C H A P T E R **4**

Environmental Contaminants

Control over contaminant levels in a computer room is an extremely important consideration when evaluating an environment. The impact of contamination on sensitive electronic hardware is well recognized, but the most harmful contaminants are often overlooked because they are so small. Most particles smaller than 10 microns are not visible to the naked eye under most conditions; yet, it is these particles that are most likely to migrate to areas where they can do damage. The following Sections describes these issues and presents recommendations and guidelines.

4.1 Recommended Air Quality Levels

Particles, gasses and other contaminants may impact the sustained operations of computer hardware. Effects can range from intermittent interference to actual component failures. The computer room should be designed to achieve a high level of cleanliness. Airborne dusts, gasses and vapors should be maintained within defined limits to help minimize their potential impact on the hardware.

Airborne particulate levels should be maintained within the limits of *Federal Standard 209E, Airborne Particulate Cleanliness Classes in Cleanrooms and Clean Zones, Class 100,000*. This standard defines air quality classes for clean zones based on airborne particulate concentrations. While this standard defines the limits of various classes, and the methods for testing and analysis, it does not define the nature of the particulate. The least stringent of these, Class 100,000, is generally accepted as an appropriate measure of data center environments. The lower class limits designate conditions for clean room classification generally associated with research and development, manufacturing and other specialized applications.

Although FED-STD-209E is a widely accepted computer room standard, it does not include some of the most harmful dust sizes: 0.3 microns and smaller. These particles are harmful to most data processing hardware because they have the tendency to exist in large numbers and can easily circumvent many sensitive components' internal air filtration systems. Like other particles, they have the ability to agglomerate into large masses or absorb corrosive agents under certain psychrometric conditions. When computer hardware is exposed to these submicronic particles in great numbers they endanger system reliability by posing a threat to moving parts, sensitive contacts and component corrosion. Concentrations of ultrafine particles must be considered when evaluating a controlled environment.

Excessive concentrations of certain gasses can accelerate corrosion and cause failure in electronic components. Gaseous contaminants are a particular concern in a computer room both because of the sensitivity of the hardware, and because a proper computer room environment is almost entirely recirculating. Any contaminant threat in the room is compounded by the cyclical nature of the airflow patterns. Levels of exposure that might not be concerning in a well ventilated site repeatedly attack the hardware in a room with recirculating air. The isolation that prevents exposure of the computer room environment to outside influences can also multiply any detrimental influences left unaddressed in the room.

Gasses that are particularly dangerous to electronic components include chlorine compounds, ammonia and its derivatives, oxides of sulfur and petrol hydrocarbons. The sources and effects of these and other gasses are included in the "Contaminant Properties and Sources" section of this manual. In the absence of appropriate hardware exposure limits, health exposure limits should be used. The following chart outlines limits for various gasses that could pose a threat to hardware. These limits should not be used as absolute limits, as numerous other factors, such as the moisture content of the air, can influence environmental corrosivity and gaseous contaminant transfer at lower levels. Concentrations exceeding these levels should, however, be considered concerning.

Chemical Name	Formula	ASHRAE	OSHA (PEL)	ACGIH	NIOSH
Acetic Acid	CH_3COOH	Not defined	10 ppm	Not defined	Not defined

Chemical Name	Formula	ASHRAE	OSHA (PEL)	ACGIH	NIOSH
Ammonia	NH	3 500 µg/m^3	3 50 ppm	25 ppm	Not defined
Chlorine	Cl	2 100 µg/m^3	3 1 ppm (c)	Not defined	0.5 ppm (c)
Hydrogen Chloride	HCl	Not defined	5 ppm (c)	Not defined	Not defined
Hydrogen Sulfide	H_2S	50 µg/m^3	3 20 ppm (c)	10 ppm	10 ppm
Ozone	O_3	235 µg/m^3	3 0.1 ppm	Not defined	Not defined
Petrol-hydrocarbons	C_nH_n	Not defined	500 ppm	75 ppm	300 ppm
Sulfur Dioxide	SO_2	80 µg/m^3	3 5 ppm	2 ppm	0.5 ppm (c)
Sulfuric Acid	H_2SO_4	Not defined	1 ppm	Not defined	1 ppm (c)
PEL: Permissible Exposure Limit ppm: Parts Per Million µg/m^3: Micrograms Per Cubic Meter (c): ceiling					

