Managing Buildings for Good IAQ

5

IAQ management systems will only be successful if they are organized to fit your specific building.

The relationships among building owners, management, staff, and occupants are an important factor in decisions that affect indoor air quality. The objectives of the major players in these relationships may be very different. Occupants want the building to be pleasant, safe, and attractive; if they are paying tenants, they also want to get the maximum use out of the space they rent for the least cost. Building owners and management want to maintain a reputation for providing quality property at reasonable cost, but also need to derive a profit. Facility staff are often caught in the middle, trying to control operating and maintenance costs while still keeping occupants satisfied.

Regardless of the points on which they may disagree, building occupants, staff, and management share the goal of providing a healthy indoor environment. Recognition of this common goal may help avoid conflict when discussing IAQ-related policies.

Any IAQ management system will be successful only if it is organized to fit your specific building. It would not be appropriate for this document to prescribe any single approach. However, the skills associated with IAQ management activities will be identified to help building management decide who will be best able to carry them out. Education and training programs for staff and building occupants should be provided to ensure that new procedures are understood and adopted.

Managing a building for good indoor air quality involves reviewing and amending current practice (and establishing new procedures, if necessary) to:

Operate and maintain HVAC equipment

- keep all equipment and controls in proper working order
- keep interior of equipment and ductwork clean and dry

Oversee activities of staff, tenants, contractors, and other building occupants that impact indoor air quality

- smoking
- housekeeping
- building maintenance
- shipping and receiving
- pest control
- food preparation and other special uses

Maintain communications with occupants so that management will be informed of complaints about the indoor environment in a timely way

- identify building management and staff with IAQ responsibilities
- use health and safety committees

Educate staff, occupants, and contractors about their responsibilities in relation to indoor air quality

- staff training
- lease arrangements
- contracts

Identify aspects of planned projects that could affect indoor air quality and manage projects so that good air quality is maintained

- redecorating, renovation, or remodeling
- relocation of personnel or functions within the building
- new construction

DEVELOPING AN IAQ MANAGEMENT PLAN

The chart on page 32 shows the elements of an IAQ management plan. Development of the management plan involves reviewing and revising staff responsibilities so that IAQ considerations become incorporated into routine procedures.

Organizations may assign responsibility for operations, recordkeeping, purchasing, communications, planning, and policy-making in many different ways. However, the key elements of good IAQ management remain the same:

Reach an understanding of the fundamental influences that affect indoor air quality in your building by:

- becoming familiar with literature on IAQ
- keeping abreast of new information

Select an IAQ manager with:

- clearly defined responsibilities
- adequate authority and resources

Use the IAQ profile and other available information to:

- evaluate the design, operation, and usage of the building
- identify potential IAQ problem locations
- identify staff and contractors whose activities affect indoor air quality

Review and revise staff responsibilities to ensure that responsibilities that may affect indoor air quality are clearly assigned. In addition, establish lines of communication for sharing information pertaining to:

- equipment in need of repair or replacement
- plans to remodel, renovate, or redecorate
- new uses of building space or increases in occupant population
- installation of new equipment

Review standard procedures and make necessary revisions to promote good indoor air quality, such as:

- terms of contracts (e.g., pest control, leases)
- scheduling of activities that produce dust, emissions, odors
- scheduling of equipment operation, inspection, and maintenance
- specifications for supplies (e.g., cleaning products, construction materials, furnishings)
- policy regarding tobacco smoking within the building

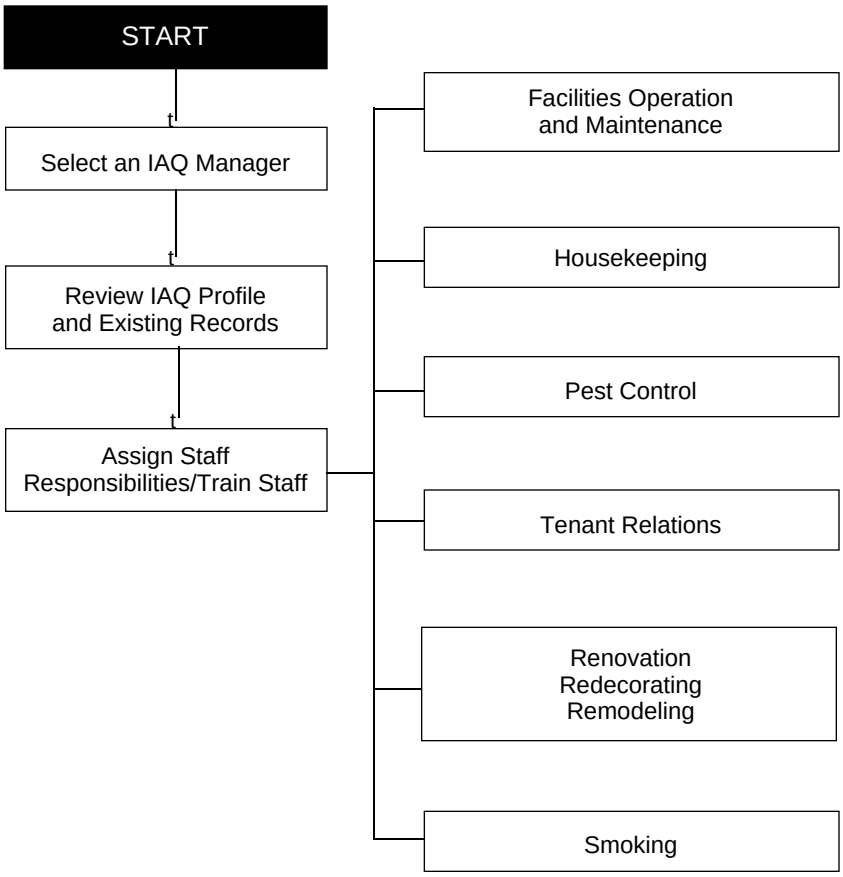
Review the existing recordkeeping system and make necessary revisions to:

