



## IAQ in Large Buildings

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# IAQ Building Education and Assessment Model (I-BEAM)

## Text Modules: IAQ Maintenance and Housekeeping Programs

Good preventive maintenance and housekeeping practices are at the core of establishing and maintaining good indoor air quality in buildings. In this module, we describe the essential elements of preventive maintenance and housekeeping programs and describe their relationship to IAQ.

This module contains detailed [maintenance](#) and [housekeeping](#) schedules which the user can modify to satisfy individual building requirements, or to establish an IAQ maintenance and housekeeping budget.

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### I-BEAM Text Modules

- Fundamentals of IAQ in Buildings
- Heating, Ventilation, and Air-conditioning (HVAC)
- **IAQ Maintenance and Housekeeping Programs**
- Indoor Air Quality and Energy Efficiency
- Diagnosing and Solving Problems
- Renovation and New Construction
- Managing for Indoor Air Quality
- IAQ Budgets and Accounts

- Overview of I-BEAM
- Overview of Text Modules
- Overview of Visual Reference Modules
- IAQ Budgets and Accounts
- I-BEAM Forms

### IAQ Maintenance and Housekeeping Programs (PDF, 14 pp, 79KB)

You will need Adobe Reader to view some of the files on this page. See EPA's PDF page to learn more.

Indoor Air Quality (IAQ)

- Thoroughly Dry Wet Carpet or Other Porous Material After Spills or Cleaning
- Properly Mix and Store Housekeeping Products in a Ventilated Room or Closet
- Train Housekeeping Personnel
- Scrutinize Contractors
- Monitor Results
- Establishing a Housekeeping Program
  - Survey the Building
  - Establish Areas Requiring Differential Attention
  - Develop a Housekeeping Program

## **IAQ Maintenance Program** (see also IAQ Forms)

### **Relation of Preventive Maintenance (PM) to IAQ**

A PM program provides the care to all building mechanical systems and components that keeps them operating at peak performance according to manufacturer's specifications. An effective preventive maintenance (PM) program is the most important tool to preventing IAQ problems.

- Lack of effective PM is one of the biggest causes of IAQ problems.
- Facilities with effective PM programs generally have fewer problems.
- You cannot quickly diagnose and solve many IAQ problems without an effective PM program because you won't have the system knowledge and records to do so.
- Should IAQ problems result in legal action, your PM records may prove good faith efforts to control IAQ.

### **Economics of Good PM**

PM is ***one of the most cost effective tools*** available for increasing energy efficiency in most buildings. For example:

- All equipment works at peak efficiency according to design.
- Clean filters and ductwork reduce workload on fans.
- Clean heating and cooling coils transfer temperature more efficiently.
- Controls operate to provide service when needed, and to shut down when not needed.

PM reduces problems and complaints and the time and expense of responding to them.

- Less time and expense responding to complaints.
- Reduced liability exposure.

PM extends equipment life and results in fewer unscheduled repairs.

### **Types of Preventive Maintenance**

#### ***Scheduled Maintenance***

Scheduled maintenance is planned and scheduled through the PM system and controlled through PM work orders. Scheduled maintenance is critical to avoiding IAQ problems. Potential problems are discovered through the PM system and fixed before they become IAQ issues that require an IAQ investigation (see Forms)

B2).

### ***Unscheduled Maintenance***

Unscheduled maintenance activities are those that occur outside of the regularly scheduled maintenance program. IAQ problems occur most readily in buildings where most equipment is maintained only when it breaks down. A good IAQ program will avoid IAQ problems from equipment failure by maintaining a good PM program.

Unscheduled maintenance will also occur as a result of a PM inspection which identifies repairs which can not be completed during the inspection, and establishes a repair work order. When repairs are completed, information about the repair, including what was done, what supplies were used, what caused the problem, and how long the job took, is entered into the PM information system.

### **Elements of a PM System**

#### ***Administrative Method***

The administrative method of a PM system is its organizing tool in which records are kept. This may be a manual using file folders and three ring binders, or a computer-based system. Both systems are commercially available.