4.2 Contaminant Properties and Sources

Contaminants in the room can take many forms, and can come from numerous sources. The processes by which particles with the properties that make them dangerous to sensitive hardware are produced and the means by which they make their way to areas where they can do damage vary. Any mechanical process in the room can produce dangerous contaminants or agitate settled contaminants. The sources of contamination are as diverse as the contaminants themselves.

A particle must meet two basic criteria to be considered a contaminant. First, it must have the physical properties that could potentially cause damage to the hardware. Second, it must be able to migrate to areas where it can cause the physical damage. The difference between a potential contaminant and an actual contaminant is time and location. It is only necessary for one potential contaminant to be instigated to active status for a failure to occur. If all hardware units with a specified design life are designed to endure a given number of potential contaminants before one becomes active and interferes with the functioning of the components, then it stands to reason that a decrease in the potential contaminants in the operating environment will lower the possibility of a potential contaminant moving to an area where it can do damage. Thus, a reduction of potential contaminants will decrease the possibility of contaminant-related failure and increase product life.

Particulate matter is most likely to migrate to areas where it can do damage if it is airborne. For this reason, airborne particulate concentration is a useful measurement in determining the quality of the computer room environment. Depending on local conditions, particles as big as 1,000 microns can become airborne, but their active life is very short, and they are arrested by most filtration devices.

Submicronic particulate is much more dangerous to sensitive computer hardware, because it remains airborne for a much longer period of time, and they are more apt to bypass filters.

4.2.1 Operator Activity

Human movement within the computer space is probably the single greatest source of contamination in an otherwise clean computer room. Normal movement can dislodge tissue fragments, such as dander or hair, or fabric fibers from clothing. The opening and closing of drawers or hardware panels or any metal-on-metal activity can produce metal filings. Simply walking across the floor can agitate settled contamination making it airborne and potentially dangerous.

4.2.2 Hardware Movement

Hardware installation or reconfiguration involves a great deal of subfloor activity, and settled contaminants can very easily be disturbed, forcing them to become airborne in the supply air stream to the room's hardware. This is particularly dangerous if the subfloor deck is unsealed. Unsealed concrete sheds fine dust particles into the airstream, and is susceptible to efflorescence -- mineral salts brought to the surface of the deck through evaporation or hydrostatic pressure.

4.2.3 Outside Air

Air introduced into the hardware space can be a source of contamination. Inadequately filtered air from outside the controlled environment can introduce innumerable contaminants. Post-filtration contamination in duct work can be dislodged by air flow, and introduced into the hardware environment. This is particularly important in a downward-flow air conditioning system in which the subfloor void is used as a supply air duct. If the structural deck is contaminated, or if the concrete slab is not sealed, fine particulate matter (such as concrete dust or efflorescence) can be carried directly to the room's hardware.

4.2.4 Stored Items

Storage and handling of unused hardware or supplies can also be a source of contamination. Corrugated cardboard boxes or wooden skids shed fibers when moved or handled. Evidence of this is indicated by the prevalence of the materials in samples obtained from subfloor deposits. Stored items are not only contamination sources; their handling in the computer room controlled areas can agitate settled contamination already in the room.

4.2.5 Outside Influences

A negatively pressurized environment can allow contaminants from adjoining office areas or the exterior of the building to infiltrate the computer room environment through gaps in the doors or penetrations in the walls. Ammonia and phosphates are often associated with agricultural processes, and numerous chemical agents can be produced in manufacturing areas. If such industries are present in the vicinity of the data center facility, chemical filtration may be necessary. Potential impact from automobile emissions, dusts from local quarries or masonry fabrication facilities or sea mists should also be assessed if relevant.

