delivery model tailored to the client's needs.
Health & Safety record	The cleaning provider should have a good Health & Safety record of working in Data Centre environments, all cleaning operatives should also be trained in delivering toolbox talks and completing dynamic risk assessments when onsite.
Sufficient insurance cover	The cleaning provider should have sufficient insurance cover for working/operating in mission critical spaces.

5.10 Security vetting of cleaning operatives

Cleaning providers operating within Data Centres/mission critical spaces should be vetted to a specific level of clearance for security purposes.

BS7858 – Security screening of individuals employed in a security environment – This code sets the standard for the security screening of staff in an environment where the safety of people, goods, or property in essential. This includes data security, sensitive and service contracts and confidential records.

For Governmental and Ministry of Defence projects, all operatives will need to obtain a level of SC clearance for access to the facility. Individual background checks include basic demographic and fingerprint based criminal record checks, and, depending on an individual appointment's requirements, credit checks, loyalty, and field checks might be conducted.

5.11 Anti-contamination products

Anti-contamination products should be installed where appropriate to reduce contamination being brought into the critical spaces, specialised floating floor mats should be positioned at all entrances thus reducing dust particles from disrupting data centre environments.

The key benefits from specialised floating floor mats are as follows:

1. The size of the floating mats allows for six footfalls or three full wheel rotations to remove contamination.
2. Conforms to shoe and wheel profiles collecting and retaining particles between 1-100 microns.
3. Polymetric surface creates natural tack and short-range electromagnetic forces.

Contamination control mats (also known as tak mats) can also be installed near entrance areas into the building/critical space, their mildly sticky surface can capture dirt from shoes or wheels, these mats are tough, non-slip and designed with a low-profile surround to prevent tripping and problems with trolley wheels.

The mats are freestanding and comprise 36 resin impregnated woven cotton layers in a rigid plastic disposable surround (an alternative is “Low profile” tak mats comprising of 30 layers but otherwise the same as standard tak mat). As each layer becomes soiled by traffic it can be peeled away to expose a clean new sheet, effective contamination removal needs at least six footfalls, three for each foot, or three full wheel rotations.

Using an average person’s walking stride, the matting length required is approx. 4.6m, ideally this distance would be applied to all contamination control mats, however this is not always possible due to space limitations. One major consideration must be to ensure that people entering the facility cannot bypass the material (ie step around it).

6 Covid-19 Information

6.1 Covid-19 Air filters for air cleaning & Standalone filter units

Increasingly airborne infectious particles are being seen as the primary route of transmission of Covid-19 infection. Waves of infection and new variants are constantly appearing.

Therefore, the use of air filtration as a mechanical intervention is sensible when people are present and occupying the datacentre building indoor areas.

Particle air filters tested to International Technical Standards EN1822 and ISO16890 offer accurately measured performance of particle removal efficiency.

For standalone air cleaners and air purifiers EN1822 Hepa filters class H14 are recommended. These are 99.995% efficient at MPPS Most penetrating particle size which is typically about 0.12 to 0.16 micron. (About the same size as Covid-19 virus)

For general HVAC air filtration ISO16890 at least ePM1 80% total efficiency filters are advised. PM1 particles are those sized at one micron and below and include the virus size and small airborne droplet aerosol sizes that stay airborne for long periods. ISO16890 allows calculation of multistage filter efficiency. So, for example 2 stages of ePM1 70% gives 90% PM1 efficiency and 3 stages give over 97% PM1 efficiency. Removal of infectious particles from air to this efficiency will give people a high level of protection against infection when they breathe in the cleaner air.

Tightly sealed air filter mountings to EN1886 guidelines will ensure high filtration efficiency is achieved in HVAC systems using ISO16890 tested air filters.

The latest ASHRAE Core Covid-19 guidance advises using a combination of filters and air cleaners for air re-circulated by HVAC systems. Air monitoring (PM1, PM2.5) and control devices are increasingly being used to confirm delivery of clean healthy air. Protecting people will also afford greater protection to the datacentre plant and improve staff working efficiency.

6.2 Covid-19 Data centre cleaning

Meticulous deep cleaning of the critical and ancillary space by a professional and Data Centre specific cleaning company is recommended. A full deep clean of the facility should be undertaken, this clean should fall in line with the recommended air cleanliness levels of ISO14644-1:2015 level 8, followed by a full disinfectant clean/wipe of all surfaces, touch points and display units that site engineers are likely to come into contact with through routine maintenance. The Data Centre should be kept in a sterile state and increased cleaning regimes are key for engineer and staff safety.