#### ***Files and Records***

The main files and records in a PM program are:

- **A master equipment list:** Contains serial numbers, spare parts required, parts suppliers, and all equipment specifications. The equipment inventory enables the ordering of all parts and services directly from the PM equipment files.
- **An equipment history record file:** Contains a historical record of the installation and all work performed on each piece of equipment.
- **Operating Manuals, Manufacturer's Data, and System Prints:** This set of files should include:
  - Updated facility design blueprints
  - Chronological set of as-built blueprints of mechanical, electrical and plumbing systems. Control blueprints should include a written description of how the system operates
  - Manufacturers specifications for all system controls, including catalogs
  - Schematic duct layout from last testing and balancing showing ductwork, fans, outlets, etc.
  - Air balancing reports and air flow specifications
  - Building commissioning reports
  - A print for each floor detailing all occupant activities and room layouts

#### ***PM Charts and Work orders***

Each piece of equipment will have a PM chart that identifies all the scheduled

maintenance on that equipment throughout the year. A PM work order is a form or "ticket" that is designation of tasks to be performed on a piece of equipment. For example, if the PM chart identifies a set of tasks to be performed every quarter, there will be 4 PM work orders issued throughout the year.

PM work orders include:

- Inspections for unusual conditions like excessive noise and heat
- Inspections for leaks, rust, dirt and mechanical problems
- Regular and careful lubrication
- Mechanical and electrical adjustments
- HVAC testing and balancing
- Operational checks
- Parts replacement
- Coil cleaning and filter replacement

Tasks associated with these work orders may be scheduled daily, weekly, monthly, quarterly, biannually or annually. The schedule is indicated on the PM chart.

Repair Work orders are created as unscheduled maintenance when equipment fails or when repair needs of more than a few hours are noticed during a PM inspection. For example:

- Periodically, maintenance personnel work from a PM work order and check the general operation of all HVAC fans. They inspect belt tension, damper operation, filter cleanliness, and all mechanical supports like motor mounts. They tighten the belts, change the filters, and make other minor corrections as needed during their inspection. They note other repairs needed. These are handled as unscheduled maintenance through a repair work order.

### ***Master Schedule***

A master schedule identifies all PM tasks and identifies the frequency (number of times per year) with which the task is performed. See an I-BEAM example for PM schedules for [HVAC Maintenance](#) and [General Maintenance](#).

### **How to Set Up a PM System**

Take the following steps to set up a PM system:

- Select an administrative system.
- Survey and develop an inventory of all equipment in the building.
- Record the condition of each piece of equipment, and develop work orders for their repair. The objective is to bring each piece of equipment up to peak operating performance.
- Establish a master equipment list and an equipment history record file.
- Organize master files of operating manuals, manufacturer's data, and system prints. Review and update. Create working copies of these files.
- Using operating manuals and manufacturer's specifications as a guide, develop PM charts for each piece of equipment.
- From the PM charts, develop PM work orders.
- Organize all work orders chronologically into a Master Schedule.
- Adjust the schedule to insure an even workload of basic PM scheduled evenly throughout the year.

- Leave time for unscheduled maintenance.
- Your PM system is now in place.

## Housekeeping Program

### General

Sources of dirt and dust can be internal or external. Internal sources include human and animal dander, the breakdown of materials and furnishings, plants, building activities such as cooking and printing, smoking, and cleaning materials such as powders, waxes, and solvents. External sources include dirt brought in from pedestrian traffic, diesel or bus exhaust, as well as airborne dust and chemical contaminants outside the building.

Housekeeping both cleans and has the potential to pollute the indoor environment. This is why the choice of materials and methods is crucial to indoor air quality.

A housekeeping program is more than just a cleaning program. It involves:

- Actions to **prevent dirt** from entering the environment as well as its removal once it is there.
- **Choices of products and methods** that minimize the introduction of pollutants into the environments that the housekeeping program is designed to clean.
- Tasks designed for **health and safety** as well as tasks designed for appearance.
- **Training, negotiating, and monitoring** performance.