4.2.6 Cleaning Activity

Inappropriate cleaning practices can also degrade the environment. Many chemicals used in normal or "office" cleaning applications can damage sensitive computer equipment. Potentially hazardous chemicals outlined in the Section 4.8, Cleaning Procedures and Equipment" should be avoided. Out-gassing from these products or direct contact with hardware components can cause failure. Certain biocide treatments used in building air handlers are also inappropriate for use in computer rooms either because they contain chemicals, that can degrade components, or because they are not designed to be used in the airstream of a recirculating air system. The use of push mops or inadequately filtered vacuums can also stimulate contamination.

It is essential that steps be taken to prevent air contaminants, such as metal particles, atmospheric dust, solvent vapors, corrosive gasses, soot, airborne fibers or salts from entering or being generated within the computer room environment. In the absence of hardware exposure limits, applicable human exposure limits from OSHA, NIOSH or the ACGIH should be used. ASHRAE Standard 62 is also an adequate guideline for both operator safety and hardware exposure. Information regarding these agencies and organizations is included in the "References" section of this manual.

4.3 Contaminant Effects

Destructive interactions between airborne particulate and electronic instrumentation can occur in numerous ways. The means of interference depends on the time and location of the critical incident, the physical properties of the contaminant and the environment in which the component is placed.

4.3.1 Physical Interference

Hard particles with a tensile strength at least 10% greater than that of the component material can remove material from the surface of the component by grinding action or embedding. Soft particles will not damage the surface of the component, but can collect in patches, that can interfere with proper functioning. If these particles are tacky they can collect other particulate matter. Even very small particles can have an impact if they collect on a tacky surface, or agglomerate as the result of electrostatic charge build-up.

4.3.2 Corrosive Failure

Corrosive failure or contact intermittence due to the intrinsic composition of the particles, or due to absorption of water vapor and gaseous contaminants by the particles can also cause failures. The chemical composition of the contaminant can be very important. Salts, for instance, can grow in size by absorbing water vapor from the air (nucleating). If a mineral salts deposit exists in a sensitive location, and the environment is sufficiently moist, it can grow to a size where it can physically interfere with a mechanism, or can cause damage by forming salt solutions.

4.3.3 Shorts

Conductive pathways can arise through the accumulation of particles on circuit boards or other components. Many types of particulate are not inherently conductive, but can absorb significant quantities of water in high-moisture environments. Problems caused by electrically conductive particles can range from intermittent malfunctioning to actual damage to components and operational failures.

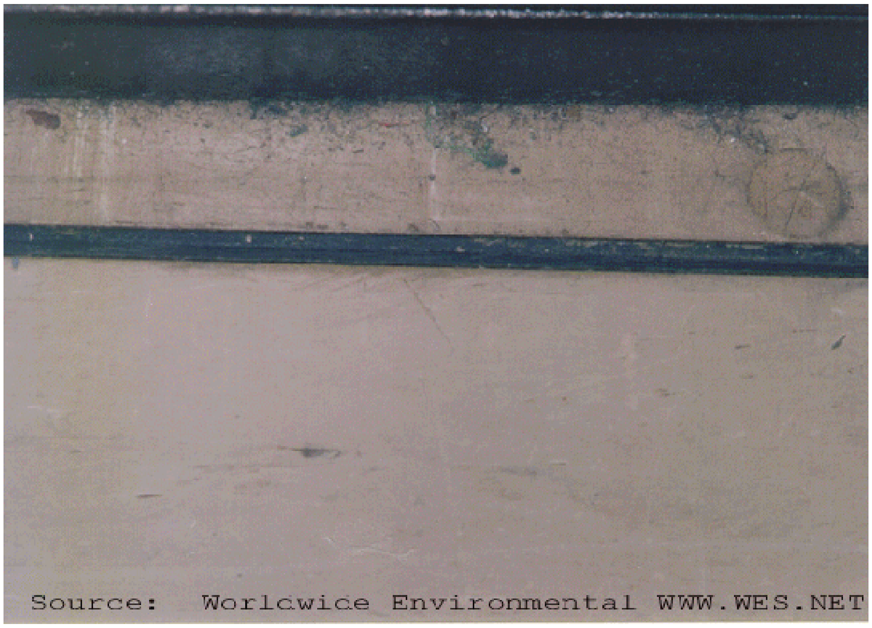
4.3.4 Thermal Failure

Premature clogging of filtered devices will cause a restriction in air flow that could induce internal overheating and head crashes. Heavy layers of accumulated dust on hardware components can also form an insulative layer that can lead to heat-related failures.