- establish a system for logging IAQ-related complaints
- obtain Material Safety Data Sheets for hazardous materials used and stored in the building

Educate building staff, occupants, and contractors about their influence on indoor air quality by:

- establishing a health and safety committee
- instituting training programs as needed

FIGURE 5-1: Developing an IAQ Management Plan



IAQ problems may occur even in buildings whose owners and managers conscientiously apply the best available information to avoid such problems. Those who can demonstrate their ongoing efforts to provide a safe indoor environment are in a strong legal and ethical position if problems do arise.

Select an IAQ Manager

IAQ management will be facilitated if one individual is given overall responsibility for IAQ. Whether or not this person is given the title of "IAQ Manager," he or she should have a good understanding of the building's structure and function and should be able to communicate with tenants, facility personnel, and building owners or their representatives about IAQ issues.

The IAQ manager's ongoing responsibilities might include:

- developing the IAQ profile
- overseeing the adoption of new procedures
- establishing a system for communicating with occupants about IAQ issues
- coordinating staff efforts that affect indoor air quality, and making sure that staff have the information (e.g., operating manuals, training) and authority to carry out their responsibilities
- reviewing all major projects in the building for their IAQ implications
- reviewing contracts and negotiating with contractors (e.g., cleaning services, pest control contractors) whose routine activities in the building could create IAQ problems
- periodically inspecting the building for indicators of IAQ problems
- managing IAQ-related records
- responding to complaints or observations regarding potential IAQ problems
- conducting an initial walkthrough investigation of any IAQ complaints

PRODUCTS OF THE REVIEW OF THE IAQ PROFILE AND OTHER EXISTING RECORDS

- a priority list of locations and activities within the building that will require special attention in order to prevent indoor air quality problems
- a list of staff and contractors whose responsibilities need to be included in the IAQ management plan

Review IAQ Profile and Other Existing Records

If the IAQ manager was not actively involved in developing the IAQ profile, one of the first tasks will be to review the profile carefully. The manager can start by also identifying building locations with a potential for IAQ problems, staff and contractors whose activities impact indoor air quality, and other building occupants whose activities impact indoor air quality.

In addition to information from the IAQ profile, it may be helpful to review lease forms and other contractual agreements for an understanding of the respective legal responsibilities of the building management, tenants, and contractors. Incorporation of IAQ concerns into legal documents helps to ensure the use of proper materials and procedures by contractors and can help to limit the load placed on ventilation equipment by occupant activities.

Assign Responsibilities/ Train Staff

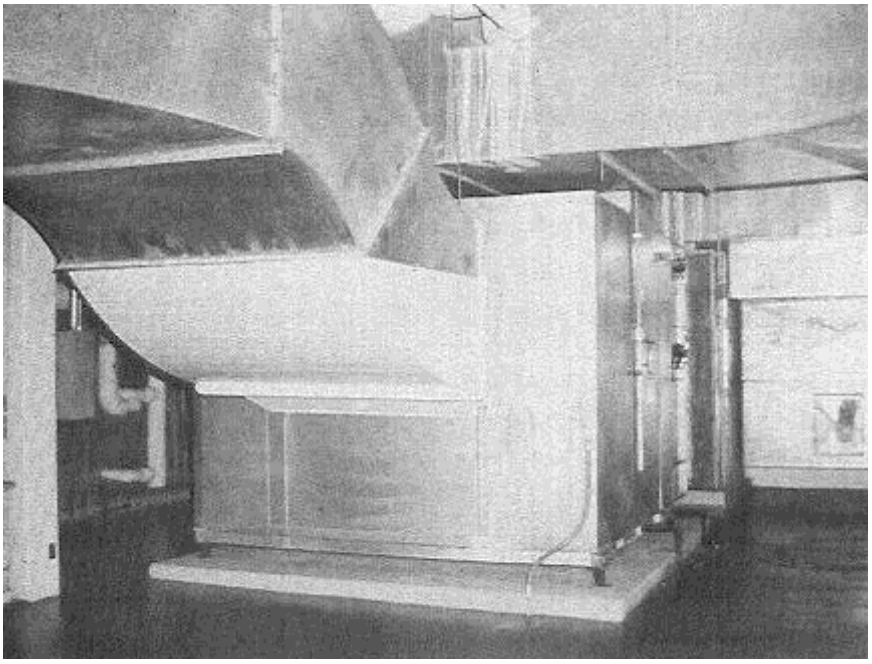
The assignment of responsibilities varies widely between organizations, depending upon the routine activities to be carried out and the capabilities of the available personnel. It would not be appropriate for this document to suggest how IAQ-related responsibilities should be allocated in your organization. For example, issues of access in buildings with tenant-occupied space highlight the need for cooperation between building managers and the

