FUJITSU

Gaseous and Particulate Contamination Guidelines for Datacenters

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1. Objectives

This document explains environmental conditions and preventive measures such that Fujitsu hardware products can operate in stable conditions. Fujitsu strongly recommends examination of the datacenter environment before equipment installation. If not, equipment may malfunction over time. Worse, such circumstances make it more difficult to identify the root cause(s). You are also required to refer to the relevant manuals for each specific Fujitsu product.

"Datacenter" as referred in this documents means facilities or dedicated rooms for accommodating computer systems .

2. Ambient temperature and humidity

Regular examination of the datacenter is required to ensure the follow ambient temperatures and humidity conditions are met before and after installation of Fujitsu products.

It is essential that you eliminate water condensation in the datacenter. It can easily occur under sudden temperature changes. Please also notice that this might occur even if temperature changes occur within the conditions below.

Table 2-1 Tolerances for ambient temperature and humidity

Items	Equipment conditions		
Equipment status	Equipment in operation	Equipment not operating	Recommended
Ambient temperature (℃)	15 ~ 32	5 ~ 45	18 ~ 27
Humidity (%RH)	20 ~ 80 *1	20 ~ 80 *1	60 %RH or lower Datacenter must follow conditions. • 5.5 ~ 6.0℃ DP

*1 This assumes no water condensation.

2.1. Policy

Environmental conditions described in Table 2-1 are based on environmental standards of ASHRAE's (American Society of Heating, Refrigerating and Air-Conditioning Engineers). However, the humidity conditions include Fujitsu's specific standards.

2.2. Surveillance of ambient temperature and humidity

Fujitsu recommends regular monitoring of ambient temperature and humidity in datacenters including under-floor air conditioners.

Temperature and humidity recorders should be placed near inlets of relevant Fujitsu products. It is assumed that ventilations of adjacent equipment do not affect these records.

If such recorders are not placed in these locations, you must estimate ambient temperature and humidity from the available records. You should also monitor at multiple spots for correct estimations.

2.3. Recommended actions on abnormality

You should eliminate or mitigate any causes of the poor environments below.

(1) Bad environmental conditions found before system operation commences.
Datacenter administrators should investigate air conditioners. Typical causes are shown for reference.

- Badly adjusted air conditioners
- Inefficient air circulation
- Other causes, such as high density mountings, that may affect temperature or humidity

(2) If Table 2-1 conditions are not met after operation commences.
Datacenter administrators should switch to a stand-by air conditioner or if no improvement is seen after such switching, take proper action to resolve the problem.

2.4. Air conditioner selection and management for ambient temperature and humidity

(1) Air conditioner selection
To maintain temperatures and humidity in the datacenter in the range stated in Table 2-1, air conditioners dedicated for datacenter use should be employed.

(2) Air conditioner redundancy
Air conditioners should be redundant. In other words, even if one air conditioner malfunctions, another air conditioner can take over to ensure non-disruptive control of temperature and humidity.

To detect abnormalities in the fastest possible manner, changes of temperature and humidity should be monitored constantly.

Datacenter air conditioners should eliminate particulate and gaseous contamination to ensure the well functioning of equipment.

(3) Proper placement of equipment
Equipment placement design should ensure that that equipment does not intake exhaust air from other equipments.

3. Particulate Contamination

For datacenters without airside economizers, ISO 14644-1 class 8 cleanliness can be met simply by the choice of the following filtration methods:

- The room air is continuously filtered using MERV 8 filters.
- Air entering the data center can be filtered with MERV 11 or preferably, MERV 13 filters.

For data centers with airside economizers, **the choice of filters to achieve ISO 14644-1 class 8** cleanliness depends on the specific conditions present at that data center.

For details of maximum particle concentration allowed in class 8, see "Gaseous and Particulate Compamination Guidelines For Data Centers FTS 04230".