4.4 Room Conditions

All surfaces within the controlled zone of the data center should be maintained at a high level of cleanliness. All surfaces should be periodically cleaned by trained professionals on a regular basis, as outlined in the Section 4.8, Cleaning Procedures and Equipment." Particular attention should be paid to the areas beneath the hardware, and the access floor grid. Contaminants near the air intakes of the hardware can more easily be transferred to areas where they can do damage. Particulate accumulations on the access floor grid can be forced airborne when floor tiles are lifted to gain access to the subfloor. It is important that these deposits be removed in an appropriate manner, and that all surfaces are maintained in good condition, so as to not contribute contamination to the environment.

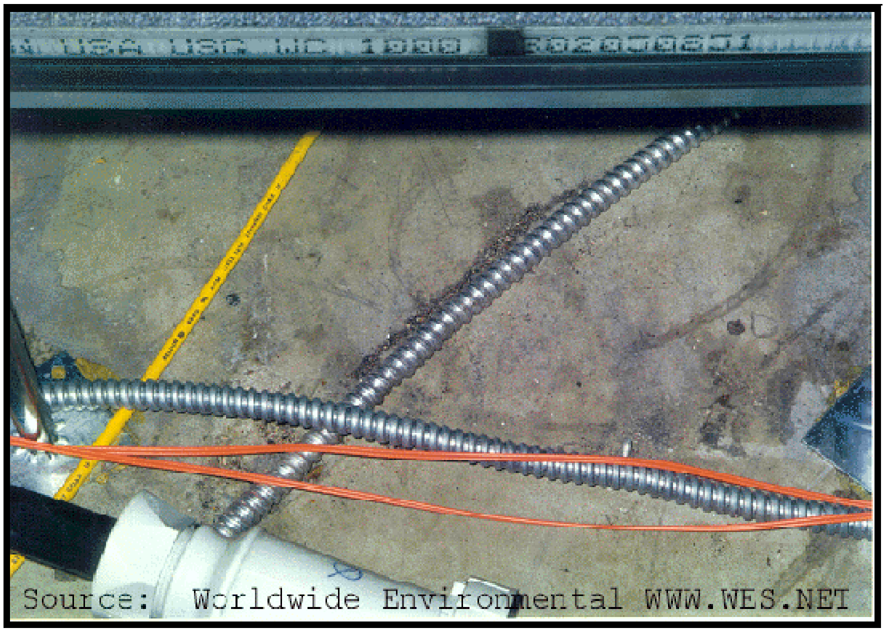
FIGURE 4-1 Floor Surface Contaminants Air Plenum Conditions.



The subfloor void in a downward-flow air conditioning system acts as the supply air plenum. This area is pressurized by the air conditioners, and the conditioned air is then introduced into the hardware spaces through perforated floor panels. Thus, all air traveling from the air conditioners to the hardware must first pass through the subfloor void. Inappropriate conditions in the supply air plenum can have a dramatic effect on conditions in the hardware areas.