IAQ management will be facilitated if one individual is given overall responsibility for IAQ.

tenants' office managers. The building staff may be limited in its access to tenant spaces and tenants may not have access to building operations areas such as mechanical rooms, yet both tenants and building management have responsibilities for maintaining good indoor air quality.

Facility personnel are not generally trained to think about IAQ issues as they go about their work. Even though building staff may be observing events and conditions that would indicate potential problems to an experienced IAQ investigator, the staff member's attention may be directed elsewhere. As new practices are introduced to prevent indoor air quality problems, an organized system of recordkeeping will help those practices to become part of routine operations and to "flag" decisions that could affect IAQ (e.g., renovations, new tenants). The best results can be achieved by taking time to think about the established channels of communication within your organization, so that new forms can be integrated into decisionmaking with minimum disruption of normal procedures.

A clean mechanical room, free of tracked-in dirt and stored chemicals, is an important element in the prevention of indoor air quality problems. Airborne contaminants in the mechanical room can be drawn into ductwork through return air openings or unsealed seams in return ducts and circulated throughout the building.



Using information from the IAQ profile, the IAQ manager should work with staff and contractors to ensure that building operations and planning processes incorporate a concern for indoor air quality. New procedures, recordkeeping requirements, or staff training programs may be needed. (Growing interest in IAQ is stimulating government agencies and private sector organizations to develop training programs. See *Appendix G* for additional information.) The flow of information between the IAQ manager and staff, occupants, and contractors is particularly important. Good indoor air quality requires prompt attention to changing conditions that could cause IAQ problems, such as installation of new equipment or furnishings, increases in occupant population, or new uses of rooms.

Facility Operation and Maintenance

Indoor air quality can be affected both by the quality of maintenance and by the materials and procedures used in operating and maintaining the building components including the HVAC system.

Facility staff who are familiar with building systems in general and with the features of their building in particular are an important resource in preventing and resolving indoor air quality problems. Facility personnel can best respond to indoor air quality concerns if they understand how their activities affect indoor air quality. It may be necessary to change existing practices or introduce new procedures in relation to:

Equipment operating schedules: Confirm that the timing of occupied and unoccupied cycles is compatible with actual occupied periods, and that the building is flushed by the ventilation system before occupants arrive. ASHRAE 62-1989 provides guidance on lead and lag times for HVAC equipment. In hot, humid

climates, ventilation may be needed during long unoccupied periods to prevent mold growth.

Control of odors and contaminants: Maintain appropriate pressure relationships between building usage areas. Avoid recirculating air from areas that are strong sources of contaminants (e.g., smoking lounges, chemical storage areas, beauty salons). Provide adequate local exhaust for activities that produce odors, dust, or contaminants, or confine those activities to locations that are maintained under negative pressure (relative to adjacent areas). For example, loading docks are a frequent source of combustion odors. Maintain the rooms surrounding loading docks under positive pressure to prevent vehicle exhaust from being drawn into the building. Make sure that paints, solvents, and other chemicals are stored and handled properly, with adequate (direct exhaust) ventilation provided. If local filter traps and adsorbents are used, they require regular maintenance. Have vendors provide Material Safety Data Sheets (MSDSs).

Ventilation quantities: Compare outdoor air quantities to the building design goal and local and State building codes and make adjustments as necessary. It is also informative to see how your ventilation rate compares to ASHRAE 62-1989, because that guideline was developed with the goal of preventing IAQ problems. (*Note*: Increasing ventilation quantities to meet ASHRAE guidelines may exceed the capacity of HVAC equipment to condition the air.)

HVAC equipment maintenance schedules: Inspect all equipment regularly (per recommended maintenance schedule) to ensure that it is in good condition and is operating as designed (i.e., as close to the design setpoints for controls as possible). Most equipment manufacturers provide recommended maintenance schedules for their products. Components that are exposed to water (e.g., drainage pans, coils, cooling towers, and humidifiers) require scrupulous maintenance to prevent microbiological growth and the entry of undesired microbiologicals or chemicals into the indoor airstream.