To eliminate particulate contaminations, the following measures should be taken:

(1) Never enter datacenters with shoes on
(2) No smoke in datacenters
(3) Place dust collectors

Notices concerning the handling of dust collectors:

- Dust collectors may emit ozone gas. You must measure if the amount of ozone in datacenter is allowable
- Dust may spread from dust collectors. You must examine if the dust around the dust collectors is allowable
- If dust collectors in your datacenter have filters, you should fully isolate the microparticles in the dust collectors.
- To prevent whisker crystal growth, never use electrolytic zinc plating on the datacenter floor

4. Gaseous Contamination

4.1. Policy

Corrosive gas concentration allowances follow the environmental category for air regulations called "3C1L" in IEC60721-3-3. For allowable concentrations, see "Gaseous and Particulate Compamination Guidelines For Data Centers FTS 04230".

4.2. Gaseous Contamination Surveillance

4.2.1. Outline

Fujitsu recommends corrosive gases are monitored and reported in the datacenter. Measurement of corrosive gasses should be reported in a timely manner if you are asked to report such documents.

Fujitsu recommends the reporting of such measurements on a regular basis as air pollution conditions may be influenced by environmental changes including seasons. For instance, a new chemical factory built near the datacenter may influence such environmental changes.

4.2.2. Surveillance Methodology

Examples of corrosive gasses measurements are given below.

Table 4-1 Methods for corrosive gasses measurements

Chemical symbol	Accumulative measurement	Instantaneous measurement	Continuous measurement
SO_2	Lead dioxide method Alkaline filtration method	Rosaniline formalin method Nephelometry method (detector tube method)	Liquid conductivity method Coulometric titration method Visible Spectrophotometric method
NO_2	Alkaline filtration method	Saltzman reagent method (detector tube method)	Visible Spectrophotometric method Infrared ray absorption method
H_2S	Zinc acetate cylinder method	Methylene blue method Sensitive filter paper (detector tube method)	Coulometric titration method Coloring filter paper
CL_2	Alkaline filtration method	Sensitive filter paper Spectrophotometric method (detector tube method)	Liquid conductivity method Ultraviolet ray absorption method Coloring filter paper
NH_3	Acid filtration method	Indophenol blue spectrophotometric method (detector tube method)	Zwitterionic electrode

(1) Accumulative measurement

Absorbers can capture gas over long periods from one week to a month. Therefore, this method is good for sensing low-concentrated gases. Note: you cannot convert the measurements by this method to Parts Per Million (PPM) directly.

(2) Instantaneous measurement

Measurements by this method are more influenced by environmental factors including sunlight, ventilation, rainfall, trees, and buildings. Therefore, you need to take full care of the measurement environment including time of year, location, and natural conditions, beforehand.

One Instantaneous measurement called the Detector tube method can sense high-concentrations of gases, higher than 0.5 PPM.

(3) Continuous measurement

Because measuring equipment is large and expensive, it must be placed in the datacenter.

Classification of Corrosive Gas Environments

Corrosive gas environments can be classified according to interactive factors for gaseous contamination including temperature, humidity, and degree of staining. According to the sum of the evaluated factors, corrosive gas environments can be classified as follows:

Table 4-2 Classification of corrosive gas environments *

Environment	Class	Total
Favorable environment with low temperature and low humidity. Corrosive gas is not detected.	Class A	≤9
Standard environment with low humidity. Small amounts of corrosive gases detected.	Class B	10 ~ 25
Humidity rather high. Small amounts of corrosive gases detected.	Class S1	26 ~ 36
Temperature and humidity high. A certain amounts of corrosive gases detected.	Class S2	37 ~ 50
Temperature and humidity high. Large amounts of corrosive gases detected.	Class S3	≥51

* This table references “Standards of Operating Conditions of Industrial Computer Control Systems” of Japan Electronics and Information technology Association (JEITA IT-1004A)

The evaluation of interactive factors for gaseous contaminations are shown below.