FIGURE 4-2 Subfloor Penetration

FIGURE 4-3 Dirty Unsealed Subfloor

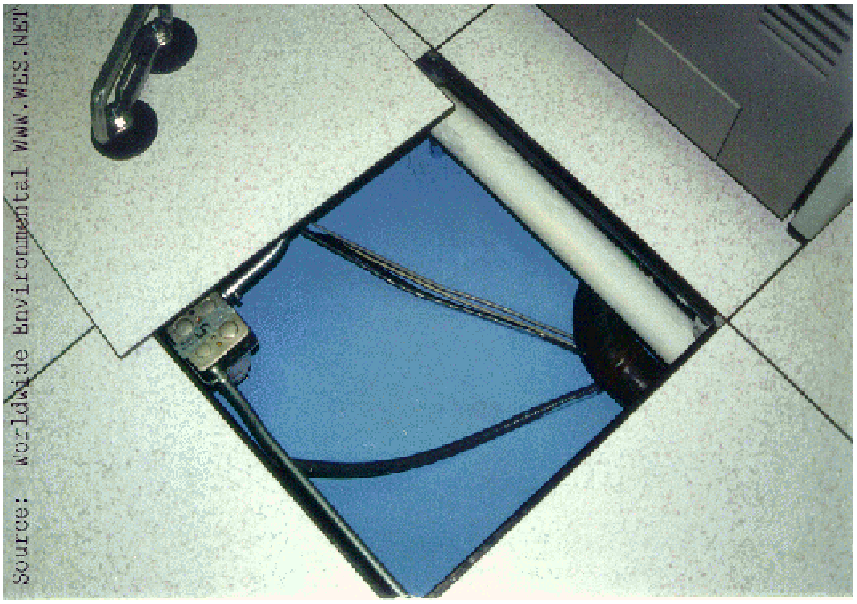


The subfloor void in a data center is often viewed solely as a convenient place to run cables and pipes. It is important to remember that this is also a duct, and that conditions below the false floor must be maintained at a high level of cleanliness. Contaminant sources can include degrading building materials, operator activity or infiltration from outside the controlled zone. Often particulate deposits are formed where cables or other subfloor items form air dams that allow particulate to settle and accumulate. When these items are moved, the particulate is re-introduced into the supply airstream, where it can be carried directly to hardware.

Damaged or inappropriately protected building materials are often sources of subfloor contamination. Unprotected concrete, masonry block, plaster or gypsum wall-board will deteriorate over time, shedding fine particulate into the airstream. Corrosion on post-filtration air conditioner surfaces, or subfloor items can also be a concern. The subfloor void must be thoroughly and appropriately decontaminated on a regular basis to address these contaminants. Only vacuums equipped with High Efficiency Particulate Air (HEPA) filtration should be used in any decontamination procedure. Inadequately filtered vacuums are incapable of arresting fine particles, passing them through the unit at high speeds, and forcing them airborne.

Unsealed concrete, masonry or other similar materials are subject to continued degradation. The sealants and hardeners normally used during construction are often designed to protect the deck against heavy traffic, or to prepare the deck for the application of flooring materials, and are not meant for the interior surfaces of a supply air plenum. While regular decontaminations will help address loose particulate, the surfaces will still be subject to deterioration over time, or as subfloor activity causes wear. Ideally all of the subfloor surfaces will be appropriately sealed at the time of construction. If this is not the case, special precautions will be necessary to address the surfaces in an on-line room.

FIGURE 4-4 Well-sealed Subfloor



It is extremely important that only appropriate materials and methodology are used in the encapsulation process. Inappropriate sealants or procedures can actually degrade the conditions they are meant to improve, impacting hardware operations and reliability. The following precautions should be taken when encapsulating the supply air plenum in an on-line room.

- Manually apply the encapsulant. Spray applications are totally inappropriate in an on-line data center. The spraying process forces the sealant airborne in the supply airstream, and is more likely to adhere cables to the deck.
- Use a pigmented encapsulant. The pigmentation makes the encapsulant visible in application, ensuring thorough coverage, and helps in identifying areas that are damaged or exposed over time.
- It must have a high flexibility and low porosity in order to effectively cover the irregular textures of the subject area, and to minimize moisture migration and water damage.
- The encapsulant must not out-gas any harmful contaminants. Many encapsulants commonly used in industry are highly ammoniated or contain other chemicals that can be harmful to hardware. It is very unlikely that this out-gassing could cause immediate, catastrophic failure, but these chemicals will often contribute to corrosion of contacts, heads or other components.