HVAC inspections: Modify the **HVAC Checklists** (reproduced in Tab V) as necessary so that they are appropriate for inspection of the specific equipment in your building. Be thorough in conducting these inspections. Items such as small exhaust fans may operate independently from the rest of the HVAC system and are often ignored during inspections. As equipment is added, removed, or replaced, document any changes in function, capacity, or operating schedule for future reference. It may also be helpful to store equipment manuals and records of equipment operation and maintenance in the same location as records of occupant complaints for easy comparison if IAQ problems arise.

Be thorough in conducting HVAC inspections. Items such as small exhaust fans may operate independently from the rest of the system and are often ignored during inspections.

Building maintenance schedules: Try to schedule maintenance activities that interfere with HVAC operation or produce odors and emissions (e.g., painting, roofing operations) so that they occur when the building is unoccupied. Inform occupants when such activities are scheduled and, if possible, use local ventilation to ensure that dust and odors are confined to the work area.

Purchasing: Review the general information provided by MSDS and request information from suppliers about the chemical emissions of materials being considered for purchase.

Note: At present there is no general system for certifying or labeling low-emission products nor is there a standard procedure for building managers to use in gathering emissions data on products they are considering for purchase. Limited information on some materials such as

PREVENTIVE MAINTENANCE

An HVAC system requires adequate preventive maintenance (PM) and prompt attention to repairs in order to operate correctly and provide suitable comfort conditions and good indoor air quality. The HVAC system operator(s) must have an adequate understanding of the overall system design, its intended function, and its limitations. The preventive maintenance program must be properly budgeted and implemented, not merely planned on paper.

A well-implemented PM plan will improve the functioning of the mechanical systems and usually save money when evaluated on a life-cycle basis. However, in some buildings, because of budgetary constraints, maintenance is put off until breakdowns occur or complaints arise, following the "if it isn't broken, don't fix it" philosophy. This type of program represents a false economy and often increases the eventual cost of repairs.

Poor filter maintenance is a common example of this phenomenon. Filters that are not changed regularly can become a bed for fungal growth, sometimes allowing particles or microorganisms to be distributed within the building. When filters become clogged, the fans use more energy to operate and move less air. If the filters are an inexpensive, low-efficiency type that becomes clogged and then "blows out," the coils then accumulate dirt, causing another increase in energy consumption. Poor air filter efficiency and poor maintenance may cause dirt to build up in ducts and become contaminated with molds, possibly requiring an expensive duct cleaning operation.

General elements of a PM plan include:

- periodic inspection, cleaning, and service as warranted
- adjustment and calibration of control system components
- maintenance equipment and replacement parts that are of good quality and properly selected for the intended function

Critical HVAC system components that require PM in order to maintain comfort and deliver adequate ventilation air include:

- outdoor air intake opening
- damper controls
- air filters
- drip pans
- cooling and heating coils
- fan belts
- humidification equipment and controls
- distribution systems
- exhaust fans

Some private sector organizations have developed guidance on preventive maintenance. (See discussion in Guidelines of Care Developed by Trade Associations on page 43.)

pressed-wood products is available, and more may be expected in the future. Public and private sector organizations are working to develop product testing procedures for acceptance by such organizations as the American Society for Testing and Materials (ASTM).

Preventive maintenance management: Maintenance "indicators" are available to help facility staff determine when routine maintenance is required. For example, air filters are often neglected (sometimes due to reasons such as difficult access) and fail to receive maintenance at proper intervals. Installation of an inexpensive manometer, an instrument used to monitor the pressure loss across a filter bank, can give an immediate indication of filter condition without having to open the unit to visually observe the actual filter.

Computerized systems are available that can prompt your staff to carry out maintenance activities at the proper intervals. Some of these programs can be connected to building equipment so that a signal is transmitted to your staff if a piece of equipment malfunctions. Individual areas can be monitored for temperature, air movement, humidity, and carbon dioxide, and new sensors are constantly entering the market. These sensors can be programmed to record data and to control multiple elements of the HVAC system.

Housekeeping

Indoor air quality complaints can arise from inadequate housekeeping that fails to remove dust and other dirt. On the other hand, cleaning materials themselves produce odors and emit a variety of chemicals.

As they work throughout your building, cleaning staff or contractors may be the first to recognize and respond to potential IAQ problems. Educate them about topics such as the following:

Cleaning schedules: Consider how cleaning activities are scheduled. Managers may want to schedule the use of some cleaning agents that introduce strong odors or contaminants during unoccupied periods. However, make sure that fumes from cleaning products are eliminated before air handling systems switch to their "unoccupied" cycles.