### Economics of IAQ Housekeeping Program

There is little difference in cost between a standard cleaning program and one which is designed to improve IAQ. Some elements of an IAQ housekeeping program increase costs and some decrease costs. Hence, the costs are generally the same. However, in the long run, the costs of an IAQ housekeeping program are likely to be lower for many reasons.

- The IAQ program requires more diligent choice of material and methods, and training which increases cleaning costs.
- The IAQ program pays attention to methods of keeping dirt out and preventing cleaning problems. This decreases cleaning costs.
- The IAQ program extends the life of carpet and furnishings. This decrease in cost is directly attributable to the improved cleaning regime.
- The principles for cleaning for indoor air quality, while not substantially different, can make a large difference in the indoor environment.

### Stewardship Principles

(see ASTM Standard E1971-98: Standard Guide for Stewardship for Cleaning of Commercial and Institutional Buildings)

Underlying any housekeeping program should be a set of principles that define the way in which the housekeeping program will be structured and managed. These principles should reflect a recognition that housekeeping services are designed to improve the indoor environment, but have the capacity to degrade it if not performed properly. Useful stewardship principles might include:

- **Clean for health and safety first, not just for appearance:** Appearances can be deceiving. Dirt, film, grime and other contaminants that can't be seen should nevertheless be cleaned because pollution will migrate and diminish indoor air quality in all parts of the building.

- **Protect workers from hazardous working conditions:** Such protections include providing adequate ventilation, personal protective equipment, proper labeling, and proper mixing areas and procedures.
- **Encourage participation and communication:** Cleaning personnel, occupants, and contractors should participate in the development, implementation, and refinement of the program. Occupants should understand how their actions, such as food debris, impact the indoor environment and the cleaning process.
- **Invest in people and equipment:** Cleaning personnel should be well trained. Equipment should be capable of performing the tasks in manner that protects the indoor environment.
- **Recognize the impact of cleaning wastes on the outdoor environment:** Proper handling and disposal of medical waste according to applicable codes and regulations is important. Regulations governing proper disposal of non-medical hazardous materials such as chemical cleaners should also be followed.

### Elements of a Housekeeping Program

A housekeeping program is a process involving more than just cleaning the building. Elements of the program are:

- Methods to reduce the introduction of dirt into the environment to be cleaned
- Identification of the cleaning tasks and performance requirements
- Definition of (and periodic reassessment of) cleaning products, equipment, and procedures
- Training of cleaning personnel
- Proper mixing, disposal and storage methods
- Provisions to protect workers from housekeeping emissions
- Provisions for timing certain tasks to minimize occupant exposures
- Inspection and monitoring of the cleaning process

### Principles to Cleaning for Indoor Air Quality

#### *Keep Dirt Out*

- Clean outside the building, especially near entry ways, so that less dirt is traveled into the building.
- Use barrier mats (walk off mats) on all entry ways, including pedestrian entrances, loading docks, receiving areas, freight entrances, garages into the building. The barrier mats are designed to trap dirt and keep it out of the building. Barrier mats should be long enough that everyone entering the building should be taking five full steps on the mat.
- Use deep and frequent cleaning of carpet in heavily used areas. Especially in entryways, as dirt accumulates it migrates further into the building. These areas should receive thorough cleaning daily, or more frequently as needed.
- Keep dirt and other pollutants away from outdoor air intake.
- Restrict smoking.
- Isolate interior polluting sources using exhaust fans and pressure control.
- Upgrade HVAC filters and change regularly.

#### *Use Maximum Extraction, Minimum Polluting Equipment and Methods*

- Deep clean carpets at regular intervals.
- Thoroughly vacuum using high efficiency filtration bags.
- Use only floor machines with vacuum capability.
- Avoid carpet treatments with sticky residues.
- Use lint free dusting cloths. Avoid dusters that don't capture dust (e.g., feather dusters).
- Cover top of dust mops with dust cloths to avoid passing dust over the mop.