Effectively encapsulating a subfloor deck in an on-line computer room is a very sensitive and difficult task, but it can be conducted safely if appropriate procedures and materials are used.

Avoid using the ceiling void as an open supply or return for the building air system. This area is typically very dirty and difficult to clean. Often the structural surfaces are coated with fibrous fire-proofing, and the ceiling tiles and insulation are also subject to shedding. Even prior to filtration, this is an unnecessary exposure that can adversely affect environmental conditions in the room. It is also important that the ceiling void does not become pressurized, as this will force air from this typically dirty area into the computer room. Columns or cable chases with penetrations in both the subfloor and ceiling void can lead to ceiling void pressurization.

4.5 Exposure Points

All potential exposure points in the data center should be addressed so as to minimize potential influences from outside the controlled zone. Positive pressurization of the computer rooms will help limit contaminant infiltration, but it is also important to minimize any breaches in the room perimeter.

All doors should fit snugly in their frames. Gaskets and sweeps can be used to address any gaps. Automatic doors should be avoided in areas where they can be accidentally triggered, as this is an unnecessary exposure. An alternate means of control would be to remotely locate a door trigger so that personnel pushing carts can open the doors easily. In highly sensitive areas, or where the data center is exposed to undesirable conditions, it may be advisable to design and install personnel traps. Double sets of doors with a buffer between can help limit direct exposure to outside conditions.

The data center should be an isolated environment if controllability is to be achieved. Seal all penetrations between the data center and adjacent areas. Avoid sharing a computer room ceiling or subfloor plenum with loosely controlled adjacent areas.

4.6 Filtration

Filtration is an effective means of addressing airborne particulate in a controlled environment. It is important that all air handlers serving the data center are adequately filtered to ensure appropriate conditions are maintained within the room. The necessary efficiency is dependent on the design and application of the air handlers.

In room process cooling is the recommended method of controlling the room environment. The in-room process coolers recirculate room air. Air from the hardware areas is passed through the units where it is filtered and cooled, and then introduced into the subfloor plenum. The plenum is pressurized, and the conditioned air is forced into the room, through perforated tiles, and then travels back to the air conditioner for reconditioning. The airflow patterns and design associated with a typical computer room air handler have a much higher rate of air change than do typical comfort cooling air conditioners. This means that the air is filtered much more often than would be the case in an office environment. Proper filtration can thus accomplish a great deal of particulate arrestance. The filters installed in the in-room, recirculating air conditioners should have a minimum efficiency of 40% (Atmospheric Dust-Spot Efficiency, ASHRAE Standard 52.1). Low-grade prefilters should be installed to help prolong the life of the more expensive primary filters.

Any air being introduced into the computer room controlled zone, for ventilation or positive pressurization, should first pass through high efficiency filtration. Ideally, air from sources outside the building should be filtered using High Efficiency Particulate Air (HEPA) filtration rated at 99.97% efficiency (DOP Efficiency MIL-STD-282) or greater. The expensive high efficiency filters should be protected by multiple layers of prefilters that are changed on a more frequent basis. Low-grade prefilters, 20% ASHRAE atmospheric dust-spot efficiency, should be the primary line of defense. The next filter bank should consist of pleated or bag type filters with efficiencies between 60% and 80% ASHRAE atmospheric dust-spot efficiency. Please refer to TABLE 4-2 for a comparison of filter efficiencies.

Typical Efficiencies of Various Filters			
ASHRAE 52-76	Fractional Efficiencies,%		
Dust spot efficiency,%	3.0 micron	1.0 micron	0.3 micron
25-30	80	20	<5
60-65	93	50	20
80-85	99	90	50
95	>99	92	60
DOP 95	--	>99	95

Note - Source: *ASHRAE Journal*, February 1995

As the previous chart demonstrates, low efficiency filters are almost totally ineffective at removing submicronic particulate from the air.

It is also important that the filters used are properly sized for the air handlers. Gaps around the filter panels can allow air to bypass the filter as it passes through the air conditioner. Any gaps or openings should be filled using appropriate materials, such as stainless steel panels or custom filter assemblies.