Purchasing: Become more familiar with the chemicals in cleaning and maintenance products and their potential toxicity. Select the safest available materials that can achieve your purpose. Review the information provided by product labels and Material Safety Data Sheets. Request information from suppliers about the chemical emissions of products being considered for purchase.

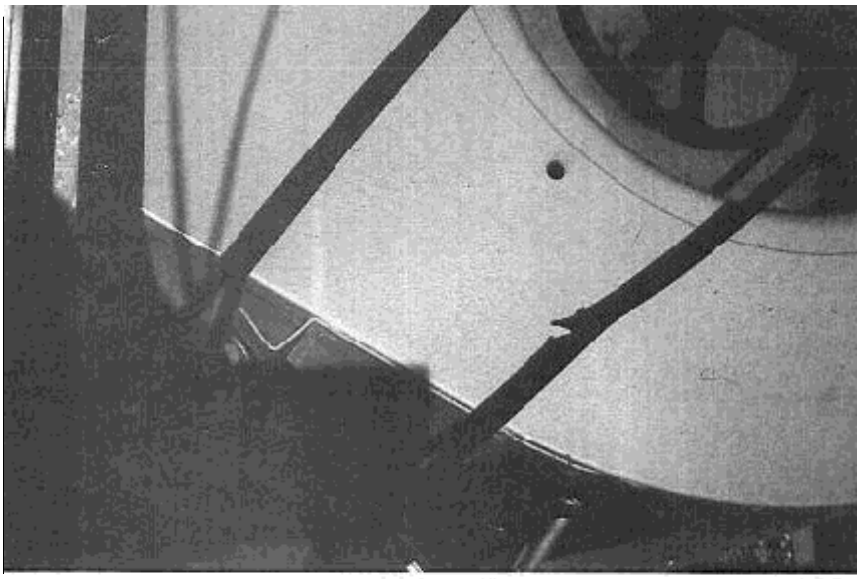
Material handling and storage: Review the use of cleaning materials to ensure proper use and storage.

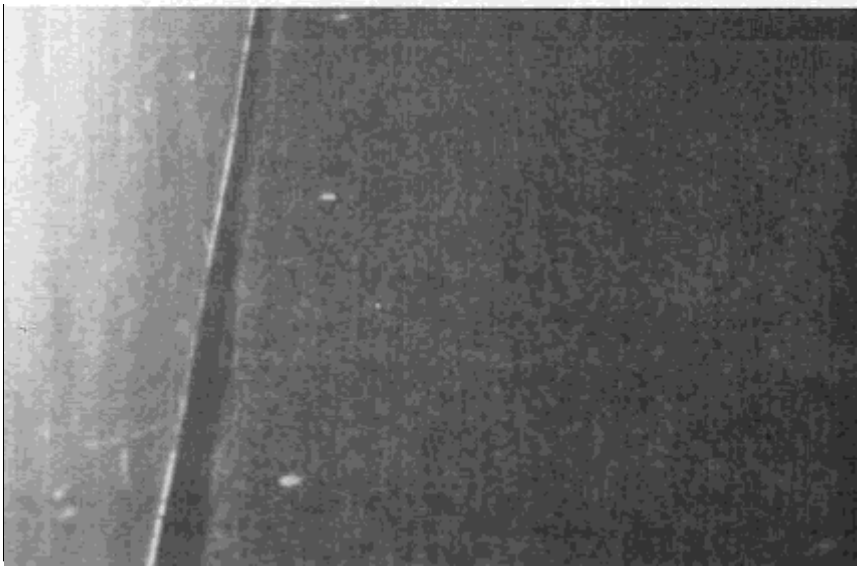
Trash disposal: Follow proper trash disposal procedures. If there is a restaurant in the building, require daily pick-up of perishable refuse. Ensure that the containers are covered, pest control is effective, and that the trash collection area is cleaned at least daily.

Shipping and Receiving

Shipping and receiving areas can create indoor air quality problems regardless of the types of materials being handled. Vehicle exhaust fumes can be minimized by prohibiting idling at the loading dock. This is particularly important if the loading dock is located upwind of outdoor air intake vents. You can also reduce drafts and pollutant entry by pressurizing interior spaces (e.g., corridors) and by keeping doors closed when they are not in use.

A good preventive maintenance program can help a facility manager identify and correct problems before they occur. If this fan belt breaks, the area served by the air handling unit may be without ventilation. If it is slipping, it is already reducing the airflow.





A termiticide misapplication resulted in an indoor air quality problem in this school. Detectable levels of chlordane were found in both wipe (surface) and air samples near the injection holes drilled into the ground floor. Note the small white circles near the wall. (Under an agreement with EPA, manufacturers have withdrawn chlordane from sale.) Proper application methods are important for all pesticides.

INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) is a coordinated approach to pest control intended to prevent unacceptable levels of pests, while causing the least possible hazard to people, property, and the environment and using the most cost-effective means. IPM uses a combination of tactics, including sanitation, monitoring, habitat modification, and the judicious application of pesticides when absolutely necessary.

IPM methods include:

- improved sanitation (e.g., removing food from desks, cleaning)
- inspection and monitoring of pest population sites
- managing waste (e.g., keeping refuse in tight containers, locating waste containers away from building if possible)
- maintaining structures (e.g., fixing leaking pipes promptly, sealing cracks)
- adding physical barriers to pest entry and movement (e.g., screens for chimneys, doors, and windows; air curtains)
- modifying habitats (e.g., removing clutter, relocating outside light fixtures away from doors)
- using traps (e.g., light traps, snap traps, and glue boards)
- using pesticides judiciously

An efficient IPM program will integrate pest management planning with preventive maintenance, housekeeping practices, landscaping, occupant education, and staff training.

Pest Control

Pest control activities that depend upon the use of pesticides involve the storage, handling, and application of materials that can have serious health effects. Common construction, maintenance practices, and occupant activities provide pests with air, moisture, food, warmth, and shelter. Caulking or plastering cracks, crevices, or holes to prevent harborage behind walls can often be more effective than pesticide application at reducing pest populations to a practical minimum.

Integrated Pest Management (IPM) is a low-cost approach to pest control based upon knowledge of the biology and behavior of pests. Adoption of an IPM program can significantly reduce the need for pesticides by eliminating conditions that provide attractive habitats for pests.

If an outside contractor is used for pest control, it is advisable to review the terms of the contract and include IPM principles where possible. The following items deserve particular attention.

Pest control schedule: Schedule pesticide applications for unoccupied periods, if possible, so that the affected area can be flushed with ventilation air before occupants return. Pesticides should only be applied in targeted locations, with minimum treatment of exposed surfaces. They should be used in strict conformance with manufacturers' instructions and EPA labels. General periodic spraying may not be necessary. If occupants are to be present, they should be notified prior to the pesticide application. Particularly susceptible individuals could develop serious illness even though they are only minimally exposed.

Materials selection, handling, and storage: Select pesticides that are species specific and attempt to minimize toxicity for humans and non-target species. Ask contractors or vendors to provide EPA labels and MSDSs. Make sure that pesticides are stored and handled properly consistent with their EPA labels.

Ventilation of areas where pesticides are applied: If only limited areas of the building are being treated, adjust the HVAC system so that it does not distribute contaminated air throughout the rest of the building. Consider using temporary exhaust systems to remove contaminants during the work. It may be necessary to modify HVAC system operation during and after pest control activities (e.g., running air handling units on 100% outdoor air for some period of time or running the system for several complete air exchanges before occupants re-enter the treated space).

MATERIAL SAFETY DATA SHEETS

Under OSHA regulations, responsible parties are required to document information on potentially hazardous products. These Material Safety Data Sheets (MSDSs) may be of limited help in identifying some products that may pose IAQ concerns. However, professional judgment and collection of additional information may be necessary in order to make full use of the MSDS. The following table summarizes some of the issues to keep in mind when deciding whether information from MSDSs is applicable to emission sources and exposures of concern in a building.

Item	Possible Uses	Comments
Substances Covered	n MSDSs *may* identify significant airborne contaminants	n MSDSs may not be available onsite for many products n some components are listed as proprietary and are not disclosed n MSDSs do not always highlight products most likely to be airborne n contaminant byproducts inadvertently formed during manufacture won't always be listed
Personal Protection/ First Aid	n may suggest precautions for conducting source inspection	n usually relates only to high-level, worst-case exposures in general industry
Health Effects	n *generally* presents types of health effects that may be expected primarily at high level (e.g., industrial) exposures	n symptoms listed may not occur at low-level concentrations found in indoor air n MSDSs may not include more subtle IAQ aspects such as nuisance factors and sensitivity to mixtures
Physical Data	n odor description may help identify sources n volatility *may* suggest which products are likely to be airborne n contaminants to expect in event of a fire or decomposition may be listed n reactivity data may suggest potential problems with storage or use	n reference material on how to use physical data information to predict IAQ impacts may be scarce
Control Measures	n identifies proper storage and packaging procedures n identifies steps for cleanup of gross spills	n many office chemicals are kept in much smaller amounts than found in industrial settings n spill cleanup may not eliminate airborne contamination n does not specify routine emission controls

A reasonable effort should be made to collect available MSDSs during IAQ profile development. Care should be taken to consider information that is relevant to IAQ concerns. Other important indicators of how a particular product may affect IAQ are available from direct odor and dust observations, a review of work practices and interviews with operators and occupants. The manufacturer is a good source of follow-up information on a given product (phone number should be included on each MSDS).

It is important for building occupants to understand that their activities can create indoor air quality problems. Smoking releases both carcinogenic and irritating substances into the air.