- Avoid aerosol sprays.
- Use toggle top chemical dispensers or trigger spray directly onto cloth.
- Vacuum dust skirts on floor machines.

### ***Choose Low Polluting Products***

- Use MSDS sheets to select “environmentally preferable” products. Minimize volatile organic compounds.
- Choose products with a moderate PH (between 5 and 9). Minimize use of ammonia, chlorine, and volatile acids, and other products that are corrosive, or reactive with other cleaning products.
- Minimize use of aerosols or particle cleaners as they may become airborne.

### ***Thoroughly Dry Wet Carpet or Other Porous Material After Spills or Cleaning***

- Wet or damp materials are a breeding ground for mold.
- Thoroughly dry material after a water spill immediately. If not dried within 24 hours, the material may have to be discarded.
- Thoroughly dry after wet process cleaning.

### ***Properly Mix and Store Housekeeping Products in a Ventilated Room or Closet***

- Follow protocol for storing any chemical product in room or closet exhausted to the outside and under negative pressure, with no opening to the return air plenum.

### ***Train Housekeeping Personnel***

- Train all housekeeping personnel before they are allowed to participate in the cleaning operation. One improper application of a chemical product, or failure to use dust free wipe can contaminate a whole environment and create problems.
- Training should include developing an appreciation for the role the person plays in creating and maintaining a healthy environment in addition to training on equipment, materials and methods.

### ***Scrutinize Contractors***

- Many buildings will use a housecleaning contractor.
- Negotiate contracts laying forth the principles outlined in I-BEAM to insure that the housekeeping plan supports IAQ in the building.

### ***Monitor Results***

- Monitor the results of housekeeping tasks to insure that the building is kept clean as required.
- Monitor the actual performance of tasks to insure that the tasks are performed as required.
- Monitor the complaints and reactions of building occupants.
- Do not tolerate deviations from good practices. Good indoor air quality depends on diligence in following these performance guidelines.
- Keep good records of what is cleaned, how it is cleaned, and when it is cleaned.

## **Establishing a Housekeeping Program**

### ***Survey the Building***

A cleaning survey involves an assessment of sources of dirt, and assessment of methods to

prevent dirt from entering the building, and an assessment of cleaning needs of individual spaces. Particular attention in the survey should be given to sources of dirt and areas of dirt accumulation. For example:

- Assess dirt potential of pedestrian traffic, loading docks, receiving areas, and garages.
- Assess surrounding vegetation, pollen, and proper drainage around building.
- Assess interior sources such as printing and copying rooms, kitchens, eating areas, and smoking, trash needs, storage areas, carpets and furnishings, ceiling tiles.
- Assess dirt accumulation areas such as horizontal surfaces, corners and edges, furniture, high surfaces, windows and blinds.

### ***Establish Areas Requiring Differential Attention***

From this survey, you will be able to assess ways to prevent dirt and pollution from entering the building space, and then to assess differential cleaning needs of each part of the building. Different parts of the building will require different types of cleaning. Areas requiring differential attention will include:

- Entryways and lobbies
- Bathrooms
- Hallways and corridors
- Kitchens and cafeterias
- Offices

### ***Develop a Housekeeping Program***

From the needs identified in the survey, develop a housekeeping program including all the elements recommended by I-BEAM and based on the principles of stewardship. Compare the housekeeping tasks with I-BEAM's example task list below and refine as appropriate.

1. Print out and/or view examples of **IAQ Maintenance Tasks** which includes inspection/actions and possible frequency time between tasks.
  - Operations and Maintenance: **I-BEAM Form B2 - Periodic IAQ Maintenance Inspection** ([PDF](#), 13 pp, 52KB)
2. Print out and/or view examples of IAQ Housekeeping Tasks by activity. Source: Specifications for Superior Service Building - Office Building Cleaning Operations in North America, Building Owners and Managers Association International, 1990 - Page 61-63.
  - **Examples of IAQ Housekeeping Tasks** ([PDF](#), 4 pp, 24KB)