4.7 Positive Pressurization and Ventilation

A designed introduction of air from outside the computer room system will be necessary in order to accommodate positive pressurization and ventilation requirements. The data center should be designed to achieve positive pressurization in relation to more loosely controlled surrounding areas. Positive pressurization of the more sensitive areas is an effective means of controlling contaminant infiltration through any minor breaches in the room perimeter. Positive pressure systems are designed to apply outward air forces to doorways and other access points within the data processing center in order to minimize contaminant infiltration of the computer room. Only a minimal amount of air should be introduced into the controlled environment. In data centers with multiple rooms, the most sensitive areas should be the most highly pressurized. It is, however, extremely important that the air being used to positively pressurize the room does not adversely affect the environmental conditions in the room. It is essential that any air introduction from outside the computer room is adequately filtered and conditioned to ensure that it is within acceptable parameters. These parameters can be looser than the goal conditions for the room since the air introduction should be minimal. A precise determination of acceptable limits should be based on the amount of air being introduced and the potential impact on the environment of the data center.

Because a closed-loop, recirculating air conditioning system is used in most data centers, it will be necessary to introduce a minimal amount of air to meet the ventilation requirements of the room occupants. Data center areas normally have a very low human population density, thus the air required for ventilation will be minimal. In most cases, the air needed to achieve positive pressurization will likely exceed that needed to accommodate the room occupants. Normally, outside air quantities of less than 5% make-up air should be sufficient (ASHRAE Handbook: Applications, Chapter 17). A volume of 15 CFM outside air per occupant or workstation should sufficiently accommodate the ventilation needs of the room (Uniform Building Code, Chapter 12). The amount of air introduced should be kept to the absolute minimum necessary to achieve the positive pressurization and ventilation requirements of the room.

4.8 Cleaning Procedures and Equipment

Even a perfectly designed data center will require continued maintenance. Data centers containing design flaws or compromises may require extensive efforts to maintain conditions within desired limits. Hardware performance is an important factor contributing to the need for a high level of cleanliness in the data center. All electronic and mechanical devices are sensitive to contamination in a variety of ways and means. Increased component failure caused by excessive contaminant exposure will result in an interruption of service to the data processing users.

Operator awareness is another consideration. Maintaining a fairly high level of cleanliness will raise the level of occupant awareness with respect to special requirements and restrictions while in the data center. Occupants or visitors to the data center will hold the controlled environment in high regard and are more likely to act appropriately. Any environment that is maintained to a fairly high level of cleanliness and is kept in a neat and well organized fashion will also command respect from the room's inhabitants and visitors. When potential clients visit the room they will interpret the overall appearance of the room as a reflection of an overall commitment to excellence and quality.

An effective cleaning schedule must consist of specially designed short-term and long-term actions. These can be summarized as follows:

Frequency	Task
Daily Actions	Rubbish removal
Weekly Actions	Access floor maintenance (vacuum and damp mop)
Quarterly Actions	Hardware decontamination
	Room surface decontamination
Bi-Annual Actions	Subfloor void decontamination

Frequency	Task
	Air conditioner decontamination (as necessary)

4.8.1 Daily Tasks

This statement of work focuses on the removal of each day's discarded trash and rubbish from the room. In addition, daily floor vacuuming may be required in Print Rooms or rooms with a considerable amount of operator activity.

4.8.2 Weekly Tasks

This statement of work focuses on the maintenance of the access floor system. During the week, the access floor becomes soiled with dust accumulations and blemishes. The entire access floor should be vacuumed and damp mopped. All vacuums used in the data center, for any purpose, should be equipped with High Efficiency Particulate Air (HEPA) filtration. Inadequately filtered equipment can not arrest smaller particles, and simply agitates them, degrading the environment they were meant to improve. It is also important that mop-heads and dust wipes are of appropriate non-shedding designs.