Occupant Relations

Managing occupant relations to prevent IAQ problems involves: allocating space and monitoring the use of building areas to isolate odor- and contaminant-producing activities and avoid re-entrainment; establishing a communication strategy that is responsive to complaints and provides tenants with information about their role in preventing indoor air quality problems; and modifying employee manuals or lease agreements as necessary to clarify the responsibilities of occupants and building management. A health and safety committee or joint tenant-management IAQ task force that represents all of the major interest groups in the building can be very helpful in disseminating information and fostering a cooperative approach to IAQ management. See *Section 3* for a discussion of these points.

Renovation, Redecorating, and Remodeling

Renovation, redecorating, and remodeling activities can create indoor air problems by producing dust, odors, microbiologicals and their spores, and emissions. It is difficult to prevent IAQ problems if some building areas are undergoing renovation while adjoining areas continue normal operations.

Close monitoring of renovation, redecorating, and remodeling projects is recommended. The following suggestions may be helpful:

Working with professional consultants: Communicate your concern about preventing indoor air quality problems to the engineer, architect, interior designer, or other professionals involved in the project.

Product selection: Specify products and processes that minimize odors and emissions, while maintaining adequate safety and efficacy. Review the general information provided by the product labels and MSDSs. Request information from suppliers about the chemical emissions of products being considered for purchase.

Work schedules: Schedule activities that produce dust, odors, or emissions for unoccupied periods if possible.

Isolation of work areas: Block off return registers so that contaminants are not recirculated from the demolition/construction area into adjoining areas, and install temporary barriers to confine dust and noise. If possible, install temporary local exhaust to remove odors and contaminants, and check to confirm that the temporary ventilation system is operating as planned.

Installation of new furnishings: Ask suppliers to store new furnishings in a clean, dry, ventilated location so that volatile organic compounds will be emitted before installation. Minimize the use of adhesives during installation or specify low-emitting products. After new furnishings are installed, increase the ventilation rate to flush the area with outdoor air and dilute emissions.

Smoking

Although there are many potential sources of indoor air pollution, both research and field studies have shown that environmental tobacco smoke (ETS) is one of the most widespread and harmful indoor air pollutants. Environmental tobacco smoke is a combination of sidestream

smoke from the burning end of the cigarette, pipe, or cigar and the exhaled mainstream smoke from the smoker. ETS contains over 4,000 chemicals; 43 of which are known animal or human carcinogens. Many other chemicals in ETS are tumor promoters, tumor initiators, co-carcinogens (i.e., chemicals that are able to cause cancer when combined with another substance), or cancer precursors (i.e., compounds that can make it easier to form other carcinogenic chemicals).

In 1986, *The Health Consequences of Involuntary Smoking: A Report of the Surgeon General on Environmental Tobacco Smoke* concluded that ETS was a cause of lung cancer in healthy non-smokers and that "the scientific case against involuntary smoking as a public health risk is more than sufficient to justify appropriate remedial action, and the goal of any remedial action must be to protect the non-smoker from environmental tobacco smoke." In the same year, the National Research Council of the National Academy of Sciences issued a report, *Environmental Tobacco Smoke: Measuring Exposures and Assessing Health Effects,* which also concluded that passive smoking increases the risk of lung cancer in adults.

In June 1991, NIOSH issued a *Current Intelligence Bulletin (#54)* on ETS in the workplace that dealt with lung cancer and other health effects. In its *Bulletin,* NIOSH concluded that the weight of evidence is sufficient to conclude that ETS can cause lung cancer in non-smokers (i.e., those who inhale ETS). It recommended that the preferable method to protect non-smokers is the elimination of smoking indoors and that the alternative method is to require that smoking be permitted only in separately ventilated smoking areas. The NIOSH *Bulletin* emphasized that provision of such isolated areas should be viewed as an interim measure until ETS can be completely eliminated indoors.

PRODUCTS OF THE ASSIGNMENT OF RESPONSIBILITIES AND REVIEW OF TRAINING

- job descriptions and/or contracts, work procedures, and schedules revised to reflect indoor air quality concerns
- procedures for reviewing purchases of supplies, new projects, contracts, and policies in relation to indoor air quality
- smoking policy revisions, if necessary
- plans for educating occupants and training staff training in relation to indoor air quality

Smoking areas must be separately ventilated, negatively pressurized in relation to surrounding interior spaces, and supplied with much more ventilation than non-smoking areas. The NIOSH *Bulletin* also recommends that the air from the smoking area should be exhausted directly outdoors and not recirculated within the building or vented with the general exhaust for the building. ASHRAE Standard 62-1989 recommends that smoking areas be supplied with 60 cubic feet per minute (60 cfm) per occupant of outdoor air; the standard also recognized that using transfer air, which is pulled in from other parts of the building, to meet the standard is common practice.