If a Data Centre houses floor or ceiling voids, these spaces should also be included in the deep cleaning specification and cleanroom style techniques should be adopted in the Data Centre. These techniques range from adopting a process flow from cleaning the Data Centre from the furthest point and working towards the exit, overlap cleaning of walls, doors and floors, correct disposal of contaminated cloths, consumable materials and PPE via labeled bio-hazard waste bags with these then being destroyed by professionals.

6.3 Covid-19 – UV light

UV light is a proven technology when it comes to reducing bacteria, viruses and other harmful microorganisms that pose a risk to human health. Ultraviolet (UV-C) light kills or inactivates microorganisms by destroying nucleic acids and disrupting their DNA, leaving them unable to perform vital cellular functions.

UV germicidal lamps have been used for disinfection of air and surfaces within hospitals, laboratories, and many other organisations where hygiene and cleanliness are of utmost importance. In light of the current Coronavirus outbreak, UV is just one of the many technologies available for use on the market and being utilised to help reduce and control the spread of the virus. Very little is known about UV light being used in Data Centre environments for virus control and the lasting effects on IT equipment and cabling systems, for the purpose of this report and until further information is established for the sector, it is recommended that all surfaces should be cleaned/wiped with specialised disinfectant solutions (inside floor voids/ceiling voids/IT racks and touch points), disinfectant inactivates nearly 100% (99.9999%) of the relevant strains of microorganisms on a surface withing a 5-10 minute time period.

Please note – UV-C is also extremely harmful to the skin and eyes of the operator and people in the direct vicinity. Due to exposure limit values for operators, full UV protective face shield along with gloves and full protective clothing will need to be worn, this should be taken into consideration and relevant risk assessments performed if Data Centre owners and operators do adopt UVC techniques.

6.4 Post Covid-19 – Best practice guideline

During a global pandemic, Data Centres and operators face huge challenges with risk to staff, engineers and third-party suppliers that are vital to the uptime of the critical environment. Below is a table that details risk adverse recommendations from a cleaning and contamination control perspective.

	Covid-19 Best Practice Detail 2023 Data Centre Specific
1.	All major touch points around the Data Centre should be cleaned with a disinfectant solution to control the spread of viruses.
2.	Touch screen displays should be isolated and cleaned/wiped after use (AHC displays following maintenance for example).
3.	For standalone air cleaners and air purifiers EN1822 Hepa filters class H14 are recommended. These are 99.995% efficient at MPPS Most penetrating particle size which is typically about 0.12 to 0.16 micron. (About the same size as Covid-19 virus)
4.	Rack access points should be subject to an intense touch point clean daily (disinfectant wipe).
5.	Avoid equipment sharing where possible. If this cannot be physically achieved, ensure all items are wiped in between being handled.
6.	Cleanroom style cleaning techniques should be adopted in the Data Centre. These techniques range from adopting a process flow from cleaning the Data Centre from the furthest point and working towards the exit, overlap cleaning of walls, doors, and floors.
7.	Data Centre air or people traps should be cleaned on a more regular basis as they could present a repository for the virus due to being a confined space.
8.	Review scheduled replacement of HVAC filters. Consider replacing filters more frequently and/or using filters with higher MERV ratings.
9.	To ensure social distancing is upheld whilst cleaning, staff to be allocated set areas in the Data Centre to clean – reduce changeover of activities.
10.	Disinfectant should be used on surfaces that have already been cleaned in the Data Centre. Disinfectants kill 99.9999% of microorganisms on a surface withing a 5–10-minute time period.
11.	Only engage cleaning companies who are experienced in the field of delivering Data Centre and critical environment cleaning.
12.	Allow no cross-contact of cleaning staff if the process is over multiple days/weeks.
13.	Data Centre cleaning should be more frequent depending on people visiting/working in the space.
14.	All cleaning staff should be subject to temperature checks before entering the site, a high temperature - 38 degrees Celsius or above would result in self isolation and Covid 19 testing.
15.	Ensure personal hygiene is maintained at all times. Adopt sensible hygiene measures by washing hands thoroughly with warm water and soap, for a minimum 20 seconds before food, on arrival and leaving site and more frequently than normal. Ensure hands are thoroughly dried each time after washing.