Cleaning solutions used within the data center must not pose a threat to the hardware. Solutions that could potentially damage hardware include ammoniated products, chlorine based products, phosphate based products, bleach enriched products, petrol-chemical based products, floor strippers or re-conditioners. It is also important that the recommended concentrations are used, as even an appropriate agent in an inappropriate concentration can be potentially damaging. The solution should be maintained in good condition throughout the project, and excessive applications should be avoided.

4.8.3 Quarterly Tasks

The quarterly statement of work involves a much more detailed and comprehensive decontamination schedule and should only be conducted by experienced computer room contamination-control professionals. These actions should be performed three to four times per year, based on the levels of activity and contamination present.

All room surfaces should be thoroughly decontaminated including cupboards, ledges, racks, shelves and support equipment. High ledges and light fixtures and generally accessible areas should be treated or vacuumed as appropriate. Vertical surfaces including windows, glass partitions, doors, etc. should be thoroughly treated. Special dust cloths that are impregnated with a particle absorbent material are to be used in the surface decontamination process. Do not use generic dust rags or fabric cloths to perform these activities. Do not use any chemicals, waxes or solvents during these activities.

Settled contamination should be removed from all exterior hardware surfaces including horizontal and vertical surfaces. The unit's air inlet and outlet grilles should be treated as well. Do not wipe the unit's control surfaces, these areas can be decontaminated by the use of lightly compressed air. Special care should also be taken when cleaning keyboards and life-safety controls. Specially treated dust wipes should be used to treat all hardware surfaces. Monitors should be treated with optical cleansers and static-free cloths. No ElectroStatic Discharge (ESD) dissipative chemicals should be used on the computer hardware, since these agents are caustic and harmful to most sensitive hardware. The computer hardware is sufficiently designed to permit Electrostatic dissipation thus no further treatments are required.

After all of the hardware and room surfaces have been thoroughly decontaminated, the access floor should be HEPA vacuumed and damp mopped as detailed in the Weekly Actions.

4.8.4 Bi-Annual Tasks

The subfloor void should be decontaminated every 18 months to 24 months based on the conditions of the plenum surfaces and the degree of contaminant accumulation. Over the course of the year, the subfloor void undergoes a considerable amount of activity, that creates new contamination accumulations. Although the weekly above floor cleaning activities will greatly reduce the subfloor dust accumulations, a certain amount of surface dirt will migrate into the subfloor void. It is important to maintain the subfloor to a high degree of cleanliness since this area acts as the hardware's supply air plenum. It is best to perform the subfloor decontamination treatment in a short time frame to reduce cross contamination. The personnel performing this operation should be fully trained to assess cable connectivity and priority. Each exposed area of the subfloor void should be individually inspected and assessed for possible cable handling and movement. All twist-in and plug-in connections should be checked and fully engaged before cable movement. All subfloor activities must be conducted with proper consideration for air distribution and floor loading. In an effort to maintain access floor integrity and proper psychrometric conditions, the number of floor tiles removed from the floor system should be carefully managed. In most cases, each work crew should have no more than 24 square feet (six tiles) of open access flooring at any one time.

The access floor's supporting grid system should also be thoroughly decontaminated, first by vacuuming the loose debris and then by damp-sponging the accumulated residue. Rubber gaskets, if present, as the metal framework that makes up the grid system should be removed from the grid work and cleaned with a damp sponge as well. Any unusual conditions, such as damaged floor suspension, floor tiles, cables and surfaces, within the floor void should be noted and reported.

4.9 Activity and Processes

Isolation of the data center is an integral factor in maintaining appropriate conditions. All unnecessary activity should be avoided in the data center, and access should be limited to necessary personnel only. Periodic activity, such as tours, should be limited, and traffic should be restricted to away from the hardware so as to avoid accidental contact. All personnel working in the room, including temporary employees and janitorial personnel, should be trained in the most basic sensitivities of the hardware so as to avoid unnecessary exposure.

The controlled areas of the data center should be thoroughly isolated from contaminant producing activities. Ideally, print rooms, check sorting rooms, command centers or other areas with high levels of mechanical or human activity should have no direct exposure to the data center. Paths to and from these areas should not necessitate traffic through the main data center areas.