Table 4-3 Categories and evaluations for environmental factors *

			Category							
			1		2		3		4	
Environmental factors			measurement	evaluation	measurement	evaluation	measurement	evaluation	measurement	evaluation
Ambient temperature (℃)		A	≤ 20	1	≤ 25	2	≤ 30	4	> 30	8
Ambient humidity (%)		B	≤ 50	1	≤ 60	8	≤ 75	16	> 75	24
Gas (ppb)	SO_2	C1	≤ 40	1	≤ 80	3	≤ 200	6	≤ 5,000	9
	NO_2	C2	≤ 20	1	≤ 50	3	≤ 100	6	≤ 5,000	9
	H_2S	C3	≤ 3	1	≤ 10	8	≤ 100	14	≤ 10,000	20
	Cl_2	C4	≤ 2	1	≤ 10	10	≤ 100	20	≤ 1,000	30
	NH_3	C5	≤ 100	1	≤ 1,000	2	≤ 10,000	4	≤ 100,000	8
Equivalent amount of salt (mg/cm^2)		D	≤ 0.93	1	≤ 0.06	8	≤ 0.12	16	> 0.12	24

* This table references “Standards of Operating Conditions of Industrial Computer Control Systems” of Japan Electronics and Information technology Association (JEITA IT-1004A)

Gaseous contaminations affect industrial equipment including servers and storage. The classifications of datacenter environments can be used as indexes for the effect of gaseous contaminations.

(1) Class A environment

Datacenters in this category can sustain a favorable datacenter environment with dedicated equipment. No corrosion, liable to erode the quality of industrial equipment, occurs in such datacenters.

(2) Class B environment

Datacenters in this category may not have dedicated equipment for sustaining a good datacenter environment. However, gaseous contamination would not affect the reliability of industrial equipment.

In this category, elaborate measurement of gaseous and particulate contamination is required because industrial equipment is more easily corroded at medium or high humidity if more corrosive gas or contaminated particles intrude into the datacenter.

Datacenters in this category should remain within the following environment:

- Low humidity with small amounts of multiple corrosive gasses, or
- Low humidity and Low temperature with small amounts of a certain corrosive gas

In the latter case, air pollution can be detected.

(3) Class S1 ~ S3 environments

Datacenters in these categories have corrosive gasses at high humidity and high temperature. So gaseous contamination will occur for a certain period – months to years. Such contamination will affect the reliability of industrial equipment.

Datacenters in these categories should have equipment to sustain a good environment; otherwise, industrial equipment must be isolated from such contaminated environments.

4.3. Recommended actions for purifying datacenter air

Air purification examples, ventilation methods and activated charcoal methods are described below.

(1) Ventilation method

This method can help isolate datacenters from outside air by keeping air pressure in the datacenter higher than that outside. However, to do so, continuous air supply is necessary

Note: corrosive gasses may be generated near the inlet in ventilators. In such cases, the corrosive gasses may easily intrude into the datacenter. To prevent such intrusions, you should measure corrosive gasses near the inlet in the ventilators.

Ideally, a room with servers and storage should be sealed. Examples of preventive measures are as follows.

- Double sealing on window and door frames
- Spaces around cable ducts or other similar spots should be covered by scraping paste

(2) Activated charcoal method

Activated charcoal for gas absorption is required to have 600 to 1,500 m^2 of surface area per gram with micro holes. Activated charcoal filters should have the following absorption performance:

① Sufficient absorption performance
② Low losses by pressure
③ Small space for its installation
④ Easy installation and removal operations
⑤ Sufficient endurance to corrosion

4.4. Precautions

(1) You should measure corrosive gasses around the datacenter
(2) You should take preventive measures against corrosive gas intrusion by sealing window frames, doubling doors and keeping datacenter air pressure high.
(3) You should keep air in the datacenter purified by placing activated charcoal filters around ventilator and air

conditioner inlets.

(4) You should carefully monitor temperature and humidity in the because corrosive gasses have more effect at higher temperatures and higher humidity.

(5) You should keep concentrations of all corrosive gasses below the recommended upper limits, as even one gas at higher concentration may cause corrosion.

(6) Before installations of servers or storage, you should measure corrosive gasses around where the equipment is to be placed.

For the control of airborne contaminations in datacenters, Fujitsu recommends the use of the Fujitsu Eco checker. Eco checker is a device containing 5 different metals in a small case. After exposing the eco checker to the subject environment for 30 days, discoloration in the metal test pieces can be compared against the "Reference color" to identify the corrosive gases found and their approximate concentration. The kinds of gas detectable with this device are sulfur dioxide, hydrogen sulfide, and chlorine gases.

For the details on the Fujitsu Eco checker, please contact Fujitsu sales at your region.

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