7 Cleaning Frequency

7.1 Minimum recommendation for data centre cleaning

The below table supplies a breakdown of recommended cleaning services and a minimum frequency of the operation. The minimum frequency should be reviewed if any works contributing to air borne contamination has taken place in the Data Centre or supporting areas. The frequency chart also gives a recommendation as to what visual checks should be performed by the specialised cleaning contractor.

Deep Cleaning Recommendation & Frequency
All cleaning frequency recommendations should be reviewed if any works contributing to air borne contamination have been undertaken in the Data Centre, or critical space. The chart below is a guide only.

Area	Service	Frequency	Process Detail
Ceiling Void – (If applicable)	Deep Cleaning	Minimum Once per annum	Ceiling grid
			Cable trays and baskets
			Ceiling panels and infill bags
			Fire suppression pipework (if applicable/installed)
	Visual contamination checks to be performed	Minimum Once per annum	Zinc whisker (visual checks)
			Ceiling grid integrity (visual checks)
			Plenum wall aperture check – movement of contamination
			Lagging – chilled water pipework – no penetrations
Floor Void – (If applicable)	Deep Cleaning	Minimum Once per annum	Subfloor – entire plenum
			Cable trays and baskets
			Pedestal heads and bases
			Stringer system (if installed)
			Underside of floor panels
	Visual contamination checks to be performed	Minimum Once per annum	Zinc whisker (visual checks)
			Plenum wall aperture check
			Sub floor sealing and integrity (sub floor finish)
			Lagging – chilled water pipework – no penetrations
General Surface's	Deep & Surface Cleaning	Minimum 6 monthly intervals	External IT cabinet clean
			Internal IT cabinet clean
			Hot & cold aisle containment (if installed)
			Lights/containment/cable trays and baskets
			Walls/doors/ledges
			Windows/internal glass
			PDU's/AHU's/CRAC units
	Visual contamination checks to be performed	Minimum 6 monthly intervals	Air fan intakes and door seals
			Physical control measures – takmats/overshoes
			Perimeter wall aperture check – penetrations
			Contractors/trades following cleanliness procedures/rules
Floor Surface (Vinyl & Laminate)	Deep & Surface Cleaning	Minimum 6 monthly intervals	Intensive clean & hand tool
			Electric rotary buff vinyl panels
			Vacuum floor surface (post rotary process)
			Debris/contamination removal from grilles
Floor Surface (Carpet)	Deep & Surface Cleaning	Minimum 6 monthly intervals	Electric rotary buff carpet panels
			Vacuum floor surface (post rotary process)
			Debris/contamination removal from grilles
Air Quality Testing	Testing	Minimum 6 monthly intervals	Air quality sampling to be undertaken under ISO14644-1:2015 guidelines
			Testing to be performed 1m in height from the floor
			Particle count machine to have a valid calibration certificate

8 Summary

Recommended ways to avoid contamination, reduce risk and avoid problems.