Both EPA and NIOSH advise that building owners or facility managers considering the introduction of smoking restrictions should implement smoking cessation programs. In addition, employees and labor unions should be involved in the development of non-smoking policies in the workplace.

(Refer to *Appendix G* for citations on all the publications mentioned in this section. See especially NIOSH *Current Intelligence Bulletin (#54), Environmental Tobacco Smoke in the Workplace: Lung Cancer and Other Health Effects.* Additional resources on ETS, including an assessment of respiratory disorders in children and lung cancer risks in adults, and a guide to developing effective smoking policies, will be available from EPA early in 1992.)

According to a 1986 report of the Surgeon General, "the case against involuntary smoking is more than sufficient to justify appropriate remedial action to protect the non-smoker from environmental tobacco smoke."

Sample Form

Management Checklist

Item	Date Begun or Completed (as applicable)	Responsible Person (name, telephone)	Location ("NA" if the item is not applicable to this building)
IAQ PROFILE			
Collect and Review Existing Records			
HVAC design data, operating instructions and manuals			
HVAC maintenance and calibration records, testing and balancing reports			
Inventory of locations where occupancy, equipment, or building use has changed			
Inventory of complaint locations			
Conduct a Walkthrough Inspection of the Building			
List of responsible staff and/or contractors, evidence of training, and job descriptions			
Identification of areas where positive or negative pressure should be maintained			

SEE COMPLETE FORM PAGE 171

*The **IAQ Management Checklist** shown in part here and included in full within Tab V can be used to help confirm that you have accounted for the major factors that could cause IAQ problems in your building.*

GUIDELINES OF CARE DEVELOPED BY TRADE ASSOCIATIONS	The following associations have developed guidelines of care that may have a direct or indirect impact on indoor air quality. These standards are described below so that building management may become aware of them. Neither EPA nor NIOSH endorse these standards.
Air Conditioning Contractors of America (ACCA)	Technical Reference Bulletin Series. Indoor air quality is one of the topics covered in this series of technical bulletins on heating, ventilation and air conditioning (HVAC). Bulletins can be filed in the ACCA Technical Reference Notebook. The Air Side Design tab of the notebook includes bulletins devoted to indoor air quality control.
Air Conditioning and Refrigeration Institute (ARI)	Air Conditioning and Refrigeration Equipment General Maintenance Guidelines for Improving the Indoor Environment (1991). General maintenance requirements for heating ventilation, air conditioning,and refrigeration (HVACR) equipment. Specific equipment/component maintenance is given for the following: air cleaning systems; ducts; registers/diffusers and air terminals; dampers/economizers; drain pans; air handlers; humidifiers; package terminal units; and evaporator, condenser, hydronic and economizer coils. The guidelines do not supersede any maintenance instructions that are provided by the manufacturer. In addition, the Institute has issued an Indoor Air Quality Briefing Paper that addresses the interactions between HVACR equipment and the quality of indoor air.
Associated Air Balance Council (AABC)	National Standards for Testing and Balancing Heating,Ventilation, and Air Conditioning Systems (1989). Establishes a minimum set of field testing and balancing standards and provides comprehensive and current data on testing and balancing HVAC systems. Chapters receiving special attention include Cooling Tower Performance Tests, Sound Measurements, Vibration Measurements, Fume Hoods, and AABC General Specifications. The book contains a complete index to the technical data provided.
National Environmental Balancing Bureau (NEBB)	Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems (1991). A "how-to" set of procedural standards that provide systematic methods for testing, adjusting, and balancing (TAB) of HVAC systems. Includes sections on TAB instruments and calibration, report forms, sample specifications, and engineering tables and charts. A valuable innovation is the "Systems Ready to Balance" start-up checklist to help organize jobs systematically. Other features include: additional engineering data, condensed duct design tables/charts, hydronic design tables/charts, and pertinent HVAC equations in U.S. and metric units.
National Pest Control Association (NPCA)	Good Practice Statements. Periodically updated, officially approved and adopted by the Association's Board of Directors, these "Good Practice Statements" are designed as guidelines for performing various services rather than standards of operation. In addition, the Association produces a self-study series for technicians that covers five areas of pest control, management manuals, an encyclopedia of structural pest control, a number of specific subject matter technical reference manuals, and a pamphlet series.
Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)	HVAC Duct Construction Standards — Metal and Flexible (1985). Primarily for commercial and institutional work, this set of construction standards is a collection of material from earlier editions of SMACNA's low-pressure, high-pressure, flexible duct, and duct liner standards. In addition, SMACNA has published a manual entitled *Indoor Air Quality* that contains basic information on many aspects of indoor air quality and guidance on conducting building evaluations and indoor air quality audits. Other related SMACNA publications incl*ude HVAC Duct Systems Inspection Guide*, *HVAC Systems—Testing, Adjusting and Balancing,* and *HVAC Air Duct Leakage Test Manual.*