	Anti-Contamination Guide Summary Detail 2023 Physical & Gaseous Contamination
1.	Ensure all bare construction materials such as, concrete, plasterboard, masonry, brickwork is sealed with the relevant non-water-based paint/sealer. This is to stop surface particles being drawn into the air flow and subsequently deposited into critical equipment.
2.	All equipment is to be de-boxed in a dedicated staging/de-box area, fibres in cardboard, paper and related products are released when handling and distributed into the airflow.
3.	Facility staff and contractors should remove all debris from their work site after completion of project, tie wraps, nuts bolts; screws etc. whilst these items will not be picked up in the airflow, they do obstruct airflow.
4.	Facility staff and contractors should have to hand a HEPA vacuum or equivalent and extract and contain any dust particles whilst drilling, penetrations through wall etc.
5.	All construction 'dirty works' within a DC should be completed under a "Permit to Work" scheme and checked off after completion to ensure all debris/contamination has been removed.
6	Carpet tiles within a Data Centre should be removed and replaced with vinyl or laminated RAF tiles to eliminate the distribution of carpet fibres.
7.	Foot traffic through a critical facility should be kept to a minimum to avoid the distribution of clothing, hair, skin and foot borne contamination ensure that short cuts are not used through a critical facility.
8.	ACU drive belts to be regularly inspected to ensure the drive pully is inline. An out of line pulley will cause the drive belt to wear quicker distributing rubber particles into the environment.
9.	Tak mats or tak material to be placed at all entry points to the Data Centre.
10.	Overshoes to be compulsory for anyone entering a critical environment.
11.	Rooms to be held at positive pressure to ensure particles are not drawn into the room when entering or exiting.
12.	Ensure all entry point doors have the correct door seals fitted to ensure an airtight seal when the door is closed.
13.	All cable containment services running through internal or external walls are to be correctly firewalled/ sealed to avoid contamination entering the facility.
14.	Ensure a pest control management system is installed.
15.	Soft compound ceiling tiles should be replaced with enameled metal tiles as soft compound tile will distribute fibres into the air flow.
16.	Water ingress will cause concrete/brick work to deteriorate and crumble over time releasing construction powders into the facility.
17.	Ensure all pipe lagging is of the correct specification on chilled water lines to avoid condensate build up.
18.	Ensure ACU's are maintained on a regular frequency and the correct filters are fitted and changed as the manufacture's recommendation.
19.	All contractors' tools and equipment such as steps, trolleys etc. should be in a suitable state of cleanliness to enter a critical environment.
20.	If windows are present within the access corridors, service corridors and or Data Centre itself, under no circumstance should these be opened unless in an emergency.
21.	Soft furnishings such as curtains, chairs etc. should be removed and replaced with a nonfibrous equivalent.
22.	Where major construction 'dirty works' must be completed within any part of a Data Centre facility it is recommended that the area be enclosed (polythene tenting or equivalent) to avoid the spread of contamination particulates.
23.	Any major works/construction should be carried out in conjunction with a reputable Data Centre cleaning organisation to enable the correct preventative measures and best practice are adhered too.
24.	No food or drink to be permitted, discarded food debris can invite a pest infestation.
25.	All related metal surfaces to be checked for Zinc Whiskers and the relevant management plan put in place.
26.	All signage around the Data Centre should be of a solid substance (plastic) or of a laminated finish, loose paper signs are not recommended and should be avoided.

27.	If non-Data Centre specific wall mounted AC units are utilised, as is common practice within small server, comms rooms and UPS/battery rooms, it is recommended that the primary filters are removed every 4 weeks and vacuumed with a HEPA filtered machine.
28.	Data Centre compliant foam or a suitable material is recommended for sealing redundant holes/cuts that have been made in raised access floor panels. Recommended Data Centre compliant foam is a fire retardant, impregnated polyurethane substance, which is not affected by bacteria and does not shelter or shed any particulates when cut or handled.
29.	All related metal surfaces to be checked for Tin Whiskers and the relevant management plan put in place.
30.	Recommended particle filter class for Data Centre supply air systems is minimum BS EN ISO 16890:2016 ePM1 50% and for recirculated air systems is Coarse 70%.

9. Appendix - Risk Register 2023

The risk register shows a Low/Medium/High impact on DC Operations that contamination could cause.

Risk Key

0% - 30%	Low Risk
30% - 70%	Medium Risk
70% - 100%	High Risk

Risk - Highlight	Doc Ref 2022 Edition	Risk Detail	Comments	Risk Charting -H/M/L	Risk Percentage Weighting	Financial impact on DC Operations?
Gaseous Contaminants - Chemical Corrosion	3.5	By not undertaking an environmental contamination monitoring exercise, the Data Centre could be at risk from gasses that corrode PCB's (printed circuit boards)	The environmental monitoring would analyse risk management/mitigation and improvement plan if needed	High	80%	Yes if environmental monitoring is not undertaken
Tin or Zinc Whiskers	3.8	If the Data Centre has confirmed zinc or tin whiskers, the infrastructure maybe at risk from the whiskers becoming air borne and shorting out mission critical equipment	Tin or Zinc whiskers are minute electrically conductive pure-metal crystalline structures that grow on components and products having electroplated tin as a surface finish	High	80%	Yes if tin or zinc whisker testing is not undertaken in the Data Centre
White Rust	3.9	White rust can cause particulate contamination of the data centre as a result of the white chalky matter becoming loose and airborne within the facility	Atmospheric moisture contains a small amount of contaminates (salt or minerals) and zinc will react quickly with it to form zinc hydroxide, a chalky white and relatively unstable oxide of zinc. Where freshly galvanized steel is exposed to this type of moisture (rain, dew, condensation) in oxygen deficient environment, the moisture will continue to react with the zinc and aggressively consume the coating	High	70%	Yes if construction materials are not stored correctly at the build stage of the project
Flora & Fauna	3.12	Data Centre can be havens for mice and rats, these chew through cabling causing outage. They can also build nests using shredded paper and debris that can raise the risk of fire	All open apertures to the Data Centre must be sealed to stop rodents entering the space, No food must be taken into the Data Centre	High	70%	Yes if rodents are present inside the live DC - this could result downtime if the cabling structure is damaged
Unsealed Concrete	4.2	Concrete materials and exposed concrete surfaces continually oxidise and breakdown, this releases loose sand and lime. Lime dust is particularly corrosive when combined with water or is humidified	The oxidisation is amplified if the unsealed concrete is found in the sub-floor, due to the constant air-flow being moved over the surface	High	70%	Yes if concrete remains unsealed throughout the DC facility - especially in the sub floor
Exposure Points	4.2	All potential exposure points in the data centre should be addressed to minimise potential influences from outside the controlled environment	Areas to be inspected are as follows - Breaches in the sub wall - Breaches within the ceiling void - All door sweeps are correctly in position and are not damaged in any way - all entrance doors should fit correctly	Medium	50%	Yes if the live DC is not correctly sealed from the outside environment
Cardboard on the live floor	5.3	Cardboard packing material can itself be a source of contamination, fibres as well as being subject to dust and dirt contamination via transportation & intermediate storage and handling prior to arrival to the technical space	All equipment packaged in boxes should be unpacked in a designated 'de-box' area/room away from the live DC floor	Medium	50%	Yes if cardboard is being opened/stored on the live DC floor
Air Conditioning Filters	5.4	Incorrect specification/or use of filter for the environment	It is recommended that a specialist filter company be consulted with, considerations should also be made in regards to gaseous contamination as well as particulate contamination ****Further information is supplied in the DCA Anti Contamination Guide - 2022 Edition**	High	90%	Yes if the incorrect speciation of filter is being used and gaseous contamination isn't being factored in the filter choice
Air Conditioning Filters	5.4	Air conditioning (dirty) filter change must be completed in a controlled manor to stop contamination becoming air borne	Ensure all contaminated air-conditioning filters are correctly removed from the live environment before cleaning; the filters should be placed into bags and sealed to prevent any particulate matter becoming air borne	Medium	50%	Yes if contamination is being re-released back into the environment through poor filter changing procedures
Air Conditioning Units	5.4	Contamination from belt driven units (degradation)	Regular maintenance checks for 'belt degradation' within the air conditioning units (if belt driven) the visual sign is a fine black soot-like contamination, the contamination caused by the degradation of the AC belt will become air-borne throughout the Data Centre	High	70%	Yes if AC belt degradation is happening in the Data Centre space
Cleaning Processes	5.5	Contractors/cleaners using incorrect tools for removing particulate matter from the live DC environments	Ensure all contractors performing tasks within the technical facility use HEPA filtered vacuums to remove contamination/dust/debris. A traditional vacuum cleaner fitted with a standard textile dust bag can filter down to a 30 micron particle size whereas 'HEPA' filtered vacuum cleaners will ensure that the exhaust air is 'biologically' clean and filtered down to 0.3 microns	Medium	60%	Yes if contamination is not being contained within the vacuum units, inadequate cleaning equipment is posing a threat to mission critical equipment
Cleaning Contractor	5.8	Selecting a cleaning contractor that is not experienced in cleaning Data Centres or have no knowledge of the environment and the risks inherent	Ensure contractors have knowledge of using the correct power points, the fire protection and warning system(s) needing to be isolated, the correct lifting of data centre floor tiles and a general good understanding of the data centre environment and awareness of its functions	High	80%	Yes if untrained cleaning staff are exposed to the live Data Centre environment , the risk of accidental down-time is increased
Contamination Control Products (Mats)	5.10	Non use of disposable contamination matts at the entrances to the mission critical spaces	70% of contamination entering critical spaces does so from underfoot	High	70%	Yes if high amounts of particulate matter is being transferred into the technical space underfoot with no control measures in place

For further information, please view the DCA Data Centre Anti-Contamination Guide - 2022 Edition

10. Credits

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